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INDEX TO VOLUME LII

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EXPLANATORY NOTE

Illustrated articles are marked with an asterisk (*), book notices with a dagger (†), and new shop equipment as described in the departments "Shop Equipment News" and "Condensed Clipping Index of Equipment" with a double dagger (‡). Book reviews are listed under the heading "New Publications." Cross references to a particular initial word may apply also to its derivatives. The cross references condense the matter and assist the reader, but are not to be regarded as complete or conclusive. So, if there were a reference from "Milling" to "Jigs and Fixtures," and if the searcher failed to find the required article under the latter topic, he should look through the "Milling" entries, or others that the subject might suggest, as he would have done had there been no cross reference. The plural of any given item may not necessarily follow the singular immediately, as the items are listed in alphabetical order. All articles written by any given author are listed directly under his name in the special author's index which starts on page 21. Articles that are not credited to any author may be found under the heading "No author credited," listed under "N" in the Author's Index.

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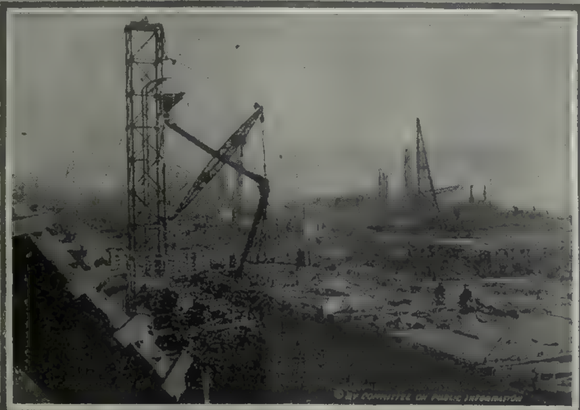
January 1, 1920 American Machinist Vol. 52, No. 1

Pre-assembly in Ship Construction



By R. D. Gatewood, Commander U.S.N.
U.S. Navy Yard, Philadelphia, Penn.

The application of pre-assembly methods to ship building is accomplishing just what it does in other branches of machine work. It makes possible the building of parts where there is plenty of room to work and prevents the delay of one gang waiting for another to get through. This method should be carefully considered by all ship builders and those engaged in many other lines, for with labor shortage an unpleasant actuality, lost time is a serious matter and one to be avoided.

SUPPOSE you had just received a contract for 40 airships or automobiles, 40 pumps or penstocks, 40 lathes or locomotives, or even for forty 8800-ton merchant ships—each one exactly alike—wouldn't it occur to you right away, as a good business proposition, to build each integral part or piece in lots of 40?

Now, while you are supposing pleasant conditions to make the work easier, just go a step farther and suppose the contract called for delivery "at the earliest possible date" or thereabouts, because the ships were very valuable *now* but wouldn't be perhaps in the distant future. And suppose you had only twelve building slips to launch these ships from and were anxious to get each ship overboard so that you could lay down the ones that were to follow as soon as possible or perhaps sooner. Wouldn't it seem logical to build each part wherever you could find suitable space for it in your big yard and assemble the parts later in some one place, rather than to try to crowd and jam the building of all the separate parts into the confined area of a building slip?

Suppose you had an unusually large yard area, unusually well served with cranes and transportation facilities, and you couldn't get all the skilled labor you needed and, moreover, the cost of the ships, as is the case *even* with ships built for the Government, was to be "reduced to a minimum," wouldn't you try to train

FIG. 2. ASSEMBLING THE KEEL

FIG. 3. BULKHEAD ASSEMBLY

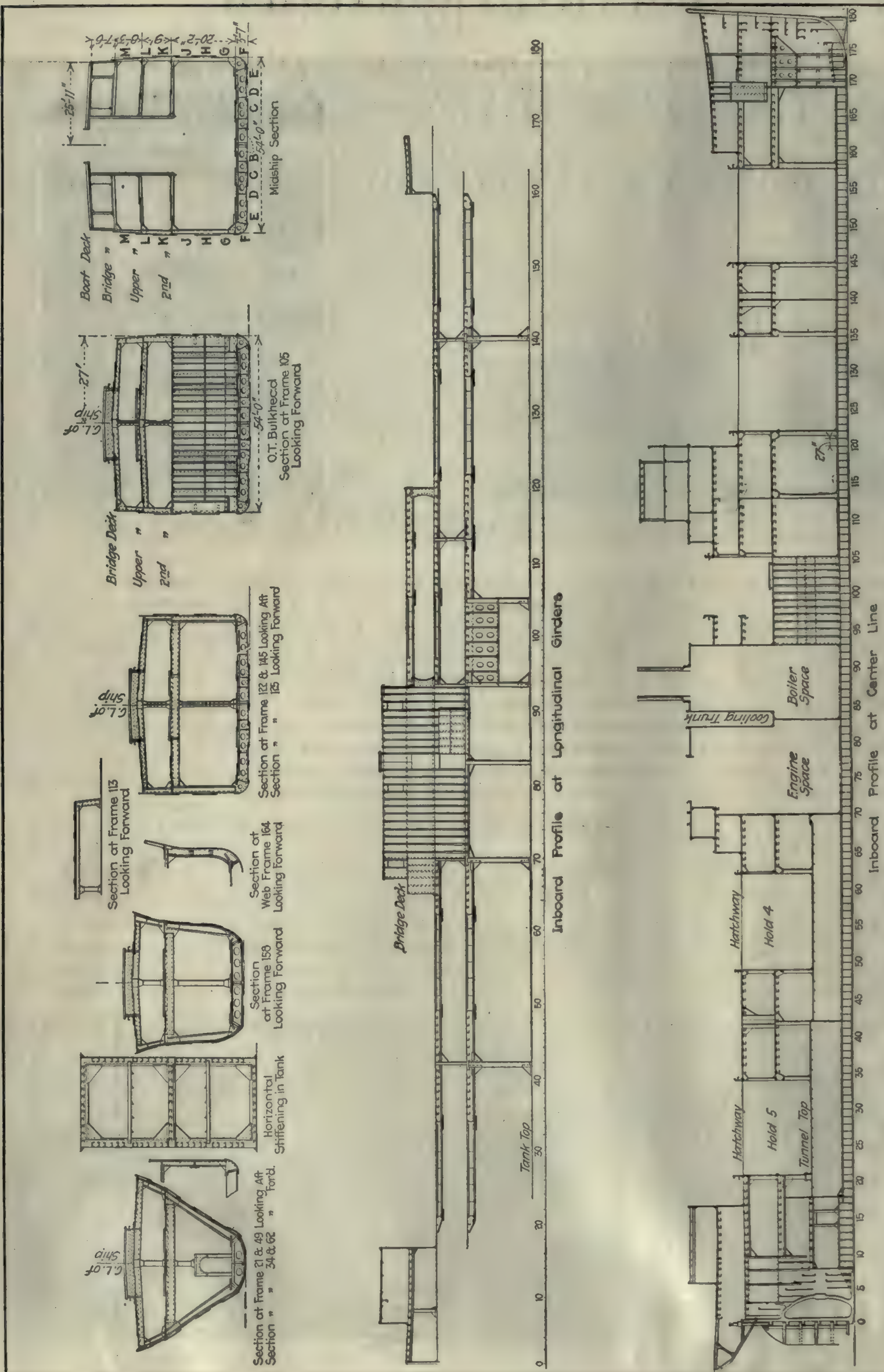


FIG. 1. GENERAL PLAN OF SHIPS BUILT BY PRE-ASSEMBLY METHODS

FIG. 4. AN OIL-TIGHT BULKHEAD

the *same* set or "gang" of unskilled men to build the *same* part so far as possible, leaving the more difficult regulating, fairing, and final connecting to the more skilled men?

And if the price for assembling and riveting was much less when done in the yard, or "on the ground" as it is called, than when done on board ship where many places are dark and inaccessible and hard to work in and harder to supervise in, wouldn't it seem reasonable to do all you could out in the yard where it is light and there is plenty of room to work? Besides getting more work, wouldn't you think the quality of what you got would be better when done out in the light where the men could see what they were doing and you could see what they were doing too?

This pre-assembly proposition, involving as it does a division of labor and a distribution of effort, seems a very simple, common-sense solution of a large construction project where the saving of time and money is a governing feature, and one asks involuntarily why no one thought of it before and, now that it is thought of and practiced, why everyone in the shipbuilding world doesn't accept it at once as the best and most advanced practice?

Whoever thought of building forty 8800-ton ships at the same plant in two years; whoever thought of a shipyard with fifty building-slips; whoever thought of building ships "custom-made" instead of "made to order" anyway? Nobody but "a damned Yankee." That's the principal reason why everyone doesn't accept it right away, because you've got to be big enough to think in big figures and lots of us aren't that big. Then, too, there has always been a more or less accepted way to build a ship just as there has been to make a dress. If somebody told a woman that a way had been devised for making her dress by making the skirt, the waist, the sleeves, the neck, and ruffles, all separately and bringing them together and finding that they fitted each other and that the dress fitted her the very first time—would she believe it? She would *not*.

Yet that is just what the Merchant Shipbuilding Corporation is doing for the Emergency Fleet Corporation at their plant at Harriman on the Delaware River. It was just such ideas as this, just such "dreams" as people called them at first, that the Government in its great wisdom allowed to percolate into Germany soon after they were born.

This particular shipyard was not the first to adopt pre-assembly. Nor would it advise it for other yards not similarly laid out and equipped. But it is the first in this country or abroad to develop it to its present radical extent so that each of the hundreds of integral parts of its ships is built complete in itself and afterward assembled very much as is the case with watch or rifle construction. The principal considerations that governed this shipyard in making this radical departure from conventional shipbuilding were:

First—Forty identical ships to build.

Second—Ample space in the assembly yard (very seldom found in any shipyard).

Third—Ample crane service in assembly yard, permitting the easy handling of material which can be delivered at approximately the point of assembly.

Fourth—The layout of the plant enabled the assembling of large units in spaces outside the assembly yard (spaces almost never available in the average yard).

Fifth—Capacity of yard cranes permitting the handling of weights up to 50 tons.

Sixth—Inability to get skilled labor needed to assemble and install on board, but ability to get unskilled labor that could specialize on multiple work on the ground.

Seventh—Tidal conditions prevailing making it impossible to work on the sterns of vessels on the slips longer than three or four hours a day.

FIG. 5. A COMPLETE TRANSVERSE BULKHEAD

FIG. 6. NAVIGATING-BRIDGE DECK HOUSE

The general practice of this shipyard gained after much hard experience and now well standardized is so different from the more or less established way of constructing large vessels and is believed to be of such interest and real value to the progressive and practical shipbuilders and ship mechanics of the country that it is given in what follows in considerable detail.

The type plan of vessels under construction is shown in Fig. 1 and it should be remembered that the frame spacing is only 27 in. and that frames are numbered from the stern forward.

The details follow:

THE KEEL.—This section extends from frame No. 19½ to No. 169. The assembly includes all flat keel plates, vertical keel slip connections to floors, top and bottom keel angles. This section is assembled complete on the ground on a set of skids prepared for this purpose. The work is bolted, reamed and the keel checked for fairness and length. The only riveting performed is through the keel plate to bars. The reason for driving these rivets is to obtain a fair surface when laying keels on the permanent blocks at shipways, and to prevent, as far as possible, the removal of keel blocks. This section is approximately 350 ft. long. For erection it is divided into four sections which necessitate three splices. No additional expense is involved in the riveting. By this method a keel can be laid complete in 30 min.—the laying of the entire length of keel taking place 6 hr. after the launching of a boat. Immediately after keel laying and bolting up of splices, two gangs of riveters are started at center. One gang works aft and the other forward in order to keep clear of the erectors who start in the midship portion of the ship.

The top and bottom bars on the first nine boats were riveted except the splices. It was found that an accumulation of odd rivets was the result of this method; therefore the riveting of this work was discontinued on the ground and is now being performed on the ship as mentioned.

AFTER SECTION OF VERTICAL KEEL, FRAMES NO. 8 TO NO. 18.—This section includes after keel plates, rider plates, top and bottom, and fore and aft angles, floors No. 9 to No. 18 and B-2 shell plates, port and starboard. This work is assembled complete and riveted, including the B-2 shell plates. The rider plates are assembled and the work is driven in a downward position, Fig. 2. Then the section is inverted and the bottom shell plates fitted and riveted in a downward position. This permits the work to be performed in the easiest manner. There are a number of reasons that make it possible to save a greater amount of time and cost on this unit than on the ordinary assembly unit:

First—The work on the rider plates when assembled and riveted on the ship is performed in a very cramped and difficult position; the work on the B-2 shell plates is also very difficult and inaccessible and is performed under the worst conditions of overhead work. This is made very easy in an inverted position.

Second—The tidal conditions at this yard are such that no work can be performed in this locality except at low tide. Under the best working conditions and the best tidal conditions, four hours a day is the greatest amount of time in which work can be carried along.

FLOORS, NO. 19 TO NO. 47 INCLUSIVE; NO. 152 TO NO. 168 INCLUSIVE.—These floors are sent to this yard with the top and outboard angles already riveted. This yard furnaces and fabricates the bottom angle or channel, whichever the case may be. These channels are then bolted and bull riveted in the assembly yard. When erected, these floors are practically in the same condition, as to completion, as the floors in the amidship section which are sent from the American Bridge Company.

MAIN BULKHEADS, 42, 70, 83, 93, 105 AND 140, TANK TOP TO 2ND DECK, AND BETWEEN-DECK BULKHEAD, 2ND DECK TO UPPER DECK.—The bulkheads are assembled and riveted complete on the ground. All bounding angles, except the wing staples, are included in the assembly and riveted. The object in riveting these bulkheads complete is to establish a fairing-up point at the ships. At this yard no ribbands[1] of any description are used for fairing up. The bulkheads are checked for width and height, which assures a correct point to work to. When erected, these bulkheads are horned[2] and all other work made to come to these points. Up to hull No. 15 these bounding angles were left loose, but it was found that the fairing-up point which had been established was not correct unless these were riveted. See Figs. 3, 4 and 5.

[1]"Ribband"—A stiff timber used for fairing and holding in place the frames.

[2]"Horned"—Squared with the keel.

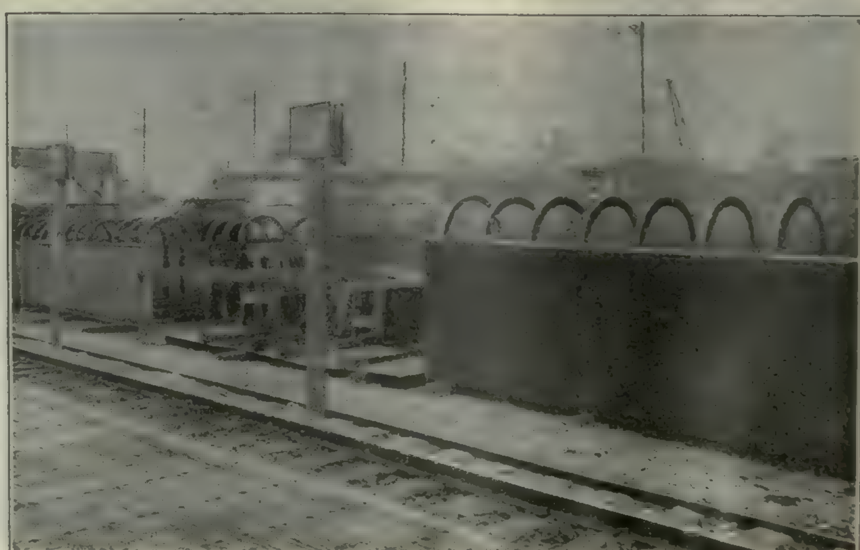


FIG. 7. ASSEMBLING THE SHAFT ALLEY

AFTERPEAK BULKHEADS NO. 8 AND NO. 10. FORECASTLE BULKHEAD NO. 169.—These bulkheads form the forward boundary of the afterpeak bulkhead and are very important from the standpoint of getting a high grade of work, which is only possible by assembling complete on the ground and riveting.

It should be particularly noted that bulkheads Nos. 8, 10 and 169 are very difficult, inaccessible work in a close corner of the ship, it being almost impossible to do good work in such spaces.

Bulkheads Nos. 8 and 169, which carry the heaviest pressure, are assembled complete and are bull riveted and calked before being erected. The amount of trouble, time and cost saved by the assembly of this section can only be appreciated by one who has attempted to perform this work in the close spaces which are common to the ends of all ships.

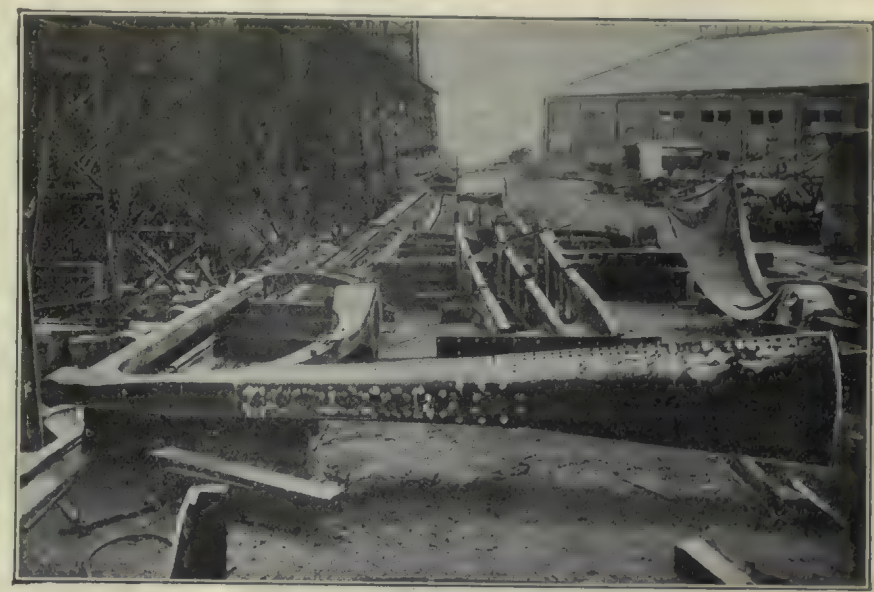


FIG. 9. STERN FRAMES LAID OUT

FORECASTLE-END BULKHEAD NO. 160.—The same remarks apply to the forecastle-end bulkheads as to the main bulkheads, except that the outboard angle connections to the shell are lifted from ship, this being a point where the ship must be fair and this particular part of the work must suit conditions.

BRIDGE-FRONT BULKHEAD NO. 120; BRIDGE-END BULKHEAD NO. 65; POOP-FRONT BULKHEAD NO. 17.—These bulkheads are assembled complete and riveted, with all bounding angles riveted. They establish the same fairing-up points as the main bulkheads.

On bulkhead No. 65 on the port side, two plates are left loose for shipping the fresh-water tanks, which are located under the bridge deck.

FORWARD-BRIDGE DECK HOUSE.—These houses are assembled complete with all connections, tie plates, beams, face bars, collars, etc., and are riveted complete on the ground except the bottom bounding angles which are left loose for adjusting and fairing up. On one hull, No. 16, trouble was experienced in regulating the bridge-front-bulkhead connection to the forward-bridge deck-house connection. This has been overcome by making a template from bulkhead No. 120 and regulating the forward-bridge deck house to this template.

The bottom bounding-angles were riveted up to and including hull No. 18. From this point, these angles are being left loose, trouble having been experienced in regulating this connection.

FIG. 8. SHAFT ALLEY READY FOR INSTALLATION

NAVIGATING-BRIDGE HOUSE.—The same remarks apply to this section as to the forward-bridge deck house, except with respect to the connection to bulkhead No. 120. See Fig. 6.

POOP-DECK HOUSE.—The same remarks apply as to the navigating-bridge deck house.

AFTER BOAT-DECK HOUSE.—This deck house is assembled in five pieces—owing to the fact that it is not continuous on account of the boiler and engine casing—one section port and one section starboard, one section aft and two sections forward. These sections are assembled complete in every respect with the exception of the bottom bounding angles. The same remarks apply to the bottom bounding angles as regard the forward-bridge deck house.

SHAFT ALLEY.—The shaft alley extends from bulkhead No. 18 to No. 70. This alley is assembled complete in two sections, and riveted, with stiffeners, floor plates, supports and shaft bearers.

Owing to the way material comes in, considerable difficulty has been experienced in assembling this unit, but gangs of specialists have been developed who perform no other work, and they have reached a point of efficiency by concentrating on this one unit, so that they are able to complete a unit in much less time than would be the case if each foreman were compelled to overcome the difficulties common to this section.

The bottom bounding angles and stiffener clips are riveted and the tank top calked before the shaft alley is placed on the ship.

The assembly of the shaft alley has proved a time-saving factor, from the standpoint of being able to proceed with the erection of the after end of the ship immediately after bottom bounding angles are driven. This is true from the fact that stanchions connect to the top of the shaft alley. These stanchions, strong beams and web frames cannot be erected until the shaft alley is placed on the ship. The erection of the stanchions, etc., permits proceeding with the erection of "J" strake plates, frames and girders, which erection opens up the erection of all other shell plate and second-deck beams, etc. If the shaft alley was placed on the ship piece-meal the erection of the alley could not begin until the bottom bounding angles were riveted and calked, as in the case of the assembled shaft alley. After the completion of the bounding angles the work

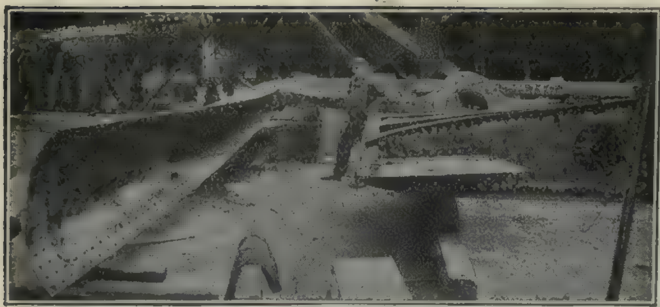


FIG. 10. ASSEMBLING STERN FRAMES

of slowly erecting the shaft alley in pieces would begin and until this was completed piece by piece, regulated, reamed and bolted, the stanchions, girders and frames, for holding up the after end, could not be erected.

It is important in this yard to push the erection of the stern end of the ship and it is only by taking advantage of each little point that this is possible. The shaft alley

FIG. 11. ANOTHER STERN FRAME

is the main and most important point in the speedy erection of this part of the ship. See Figs. 7 and 8.

THE STERN FRAME.—The stern frame is a one-piece steel casting weighing about 18 tons. Owing to the tidal conditions existing at this yard the shoe plate was assembled beginning with the 12th boat. On the 16th boat it was found that there could be assembled to advantage the B-1 shell plates and also frames Nos. 5, 6 and 7. All of this work was completely riveted on the ground at a tremendous saving in cost, which is only the natural result of not being compelled to shift men back and forth to this job when tide permitted work to be carried along. On the 22nd boat, bulkhead No. 8, C-1 and D-2 plates were assembled. No riveting was performed on the C-1 or D-2 plates, this work being left loose for fairing up. Beginning with hull No. 25, the assembly of this section has been extended by adding the boss plates. This permits the erection of the stern portion of the ship in a state of completion which permits the early completion of this end of the afterpeak, the early completion of boring out the stern tube, the early completion of fitting tube to shaft alley, which allows, at an early date, all machinery and shafting to be lined up right through to the condenser. The handling and placing of this unit is done in about one hour from the front of the slip. The work on hull No. 22 faired into the remainder of the ship very nicely, absolutely no additional work being required on this section. (See Figs. 9, 10, 11 and 12.)

FRAME NO. 91.—This frame is assembled with side plates of coal trunk and riveted complete in the assembly yard.

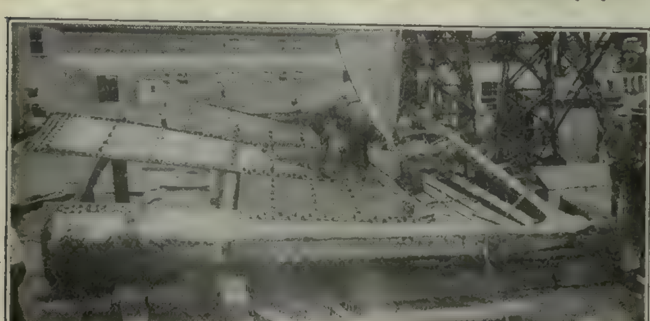


FIG. 12. PUTTING ON THE LAST TOUCHES

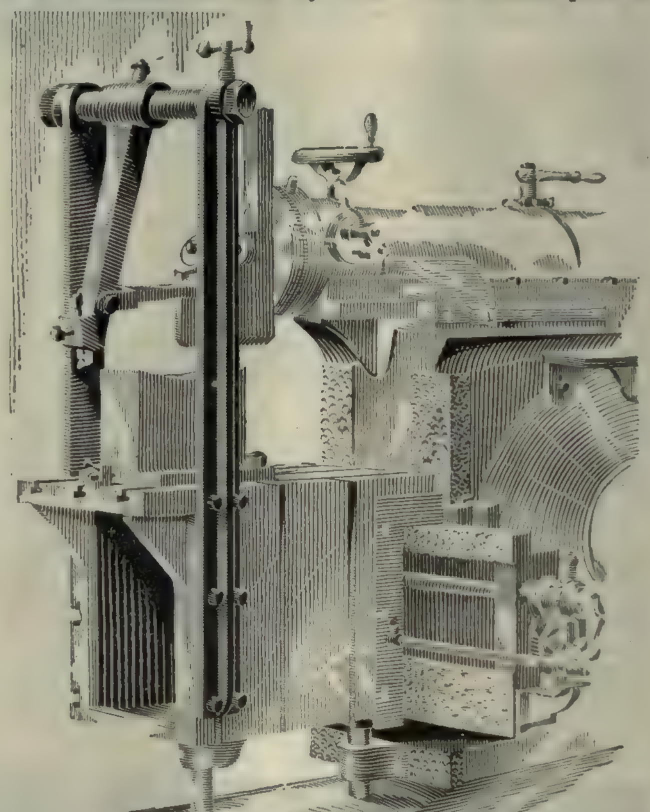
Planing an Arc on the Shaping Machine

BY HERBERT FOX

A curved surface of large radius is usually a difficult thing to machine unless the shop where it is done has a large boring mill available, but there are makeshift methods that can be used in the small shop by which such work can be accomplished—within limits. The illustration shows how it was done on a number of castings in one such shop.

The upright pieces were made for the job, as was also the swinging arm and the connecting-rod; but, if there should not be a sufficient number of pieces to be finished to warrant the expense of patterns and castings, these could be made up from cold-rolled bar stock and the expense avoided.

The uprights were bolted to the sides of the table and connected across the top by a shaft shouldered into the hubs and held by nuts. The middle part of



DEVICE FOR PLANING A RADIUS

the connecting shaft was turned to a running fit in the hole at the upper end of the swinging arm. The hub of the connecting-rod was made to take the place of the clapper, and was held by the same taper pin.

The distance of the center of arc above the base of the work was of course established when the uprights were bolted to place. Roughing and finishing cuts were provided for by using two tool bits, each abutting against a screw in the swinging arm. Wear and grinding on the finishing tool was compensated for by advancing this abutment screw, the radius being established and maintained by a special gage which hooked over the central shaft.

It was thought at first that trouble might develop from cramping of the swinging arm in its passage across the shaft and the oil cup was provided as a sort of insurance against it, but no such trouble developed; the device worked very nicely from start to finish and is ready for any similar job in the future.

A Progressive Indexing Jig

SPECIAL CORRESPONDENCE

This article describes how a job that looked at first as if it would require costly tools was finally accomplished with a few comparatively inexpensive ones. It is not always the wisest course to remove the limit to the tool cost entirely in order to expedite production; sometimes the quantity will not warrant it, and sometimes the nature of the product will require skilled labor to be used in its production anyway, regardless of the elaborateness of tool construction. In this latter case, it is not bad practice to make the skill of the worker count to its utmost against excessive tool cost.

A JOB that upon first consideration presented a rather formidable appearance and seemingly required the construction of somewhat complicated and expensive tools, came to the writer sometime ago. The work, which is shown completed except for the rollers in Fig. 1, is a cage or shell for a roller bearing, and is used in the bearings of a rolling mill.

Such bearings are, of course, a commercial product and the manufacturers of them probably have ways of producing the cages that have our method "skinned a mile." Nevertheless, as our firm had a large number of mills so equipped and the service was severe, resulting in excessive maintenance cost, they decided to attempt the construction themselves and the way in which our designer attacked the job was a study in simplicity, in which accuracy of workmanship stood in lieu of complicated and expensive devices. Briefly, he decided to depend upon progressive indexing, the bug-a-boo of so many tool designers, rather than to make costly tools that would provide independent indexing for each position.

Twenty-One Divisions in the Cage

So far as the cages were themselves concerned, absolute accuracy was not essential, but because of the cumulative effect involved in the method of production, an original error of even 0.0001 in. would have proved embarrassing. As may be seen from the drawing, there were 21 divisions in the cage, thus the original error would be multiplied by that number. The same tools were used to produce the cover, or binder-ring, in which the total error would be duplicated. Now as the cover must necessarily be inverted to put it in place, adding its accumulated error to that of the cage, the total error (assuming 0.0001 in. times 42) would prevent the two parts from going together.

The cages were cast from hard bronze in the form of cylinders. The first operation was to chuck them in a lathe, rough-turn (as far as the chuck jaws would allow), rough-bore clear through, face outer end, and then finish-turn to correct outside diameter, which must be quite accurate because of the method of holding in the succeeding operation.

The first special tool was an iron pot casting similar to those used for making piston rings, but heavier, and with a substantial flange so that it could be bolted to the faceplate of a lathe. The only machine work on this casting was to face the flange and drill the bolt holes to attach it to the faceplate and when it was properly swung up, to bore it to a push fit for the outside diameter of the brass shells. The shells were pushed into this holder with the tail-spindle screw and when finished could usually be pushed out with a rod through the lathe spindle used in conjunction with a piece of strap iron placed across the inner end of the shell. Sometimes, however, the operator would get too enthusiastic in pushing the work in, in which case it became necessary to dismount the whole business to drive the shell out. The set-up is shown in Fig. 2.

With the shell in this holder, the remainder of the outside surface (where the chuck had gripped it in the first setting) was finished and this end faced. A light finishing cut was then run through the bore, and here again good work was necessary as in the next set-up the shell became a part of the indexing jig.

This may sound like excessive refinement in the preliminary operations, but it did not seem so while doing it. No part of the job was exactly work for unskilled labor and with an average man on the job the work went foward rapidly and without undue trouble. It was not necessary to send the shell clear home in the holder to do the finish-boring; it must not be loose or it would not drive, but if it was a "leetle too tight" we didn't push it in so far, and if it wouldn't go in far enough to make it safe to work on, it was chucked in another lathe and filed. This extra chucking as well as the dismounting of the holder to drive out a shell that had been too tightly forced was hard work, and after trying both a few times the workman decided it was easier to make them right the first time.

The Tools Used

In Figs. 3 and 4 are shown the few simple tools used to cut the roller cells. The work was all done in an ordinary drilling machine. The base *A*, Fig. 3, was of cast iron with a hardened-steel ring shrunk on the shoulder, over which the brass shell sets. The cover *B* was of machinery steel with a shoulder tightly fitting the inside of the shells. Twenty-one semicircular notches in the periphery of this cover were made to correspond to the roller cells, but these had no part in the indexing, being merely for clearance in the counterboring operation.

Each of the projections extending between these notches had a hardened center-point sunk into its under surface for the purpose of supporting the upper ends of the slender finger-like dividers that was all that remained of the shell after the counterboring was finished. A ring nut upon the central stud clamped the cover tightly onto the shell and held the whole together as one unit.

A sector *C* made of cast iron with three steel bushings, swung upon the central stud and could be clamped in any position by the hand nut *D*. One of the two outer bushings was larger than the largest tool used and was fitted with slip bushings to accommodate all tools. Two plugs *A* and *B*, Fig. 4, were fitted to the other bushing—*A* having an extension to fit the hole left by the drill, and *B*, a hole to fit over the post made by the hollow mill *C* when making the cover.

The first operation was drilling 21 holes in the shell. The drill was of such size that it did not cut through

the metal and as the drilling was done in four stages, starting with a short drill and using progressively longer ones as the depth increased, there was little tendency to "run."

Starting the operation by setting the sector to drill approximately to the center of one of the clearance spaces in the cover, a hole was run down to the limit of the drill. The sector was then set forward until the double plug would pass through its bushing and

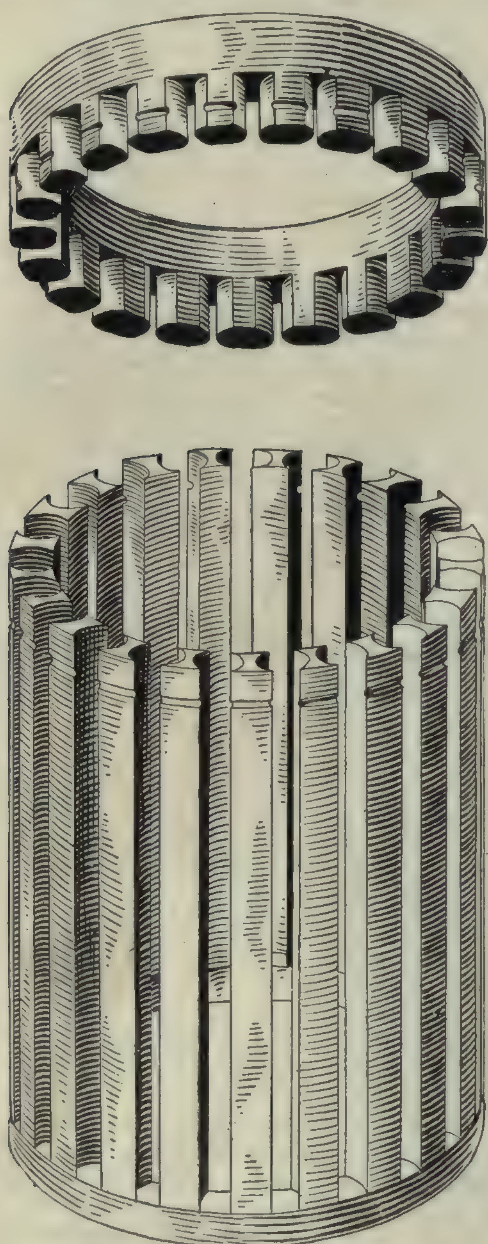


FIG. 1. ROLLER CAGE AND COVER

into the hole just drilled, the sector then being in position to drill the next hole.

For the reason that the center distance between holes in the finished cage would be too short to accommodate proper sized bushings, the center distance between the bushings had been carefully calculated to equal the chord of arc intercepted by every other hole so that the second hole drilled would be in the position of the third after finishing, leaving a blank space where the second should be. Thus, the eleventh hole drilled would be adjacent to the first one and on the sector's second time around the blank spaces would all be drilled out.

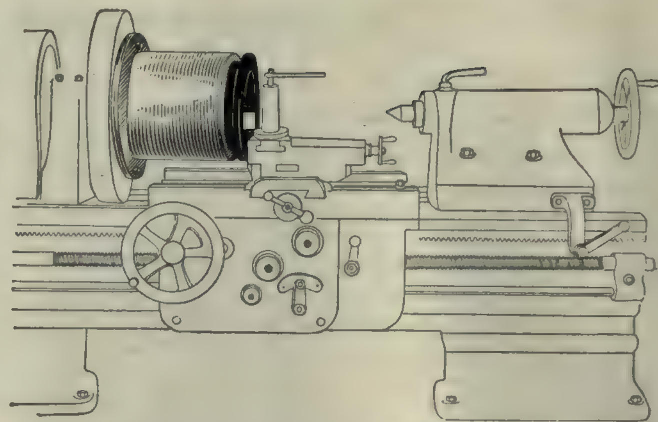


FIG. 2. HOLDER FOR FINISH-BORING

After all holes were down to the limit of the first drill, the sector was of no further service. The holes were then put down to the full depth of $8\frac{1}{2}$ in. in three succeeeding operations. A special counterbore with a pilot closely fitting the drilled hole and a body equally closely fitting in the counterbored hole now followed the drilling. As this counterbore was $\frac{1}{32}$ in. larger than the rollers to be used in the cage, it naturally "cut out" both inside and outside of the shell, but because of its peculiar shaped spiral cutting edges and closely fitting body, no trouble was experienced by reason of its running or drifting out of line. A second counterbore, a duplicate of the first except that it had no pilot, finished the holes to the required depth, leaving the bottom square and clean.

After the first hole was counterbored, the necessity for the prick points on the under side of the cover

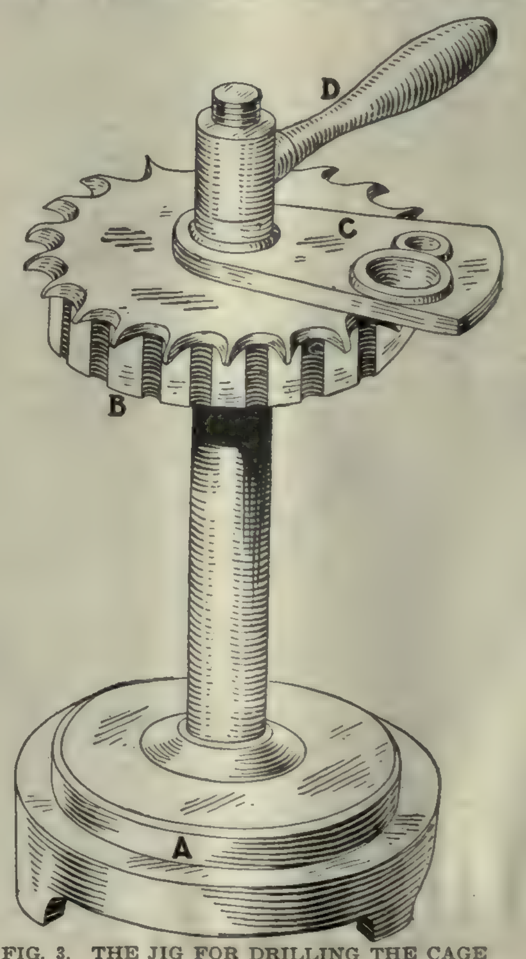


FIG. 3. THE JIG FOR DRILLING THE CAGE

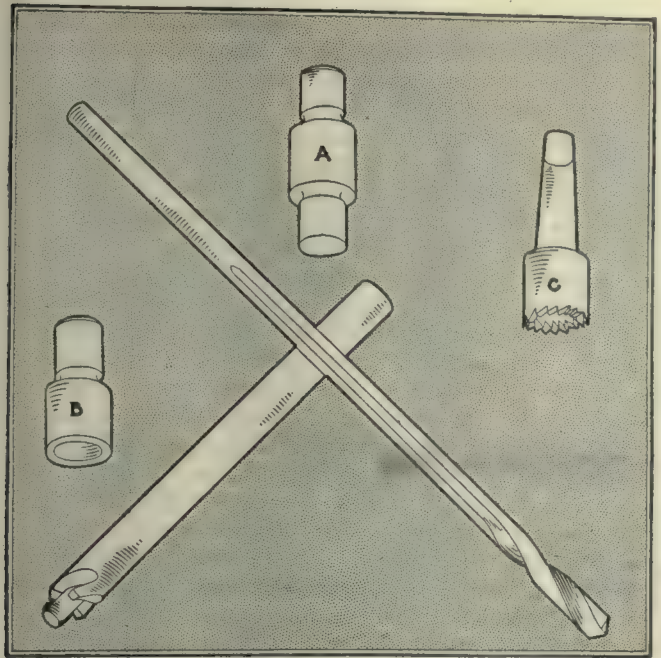


FIG. 4. TOOLS USED IN MAKING THE CAGE

became apparent, as upon counterboring, the second hole on the side toward the first, being only a slender finger of brass 8¾ in. high, would tend to spring away under pressure of the cut and not only bind the counterbore but would cause the latter to "drift" out of alignment. It was necessary, in spite of the prick points, to follow up the counterboring operation by keeping pieces of drill rod in three or four holes following the counterbore, stepping them along as the counterboring proceeded, to counteract that tendency.

The same base and sector were used for making the binder-ring, a shorter center stud being substituted and the cover omitted. As the binder-ring fitted the shoulder and projected but ⅜-in. above it no other hold was necesary. The short posts were made by the hollow mill which was indexed forward in exactly the same manner as previously described for the cage, using the hollow plug for an indexing pin.

The binder-ring was now set in place on its cage and the ⅜-in. projections tapped into place by using a mallet or a ball of lead. The cage was then mounted on an expansion mandrel and a round-bottom groove cut clear around in the solid metal, part of which was the cage and part the cover. The location of this groove may be seen in Fig. 1.

Next, taking off the cover, the hardened-steel rollers were dropped in, the cover replaced and a piece of iron wire just long enough to go around the cage was tapped into the groove, the metal being swaged over the joint to prevent the wire from coming out.

I do not remember the time required to complete one of these cages, but if the manufacturers can remove material any faster than we did from work so fragile as the cages became as soon as two or three cuts had been made, I am interested to know how it is done.

Peace and the American Machine-Tool Industry

By L. W. ALWYN-SCHMIDT

What effect will peace have on the machine-tool industry of this country? At the time of writing, the meager data at hand does not allow one to build a conclusive answer to the question. However, the happenings of the past few months have provided tangible ground work on which to form the nucleus of the solution.

THE American machine-tool industry had grounds to look with apprehension to the coming of peace. The years of the war had been marked with unusual activity and machine-tool exports had not only grown at an unprecedented rate, but there was also an enormous demand from the home market. The extent of the latter can only be estimated from the fact that the employment of labor had more than doubled.

Discussion of measures to be taken to meet the cessation of the so-called industrial war activity was complicated by the utter lack of precedence. It was calculated that most of the machine tools manufactured for the production of war material would not be suitable for other work while only a few could be rebuilt for other purposes. The manufacturers of war material had foreseen this possibility and had made their prices accordingly, which provided for the depreciation of new machines and the buildings that were erected. The wisdom of this practice has shown that the loss will be small even if the machinery that was built for special purposes eventually goes to the scrap heap. In fact there is a fair likelihood that many machine shops have written off so much of their machine equipment as to have on hand an actual surplus cash reserve that may be employed for new purchases. At any rate, plenty of warning had been given of the approaching armistice and during the latter part of October it was rumored that fewer orders for shells might be expected. Foreign orders for equipment also had been tapering off for some time, so that the industry had ample time to consider its position even before the date of actual cessation of hostilities.

The reorganization of the industrial forces of the industry, which is the important work at present, is now proceeding more smoothly than might have been expected. There is no cause to assume that the domestic demand for industrial products has decreased materially during the first months of peace. If this continues it is certain that the machine-tool industry will get its deserved share in the general prosperity; if it fails it is bound to suffer with all the others.

It was the opinion of some that our prosperity would end with the advent of peace and in support of their argument, claimed: that our war prosperity was created by the war only and consequently would end with it; that after the war, Europe would regain her position in the world's markets, thereby excluding the American manufacturer; and that a general financial panic would be the result of the war.

Let us examine each of these assumptions and see how far the actual events have proved their correctness.

The war was certainly the outward cause of much of our prosperity, and had it ended two years ago, it might have put an end to the prosperity created. The

additional two years, however, changed the situation materially, and our national industry is working today under conditions very different from those existing during 1916. Considerable money has come into the country, wages are higher, and business is continuing at a brisk rate in all lines. Prosperity has set in and it is going to stay. The reëstablishment of normal conditions in Europe, while not as powerful a factor in reconstruction as expected, will stimulate the export business and without a doubt the machine building industry will get its share. Incidentally, our exports to other countries depend not only upon the industrial activity of Europe but upon our own ability to supply their demand.

Statistics show that the machine industry of this country, in spite of losing the large orders of war material, is rapidly gaining its former foothold with the reëstablishment of normal demands for equipment. Many orders, for instance, are expected from the agricultural machinery industry. This industry has not done an extensive export business during the last few years, but there are indications from Europe that more American agricultural machinery will be used after the war than before. France and Russia especially should become large buyers and this, added to the usual demand from all the other markets together with our own home market, should tend to increase the activity in the American agricultural machinery industry to such an extent that it will be compelled to increase its machine-tool equipment.

While this reorganization process is going on at home we can hardly lose sight of the corresponding development in other countries, competitive and buying. In reorganizing her industries, Europe will be favored in one respect against America. The European nations have lived for many years under considerable stress. The experience of the war has taught them that only coöperation can solve the many difficulties incidental to peace, and they are, therefore, more inclined to support the respective propositions of their governments.

With the business of the machine makers returning to its normal channels a number of new problems have arisen, affecting the individual manufacturer. The unsound pressure under which production was carried on has not been pleasant. Unusual expansion of the industrial equipment was necessary and many new firms were organized which have increased competition, and sales departments are working harder to meet the high level of expenses incidental to advertising, selling, wages, overhead and materials. Before the war, machinery prices were kept at a low level by European exports in spite of the high prices charged by American manufacturers. Since neither England nor Germany will be able to manufacture machinery as cheaply as before, due to the fact that wages in Europe are steadily approaching our standards and their manufacturing methods are not equal to our own, foreign machine prices, therefore, will remain near our level. While the foregoing, together with the disposition of enormous quantities of raw materials, new and going war industries, and possible competition with Latin America and the Orient, presents problems which are being rapidly solved, yet the biggest problem on our hands is the disorganization of labor.

With the declaration of war in Europe, a great many men were drawn into the army who were much more needed at the lathes and benches than in the trenches. With the progress of the war, however, this mistake was remedied and many men were returned to their civil employments. Later, there appeared a very heavy demand for active men in the army, and all industrial reserves were called for service. This made necessary the employment of older men, and in many cases women, in the machine manufactories. By following the lesson taught by Europe, America avoided this mistake and the American industry is now assimilating the men returning from the armies. Many men and women who had paying positions in war work are taking up their former employments. The unemployment of discharged soldiers, however, still prevails to a certain extent. Fortunately, we have had some experience in dealing with a situation of this kind which is very similar to that which we had to meet in this country when we absorbed suddenly the great mass of unemployed during the fall and beginning of the summer of 1915. The process is now facilitated by better organization.

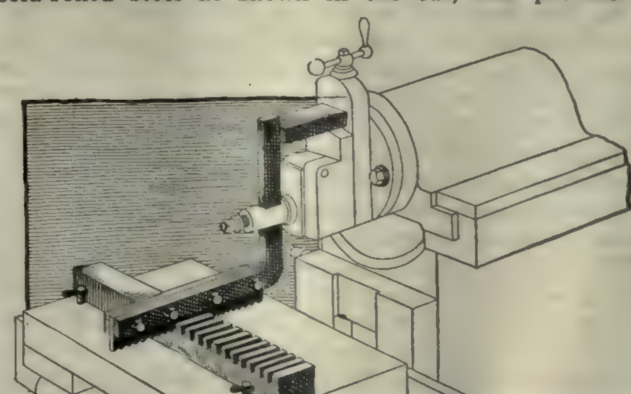
It appears that under these circumstances there will be little reason for alarm. The process of reconstructing our economic life has made very good progress during the last few months, and there is no reason yet to expect a sudden hitch, although an occasional slowing down or friction in one direction or another is to be expected. It is not easy to adjust a vast industrial equipment like that of the United States from one purpose to another. It took over a year to concentrate our whole economic energy upon the conduct of war, so we must not expect an immediate return to the conditions of peace. The machine building industry being so closely allied to all national industrial activity will soon feel the effect of the new situation.

The war prosperity of this industry has ended but it has been replaced by a new prosperity of returning peace and at the time of writing there is nothing to trouble the mind of the machine-tool maker in this country. The present activity in the industry should be easily upheld and there are a great many indications in favor of the theory that it may become more pronounced during the new year.

Tool for Making Narrow Slots

By J. A. Lucas

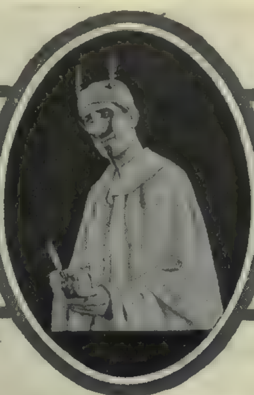
When it is necessary to make a slot or series of slots so narrow that the ordinary form of parting tool is impracticable, draw out and bend a bar of $1\frac{1}{2}$-in. cold-rolled steel as shown in the cut, and provide a



SLOTTING WITH PIECES OF HACKSAW BLADES

clamping jaw into which is tapped several collar-head or ordinary hexagon head capscrews of small size. Broken hacksaw blades furnish the cutting tools.

"MEPHISTO" BITS



HOW THEY ARE MADE

By S. A. Hand, ASSOCIATE EDITOR, AMERICAN MACHINIST

The manufacture of auger bits is one of the oldest of the tool industries in this country. Many of the factories have remained in the families of their founders for generations and, as is usual in such cases, radical improvements in either the product or the processes of manufacture have been slow. The bit described in this article has been improved, not by adding anything to it but by taking something from it. Some of the processes in its manufacture are different from those generally used in bit making. Boring is only whittling in a circle and just as one uses only one blade with which to whittle so it is only necessary to have one cutting blade on an auger bit. Likewise, it is only necessary to have one scoring lip to cut off the chip.

THE steel used in the auger bits made by the W. A. Ives Manufacturing Co., Wallingford, Conn., is made to its own specifications using genuine Swedish pig as a base. It has a slightly higher content of manganese than of carbon, to give stiffness; while for endurance of cutting edges, a trace of tungsten is added.

The blanks for the bits are sheared from a flat bar of suitable size, and after being heated the shanks are drawn out and the squares formed in dies in high-speed Bradley hammers as may be seen in Fig. 1. Next, the blade is die forged in the same type of hammer. In this operation, known as plating, the blade is left thicker at the center than at the edges, the shape being similar to that of a slitting or feather-edge file. This shape is not carried out to the extreme end, a blank space about twice as long as the width of the blade being left for drop-forging the leader-screw blank and scoring lip and to leave enough thickness of metal for forming the cutting lip. The appearance of this end after drop-forging may be seen in Fig. 2, in which *A* is the blank for the leader screw, *B* the scoring lip and *C* the part from which the cutting lip is upset. It will be noted that an unusually large flash is left from the drop-forging operation. This is to insure the maximum compression of metal at the vital part of the bit and to make certain that any accidental overheating of the metal at the edges and extreme end will not affect the cutting parts. Trimming off the flash is done in an ordinary punching machine provided with suitable dies.

FIG. 1. FORGING THE SHANK

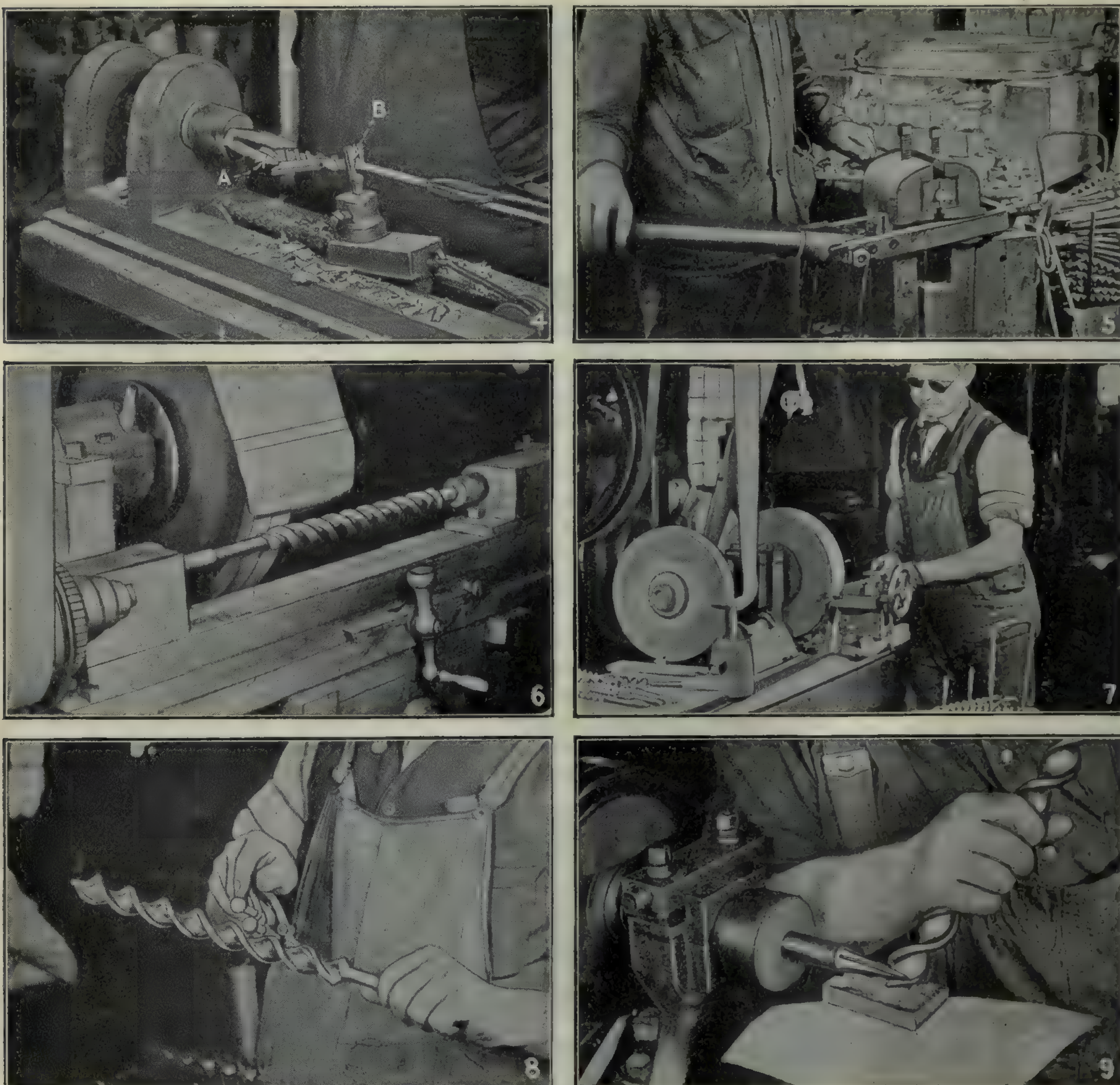
The appearance of the bit blank after it has gone through the operations described is shown in Fig. 3. *A* is the blank as cut off by the shears; *B* has the shank drawn out and the square formed; *C* shows the blade after plating. Here the thickened center and the flat at the end left for drop-forging may be seen. *D* shows the result of the drop-forging operation, and *E* represents the appearance after the flash has been trimmed.

Crimping or twisting the blade is illustrated in Fig. 4. The cutting end of the hot blank is inserted in the chuck *A*, the rear end of the blade being supported in the fork *B* while the square on the shank is held by tongs in the operator's left hand. With his right hand, the operator turns a crank connected to the spindle of the machine. Twisting is continued until in the judgment of the operator the number of turns and the lead are correct, no hard-and-fast rule being followed. Operators on this work, however, become so expert that the results are very uniform.

Bits for boring treenail holes in wooden-ship construction and for other deep-hole work are not twisted but are crimped between dies in a machine of the bull-dozer type. Such bits must have the bottoms of the crimps accurately formed so that the chips will be brought out of the hole and not clog the bit.

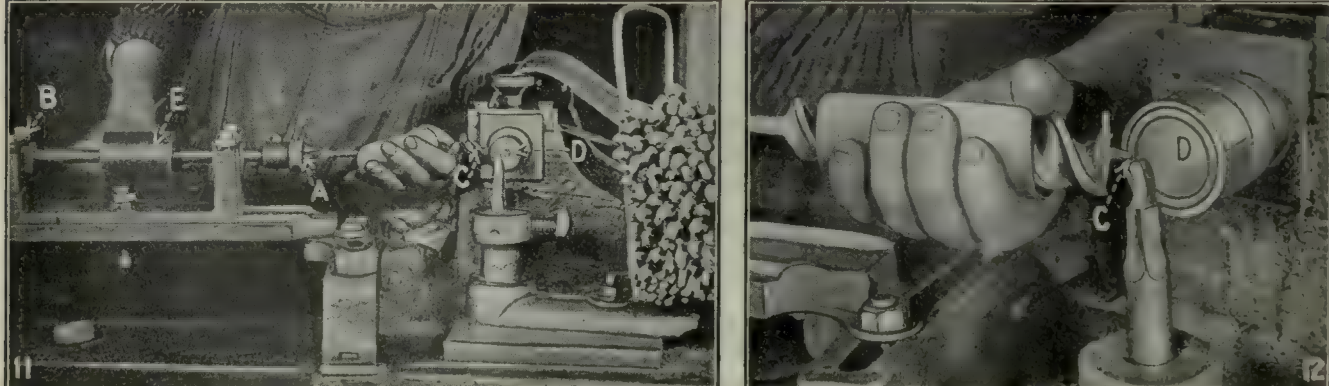
After twisting, the bit is reheated at the end and headed. In this operation both the cutting and scoring lips are formed in dies, the action of the machine being similar to that of a bolt-heading machine. The next step is to even up the twist between dies in the lever-operated fixture, Fig. 5, after which the bit is cold-straightened.

The blank for the leader screw is hollow-milled to size and shape in a hand lathe and the outside diameter is ground to size. In this latter operation the bit is held in a chuck in the live head of the machine, Fig. 6, and supported at the other end by a female center into which



FIGS. 4 TO 9. TWISTING, SIZING AND THROATING
Fig. 4—Twisting the bit. Fig. 5—Evening the crimps. Fig. 6—Grinding to size by a friction wheel. Fig. 7—Grinding the clearance. Fig. 8—Measuring the clearance. Fig. 9—Digging out the throat.

the blank for the leader screw fits. The action of the machine is similar to that of any cylindrical grinding machine except that the actual grinding is not done by an abrasive wheel, as would naturally be supposed, but by a steel wheel running at a very high peripheral speed. The removal of metal from the bit is by fric-



FIGS. 11 AND 12. CUTTING THE LEADER SCREW

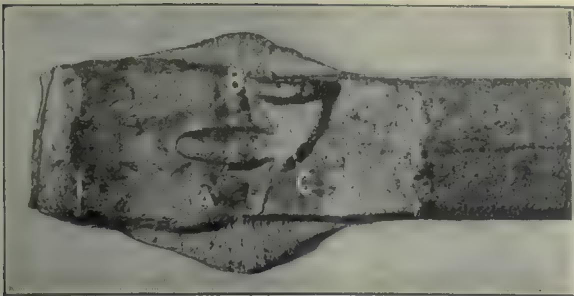


FIG. 2. THE DROP-FORGED HEAD

tion. There seems to be little wear on the wheel which is evidenced by the fact that the wheel now on the machine has been in constant use for about 17 years. The outside of the bit must be reduced in diameter behind the cutting point for clearance and the operation is performed, as shown in Fig. 7, on an ordinary abrasive grinding stand, the bit being revolved by hand between the abrasive wheel and an adjustable slide. Fig. 8 shows an inspector gaging the clearance with an adjustable limit gage.

Both the cutting lip and the blank lip opposite to it are faced back to form a tangent with the leader-screw blank and their tops are leveled off, all on hand milling machines. The throat under the cutting lip is "dug out" by milling to form the chip carrier. This operation is illustrated in Fig. 9, in which it will be noticed that the bit is being guided entirely by the workman's hands.

Various Stages the Bit Passes Through

Fig. 10 shows the stages the bit has passed through from the crimping until it is ready for cutting the thread on the leader screw. Referring to the illustration: *A* has been crimped; *B* has been headed and the blank for the leader screw hollow-milled; *C* has been ground on the outside and for clearance; *D* has been faced back; *E* has been leveled on top, and *F* has had the throat dug out.

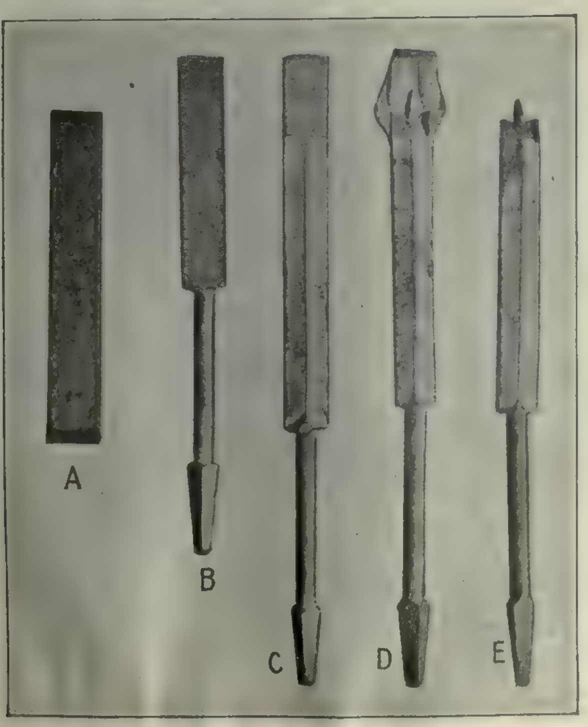


FIG. 3. OPERATIONS BEFORE TWISTING

Figs. 11 and 12 show how the threads on the leader screw are formed. The square shank of the bit is held in the chuck *A*, Fig. 11. The spindle supporting this chuck is threaded at its rear end to the same pitch as the screw to be formed and is free to revolve in the nut *B* which also acts as a back bearing. The leader-screw blank is supported by the rest *C* and drawn up by hand against the concentrically grooved steel disk *D* which

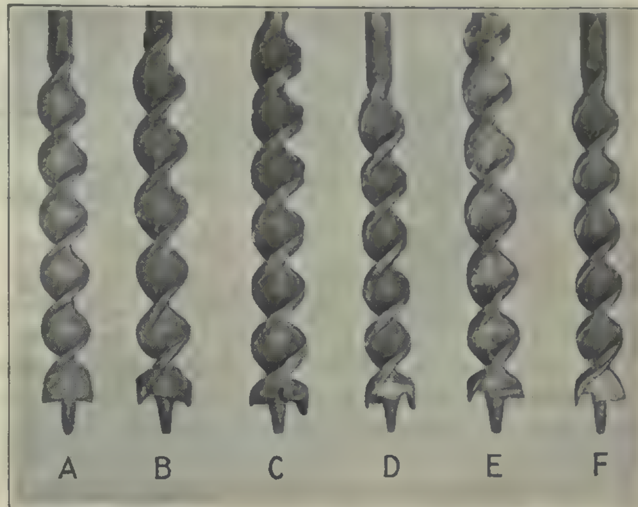


FIG. 10. SOME OPERATIONS AFTER TWISTING

runs at 8000 r.p.m. While the operator holds the leader-screw blank tightly against the disk with his left hand he rotates the spindle in one direction by rolling his right hand and arm over the wooden roll *E*; and

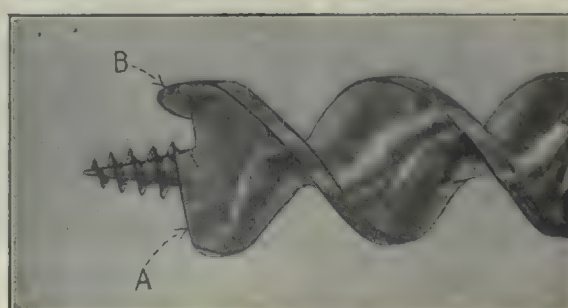


FIG. 13. A FINISHED LEADER SCREW

then relieving the pressure, rotates the spindle in the opposite direction by a reverse motion of his hand and arm, lead being given to the screw by the thread and nut at the rear. The thead is formed by friction between the leader-screw blank and the rapidly revolving disk and during the operation the leader-screw blank becomes red hot.

Relation of Leader Screw to Cutting Lip

Bits are made with leader screws of different pitches —varying from 10 per inch for bits used by electricians, where the object is to bore a hole quickly without regard to its smoothness, to 18 per inch for bits used by pattern and cabinet makers and for use in power-driven machines.

A finished leader screw is shown in Fig. 13 where it will be noticed that the cutting lip *A* is a continuation of the last thread. This construction is the secret of making a bit that will bore a hole clear through a board without requiring end pressure after the screw

FIG. 14. POLISHING THE HOLLOW

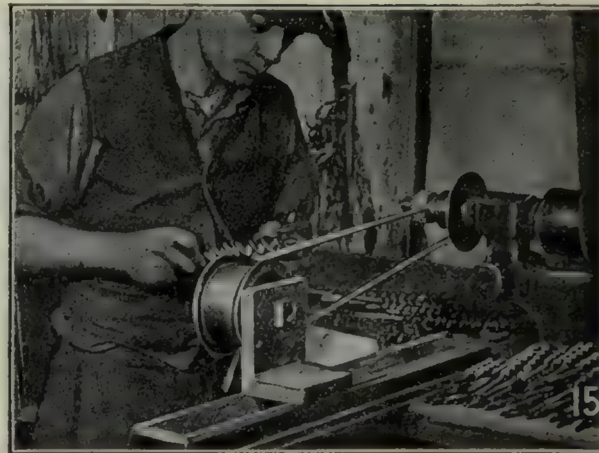
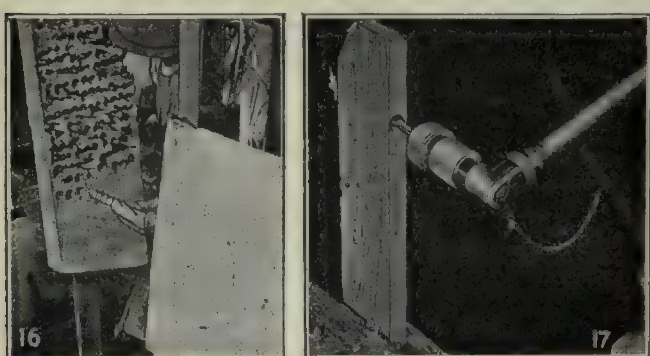


FIG. 15. POLISHING THE THROAT

has taken hold. If there should be a break in the continuity of the thread to the cutting lip, small chips would lodge there, and prevent the leader-screw from drawing the bit into the wood. Another feature that can be seen in the illustration is that the single cutting lip *A* can be sharpened without interfering with the scoring lip *B* and when sharpening the latter there will be no danger of nicking the cutting lip of the file.

Several more operations are necessary before the bit is hardened and tempered, but as they are mostly such



FIGS. 16 AND 17. BRIGHTENING THE LEADER SCREW AND TESTING A BIT FOR STRAIGHT BORING

operations as are generally performed in every-day practice only two of them are illustrated. Fig. 14 shows how the hollows in the twist are polished on a vulcanized abrasive wheel and Fig. 15 illustrates finishing the throat on an endless abrasive belt.

After hardening and drawing the temper, each bit is honed and carefully inspected. The leader screws are then polished by dipping them in oil and an abrasive and repeatedly screwing them in and out of a piece of apple wood as may be seen in Fig. 16. Every bit is tested in actual boring, and as a proof that a well-made bit will bore straight, Fig. 17 shows a bit finishing the boring of a $\frac{15}{16}$-in. hole edgewise through a 1-in. board.

Timekeeper's Cage

By Fred H. Colvin

The illustration shows the method used by the White Tractor Co., Cleveland, Ohio, for locating the routing or job-distribution office in any part of the shop which may be most convenient to the work. This cage, as can be seen, consists of practically standardized sections of heavy wire netting, including a sliding door, which is provided with a lock to prevent the cards or other records being maliciously or mischievously disturbed.

This cage contains the rack for the job tickets and also a calculagraph for recording the time of starting and stopping the various jobs. The small opening in front of the timekeeper is large enough for the passage of job tickets, while the board at the left can be let

A CAGE FOR TIMEKEEPING RECORDS

down to form a shelf, should this be more convenient at any time.

The advantage of a cage of this kind is that it can be placed in any department and in almost any location in the shop without interfering in any way with the light or ventilation of the department. If can also be moved whenever desirable.

The Manufacture of Incandescent Lamps—II

By C. W. STARKER

A high degree of skill and a steady hand are required in assembling incandescent lamps. Improvements in both methods and materials in manufacture have been many and great. Since 1879 the efficiency of the incandescent lamp has been increased nearly fifteen fold and the lamp is now five times as efficient as it was at the beginning of the present century. Lamps must be thoroughly tested before shipping—many of them to destruction—and this entails an enormous annual expenditure.

TO BRING a modern incandescent lamp to its completed form a variety of materials and a number of operations are required. The principal parts of the modern tungsten lamp are shown in Fig. 17, and their names indicated.

The filament is supported on a glass mounting called the stem, which is made by cutting a glass tube to the required length and flaring the end, as shown in Figs. 18 and 19. Next a glass rod is cut off and provided with bulges *B*, Fig. 20, the one near the bottom, the other near the top. All these operations are done in practically automatic machines, the glass being heated until it becomes soft enough to permit the staving operation. This stem is then assembled with the glass tube, the leading-in wires brought into position, and, after heating, the base is flattened, as shown in Fig. 20 at *C*. As a next step the wire supports, or anchors, at the top and bottom on which the filament is to be hung, are melted in and insulated from one another by the glass parts. After inserting the anchors the proper diameter of tungsten wire for the filament is selected, depending upon the amperage desired, and cut to length according to the voltage for which the lamp is to be used. One end of the filament is joined to a leading-in wire and wound back and forth until its end meets and is connected to the other leading-in wire. This gives what is known as the complete mount, Fig. 21. The connection between the filament and the leading-in wires is made by melting the ends of the wires together in an electric arc in a special apparatus that provides a reducing atmosphere to prevent oxidization. The anchors are made either of molybdenum, tungsten or a wire containing 10 to 15 per cent. tungsten with the molybdenum. They are formed in automatic machines designed for rapid production in large quantities.

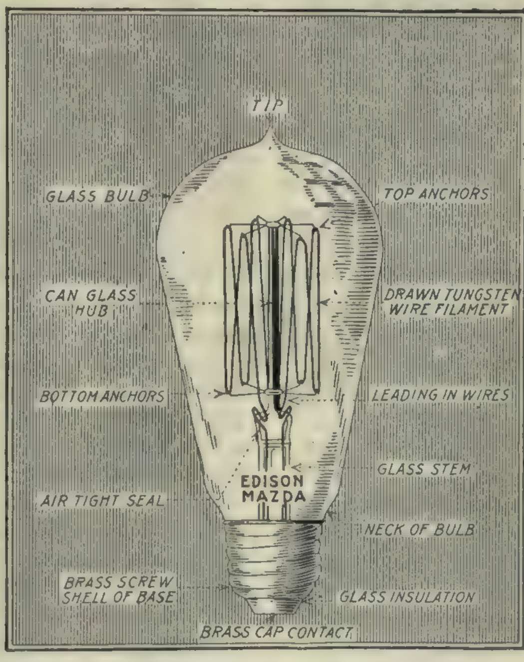
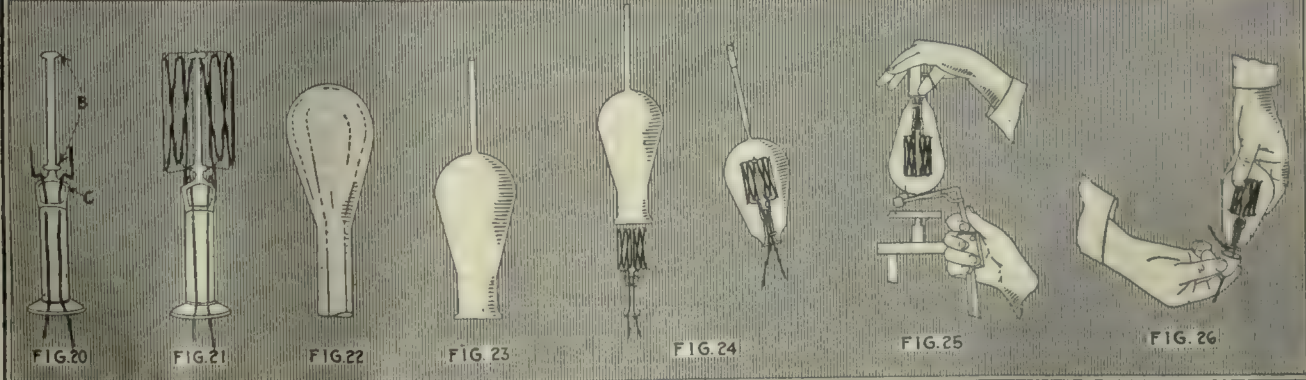


FIG. 17. A TUNGSTEN LAMP

That part of the leading-in wire which is melted into the glass must have the same coefficient of expansion as the glass and must not easily form an oxide coating as otherwise air openings or breaking of the glass would occur. Such a material is platinum, a short piece of which is inserted between the two pieces of nickel and copper wire which compose the rest of the leading-in wires. Less expensive substitutes for plat-



FIGS. 20 TO 26. LAMP PARTS AND THEIR ASSEMBLY

Fig. 20—The finished stem. Fig. 21—The completed mount. Fig. 22—The bulb as it comes from the glass works. Fig. 23—The tubulated bulb. Fig. 24—Sealing-in the filament. Fig. 25—Exhausting and sealing. Fig. 26—Applying the base.

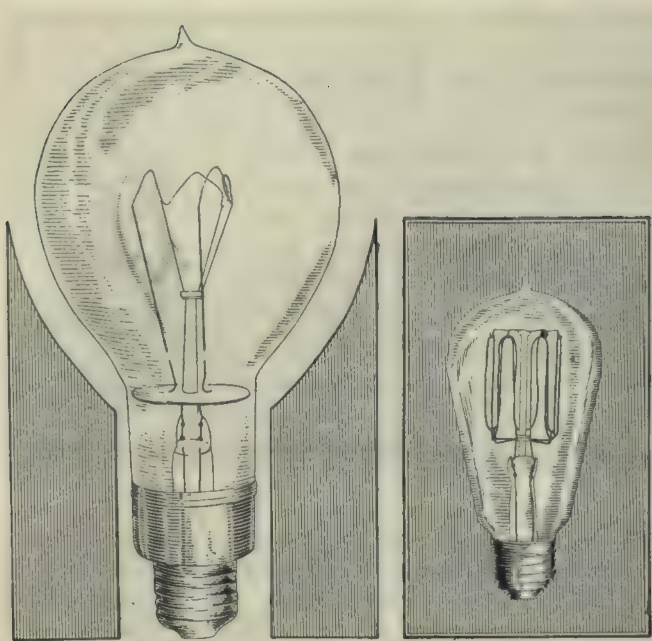


FIG. 27 FIG. 28

FIGS. 27 AND 28. TWO TYPES OF TUNGSTEN LAMPS
Fig. 27—A gas-filled lamp. Fig. 28—An exhausted lamp.

inum have come into use, such as nickel-steel wire covered with platinum.

The manufacture of the bulbs is a complete industry in itself, requiring large plants and skilled glass blowers. Formerly lamp bulbs were blown in the open, which naturally resulted in variation in size. Now,

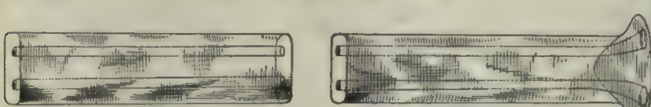


FIG. 18 FIG. 19

FIGS. 18 AND 19. THE GLASS STEM
Fig. 18—The stem flattened. Fig. 19—The stem flared

however, the bulbs are all made in molds and are therefore of uniform size. As received from the glass works the bulbs have considerable superfluous glass, Fig. 22, which is cut off by the lamp manufacturer. This is done on a semiautomatic machine, in which a number of bulbs are set up in a circle and made to revolve around their axis as well as travel around in the circle. They are set to correct height, and in their rotation they pass a cutting wheel which makes a slight scratch in the glass, and then they pass a series of gas flames directed at the point that has been scratched

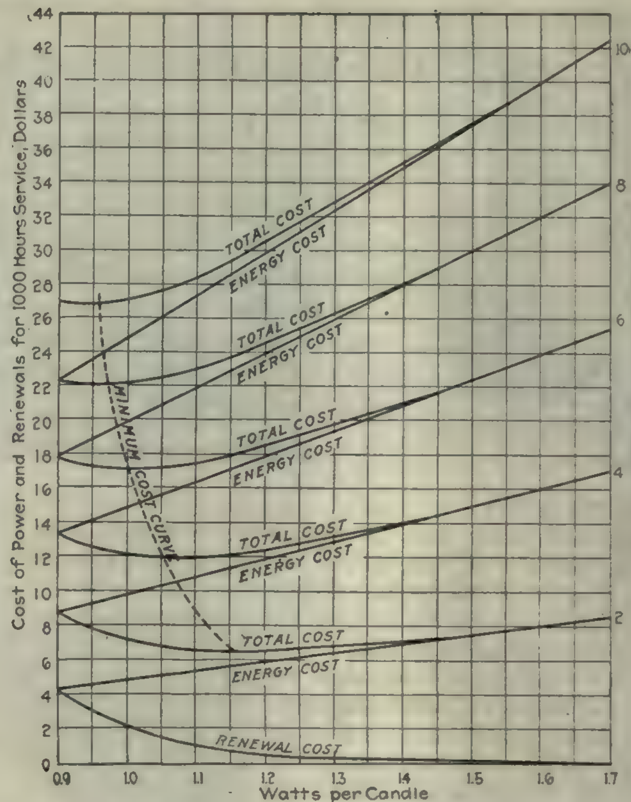


FIG. 31. RELATION OF ENERGY TO COST OF RENEWALS FOR LAMPS OF DIFFERENT EFFICIENCY

so that, due to the heat, the necks break off. Such machines perform this operation at the rate of 1000 or more bulbs an hour.

The next operation, Fig. 23, consists in melting a hole in the rounded end of the bulb and welding a glass tube at this point. The two operations of melting a hole and of inserting the tube are performed in the same machine, both tube and bulb being heated at the point of junction and brought into the proper position. Next follows the sealing-in process, in which the tubulated bulb is placed over the completed mount, Fig. 24, both parts being held in their proper relative position. Bunsen flames are applied at the neck of the bulb and both the bulb and the mount are rotated slowly until the neck of the bulb is welded to the flare of the stem tube. The seal thus formed at the neck of the bulb must be absolutely air tight.

In the next operation the exhaust tube is connected to a vacuum pump and the air exhausted from the bulb. While this is being done the lamp is inclosed in an oven heated to a temperature high enough to expel all moisture. When the exhausting is completed the lamp is sealed off, Fig. 25, by melting the glass tube at the top and forming the pointed tip.

After exhausting the lamp is "based." One of the leading-in wires is soldered to the cap at the end of the base, Fig. 26. This cap is insulated from the shell by black glass. The other leading-in wire is soldered to the brass shell and the socket cemented in place.

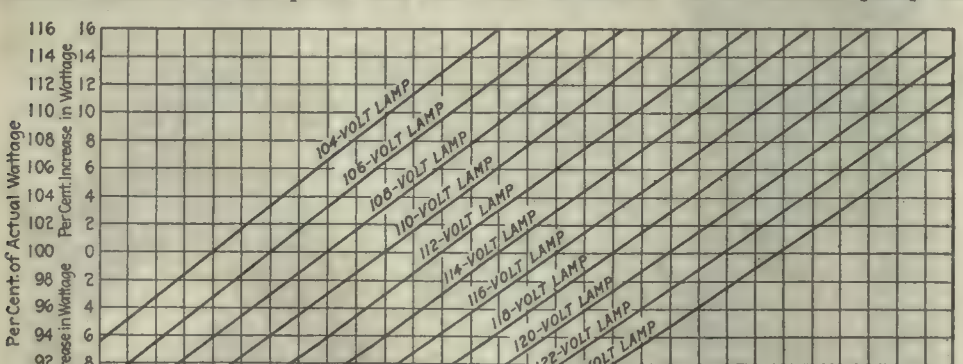


FIG. 29. CHART SHOWING VARIATION IN WATTAGE

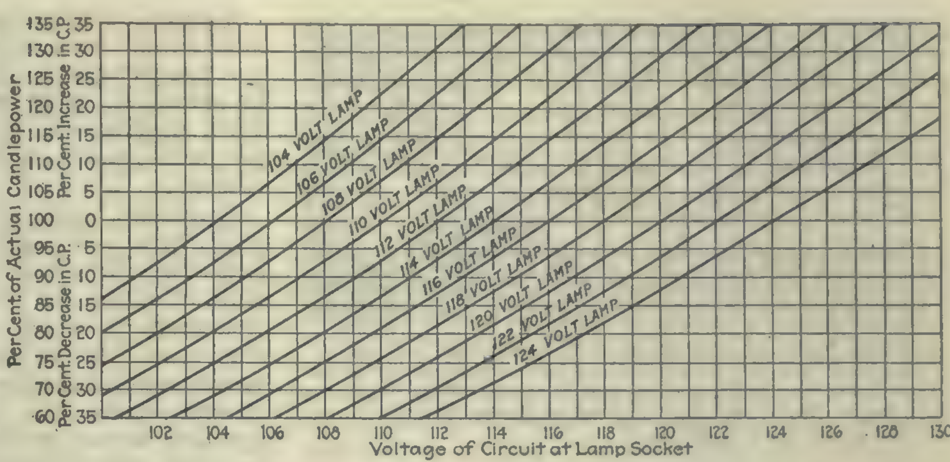


FIG. 30. CHART SHOWING VARIATION IN CANDLE POWER

Because of the impossibility of producing an absolute vacuum and with a view to reducing if possible the evaporization of the filament, the action of various gases on the filament and their influence on the blackening of the bulb have long been the subject of investigation. Early in Edison's experiments it was suggested to fill the lamps with a chemically inert gas such as nitrogen. However, this introduces the difficulty of the convection of heat from the filament through the gas to the bulb and surrounding air which would involve a loss in efficiency inasmuch as the filament would have to be heated to a correspondingly higher temperature. Fortunately the loss by convection increases in only about the $\frac{1}{3}$ power of the temperature while the radiated energy increases with the $\frac{4}{1}$ power for tungsten. In addition it was found that the cooling action of the gases has a greater influence on thin wires than on comparatively thick ones. A gas pressure of about two-thirds of an atmosphere has been found most suitable.

With the gas-filled lamp the pear-shaped bulb, Fig. 27, has become customary instead of the straight-sided shape, Fig. 28. The reasons for this new shape are that in winding the filament in the form of helical coils the exposed area is reduced, permitting thereby a smaller bulb, and the higher operating temperature necessitates a longer neck of the bulb for cooling the gases before they reach the socket.

During the process of manufacture and after completing the lamps a number of tests are made as a check on the quality of the product. Considerable difficulty was experienced in obtaining a uniform product, particularly before the advent of the present type of lamps. The modern tungsten lamp with a coiled filament of long length or comparatively large cross-section of wire fortunately affords somewhat easier working conditions. The difficulty was principally in making a filament or the individual hairpin-shaped parts of the original tungsten lamp of uniform resistance which would result in lamps of exactly predetermined voltage, amperage and candlepower.

A check on the vacuum of nongas-filled lamps is made by using a Tesla transformer. If a light-green light is emitted from the bulb the vacuum is not good; light-blue light indicates a poor vacuum, and purple still poorer, while a good vacuum is demonstrated by the lamps remaining dark.

The lamps then pass to the photometer room, where they are measured for their proper voltage and labeled accordingly. In the photometer test the light intensity is measured by comparison with a standard lamp and the current changed until a certain number of watts per candlepower is reached.

After photometering, the lamps are ready for basing. The parts of the base are placed in a mold filled with plaster of paris, the lamp then put in and allowed to stand until the plaster hardens. After basing, soldering cleaning and labeling, each lamp is subjected to a

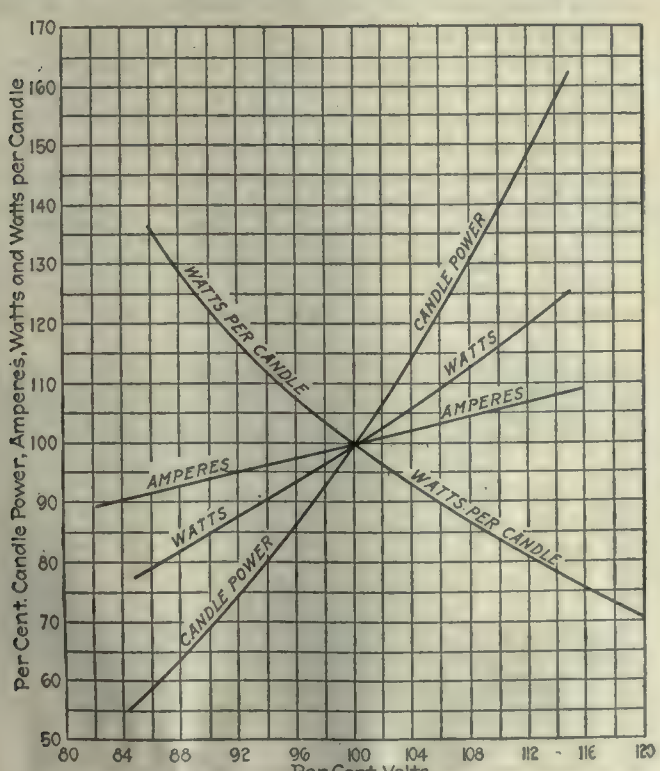


FIG. 32. EFFICIENCY CURVES OF DRAWN-WIRE TUNGSTEN LAMP

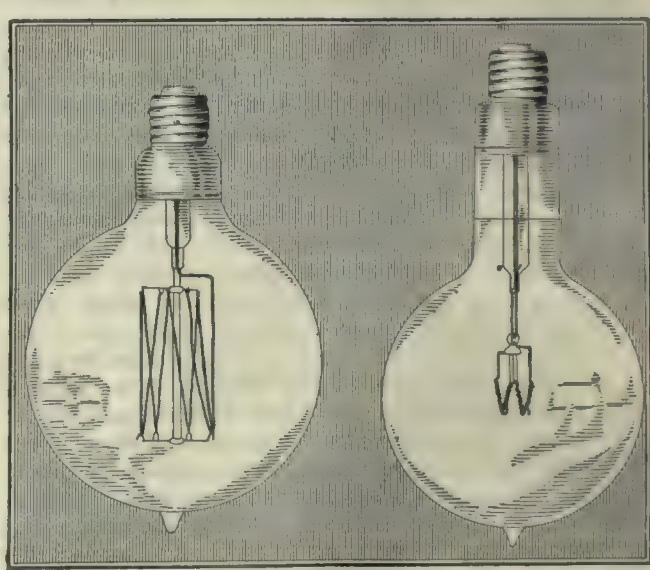
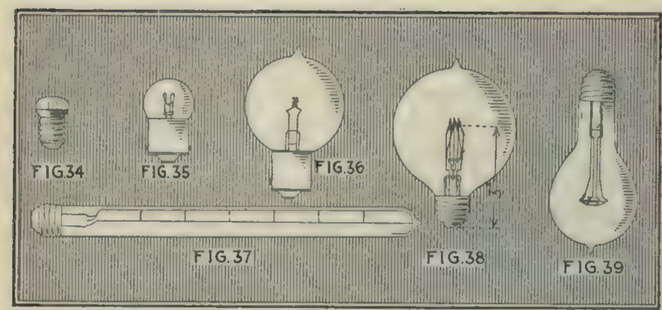


FIG. 33. RELATIVE SIZES OF A 500-WATT VACUUM LAMP (LEFT) AND A 1000-WATT NITROGEN LAMP (RIGHT)



FIGS. 34 TO 39. TYPES OF INCANDESCENT LAMPS
Fig. 34—Flashlight lamp. Fig. 35—Lamp for lighting speedometer. Fig. 36—Lamp for headlight or spotlight. Fig. 37—Lamp for lighting signs. Fig. 38—Lamp for locomotive headlight. Fig. 39—Lamp for train lighting.

final inspection for mechanical defects and is lighted up to insure that no bad lamps are shipped. In order to keep a check on the factories the engineering department of the various manufacturers test a certain percentage of all lamps made for life performance. Elaborate equipment is necessary for this, and in these life tests the lamps are of course destroyed. Huge sums of money are expended yearly for energy to burn lamps and every means taken to insure fair and accurate testing. One of the lamp-manufacturing companies in this country has in such life tests destroyed as many as 50,000 lamps to know what each method of production or each new type developed will actually do.

At one of the large lamp factories lamps are turned out at the rate of over 300 a minute every working day in the year, but accuracies are maintained hardly equaled in any other industry. The bulbs must average a specified thickness from which they may not vary 0.006 in.; the filament may not vary from a definite diameter in any particular lamp more than 0.00001 in.; the glass tubing must not vary in diameter more than 0.45 mm.; the basing cement is prepared according to a chemical formula and must not vary from fixed proportions. All lamps are made up in accordance with standard specifications. The rating of each lamp sold is decided upon only after a careful investigation of the many different factors involved. Accuracy, uniformity, attention to details in raw or finished products mean quality.

In spite of the involved processes of making filaments and of finishing the lamps their manufacture has been developed to such a point that they give satisfactory service even in the hands of the most inexperienced and furthermore their price has decreased from that of a costly laboratory product to such a low figure as to be within the reach of everybody.

The true efficiency of a lamp may be measured by the ratio of energy put into it as compared with the energy obtained in the form of light. This ratio in the best vacuum type of incandescent lamp probably does not exceed 4 to 5 per cent., and with the most recent gas-filled lamps not more than 8 or 9 per cent. The reason for this low efficiency is explained by the fact that only a small part of the total of light and heat rays emitted by the lamp lie in the visible spectrum.

The commercial efficiency is the ratio of the input in watts to light obtained measured in terms of candlepower. The early carbon-filament lamp consumed from 7 to 10 watts per candlepower, whereas the most recent gas-filled lamps operate at ½ watt per candle. The gradual rise in efficiency is shown in condensed form in the accompanying table.

However, it should not be understood that because an incandescent lamp is rated at a certain efficiency by the manufacturers this rating would hold regardless of conditions under which the lamp operates. The rated performance; that is, candlepower, watts, life, etc., holds good only when operated at the "labeled" voltage.

Frequently lamps are labeled with three voltages in steps of two volts apart, for example, 110, 108 and 106 volts. Such lamps are rated to give approximately 1000 hours of useful life when operated at high efficiency, 1300 hours at medium efficiency, and at low efficiency 1700 hours. It has been definitely established as the best practice to operate lamps at high efficiency, corresponding to the first figure given for voltage on the label, and having it well understood that this refers to the actual voltage applied at the lamp socket. On any given lamp the lower voltage means that less current

ADVANCE IN LAMP EFFICIENCY

Date	Watts per candle	Candles per watt	Type
1879	7.0	0.14	Carbon
1886	4.0	0.25	Carbon
1896	3.1	0.31	Carbon
1905	2.5	0.4	Metallized
1906	2.0	0.5	Tantalum
1907	1.25	0.8	Mazda
1913	1.0	1.0	Mazda (Drawn Wire)
1914	0.5	2.0	Mazda (Inert Gas)

is passing through the filament and that it is not heated to its proper temperature, and there results a far greater decrease in candlepower than the proportion of the decrease in current, since a very slight change in the temperature of metals produces a very great difference in the degree of incandescence. The energy cost for a certain candlepower is less and the renewal cost greater with higher efficiency. The renewal item is the smaller part of the cost of light, as the energy cost is from 10 to 15 times the renewal cost in a 60- or 100-watt lamp.

In the life of a lamp there is a distinction between the total or "burn-out" life, which refers to the number of hours the lamp will burn before the filament fails completely, and the useful life, which is defined as the number of hours a lamp may be burned before its candlepower has depreciated 20 per cent. At this point, chosen conventionally, although the filament of the lamp may be intact, it is customary to consider the lamp subject to renewal. Such lamps are consuming a wattage very nearly as high as when new but the

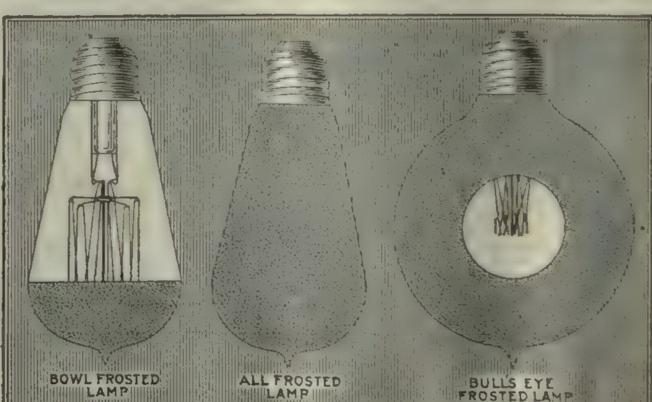


FIG. 40. FROSTED LAMPS

candlepower has fallen off and the efficiency is therefore poor.

How the candlepower and wattage of a lamp vary with the voltage applied at the socket is shown in Figs. 29 and 30. The relation between cost of energy plus cost of renewal for different efficiencies in watts per candle is shown in Fig. 31, and a set of typical characteristic curves for a modern drawn-wire tungsten lamp in given in Fig. 32, indicating the relation between candlepower, amperes, watts or watts per candle and voltage.

Quality and Color of Light

The higher the temperature at which a filament operates or the higher the degree of incandescence the nearer the violet end of the spectrum is the light emitted. In regard to the color of light there has been a steady advance and gradual approach to daylight effect, beginning with the old carbon lamp, where the ratio of blue to green rays was around 45 per cent., through the metallized filament lamp and the vacuum type of tungsten lamp up to the present ½-watt gas-filled lamps in which the ratio is over 60 per cent. and approaches daylight quite closely.

Color-absorbing materials in the bulb of the lamp are employed where it is desired to obtain a particularly close approach to daylight or other effects. This is done either by superficially coloring the bulbs or, better, by the use of so-called natural-colored lamps in which the glass mass itself is made of a composition suitable for filtering out certain shades of rays as may be required for the individual application, such as in paint shops, lithographing plants, wall-paper stores or for the warmer tints of the home.

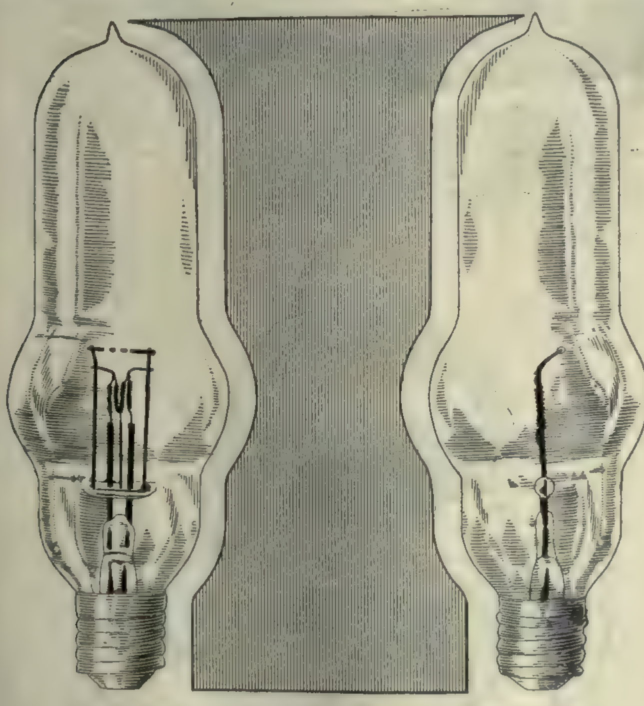


FIG. 41. LAMP FOR MOTION-PICTURE PROJECTION

Simultaneously with the rapid increase in efficiency and the approach to daylight conditions there has been an increase in the capacity of incandescent lamps beyond anything dreamt of. From a candlepower capacity of 150 the range has gradually been extended to over 2000 candlepower, while, as shown in the comparison, Fig. 33, the gas-filled coiled filament lamps can be made smaller than those of the vacuum type of much less capacity.

Incandescent lamps are now made for voltages from ½ to 260 and for all kinds of frequencies, and rugged enough for train-lighting or automobile service. It is not proposed to enumerate the multitude of modifications of incandescent lamps manufactured today for different classes of service, but a few examples are shown in Figs. 34 to 39 to indicate the range of sizes and service. In addition to these the frosted lamp may be mentioned, in which the bulb is treated in acid to give the effect shown in Fig. 40, reducing the glare of the light, or as shown by the bulb with a small round space left clear for special service such as stereopticon use, etc. For the moving-picture industry the drawn-wire type tungsten lamp is now used almost exclusively in place of the arc lamp, and special lamps have been developed for this work, Fig. 41.

Using Two Tools at Once

By Charles Canec

Referring to the article on the subject of using two tools at once which appeared on page 731 of *American Machinist*, let us analyze the problem: It is desired to use two tools instead of one, one tool roughing the work, the other finishing it—all at one setting.

Mr. Jacker mentions the greatest objection; namely, that the unevenness present in the rough material is transferred in lesser degree to the finished work. This prohibits the two-tool scheme in accurate work unless the material is quite round and centered true beforehand.

But suppose the shaft, instead of being all of the same size, is to be made with several diameters, then when we pull out the roughing tool to cut a larger diameter, out comes the finishing tool with it, leaving 3 in. or so of unfinished shaft in its wake which we must turn back to finish afterward. This prohibits the two-tool scheme when there are shoulders on the work.

Considering these disadvantages there is not much work left on which the scheme is practicable.

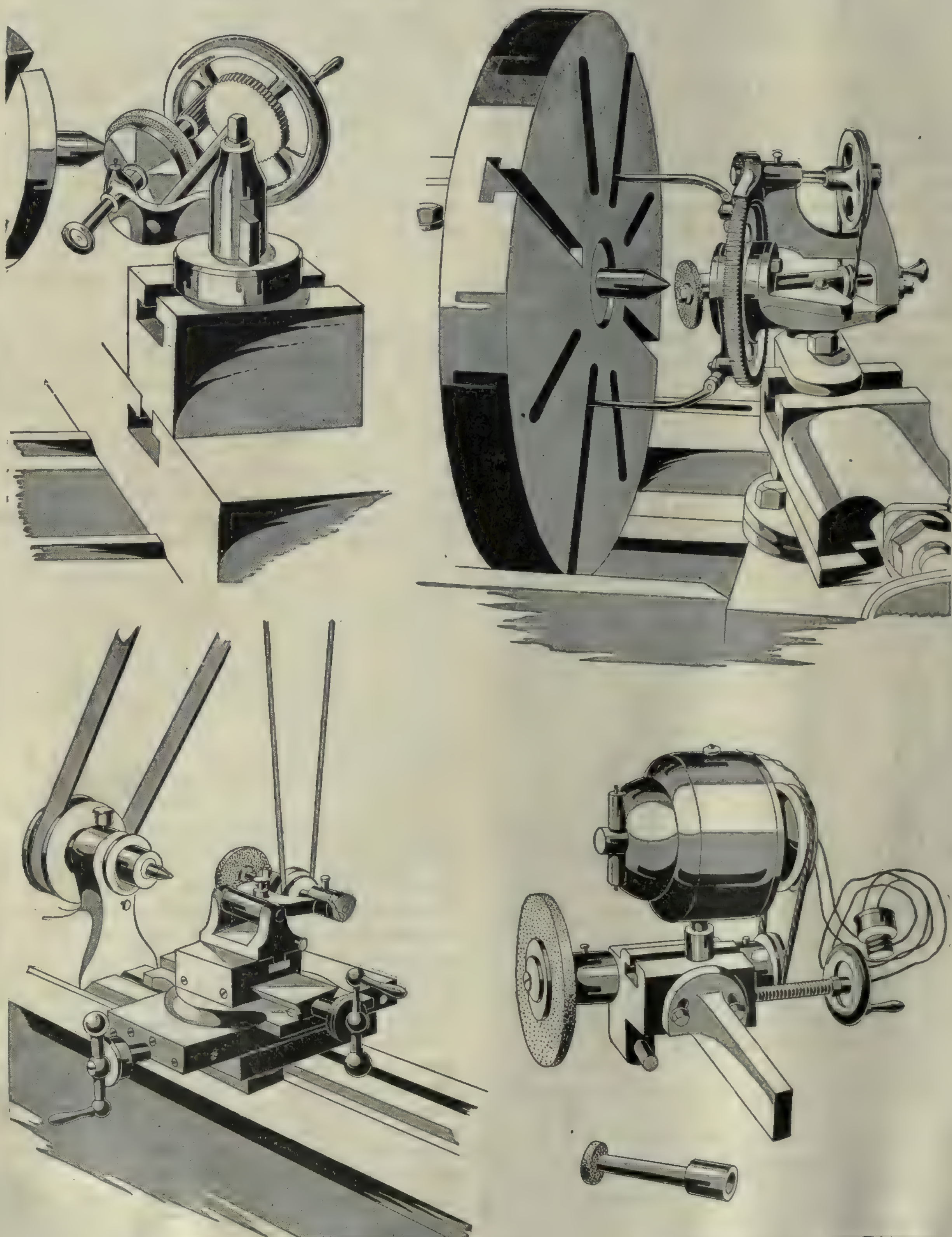
The idea of setting the tools at an angle slanting away from the direction of travel makes it impossible to work close up to the driving dog, and also increases the errors due to bulges and unevenness on the rough material. To slope the tools the other way enables them to cut close up to the dog, while bulges, etc., tend to press them more into the work and in a measure counteract the spring of the machine parts. An offset tool or toolholder is the best thing to use in this position and it so seldom moves in the toolpost that this point is hardly worth considering.

The best practice on shaft work is as follows: Face ends; center; rough-turn diameters $\frac{1}{64}$ to $\frac{1}{32}$ in. over finished dimensions; square off all shoulders to lengths required, at the same time grooving in slightly at corners to make clearance for grinding wheel; then finish by grinding. This produces accurate, well-finished work.

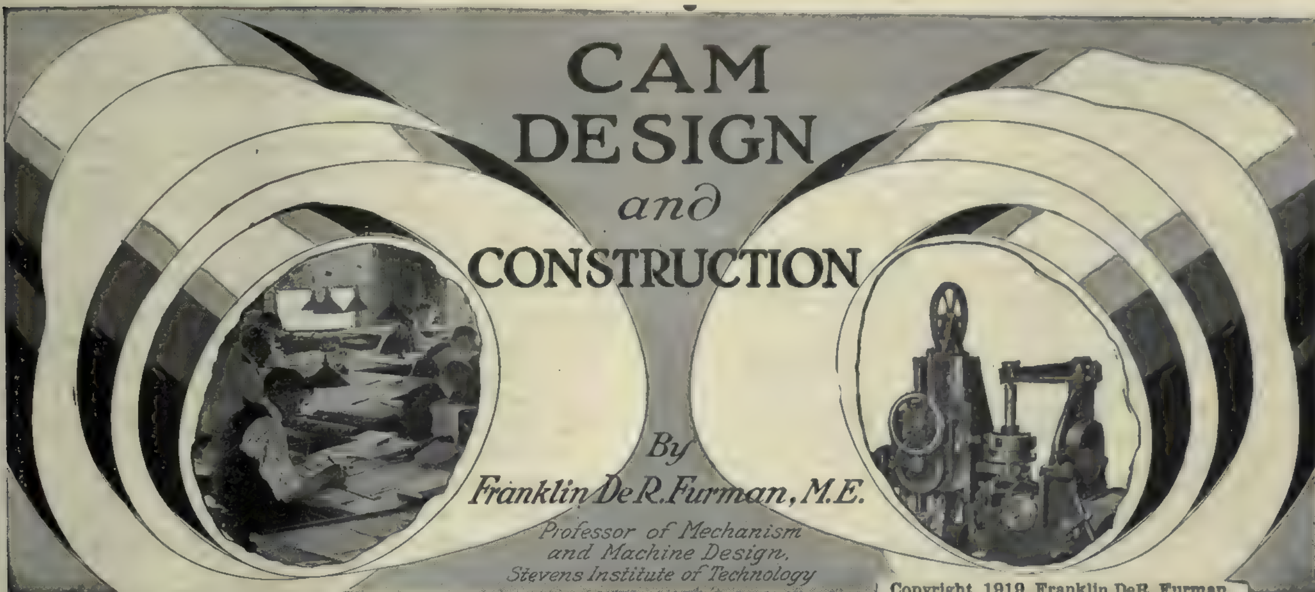
One point that all lathe men should pay attention to is to keep the gibs on the carriage and compound rest properly adjusted; for when these become slack there is too much pressure put on the screws and nuts while cutting, and the lathe cannot be depended on to hold a cut, especially on rough material.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



GRINDING LATHE CENTERS



VIII. The Tangential Cam.

The current article deals first with the cam having straight instead of curved sides, pointing out special difficulties met with in this type of cam; second, with the cam the base curve of which is made up entirely of arcs of circles; third, with the cube-curve cam, which is closely related in methods of construction to the well-known parabola cam, and fourth, with variations of the above types designed to give low starting or striking velocities.

THE TANGENTIAL CAM.—The tangential cam with its straight sides is perhaps the easiest of all cams to draw and to construct when one is not particular about the maximum-pressure angle, but it is apt to give the highest velocities and the greatest accelerations of all the cams when it is laid out by an inexperienced hand. To keep the tangential cam under

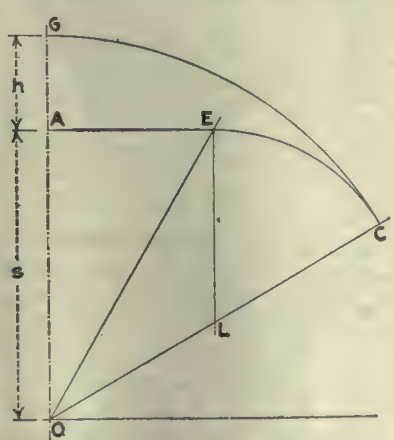


FIG. 70. TANGENTIAL CAM, PRELIMINARY SKETCH IN GRAPHICAL METHOD OF CONSTRUCTION FOR DEFINITELY ASSIGNED DATA

control when being designed requires either a preliminary graphical construction or a series of computations by means of formulas which will give results that may be laid out directly.

Problem 18. Tangential cam, case 1, required a tangential cam in which the follower (a) rises 1 unit in a 60-deg. turn of the cam; (b) falls 1 unit in a 60-deg. turn of the cam; (c) remains at rest for a

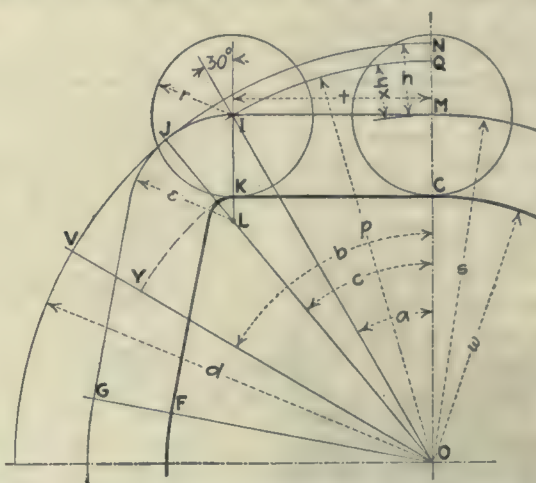


FIG. 71. TANGENTIAL CAM, SHOWING TERMS USED IN THE DIRECT CONSTRUCTION BY THE ANALYTICAL METHOD

240-deg. turn of the cam, and (d) with a maximum pressure angle of 30 deg., the end of the lobe to be rounded off by a circular arc.

Find the shortest radius of pitch surface of cam, the length of the straight-line portion of the cam lobe, the radius of the rounding-off curve at the end and the largest roller that may be used.

The graphical method of construction for the tangential cam is as follows: In a preliminary and separate drawing construct an angle AOE, Fig. 70, equal to the given pressure angle; draw a line AE at right angles to OA at any distance out, and continue AE until it intersects OE; draw an angle AOC equal to the assigned angle of action; drop a vertical line from E to OC; draw the arc EC with L as a center; draw the arc CG with O as a center, and measure the distances GA and AO. Then $GA : h :: AO : s$ where h is the assigned motion of the follower, and s is the correct radius at which to draw the line AE in the direct drawing of the cam. In the present illustration GA, Fig. 70, is

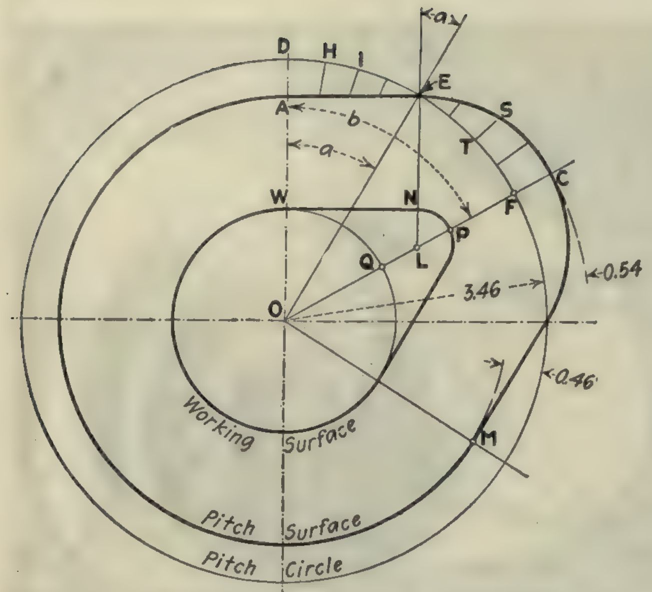


FIG. 72. CAM WITH TANGENTIAL BASE CURVE, CASE 1

1.33 units and AO is 4 units. Therefore in the direct drawing of the cam

$$s = \frac{h \times AO}{GA} = \frac{1 \times 4}{1.33} = 3.00,$$

and this value is laid off at OA, Fig. 72. The pitch surface of the cam AEC is then drawn by repeating the operations in precisely the same order as in the preliminary drawing described above. The maximum pressure angle will be 30 deg. at E where the circular easing-off arc is tangent to the straight line. The maximum radius of the roller would be EL, but as this would leave a sharp edge on the working surface of the cam a value of $\frac{3}{4}EL$ is taken as the radius, thus giving WNP as the working surface of the cam.

Analytical method of construction of the tangential cam.—A direct drawing of the tangential cam may be made from values obtained from a series of formulas, having the following notation, in which all linear dimensions are in inches and all angular dimensions in degrees unless otherwise specified. All symbols are illustrated in Fig. 71, which is for a general case:

- h = total motion of follower;
- x = fraction of follower's motion while rolling on the straight surface of the cam, or, in other words, fraction of stroke during which acceleration takes place;
- a = maximum pressure angle;
- b = time allotted by the data to the follower motion measured in angular motion of the cam in degrees;
- s = radius of pitch surface to which the straight line is drawn tangent;
- t = length of straight edge of cam on both pitch and working surfaces;
- p = radius of pitch circle;
- d = largest radius of pitch surface of cam;
- c = angle turned through by the cam when the full motion of the follower is reached; c will equal b when the straight part of the cam is not assigned in the data;
- e = radius of circular arc for rounding off outer corner of pitch cam;
- r = radius of roller;
- w = radius of working surface to which the straight working line of the cam is drawn tangent.

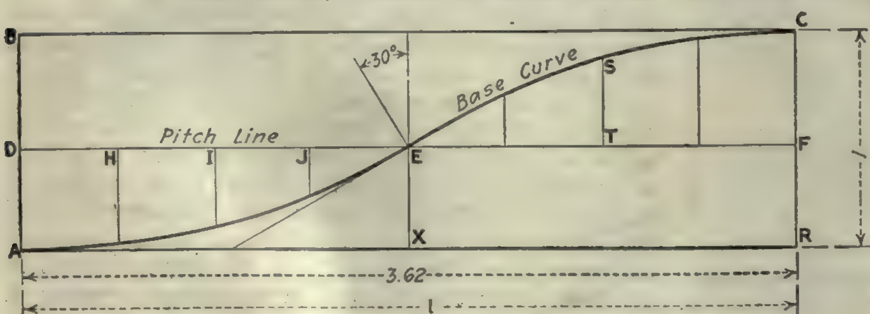


FIG. 73. CAM CHART FOR TANGENTIAL BASE CURVE, CASE 1

When the length of the straight part of the cam is not assigned in the data c and b will be equal. When the length of the straight part is assigned c will figure out differently from b; if it comes less the problem is possible with the assigned data; if more the length of the straight part must be reduced.

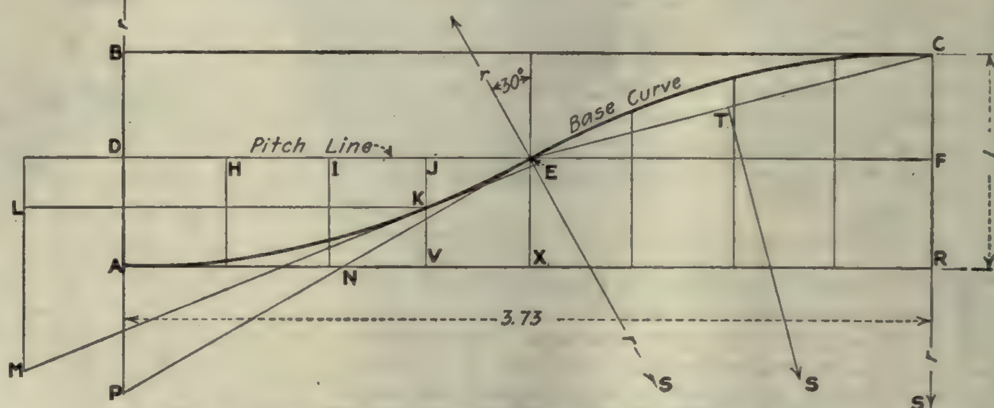


FIG. 74. CAM CHART FOR CIRCULAR BASE CURVE, CASE 1

The general formulas are:

$$s = \frac{xh}{\sec a - 1} \quad (1) \qquad t = s \tan a \quad (2)$$

$$p = \frac{t}{\sin a} \quad (3) \qquad d = s + h \quad (4)$$

$$\cot c = \tfrac{1}{2}\left(\frac{t}{h} - \frac{h}{t}\right) \quad (5) \qquad e = d - \frac{t}{\sin c} \quad (6)$$

$$r \leqq e \quad (7) \qquad w = s - r \quad (8)$$

With the data of the present problem equation 5 must be solved first, for it is the only one in which all the terms but one are known. This formula is solved for t. With t known, formula 2 may be solved for s; then formula 1 for x, and so on in order with equations 3, 4, 6, 7 and 8. These formulas give the following values in the present problem:

$t = 1.73 \quad s = 3 \quad x = 0.46 \quad p = 3.46$
$d = 4 \quad e = 2 \quad r \leqq 1.5 \quad w = 1.5$

With the above values the cam in Fig. 72 is laid out in the following manner: Lay off given angle of 60 deg. at DOC; draw circle, having

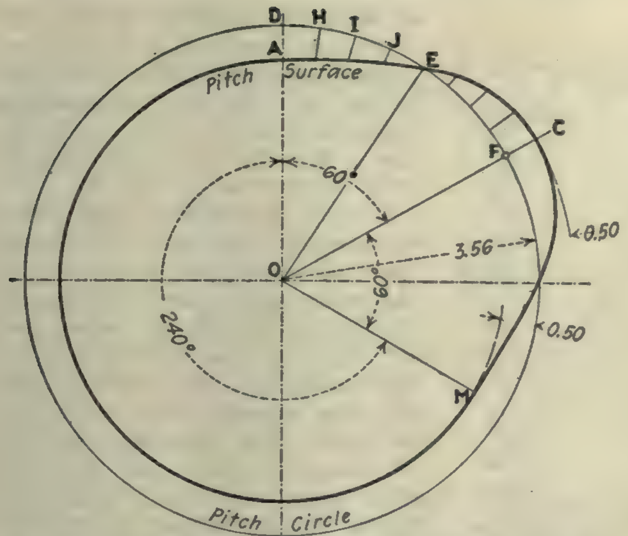


FIG. 75. CAM WITH CIRCULAR BASE CURVE, CASE 1

radius OA equal to s; draw straight part of cam AE equal to t; draw circular arc EC with center on OC and with radius of LC equal to e; call $r = 0.75e$ and make AW equal to it. Then WNP is the working surface of the cam where AW is the radius of the roller. The length WN of the straight part of the working surface is the same as the length of the straight part of the pitch surface and the circular arc of the pitch surface, and the circular arc NP of the working surface has the same center as the arc EC of the pitch surface. The values d and w are automatically included in the process of the above-described layout.

If it is desired to construct the cam chart, Fig. 73, for the tangential cam in order to find the velocity and acceleration diagrams the pitch circle of the cam should be drawn with the radius equal to OE as computed above, and radial intercepts should be placed at regular distances, as shown at H, I, etc., in Fig. 72. Then draw the part of the cam chart, shown in Fig. 73, with length equal to pitch arc DF, when both are to the same scale and with height equal to h. Draw pitch line DF on the chart at a distance above AR equal to DA on the cam when both are to the same scale. In general the pitch line on the chart will not be half way up, although it appears so in this problem. Take the lengths of the radial lines at H, I, etc., which are shown on the cam, and lay them off at equally spaced distances on the chart, Fig. 73, and draw the chart base curve AEC through the extremities of these lines.

Circular curve cam.—The circular base curve, case 1, Fig. 74, is made up simply of two equal circular arcs, as shown at AE and EC. It is the limiting case of the straight-line combination curve in which the two easing-off arcs are so large as to meet and eliminate the intermediate straight line entirely. With the circular base curve the radial distances on the cam at D, H, I, J, Fig. 75, cannot be found directly except by means of the cam chart or by computation. For graphical construction it is necessary to draw the chart, Fig. 74, first and it is then a simple matter to trans-

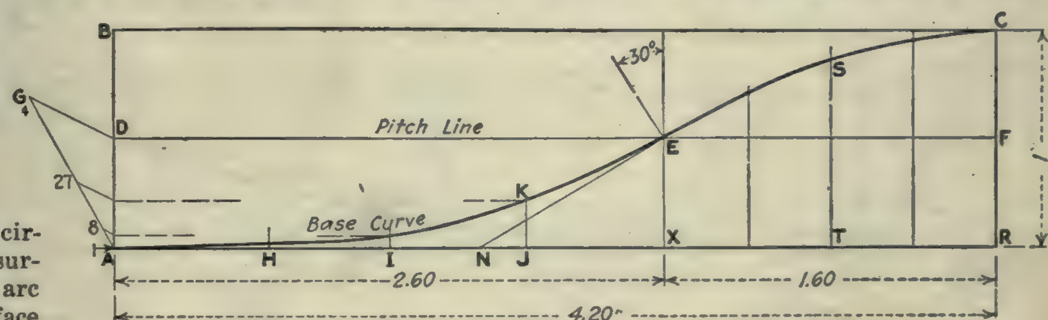


FIG. 76. CAM CHART FOR CUBE BASE CURVE, CASE 1

fer the ordinates at H, I, J to Fig. 75. The length of the chart for a maximum pressure angle of 30 deg. is 3.73 times the motion of the follower.

The length of radius for the equal arcs in the circular base curve is 3.73 times the follower motion for a 30-deg. maximum pressure angle. To find the length of radius for any other maximum pressure angle, use the formula:

$$r = \frac{h}{2(1 - \cos a)}$$

where r = the desired radius;
a = the desired maximum pressure angle, and
h = the given follower motion.

TABLE FOR CIRCULAR BASE CURVE

For Maximum Pressure Angle of	Radius of Arc Is
20 deg.	8.29 h
30 deg.	3.73 h
40 deg.	2.14 h
50 deg.	1.40 h
60 deg.	1.00 h

Problem 19. Required a circular base curve cam that will cause the follower to (a) rise 1 unit in a 60-deg. turn of cam; (b) fall 1 unit in a 60-deg. turn of cam; (c) remain stationary for a 240-deg. turn of cam, and (d) with a maximum pressure angle of 30 degrees.

The general description of the circular base curve given in the preceding paragraphs will doubtless give all the necessary information for the solution of this

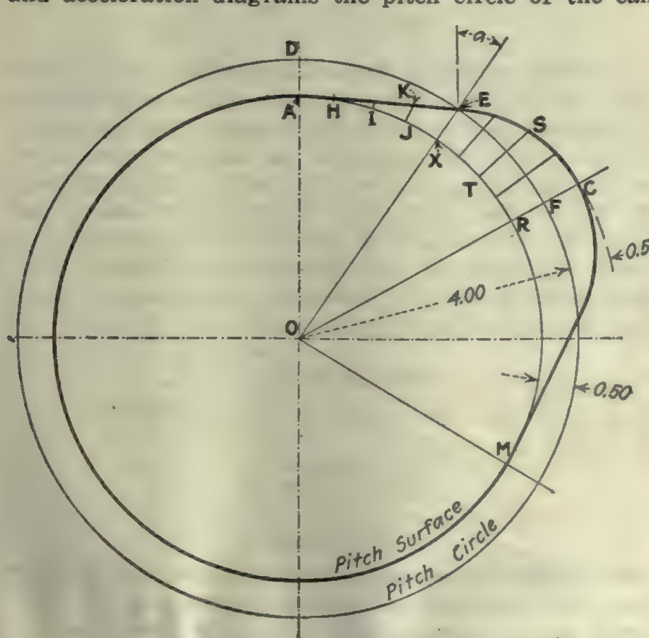


FIG. 77. CAM WITH CUBE BASE CURVE, CASE 1

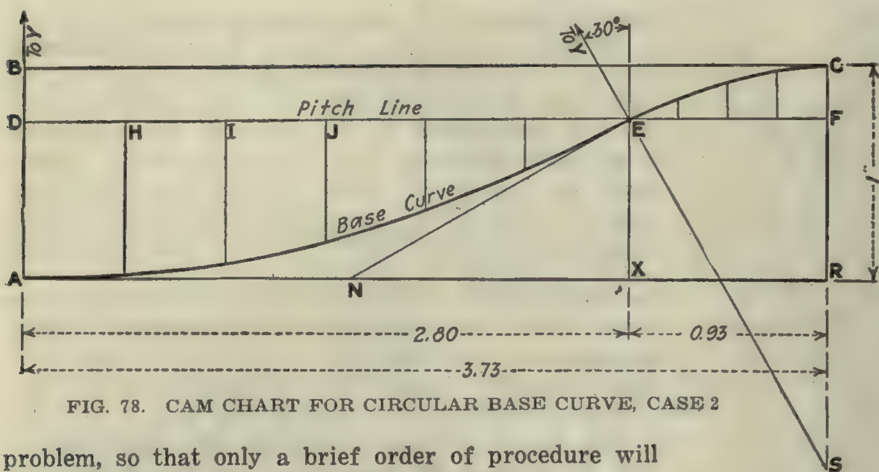


FIG. 78. CAM CHART FOR CIRCULAR BASE CURVE, CASE 2

problem, so that only a brief order of procedure will be given here. The total length of chart is

$$l \times 3.73 \times \frac{360}{60} = 22.38$$

One-sixth of this length is shown in Fig. 74. The radius of the circular arc AE, which is the same as EC, is

$$r = \frac{1}{2(1 - \cos a)} = \frac{1}{2(1 - 0.866)} = 3.73$$

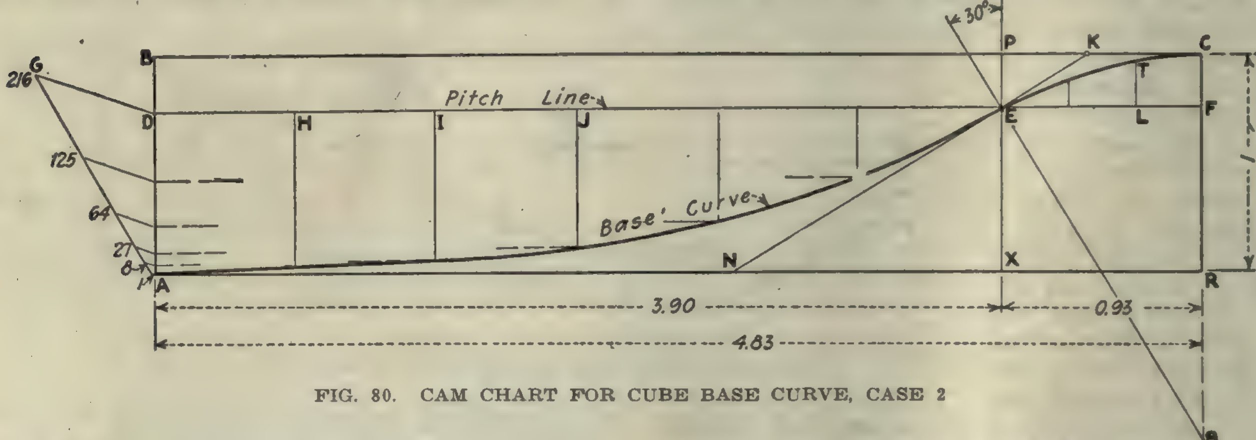


FIG. 80. CAM CHART FOR CUBE BASE CURVE, CASE 2

Draw eight equally spaced ordinates as at H, I, J, etc., Fig. 74. The radius of the pitch circle of the cam, which is drawn to one-third the scale of the chart, is

$$\frac{22.38}{2 \times 3.14} = 3.56.$$

as shown at OD in Fig. 75. Divide the assigned arc

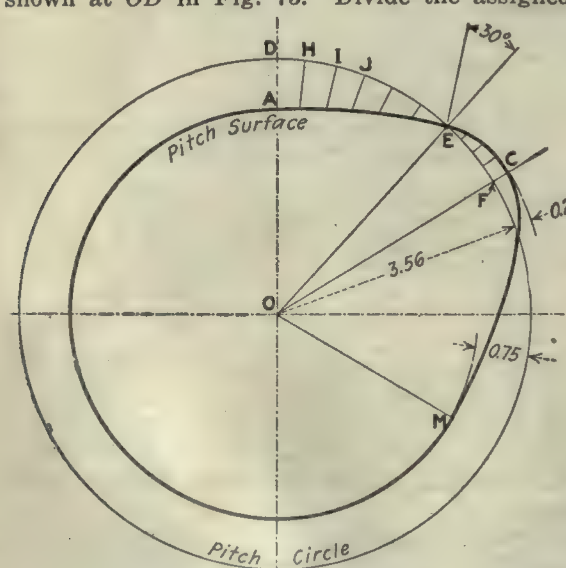


FIG. 79. CAM WITH CIRCULAR BASE CURVE, CASE 2

of action DF, which is 60 deg., into eight equal parts, as at H, I, J, etc. On the radial lines at each of these points lay off the corresponding ordinates from H, I, J, etc., in the chart, Fig. 74, thus obtaining the pitch surface AEC, Fig. 75.

In some cases it may happen when the circular base curve is assigned that the length and height only of the rectangular chart inclosing the circular curve will be known, and it may be desired to compute the radius, and the pressure angle for the circular arc that must be used. For example, in Fig. 74, assume that AR and RC are the only known values and it is desired to find the proper radius of the arc EC and the pressure angle that will exist at E. The radius may be readily computed by simple geometry, for the two triangles CFE and CTS will be similar in all cases and therefore $SC : EC :: TC : FC$. Since EF and FC are equal to one-half of AR and RC respectively their values are known and $EC = \sqrt{EF^2 + FC^2}$. The length of TC is one-half of EC.

The radius of the circular arc will be

$$SC = \frac{EC \times TC}{FC}$$

In order to obtain the pressure angle for the case given in the preceding paragraph simple trigonometry is required, and in using the trigonometry the length of the radius SC may also be obtained even more readily than by geometry. The method is as follows: In Fig. 74 the angles CST and EST are each equal to one-half the angle CSE, which is the pressure angle and is designated by a in the following formulas. The triangles CEF and CST are similar in all cases. Therefore a may be found by the following formula:

$$\tan \tfrac{1}{2}a = \frac{CF}{EF}$$

With a known, the radius of the arc EC may also be found as follows:

$$ES = \frac{EF}{\sin a} = CS$$

Cube Cam

Cube base curve, symmetrically applied.—The cube base curve is similar in method of construction to the parabola base curve, the only difference being that the cubes of the numbers 1, 2, 3, etc., instead of the squares

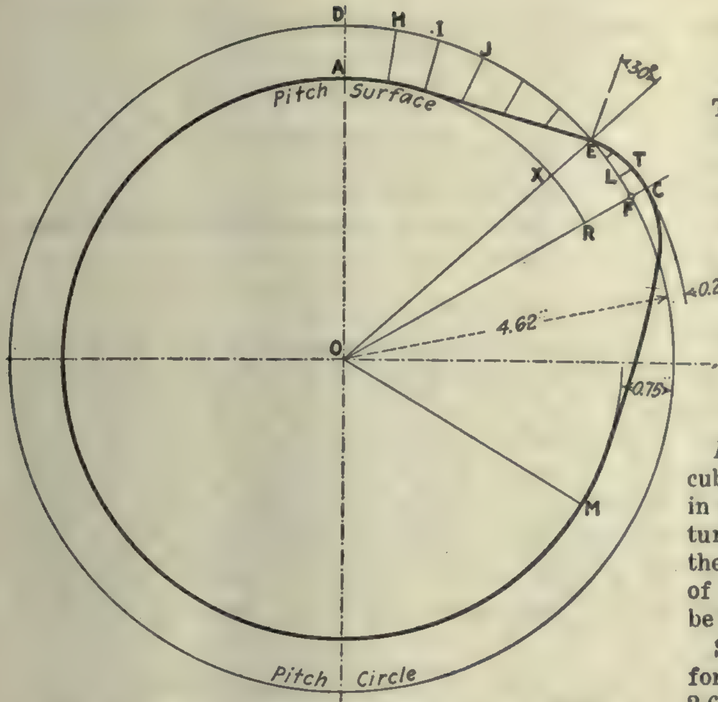


FIG. 81. CAM WITH CUBE BASE CURVE, CASE 2

are used as ordinates of the curve. The cube curve gives extremely low and slowly increasing motion to the follower at the start. The cube curve is the only one that gives uniformly increasing acceleration to the follower, which may prove an advantage in some instances, as will be pointed out in the next installment. If the cube base curve is used in the same way as the parabola; that is, if it is made up of two similar arcs placed in reverse order, it will give an extremely large cam.

Because of the similarity of method of construction of the cube and the parabola base curves, and because the large size of the symmetrical cube cam renders it impractical for most cases, its drawing will be omitted, and instead a modified and more practical construction of the cube cam will be illustrated and explained in the following paragraphs.

Cube base curve unsymmetrically applied for best advantage.—This modified cube curve will be referred to as cube curve, case 1. Its features are that it retains the very low starting values of the regulation or symmetrical cube cam and at the same time keeps down the size of the cam by using the regulation cube curve for the first half of the follower's motion and then using a short arc of another cube curve for the retardation in such a way that the maximum acceleration and retardation values shall be equal. In order to use this base curve several formulas are necessary, and they together with their notation are given in the following paragraph:

Notation and formulas for cube curve cam, case 1.—

h = distance moved by the follower;
a = pressure angle;
l = length of part of cam chart corresponding to follower's motion;
x = length of cam chart during which acceleration takes place;
x_1, x_2 = arbitrary lengths of cam chart taken for purposes of constructing chart base curve;
y_1, y_2 = length of ordinates of cam chart corresponding to the values of x^1, x^2 . . . ;
r = radius of pitch circle of cam;
b = angle turned through by cam in degrees during follower's motion.

The general formulas are:

$$l = 2.427\, h \cot a \qquad (1)$$

$$x = 0.618\, l \qquad (2)$$

$$y = \frac{h\left(\frac{x}{l}\right)^3}{2\sqrt{5} - 4} \text{ from zero to } x \qquad (3)$$

$$y = h\, \frac{3\left(\frac{x}{l}\right) - \left(\frac{x}{l}\right)^3 - (\sqrt{5} - 1)}{3 - \sqrt{5}} \text{ from } x \text{ to } l \qquad (4)$$

$$r = \frac{180\, l}{\pi b} \qquad (5)$$

Problem 20, cube curve cam, case 1.—Required a cube curve cam with unsymmetrical cube curve arcs in which the follower shall (a) rise 1 unit in a 60-deg. turn of the cam; (b) fall 1 unit in a 60-deg. turn of the cam; (c) remain stationary for a 240-deg. turn of the cam, and (d) the maximum pressure angle shall be 30 degrees.

Substituting the values given in the data in the formulas in the preceding paragraph, l = 4.20, x = 2.60, and r = 4.00. With these values, the rectangle *ABCR*, Fig. 76, for the cam chart may be drawn, *AR* being made equal to l, *AX* equal to x, and *RC* equal to h. The curve *AE* may be drawn graphically by dividing *AX* into four equal parts, *AD* into four unequal parts, as shown in Fig. 76, and projecting the division points until they meet as at *K*, *AD*, which is one-half of *AB*, is divided into the four unequal parts as follows: Draw a straight line *AG* in any convenient direction about as shown; make its length 64 units according to any convenient scale; with the scale

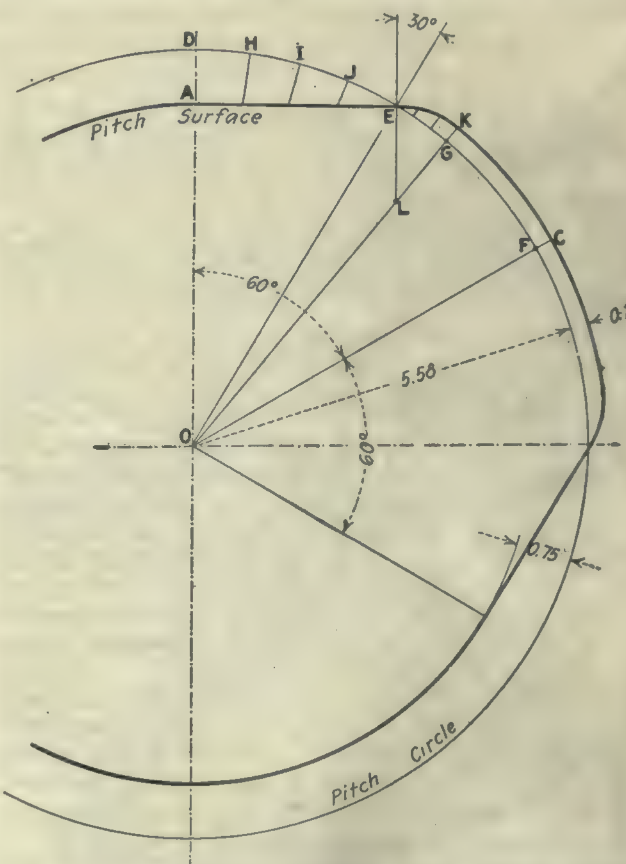


FIG. 82. CAM WITH TANGENTIAL BASE CURVE, CASE 2

still in place mark the first, eighth and twenty-seventh division points on AG, and from each of these points draw lines parallel to GD until they intersect the side AD of the rectangle; from the latter points draw horizontal lines until they intersect their corresponding ordinates, as at K. Or, the values of these ordinates, as at JK, may be computed by formula 3, as given above, by substituting the following values for x: $x^1 = \frac{1}{4}x$, $x_2 = \frac{1}{2}x$, $x_3 = \frac{3}{4}x$. The computed values of y_1, y_2, y_3 are 0.008, 0.063 and 0.211 respectively, and these are laid off at H, I and J in Fig. 76.

The portion of the cube curve from E to C, Fig. 76, is found by taking a series of any number of equally spaced ordinates, four being used in this problem and one of them marked at TS. The values of these ordinates are computed from formula 4 and are as follows: $y_4 = 0.50$, $y_5 = 0.71$, $y_6 = 0.87$ (shown at ST), and $y_7 = 0.95$. The corresponding values of x_4, $x_5 \ldots$ which were substituted for x in equation 4 in obtaining these values were $x_4 = x$, $x_5 = x + \frac{1}{4}(l - x)$, $x_6 = x + \frac{1}{2}(l - x)$, etc.

The pitch circle of the cam, Problem 20, is drawn with OD, Fig. 77, as a radius and is equal to $r = 4.00$ obtained from equation 5. The values as found for the cam chart may be now transferred to the correspondingly placed radial lines from A to R; or the values as computed from formulas 3 and 4 may be laid off directly on these radial lines without drawing the cam chart at all, thus obtaining the cam outline AEC.

Cams specially designed for low starting velocities.—In cams where the change in velocity of the follower during the latter part of its travel may take place rapidly the early motion of the follower may be made both very low and very gradual. These conditions as to velocity may be obtained by giving more than half the stroke to the acceleration of the follower, instead of one-half, as has been the case in all preceding problems. In Figs. 78 and 80 are illustrated special cases of the circular and cube base curves in which the follower is permitted to accelerate during three-quarters of its stroke, while its retardation takes place in the last quarter of the stroke.

Problem 21. Circular base curve cam, case 2.—Required a cam with a circular base curve in which the follower shall (a) rise 1 unit in a 60-deg. turn of the cam; (b) fall 1 unit in a 60-deg. turn of the cam; (c) remain stationary for a 240-deg. turn of the cam; (d) accelerate for three-quarters of its stroke, and in which (e) the maximum pressure angle shall be 30 deg.

For a graphical method of construction of case 2 of the circular base curve cam draw the cam chart as in Fig. 78, making its length

$$l = \frac{h \times f \times 360}{b}, \text{ where}$$

l = total length of chart;
h = height of chart;
f = pressure angle factor;
b = angle during which follower motion takes place.

In this problem $l = \dfrac{1 \times 3.73 \times 360}{60} = 22.38$

One-sixth of the chart is shown in Fig. 78, at AR. Lay off the height AB equal to one unit and mark the point D so that $AD = t$ where t equals fraction of stroke assigned for acceleration. Draw DF. Mark the point X on AR so that $AX = t \times AR$. Draw XE. Through E draw an inclined line making an angle with XE equal to the assigned pressure angle. Where this inclined line meets the lines AB and CR will be the centers for the circular arcs making up the base curve. These center points will be at Y and at S respectively. Draw the circular arcs AE and EC. Divide DE into a convenient number of equal parts, as at H, I ... and draw ordinates to the circular arc AE. Do the same with EF. Construct the pitch circle of the cam with a radius,

$$OD = \frac{l}{2 \times 3.14} = \frac{22.38}{6.28} = 3.56$$

as shown in Fig. 79 which is drawn to one-third the scale of Fig. 78. Lay off DOF equal to the assigned motion angle, which is 60 deg. in this problem. The arc DF will be equal in length to the line DF in the chart when both are drawn to the same scale. Make DE on the arc equal to DE on the chart and divide the arc DE into the same number of equal parts as the line DE. Draw radial lines at the division points H, I, J ... and transfer the ordinates from the chart to these radial lines, thus obtaining the pitch surface of the cam from A to E. Do likewise to obtain the arc EC of the cam.

The circular base curve, case 2, gives a smaller cam than does case 1, although both have the same pressure angle factor and the same chart length. The maximum radius of the cam for case 2 is 3.81 against 4.06 for case 1, as shown in Figs. 79 and 75 respectively. The reduction in size in case 2 is due to the fact that the pitch line DF on the cam chart is higher up in the present case and consequently that more of the pitch surface falls inside of the pitch circle than in Fig. 75. The pitch circle is the same size in both cases.

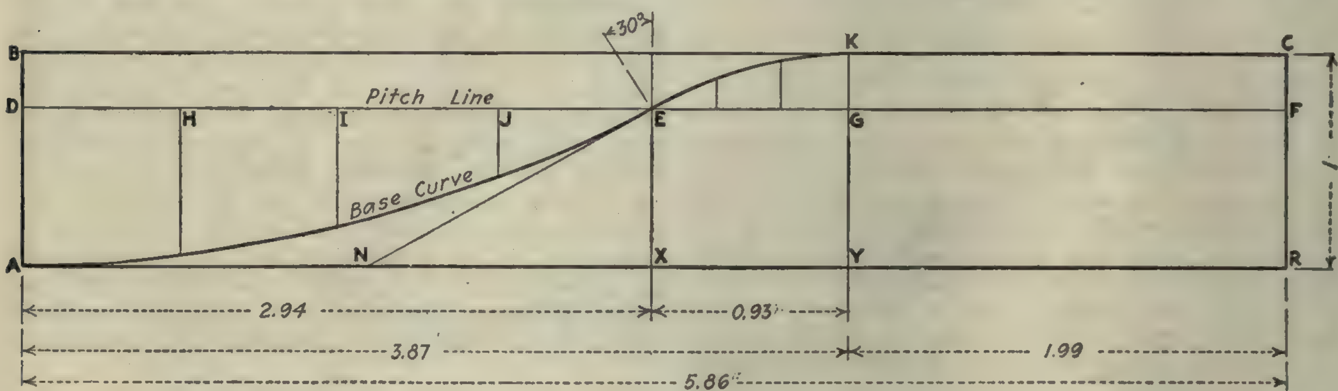


FIG. 83. CAM CHART FOR TANGENTIAL BASE CURVE, CASE 2

Method for computing circular base curve.—Computation for the lengths of the radii for the arcs AE and EC in the cam chart in Fig. 78 may be made by the following formulas, if desired, instead of finding them graphically as described above:

$$AY = \frac{ht}{1 - \cos a}, \text{ and } CS = \frac{h\,(1 - t)}{1 - \cos a}$$

where a equals the assigned pressure angle, h equals follower motion and t equals fraction of stroke assigned to acceleration.

The use of the cube curve for obtaining extremely low starting velocities is illustrated in Figs. 80 and 81. The cam is built up from a specially long arc of the cube base curve and it has a short circular base arc for easing off at the end. The chart and the base curve for this cam are shown in Fig. 80. The low starting velocities are due to the fact that the follower has three-quarters of its stroke to reach maximum velocity. This gives only ¼ stroke for retardation, which attains a very high value near the end of the stroke.

Problem 22. Cube curve, case 2.—Required a cube curve cam with a circular arc for easing-off radius in which the follower (a) rises 1 unit in a 60-deg. turn of the cam; (b) falls 1 unit in a 60-deg. turn of the cam; (c) remains stationary for a 240-deg. turn of the cam; (d) accelerates during three-quarters of the stroke, and (e) the maximum pressure angle to be 30 degrees.

In solving the above problem the length AX, Fig. 80, of that part of the chart which is given over to the cube curve is first found by the formula,

$x_1 = \dfrac{3\,th}{\tan a}$, where

t = the fractional part of the follower's motion devoted to acceleration;

h = the total motion of the follower;

a = the pressure angle;

x_1 = the length of chart under the cube curve;

x_2 = the length of chart under the circular easing-off arc.

Substituting the values given in problem 22

$$x_1 = \frac{3 \times 0.75 \times 1}{0.577} = 3.90$$

The length XR of chart, Fig. 80, necessary for the easing-off circular arc may be computed by the formula,

$$x_2 = \frac{h\,(1 - t)}{\tan 1/2\, a} = \frac{0.25}{0.268} = 0.93$$

Or the length XR may be found directly by drawing NEK so that it is tangent to the cube curve at E. The angle KEF will then be equal to the pressure angle. Make KC equal to EK. The point C will then be at the end of the chart. The center for the arc EC will be on the line CR extended, and at a point S which must also be on the perpendicular to NEK.

To find points on the cube base curve AE, Fig. 80, divide DE into any convenient number of equal parts, six being used in the illustration. Draw vertical lines through each of the division points as at H, I, ... Draw a line AG inclining upward from A in any convenient direction, and make the distance AG equal to the cube of the number of construction parts. Six parts having been chosen in this problem AG will be equal to the cube of 6, or 216 units in length, laid off to any convenient scale. At the same time lay off the division points 1, 8, 27, etc., which are the cubes of 1, 2, 3, etc. Draw the line GD and then draw lines parallel to it through the points 1, 8, 27, etc., until they intersect AD. Project these intersecting points horizontally until they meet the corresponding verticals from H, I, ..., thus giving points on the cube base curve AE.

The radius for the pitch circle of the cam will be

$$r = \frac{l \times 360}{2 \times \pi \times b} = \frac{4.83 \times 360}{6.28 \times 60} = 4.62$$

where l = length of chart used for rise of follower, and
b = angle during which the follower is moving.

With the above value of r the circle through D is drawn in Fig. 81. The arc DEF will be equal in length to the line DEF in Fig. 80 when drawn to the same scale, and it should be similarly divided and the radial lines at H, I, ..., made equal to the similarly lettered ordinates in the chart. The curve AEC thus obtained will be the pitch surface of the cam.

Tangential cam, case 2.—The tangential cam is made up of straight-line sides with a circular arc for rounding off the end of the lobe. When the length of the straight surface of the cam is not specified, or when the portion of the stroke during which the follower accelerates is not given in the data, the tangential type of cam may work out to good advantage. But when either of the above items is included in the data for the tangential cam it may conflict with the proper cam angle which should be allowed for the follower motion, as illustrated in the following problem, which contains the same data as the two previous problems. The possible difficulty met with in using the tangential cam arises from high acceleration that may be produced. The matter of accelerations produced by all types of cams will be considered in the next article.

Problem 23. Tangential cam, case 2.—Required a tangential cam with a circular easing-off arc in which the follower (a) rises 1 unit during a 60-deg. turn of the cam; (b) falls 1 unit during a 60-deg. turn of the cam; (c) remains stationary for a 240-deg. turn of the cam; (d) accelerates during three-quarters of its stroke, and (e) the maximum pressure angle to be 30 degrees.

The cam may be constructed directly by substituting values given in the data in the general formulas given in problem 18, and then laying down the results as in Fig. 82. In the present problem OA, Fig. 82, equals s as found in problem 18, $AE = t$, $OD = p$, $OC = d$, angle $DOC = b$, angle $DOK = c$ and $LE = e$. The radius r of the roller and the minimum radius w of the working surface are not shown in the illustration, but may be readily added if called for. The radius of the roller, however, cannot be greater than EL. The numerical results found by substituting the values given in the data in the series of formulas referred to above are as follows:

$$s = 4.84,\ t = 2.79,\ p = 5.58,\ d = 5.84,$$
$$c = 39\tfrac{5}{8}\ deg.,\ e = 1.47.$$

If it is desired to construct the cam chart for the purpose of determining the velocity and acceleration diagrams later it may readily be done (1) by making the length of chart AR, Fig. 83, equal to the length of the arc DF on the cam drawing; (2) by laying off the pitch line DF on the chart and subdividing the same as the arc DF on the cam is subdivided, and (3) by transferring the radial lines at H, I, ... from the cam to the chart and drawing them as vertical lines, thus obtaining points for the base curve $AEKC$.

The Care of Carburizing Compounds

By W. H. Addis

Of all the opportunities for practicing economy in the heat-treatment department, there is none that offers greater possibilities for profitable returns than the systematic cleaning, blending and reworking of artificial carburizers, or compounds.

The question of whether or not it is practical to take up the work depends upon the nature of the output.

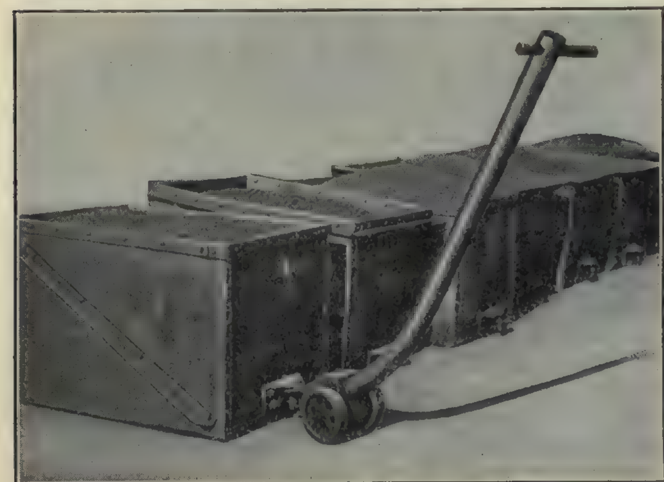


FIG. 1. THE COOLING CARTS

If the sole product of the hardening department consists of a 1.10 carbon case or harder, requiring a strong highly energized material of deep penetrative power such as that used in the carburizing of ball races, hub-bearings and the like, it would be best to dispose of the used material to some concern whose product requires a case with from 0.70 to 0.90 carbon, but where there is a large variety of work the compound may be so handled that there will be practically no waste.

This is accomplished with one of the most widely known artificial carburizers by giving all the compound in the plant three distinct classifications: "New," being direct from the maker; "half and half," being one part of new and one part first run; and "2 to 1," which consists of two parts of old and one part new.

Separating the Work from the Compound

During the pulling of the heat, the pots are dumped upon a cast-iron screen which forms a table or apron for the furnace. Directly beneath this table is located one of the steel conveyor carts, shown in Fig. 1, which is provided with two wheels at the rear and a dolly clevis at the front, which allows it to be hauled away from beneath the furnace apron while filled with red-hot compound. A steel cover is provided for each box, and the material is allowed to cool without losing much of the evolved gases which are still being thrown off by the compound.

As this compound comes from the carburizing pots it contains bits of fireclay which represent a part of the luting used for sealing, and there may be small parts of work or bits of fused material in it as well. After cooling, the compound is very dusty and disagreeable to handle, and, before it can be used again, must be sifted, cleaned and blended.

Some time ago the writer was confronted with this proposition for one of the largest consumers of carburizing compound in the world, and the problem is handled in the following manner: First the cooled compound is dumped from the cooling cars and sprinkled with a low-grade oil which serves the dual purposes of settling the dust and adding a certain percentage of valuable hydrocarbon to the compound. In Fig. 2 is shown the machine that was designed to do the cleaning and blending.

Blending the Compound

Essentially, this consists of the sturdy, power-driven separator and fanning mill which separates the foreign matter from the compound and elevates it into a large settling basin which is formed by the top of the steel housing that incloses the apparatus. After reaching the settling basin, the compound falls by gravity into a power-driven rotary mixing tub which is directly beneath the settling basin. Here the blending is done by mixing the proper amount of various grades of material together. After blending the compound, it is ready to be stored in labeled containers and delivered to the packing room.

It will be seen that by this simple system there is the least possible loss of energy from the compound. The saving commences the moment the cooling cart is covered and preserves the valuable dust which is saved by the oiling and the settling basin of the blending machine.

FIG. 2. THE BLENDING MACHINE

Then, too, there is the added convenience of the packers who have a thoroughly cleaned, dustless, and standardized product to work with. Of course, this also tends to insure uniformity in the case-hardening operation.

With this outfit, one man cleans and blends as much compound in one hour as he formerly did in ten.

Machining Operations on Reed Pipe Dies

By J. H. VINCENT

The methods employed in this plant represent the development of efficient methods of producing pipe dies of various grades and for many uses. Many of the machining operations are simply performed but the tooling fixtures are arranged to handle large quantities of parts. The method of casting the solid die is unusual and results in an appreciable saving.

A WIDE variety of pipe dies or chasers is made by the Reed Manufacturing Co., Erie, Penn., to meet all demands of the pipe-fitters' trade. The solid form of die is the simplest, and of these the "Q & E" type is ingenious because it is composed of a body of gray iron cast about high-grade steel chaser-blanks, so that a grade of steel can be used that would add greatly to the cost were the solid die composed of this material.

The bits of steel for these chaser-blanks are sheared from the bar and have several small recesses drilled in their bases to form locking holds for the cast iron. In the foundry a molder sets them in sand molds as if they were cores at an angle with the radius which is designed to give them the same degree of rake on their cutting surface as has been found most efficient in lathe-threading tools.

The first operation on these cast dies is to clean out all the fins of iron which may have formed about the steel blank, and this is done on a standard vertical die-filing machine, Fig. 1. This arrangement permits the operator to have both hands free for rapidly manipulating the parts about the small machine-operated three-cornered file. The second operation is to grind one face of the die to a smooth surface, by holding the casting in the revolving chuck *A*, Fig. 2, mounted on a movable carriage which can be advanced to press it up against the surface-grinding wheel *B*. The blanks are then milled on the opposite face to insure parallel faces of standard thickness. For this operation a large number are placed in a double row in a long horizontal fixture, Fig. 3, mounted on a milling-machine table. The four edges are milled and squared up in a similar way.

FIG. 1. USING DIE-FILING MACHINE FOR REMOVING FINS FROM SOLID CAST DIES

The blanks are taper-reamed to the proper angle and radius by means of special reamers carried on the spindle of a gang-drilling machine, Fig. 4. The fixtures which are used for holding the blanks are graduated for different sizes of dies and there are no two alike under the different spindles of the machine, so that the operator who is running the three spindles will be working on three different sizes of blanks. The chasing of the thread is done on a semi-automatic machine which has been designed for this purpose.

The type of adjustable die known as the "Improved Armstrong" is composed of solid steel parts and the blanks for these are sawed from tool-steel bar stock. As shown in Fig. 5, the large hole for the holding-down bolt *A* and the two small holes *B* which form the end of the chip-clearance recess are drilled in a gang-drilling machine which carries, in its different spindles, the required sizes of drills. The jigs used are shown at *C*. The chip-clearance groove is opened up, and the angles are milled on the ends in a manner which makes the chaser ends of these dies appear to be of unequal length, *A*, Fig. 6, and to set at unequal angles, but this is done just as in the solid dies in order to have the chasers meet their work with an angle of rake. A

FIG. 2. FINISHING FACE OF SOLID DIES

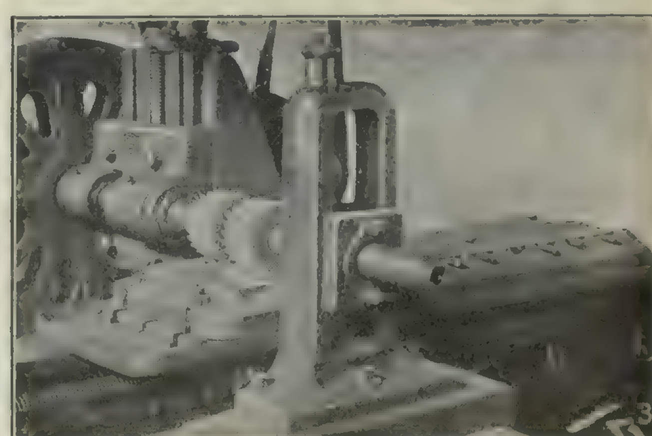


FIG. 3. MILLING DIES TO UNIFORM THICKNESS

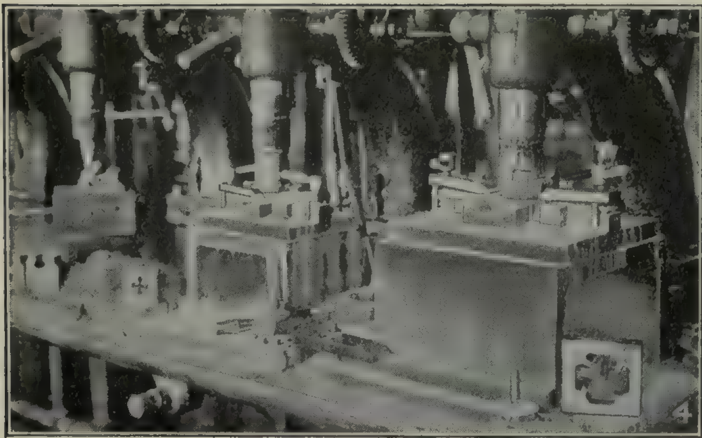


FIG. 4. TAPER-REAMING THE SOLID DIES PREPARATORY TO CHASING THE THREAD

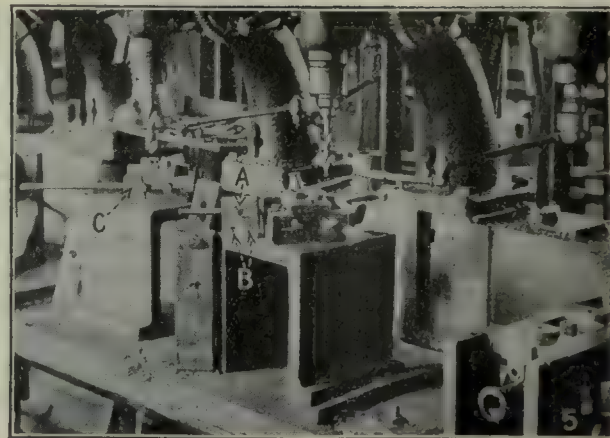


FIG. 5. DRILLING CHASER BLANKS FOR ADJUSTABLE DIES

milling fixture holding a double row of these blanks is used on the machine table, and two sets of high-speed milling cutters are carried on the arbor. A soap solution is used as a coolant and is conveyed to the milling cutters by the pipe *B* in which small holes are spaced every ½ in. throughout its length. To shut off the flow from those holes which would be of no service, small steel spring clips *C* are sprung over the pipe wherever desired.

The corner of one face of the chaser is milled away as indicated at *A*, Fig. 7, using a long holding fixture *B* which contains a double row of these blanks held down by the center blocks *C*. The latter are drawn down by means of fillister-head machine screws. The

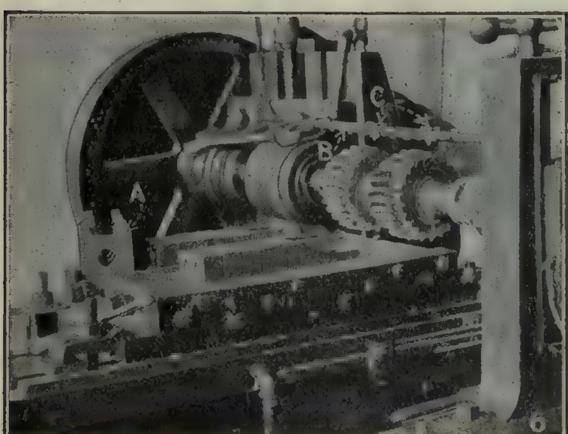


FIG. 6. MILLING CHIP GROOVE AND BEVELED ENDS OF DIE BLANK

FIG. 7. MILLING OFF CORNER AND FACING END OF BLANK

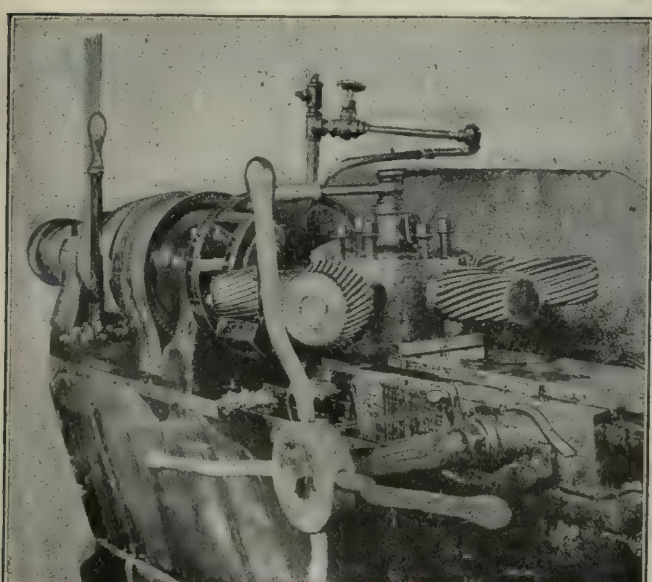


FIG. 8. TAPER-REAMING AND CHASING THREAD OF ADJUSTABLE DIES

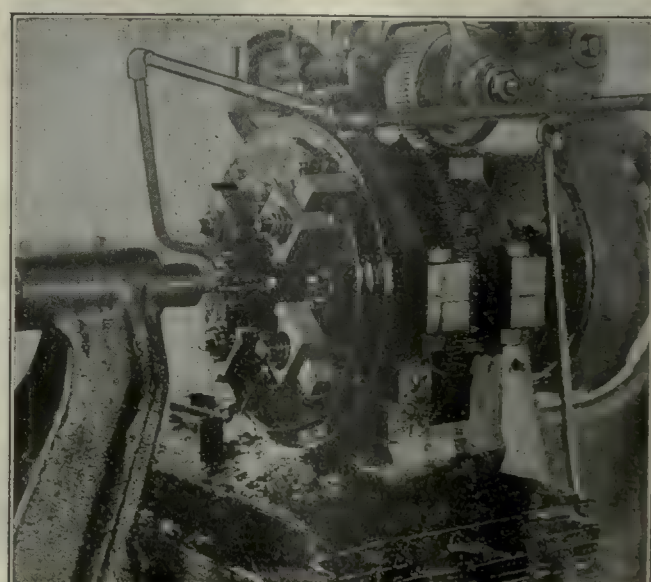


FIG. 9. MILLING RELIEVED THREADS ON LARGE PIPE DIES

blanks are also held in place by means of the dowels *D*, which fit into the large drill holes in the shank. Springs are provided beneath the center holding-down blocks, so that these will spring up and release the work when the screw pressure is removed. It will be noted that the milling cutters face off the ends of the blank at the same time that they are milling off this notched corner, thus insuring accurate length with reference to the center bolt hole, and at the same time saving one finishing operation.

For finishing the dies and chasing the threads of adjustable dies, a special chaser-holding chuck has been fitted on a turret lathe, Fig. 8, and the turret itself carries the necessary straight and taper reamers for finishing the circular portion of the chaser preparatory to cutting the thread. In the position of the machine shown, the thread-chasing hob is at work on the dies which are held in the chuck. A thread-chasing machine for cutting relieved threads on large-type chasers is shown in Fig. 9.

Technical Service to the Customer

By PETER F. O'SHEA

Should a shop offer its customers free service in the technical aspect of the factory product? Is your plant prepared to offer and to supply such service? A good many companies, through their salesmen, are now making such offers to individuals and to the general public through advertisements and standardized sales talks. Such service, particularly when it consists in helping factories to plan new equipment layouts, is invaluable during the present reorganization period.

WHAT is it that makes it worth while for factories to offer technical service? First, let us roughly divide the industries of the country, which worked on war orders, into three classes. The most fortunate was that in which the shops could be turned into making munitions, and to this class war brought prosperity. The middle class consisted of industries which were not granted priority in materials or labor supply, but were nevertheless able to go on existing and turning out their regular product. The most unfortunate class was that which had to suspend operations for short periods during the war, or take up the manufacture of products other than its regular line.

Some companies of the first class were especially fortunate in the continuity of their operations, their product, and their labor force and organization. Greenfield, Mass., for instance, was particularly well situated —as an isolated town of 15,000 inhabitants at the extreme northern end of the Bridgeport munitions district, yet within market distance, and out of the way of the feverish flurry. Considerable carfare intervened between it and the vortex of the munition whirl. A good many of the workmen own their own homes, and the green lawns of the town are noticeable. Freight on household goods was high; consequently, workmen did not move with the first breeze. Furthermore, they did not have to move to get into patriotic war production. Most of the plants in the town went on 100 per cent. Government orders, making what?—the same things which they had been making: gages, taps, dies and other tools in demand by the Government. Men could stay at home and turn out the gages which controlled and enabled the quantity production of small arms and ammunition. A similar situation prevailed with other companies at various points all over the country, which were called upon to continue making their usual products, whether trucks for the army, or rubber tires for the trucks, or other products required for war-time use.

When the war was over it was a simple matter for such industries to go back to their normal peace output. Moreover, the labor force and administrative organization was not only kept intact, but improved and in some cases increased by the extra force that had been trained in the course of the company's efficient work for the Government. It might be thought that such companies have a marked advantage over their less fortunate sister industries. But this is not entirely so. Industries are tied too tightly together, and they hold each other back as well as carry each other forward. The second and third classes, however, will have to reorganize and build up their working force again; the employees will have to be acclimated, or at least re-acclimated; for is it not the employees that make up the factory as a smooth-running productive machine?

Readjustment will be hastened, therefore, by helping people to find out what they need and want, and as soon as an industry gets in readiness itself, it can say to the rest of the industrial world, "Here we are all in running order, prepared to send you or on short notice to make you what you ask, trained to tell you what you specially need, able to design it for you, and anxious to tell you how to use it."

Just now, this sort of service is very valuable to the industrial world and to the customer. It is also very useful to the originating factory in gaining legitimate, permanent business. Therefore, the present period of reconstruction is seeing a great increase in the advertising of service as distinct from goods.

If we look through the advertising pages of this magazine, we will find what applied form this service takes. For example, a manufacturer of taps and dies stands ready to solve problems in screw threads and to have engineers assigned to take up questions of tolerance gages and installation of gage systems; a belting company has a staff of technical men ready to solve individual belting problems; a large sales and engineering corporation renews attention to its service, and so on throughout the list.

Many of the companies now offering service were doing the same thing, either formally or informally, before the war, and most of them gave similar service, intensified and highly valuable, to the Government during the war.

Before a company can advertise service to the public it must have not only a good intention, accumulated knowledge, and experience, but it must have a definite organization to deliver technical service quickly and economically in reply to an inquiry. Of course the idea of service has always been present in an indefinite way in any well-meaning industry, even if it was expressed only by a salesman's informal invitation, "Come up and look us over," or "I'll take that up with the main office and see what we can find out for you." In many companies some or all of the sales force are technical

men, who solve problems of use or give prescriptions on the spot as they meet them. Most plants also have some one available in the sales organization known as the "trouble man," who combines the function of straightening out refractory installations with the function of estimator or layout-engineer on a proposed sale. These methods, however, were administered from the point of view of getting or preserving each piece of business for the company, rather than as an unreserved offer of service to those who knew little about the product. Before advertising service you must have it ready. Perhaps the more simple form of technical service is in the form of printed instructions and advice, or flyers, pamphlets, and supplements to catalogs. The preparation, or at least the printing of this material, falls under the advertising or publicity department. In the office, men must be designated to answer special inquiries and have authority to turn the matter over to someone else for immediate investigation if the matter requires some action stronger than correspondence. A sufficient number of trained, experienced men must be on hand to go to the actual source of the inquiry for investigation, remedy, or recommendation. These men are usually allied both with the sales and the engineering departments of the factory—they are really engineering salesmen.

Inside the plant, besides definite correspondents, certain facilities are necessary, which are already present in a great many plants though they may not be under the direct jurisdiction of the department of technical sales service. A testing room, a research or experimental department, or some individuals and equipment of the engineering department of the factory should also be at the disposal of the technical service. Direct channels of communications and methods for requisitioning the required work are also necessary.

Though only part of the sales force may consist of these technical-service experts, the spirit of technical service soon permeates the whole sales force. This results in greater definite knowledge of the product by every salesman, and greater alertness for sales opportunities.

The technical service men are a direct link between the new and unforeseen needs of customers and the experimental room of the engineering or production departments. They are able therefore to bring in ideas for new products to meet present or future needs, and to contribute mutual aid to the engineering department in development work. They know the customer's needs much better than the ordinary salesman, because they know his shop or his home and the exact circumstances of work.

Of course the best kind of aid to good service is given in the shop itself by the manufacture of quality products. The knowledge, aims and spirit of the technical service department are direct connecting links between the shop and the ultimate reputation of its product. The increased reputation of the product resulting from quality combined with correct use, and the service reputation of the company due to continued development and research work, have a direct effect upon orders, the amount of work, and wages. "It would be foolish for the employees of our company," says one manager, "not to recognize that our company, in order to get the best prosperity, must continue to originate service . . . ." With the new interest that is being taken by employees in the fundamental ideas of a plant, this spirit secures valuable coöperation.

The same need for technical sales service which this period of readjustment has brought about will remain with us after the reaction period since the present moment simply happens to be one when this need is made apparent, definite, and vivid. It is also a moment from which to date a new advance and spread of the service idea. Service will become vogue—in the style.

Technical service has heretofore been developed in certain lines of industry, mostly those lines which serve other organized units of business. Office equipment, factories and branch stores have so established their advisory service that office managers and business men now consult them as a matter of course. Some companies in auxiliary lines have advertised a partial or complete office advisory service free to the public. Builders of machine tools have developed the publicity part of technical service, through instruction and standard practice pamphlets and data. Automobile firms have extended this kind of service directly to the individual public. Even a garage is now expected to respond with correct advice upon any problem in its line.

No sooner is technical service offered by an industry than it undergoes an evolution, the same as that of any other kind of service, so that which started as a free-will offering is not only expected but demanded by the public. The course of evolution is shown in the industries which have already undergone this and similar movements. Once started by one company in an industry, the others have to catch up; and the one which wishes to get a start on the others must originate the service in its line and keep it perfected.

The successive steps in the evolution, past and prospective, may be defined as follows:

1. One leading company in an industry advertises its service.

2. Individual customers are not slow to call the attention of the first company's competitors to the new service, with an implied contrast.

3. Other companies in self-defense establish a similar service.

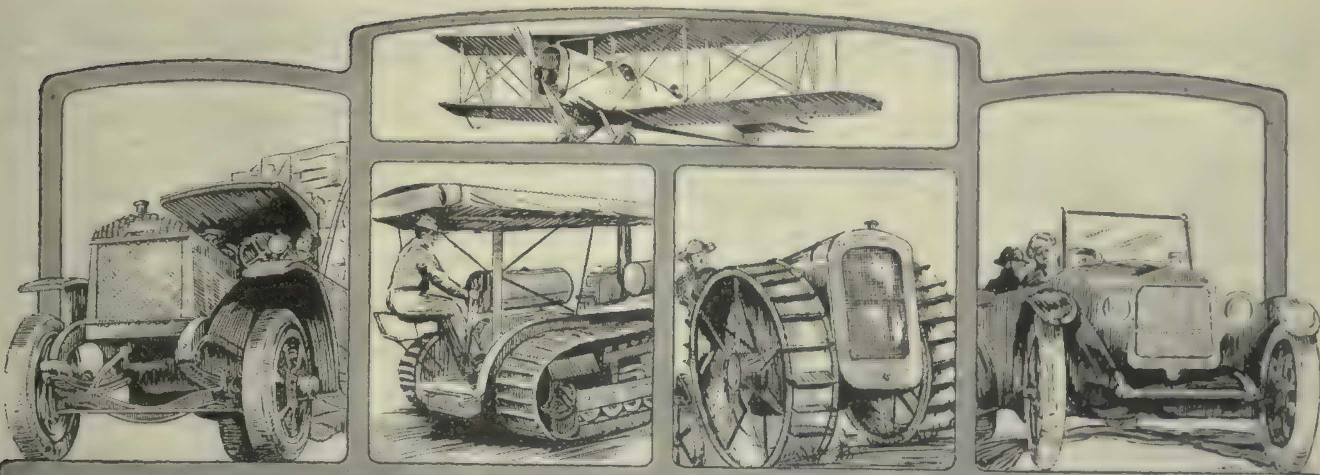
4. The public forgets that the service was originally offered to it as an extra privilege, depends upon it, takes it for granted, and is going to demand it as a right. This demand spreads not only throughout the particular industry, but to other industries.

5. There will spring up an industrial gospel that the factory, where an organization of specialists is gathered together at the source, is the easiest, most efficient, and proper place to develop the technique of the product, including its use, possibilities, and all its problems.

6. The management and employees of each producing company will come to accept as a natural duty the function of solving all technical problems in connection with their product, be responsible for having the solutions available for customers or the public at large, and aim to be in every way specialists in their product.

Indeed, why should they not be?

Companies which have always made thorough investigations, either privately or publicly, of the technical problems of their product have found that the resulting position of leadership has paid a return on the investment. Industries used to be one-man affairs, which might have grounds for fearing that they could not collect individual benefits from their development work. But companies now are big enough and permanent enough so that the same company which starts a broad movement can collect a sufficient share in the result.



AUTOMOTIVE CONSTRUCTION

Caterpillars and Their Construction—II

By K. H. CONDIT
Associate Editor, American Machinist

A distinguishing feature of the "Caterpillar" tractor is naturally the track. Old Baron Munchausen with his stunt of lifting himself by his boot straps would have welcomed this machine as a vindication of his statements to the sceptical.

THE invention of the "Caterpillar" is just one more instance of necessity mothering invention. Out in Stockton, Calif., Benjamin Holt was building farm machinery and traction engines as early as 1890, but, like other traction engines, his were practically helpless in soft ground. The vast delta lands of the San Joaquin were awaiting development, for horses could not work in the soft soils and even the widest traction wheels packed the earth, mired down and stayed there. Mr. Holt was alive to the need and finally hit upon the self-laying track as the solution. It is really a wide chain with steel plates mounted on links to increase the bearing surface. Instead of the contact surface of the round wheel which on hard ground is theoretically a line the width of the tire, the chain track gives a bearing area which is practically the width of the track multiplied by the center distance between the end-supporting rollers. The unit bearing pressure becomes even less than that of the sole of a man's foot and explains why machines of this type do not pack soft ground and are able to navigate under such seemingly impossible conditions. It also explains the disappointment of the short-sighted officer back of the British lines who endeavored to use a "caterpillar" to crush road material. He reported the attempt as "unsatisfactory."

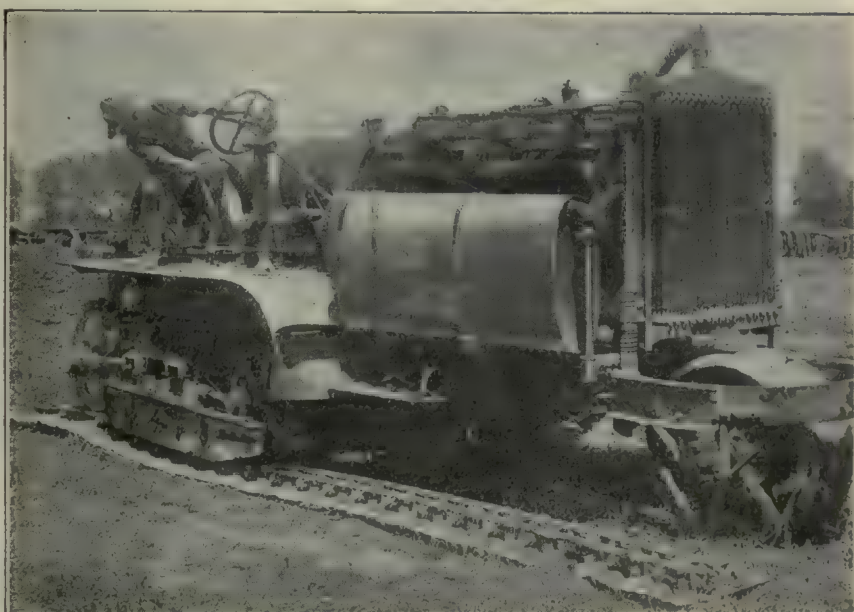


FIG. 6. "120" WITH TRACK LAID OUT

Track details vary somewhat in the different models but the same principle applies to all. A reference to Fig. 6 will give an idea of the main features of the construction. This photograph shows a "120" with one track unlinked and laid out flat. It will be seen that the inner side of the chain forms a straight, flat, double line of short rails on which the weight of the machine is carried by five rollers, three with outside flanges and two with inside flanges, as shown in Fig. 7. The assembly in Fig. 7 is called the roller frame assembly and takes the weight of the main frame through coil springs which appear in Figs. 8 and 9.

The chain runs over the two sprockets, the rear one being the driving sprocket and the forward one a blank sprocket used to support an adjustment. The upper slack between the sprockets is carried on three rollers

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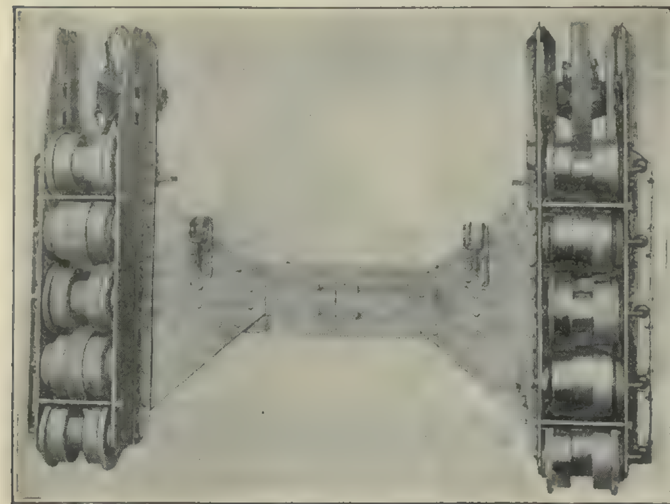

FIG. 7. ROLLER FRAME ASSEMBLY

which can be seen in Fig. 6. Power is applied through the rear sprocket which picks up the chain links on itself, the tractor rolling forward on the supporting rollers.

Fig. 8 shows the method of removing the track. The soft-steel track-pin keeper *A* has been cut with a cold chisel and the track pin *B* driven out, thus disconnecting the chain. The tractor is then backed up until the condition shown in Fig. 6 is reached.

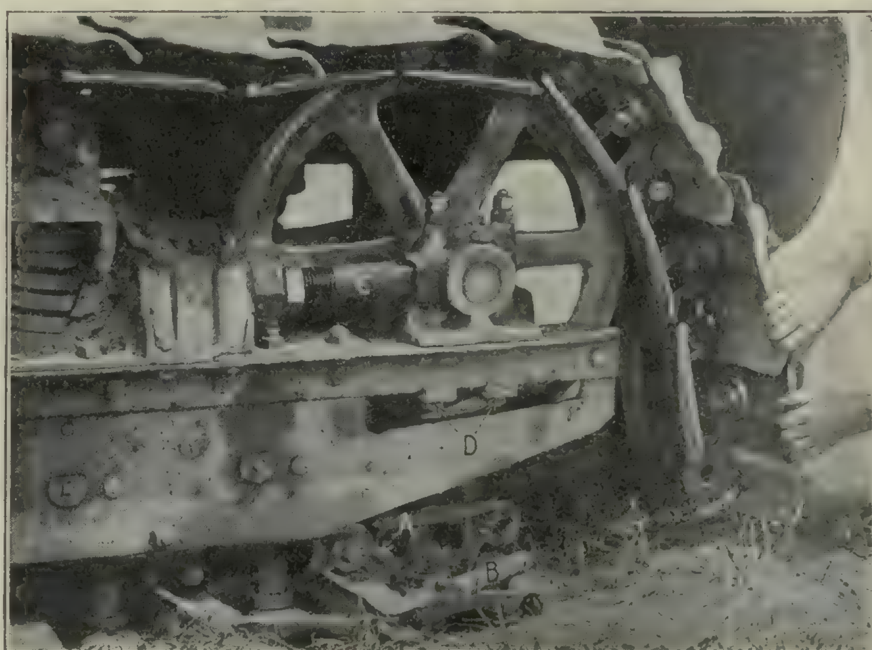

FIG. 8. FIRST STEPS IN REMOVING TRACK

Any necessary repairs can now be made and when they are completed the track will be picked up again with the aid of the chain shown in Fig. 9. In the assembling shop this job is simplified by using a wire cable and an air hoist to help pull the track together. Adjustment of the chain tension is obtained through the spacing rod *C*, Fig. 8, which slides the blank-sprocket supporting bearing forward or backward when the holding bolts *DD* are loosened.

The elements of the chain proper of the "120" are shown in Fig. 10 and consist of the right- and left-track links *A* and *B*, the space block *C* and the track pin *D*. The track links are steel castings and the first operation performed on them is the rough-broaching of the elongated hole for the space block in a Williamson-White punch press. The bottoms are then smoothed up on a Gardner disk grinding machine and the space-block holes finish-broached on a No. 3 Lapointe broaching machine to limits of +0.000 and —0.002 in. The $1\frac{5}{16}$-in. hole for the $1\frac{1}{4}$-in. track pin is then drilled, both right- and left-hand links being set in the jig shown in Fig. 11. The broached openings engage with the locating studs *A* and *B* and the ground lower faces fit against the horizontal locating pin *C*, being held by the locating screws *DD*. Supporting screws *EE* clamp the work in position. The jig is made in two pieces, the upper being slid sidewise along the lower by a spur gear *F* on the end of the shaft *G* acting on a rack mounted on its under side. The hardened bushing *H* guides the drill for the left-hand link. After this is drilled the moving part of the jig is traversed to bring bushing *K* under the drill, location being insured by the stop *L*. The two links are then assembled with a space block and the $\frac{3}{8}$-in. holes for the track shoe and grouser bolts are drilled and reamed.

The space block is made of cold-rolled steel with diameter limits ±0.002-in. and the drilling, chamfering and cutting-off operations are performed in a four-spindle Gridley automatic screw machine. The ends are then milled as shown to limits of + 0.0015 in. The track pin is made by upsetting a head on $1\frac{1}{4}$-in. steel made to S. A. E. specification No. 1020, in an Ajex bolt header. It is drilled for the mild-steel track-pin keeper already mentioned in the foregoing.

The track-shoe for the 75- and 120-hp. models is sheared to size from plow-steel sheets and then formed hot in a bulldozer, the holes for the attaching bolts being drilled. The grouser is a steel casting de-

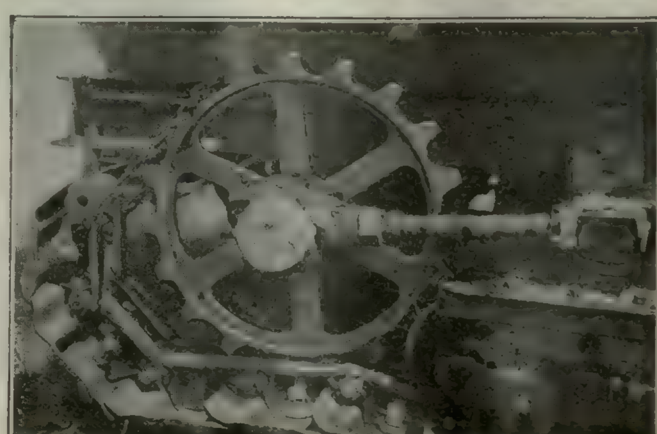

FIG. 9. PICKING UP TRACK

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signed to give the track a better grip on soft ground and it is held on by the same bolts which attach the track shoe. It is thus practically a permanent part of the tread of the big machines.

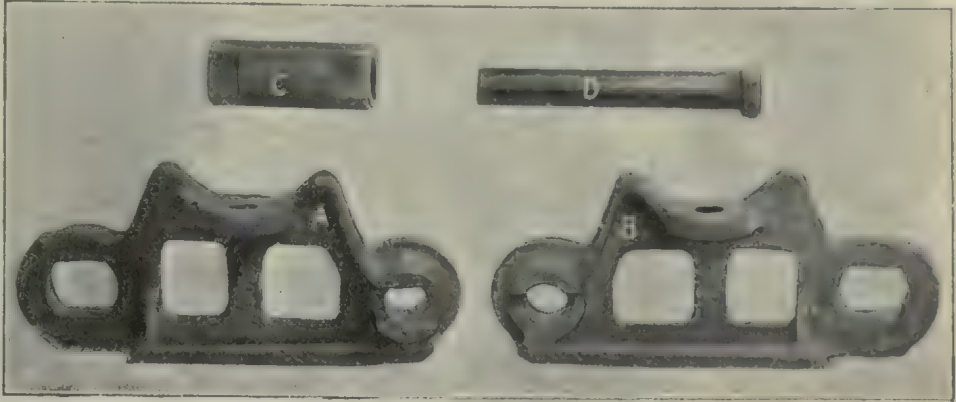

FIG. 10. TRACK LINKS, SPACE BLOCK AND PIN

Fig. 12 shows the track details in various stages of assembly and also gives a rough idea of the shape of the grouser *A*. In work of this sort it is natural that the sledge should be the most important assembling tool, but its possibilities for damage are minimized by the rather close limits applied to the track lines and space blocks, as already mentioned.

The track for the 10-ton artillery tractor differs in some respects from that of the "75" and "120." Here the track links, space blocks and track shoe have been combined in one steel casting with satisfactory results. Fig. 13 shows the assembly. It will be seen that the grouser in this case is readily removed by loosening one nut, the opposite end hooking over the side of the track shoe. This arrangement was made necessary by objections of French representatives to having their roads ruined by the ugly looking grousers. As a matter of fact, a heavy Holt tractor has been driven over asphalt on a hot day with the grousers on without leaving a mark, so that the danger was more fancied than real. This type of tractor with the grousers off presents a perfectly flat surface to the road and is more a benefit than a detriment. On the army machine the grousers are carried in a steel box under the driver's seat.

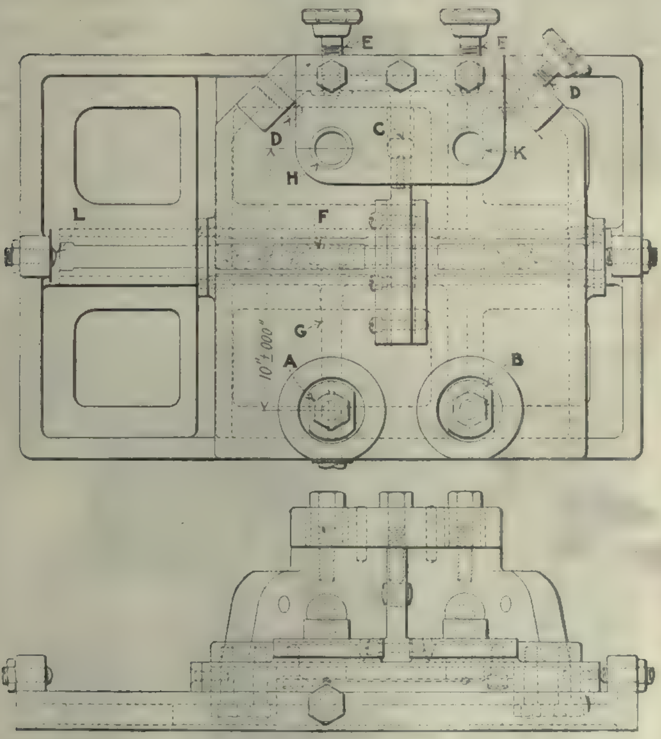

FIG. 11. TRACK LINK DRILL JIG

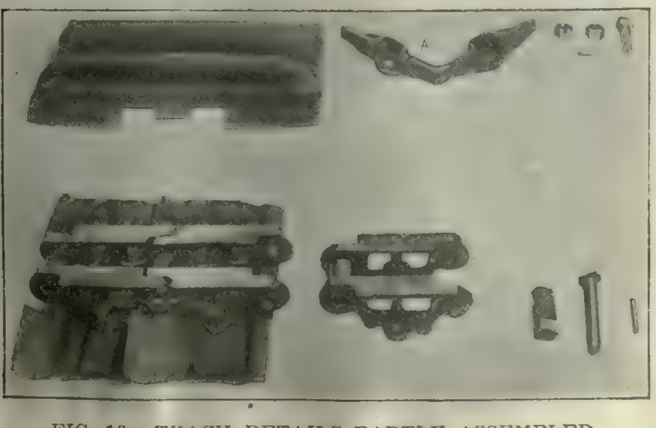

FIG. 12. TRACK DETAILS PARTLY ASSEMBLED

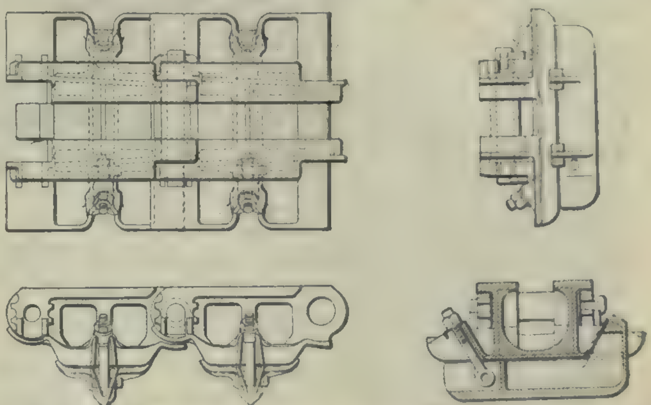

FIG. 13. 10-TON TRACK LINK AND GROUSER

Fig. 14 shows the arrangement for drilling the holes in the track link and shoe for the 10-ton. Since this photograph was taken a six-spindle drilling machine has been arranged to do the same job but with two operators. A rotating jig provides for the drilling of two holes in the top of the piece as set up and then two corresponding ones in the bottom.

The inside- and outside-flange track wheels shown in Fig. 15 present additional evidence of the Holt method of finishing farm machinery in the machine shop rather than the foundry. These wheels are semi-steel castings and are fitted with Hyatt roller bearings. The jig used for boring and counterboring the hole is illustrated in Fig. 16. The jig is practically a vise

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with special jaws. This job is also done on a turret lathe, the work being gripped in a chuck with special jaws. Here, again, the limits are closer than one would expect for this sort of a job, 0.005-in. for the rough-boring and 0.001-in. for finish-counterboring. Particular attention has been paid to keeping these bearings oil- and dust-tight. This is essential to the successful operation of parts that are often submerged in water or mud and usually caked with dirt. To provide for lubrication the track-wheel gudgeon is drilled for three-fourths of its length and the opening tapped for a $\frac{3}{8}$-in. pipe plug. Medium cup grease is inserted through this hole with a grease gun until it comes out of the hub. A radial hole taps the inner end of this passage to let the grease out. To keep out the dust and grit four washers are used; *A*, Fig. 15, which is a plain metal washer fitting against the end of the rubber bearing; *B*, a leather washer which is next to *A*; *C*, the dust washer which is a driving fit in the counterbore of the roller; and *D*, the dust collar which fits over the finished end of the wheel hub and has projections which engage sockets in the wheel to prevent rotation, with consequent wear and admission of dirt.

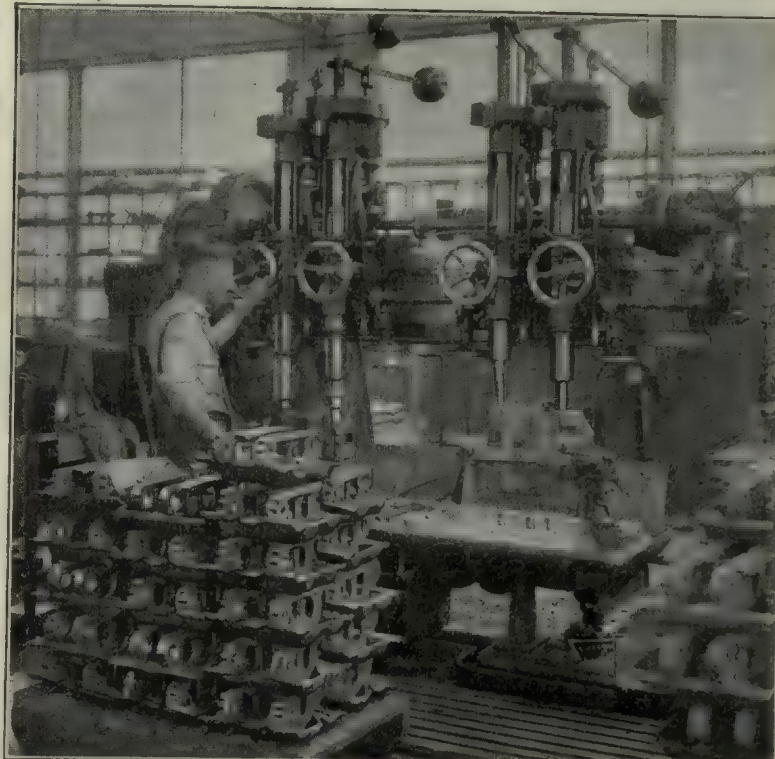


FIG. 14. MULTIPLE-SPINDLE DRILLING OF 10-TON TRACK LINKS

The track itself is provided with an oil reservoir which is so arranged that the track can be flooded with black oil about once an hour. The grade of oil to use will naturally depend upon the season of the year. The sprockets are fitted with grease cups in which a medium grade of cup grease is used.

When the manufacturer has made provision for lubrication that will insure successful running if given a reasonable amount of attention, he has done about all that can be expected of him. Unfortunately, he can't build tractor engineers that function as certainly as machines and sometimes little things like grease cups are overlooked. As one owner wrote in, "The only part of the machine that has given trouble is the operator."

The next installment will take up the various parts of the transmission which is unique in some respects.

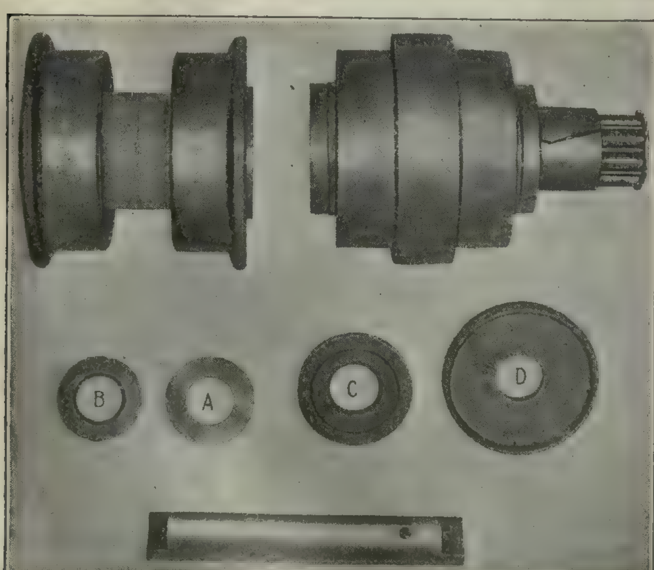


FIG. 15. ROLLER FRAME TRACK WHEELS

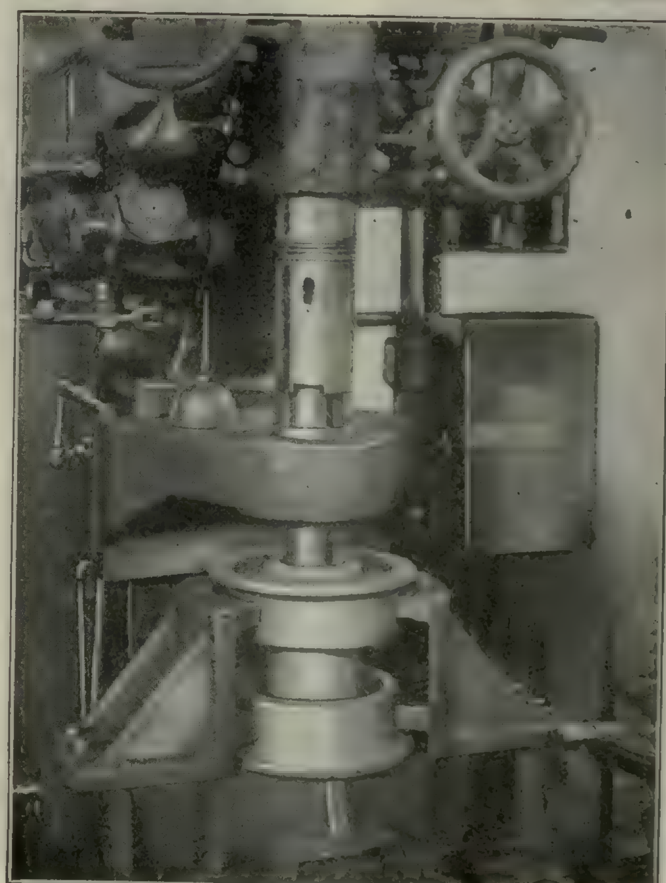
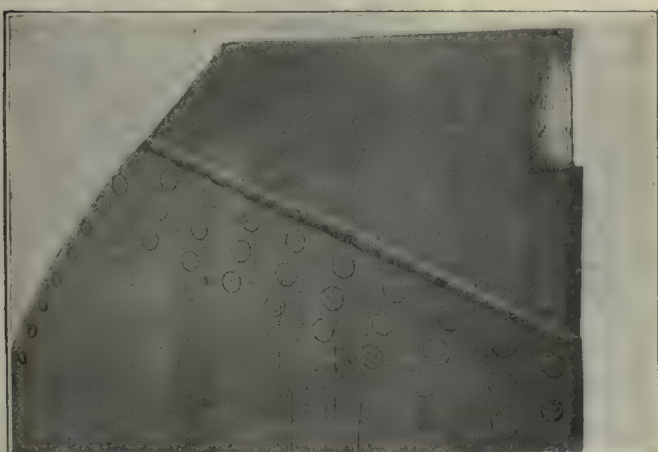


FIG. 16. BORING TRACK WHEELS

Welding a Cracked Rudder

BY D. C. COOK

Without a doubt the ship-building industry has offered a wider field for the employment of the welding processes than any other. Many interesting problems are encountered in the fabrication and construction of new vessels, but it is the repair work that taxes the



THE COMPLETED WELD

skill and ingenuity of the welders, and the manner and speed in which they accomplish the seemingly impossible is inspiring.

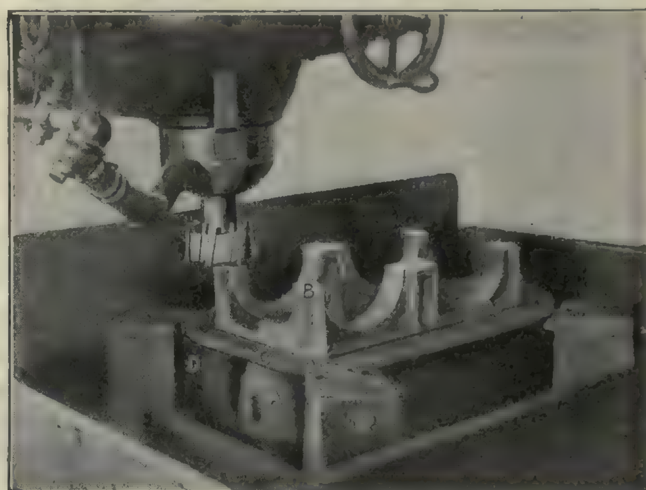
The Reid-Avery Co., Philadelphia, Penn., recently completed a job which is typical of this class of work. After dry-docking, a crack was found in the ship's rudder, and to remove it for repair would involve considerable expense and delay. However, a scaffold was erected about the rudder and the crack quickly filled and welded by the arc-welding process.

Gripping a Cover Flange

BY I. B. RICH

A front cover plate for the rear-axle housing on the Autocar truck presents a somewhat complicated problem in machining. The projection *A* carries the bearings for the drive shaft and also takes the thrust due to the beveled gears. The six surfaces *B* contact with six similar surfaces which form the seats for the caps holding the four large ball bearings in place, while surface *C*, which is milled all around the plate, makes the joint with the front of the opening in the housing.

This plate is a rather awkward piece to hold, owing to the necessity for milling its entire upper surface so as to make a good joint. The plate is both located and held by means of four plungers which are shaped as shown at *D* so as to support the lower side of the plate and also grip the outer edge firmly at the four



FIXTURE FOR SURFACING COVER FLANGE

corners. One of the main requirements is to have substantial supporting blocks for the screws in order to exert sufficient pressure to hold the plates firmly.

Preparing Parts for Local Case-Hardening

BY MATTHEW HARRIS

Where articles are to be locally case-hardened it is generally the practice to electroplate the part to be left soft with copper. To prevent the copper from being deposited on the part to be hardened, that part is coated with paraffin.

As the copper has no affinity for carbon the part so coated will not be carbonized when heated in the carbonizing compound.

At the works of the Dayton Engineering Laboratories Co., Dayton, Ohio, they have a large quantity of small

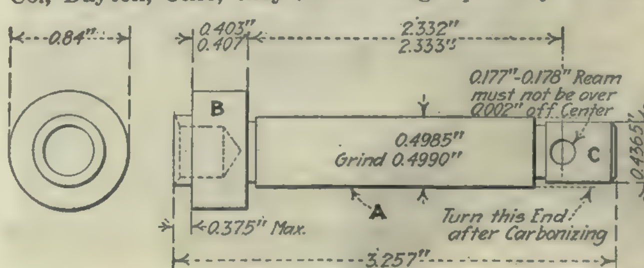


FIG. 1. THE SHAFT TO BE COATED WITH PARAFFIN

shafts, Fig. 1, that are to be case-hardened at *A* while the ends *B* and *C* are to be left soft. Formerly, the part *A* was brush-coated with melted paraffin but, as there were many shafts, this was tedious and great care was necessary to avoid getting paraffin where it was not wanted.

To insure uniform coating the device shown in Fig. 2 was made. Melted paraffin is poured in the well *A* and

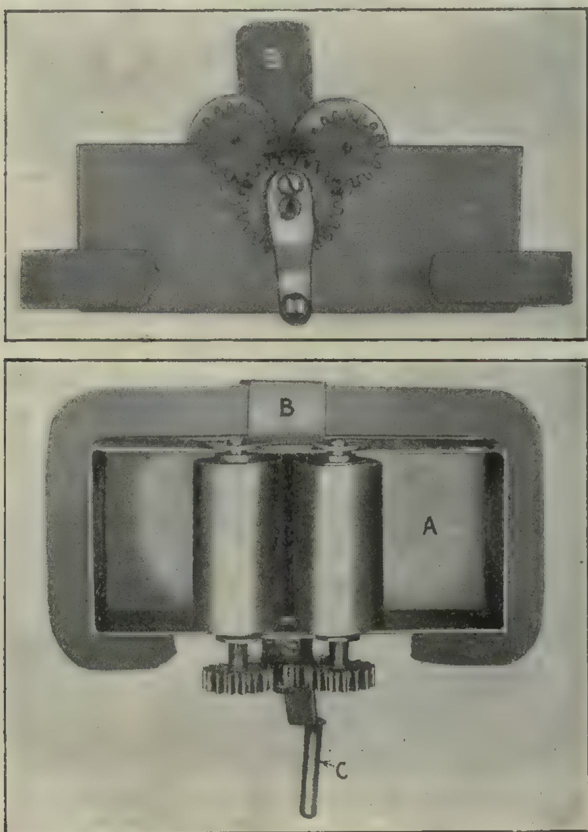


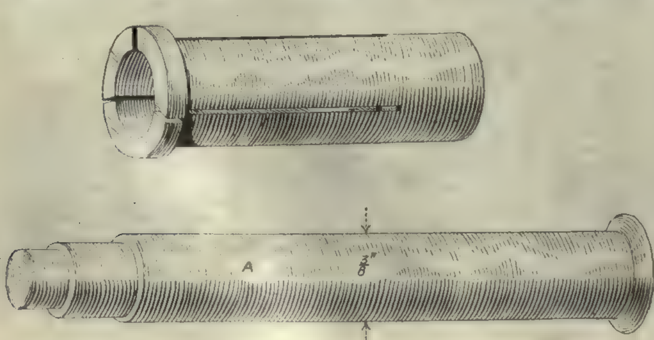
FIG. 2. DEVICE FOR COATING THE SHAFT

kept liquid by setting the device on a hot plate, the paraffin being kept high enough to touch the bottoms of the rollers. The shaft to be coated is laid between the rollers with one end against the gage *B*, when a turn or two of the crank *C* will cause it to be evenly coated.

An Auxiliary Collet for Holding Headed Pins

By Gustave A. Remacle

It sometimes happens in die work for die-castings that core pins have to be turned in the bench lathe after they have been headed at the opposite end as



HOLDING HEADED PINS WITH AUXILIARY COLLET

shown at *A* in the illustration, and the head will not allow the insertion of the piece in the spring collet from the outside.

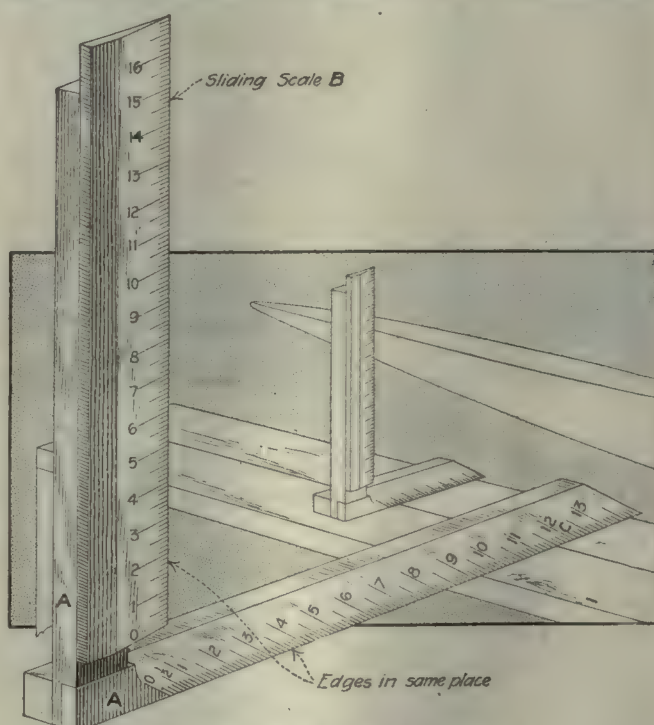
If but a few pieces are to be made the collet can be removed and the piece inserted from the rear end; but when constructing dies for casting airplane ball-bearing holders, many such core pins had to be made. Therefore, in order to save the time which the repeated removal of the collet would make necessary, an auxiliary collet was made.

Circumstances did not warrant the hardening and grinding of this auxiliary collet but care was exercised in its making and it was marked so that it could be placed in the regular collet in the same relative position every time, thus minimizing any slight errors that might exist.

A Gage for Laying Out Work in Two Planes

By Raoul J. Hoffman

The sketch shows a tool that is of advantage in laying out work where simultaneous measurement in two planes is required, as for instance in laying out or inspecting the contour and alignment of an airplane pro-



MEASURING IN TWO PLANES

peller, where the measurements are given from a center line and from the face of the propeller.

The base of the tool is a block of hard wood of rectangular section and of whatever length is desirable. One of the narrow sides is beveled to an edge for the greater part of its length and graduated, beginning at zero which coincides with the edge of the vertical scale.

The upright, which must be square with the base, carries a beveled-edge scale with its edge in the same plane as the horizontal scale. This upright scale is adjustable up and down so that its zero point may be made to coincide with whatever surface may be used as the point of departure in making measurements in the vertical plane.

ARMY ORDNANCE NEWS

Machining Problems Solved in Gun-Making—II

By J. V. HUNTER
Western Editor, *American Machinist*

The accuracy required in machining heavy pieces has frequently in the past made an exceedingly slow process of setting up the work for the cuts. These delays have largely been avoided in making the 4.7-in. gun by numerous special gaging devices, which are described for the benefit of all machine-tool men.

WHEN the jacket has been shrunk on the tube the body is turned, Fig. 18, for the shrinkage surface of the locking hoop. A closer view, Fig. 19, shows a number of gages made to fit every portion of the threaded profile of this part. After shrinking the locking hoop the gun is finish-bored in a Lodge & Shipley gun-boring lathe. For truing the muzzle end in the four-jaw chuck, Fig. 20, a micrometer *A* is used to true the steadyrest surface which was finished in one of the early operations. The arrangement for holding this indicator consists of the parallel bar *B*, which is laid across the ways of the lathe and carries the bracket *C* with the heavy bar *D* for holding the indicator, thus enabling the operator to center the piece to 0.0005 in. The breech end of the gun with the boring bar about to enter the wood-packed reamer is shown in Fig. 21. The bore has previously been opened up to a depth of from 3 to 4 in. and to the full diameter of the reamer by a special attachment which was described in a previous article. The Northwestern Ordnance Co., Madison, Wis., has devised a unique method of boring the powder chamber and the forcing slope of the bore, and of facing the breech end to length in a long Gisholt turret lathe, Fig. 22, which swings the entire length of the gun in the same way as in

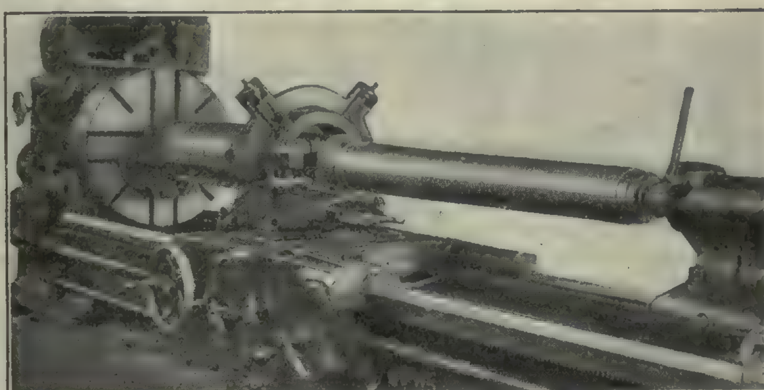


FIG. 18. TURNING SHRINKAGE SURFACE FOR LOCKING HOOP

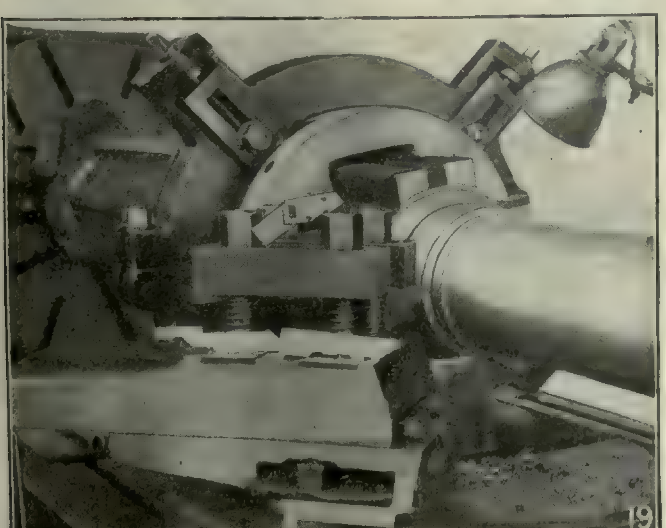


FIG. 19. FINISHING THREAD SURFACE FOR LOCKING HOOPS

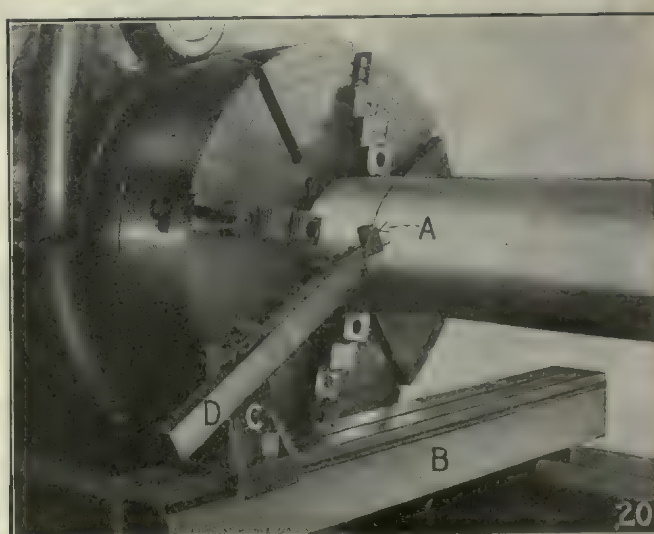


FIG. 20. MICROMETER DIAL USED FOR TRUING MUZZLE END

ARMY ORDNANCE NEWS

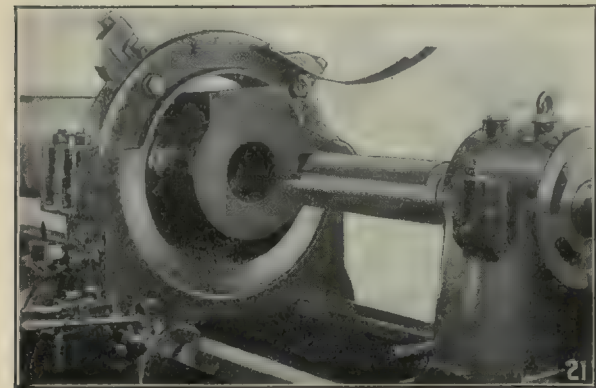


FIG. 21. FINISH-BORE REAMER ABOUT TO ENTER GUN

FIG. 22. LARGE TURRET LATHE USED FOR FINISHING POWDER CHAMBER

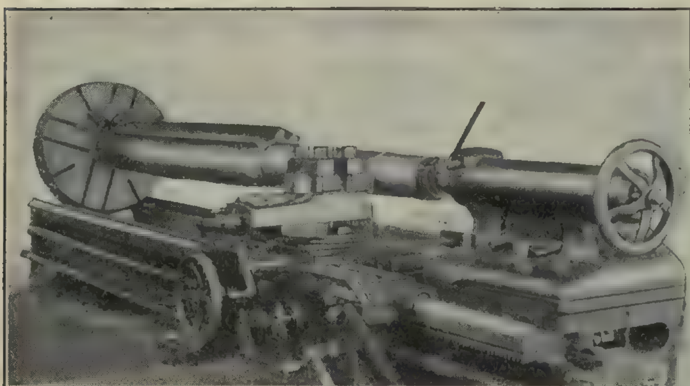


FIG. 23. TURNING MUZZLE END FOR FRONT CLIP

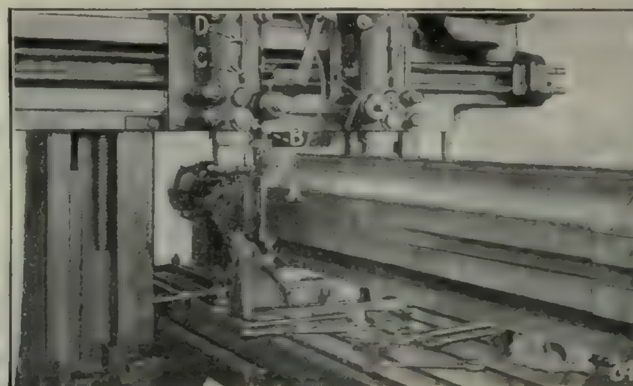


FIG. 24. MILLING OPERATION ON BREECH END

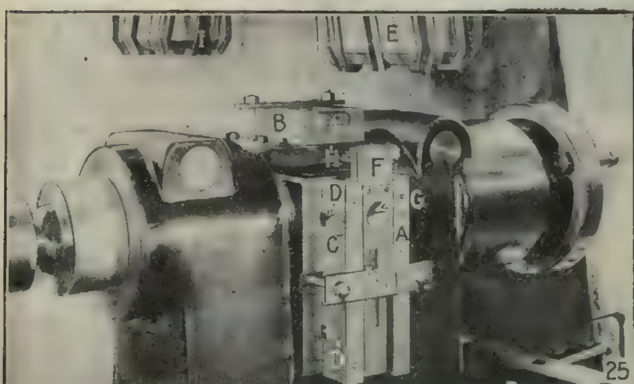


FIG. 25. SPECIAL GAGING DEVICE FOR SETTING UP MILLS

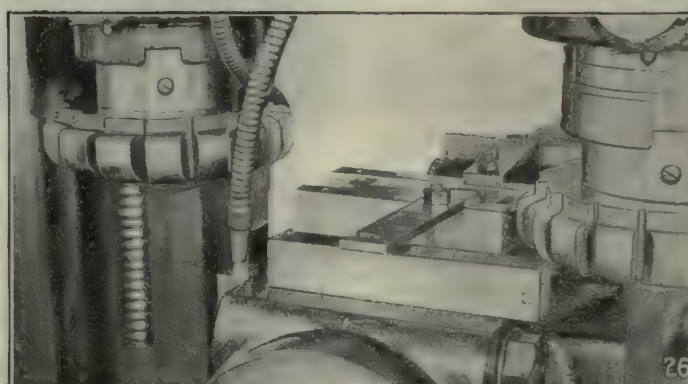
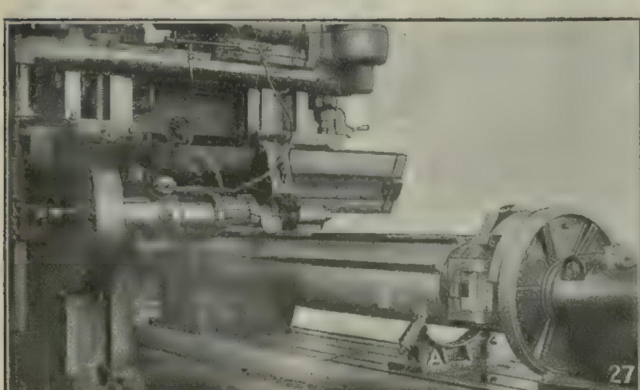
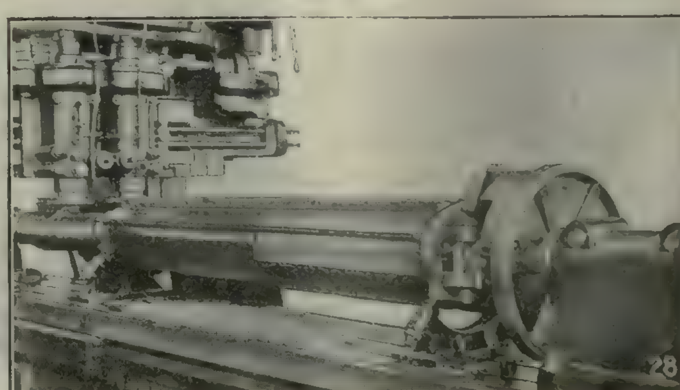


FIG. 26. GAGE USED IN SETTING UP FORM MILL





FIGS. 27 AND 28. MILLING OPERATION ON GUN-SLIDE GUIDES
Fig. 27—Heavy milling cut on gun body. Fig. 28—Milling the grooves in slide guides.

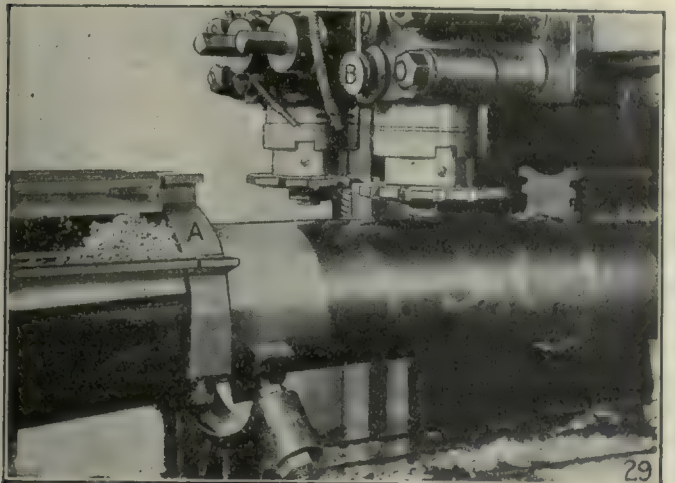


FIG. 29. FORM GAGE USED FOR SETTING MILLING CUTTERS

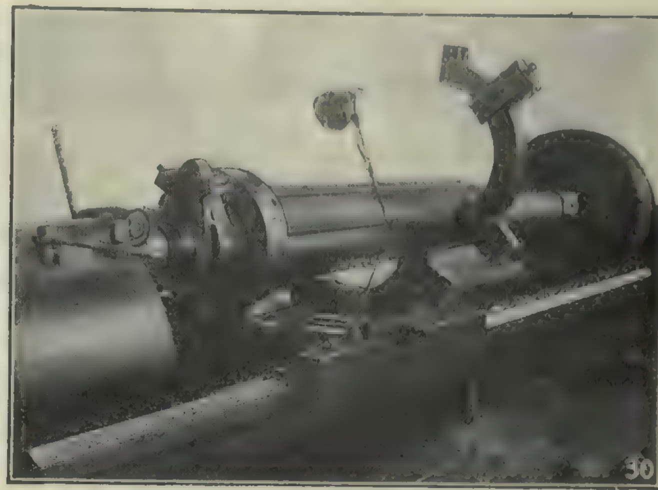


FIG. 30. OFF-CENTER PLUG USED IN SETTING UP FOR BORING BREECH.

a standard gun-boring lathe, but employs turret-head tools for boring and reaming. On this turret head the boring bar *A* is used for the first roughing cut. This is followed by a cut from the semi-finish reamer *B*, and a final finish by the wood-packed reamer *C* insures the accuracy of the powder chamber and forcing slope. The standard lathe carriage with facing-off tools finishes the end of the breech to length. Turning of the muzzle end of the gun in a Bridgeford lathe, Fig. 23, completed the lathe operation for the time being.

The improvements in the methods of gaging for setting up milling cuts are worthy of special attention and might be adopted profitably in other lines—taking as an example the set-up that involves milling the two sides of the breech end simultaneously after finishing the top surface. Fig. 24 shows a small gage *A* which rests on the top finished surface and extends to the upper face of the milling cutter, thus indicating how high to raise the cutter.

However, in addition to this gage there is a micrometer-dial attachment *B*, which is mounted on the frame of the milling-machine spindle. When the gage *A* has been placed and the spindle drawn up to the proper height the rod *C* is lowered until it forces a reading of perhaps 0.125 in., and the dial turned back to read zero without disturbing the indicator finger. The rod *C* is carried on the stud *D*, which is equipped with an adjusting thumb nut and is fastened to the spindle of the milling cutter. It is the custom to take a rough and a finish cut, and after the cutter has been set by the gage *B* the micrometer dial is of service to the operator who now raises the spindle until the dial indicates that he has backed out the cutter a distance of possibly 0.050 in. After the roughing cut is made the spindle is lowered until the dial again reads zero, and is then in the correct position to proceed with the finishing cut.

Gages for setting milling cutters are illustrated in Fig. 25 at *A* and *B*. All gun work is located to some extent with reference to dimensions given from the center of the bore, and during the majority of the milling operations on the breech end and slide guide portions of the gun body it is carried on centers which are accurately located in the bore; consequently, when located for milling cuts such as those shown in Fig. 24, it is supported by the center head more clearly shown in Fig. 25.

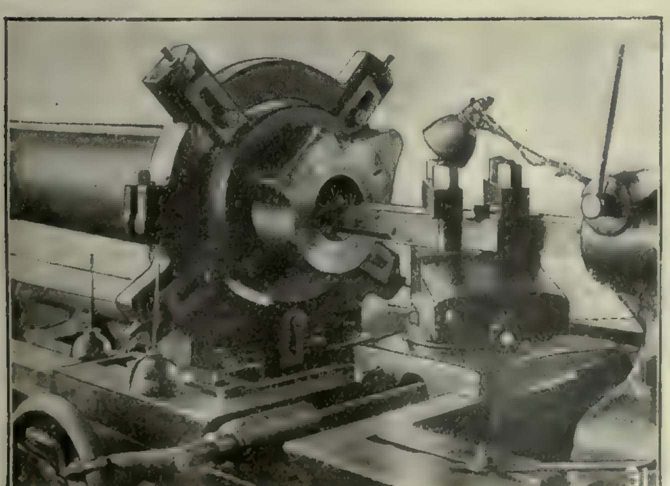


FIG. 31. CUTTING BREECH-LOCKING THREADS

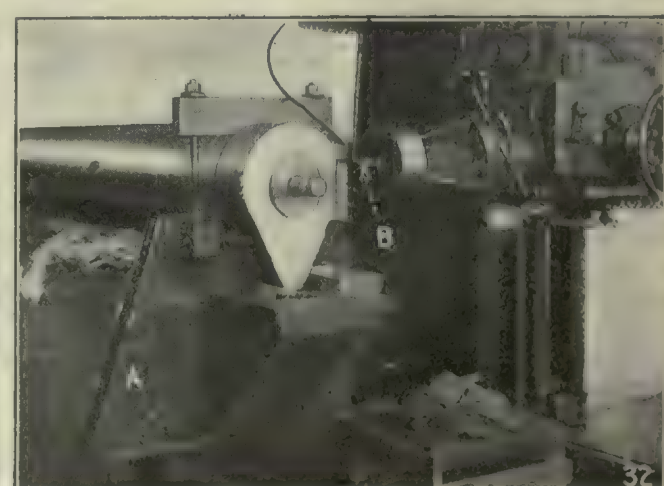


FIG. 32. MILLING OUT HINGE-LUG RECESS

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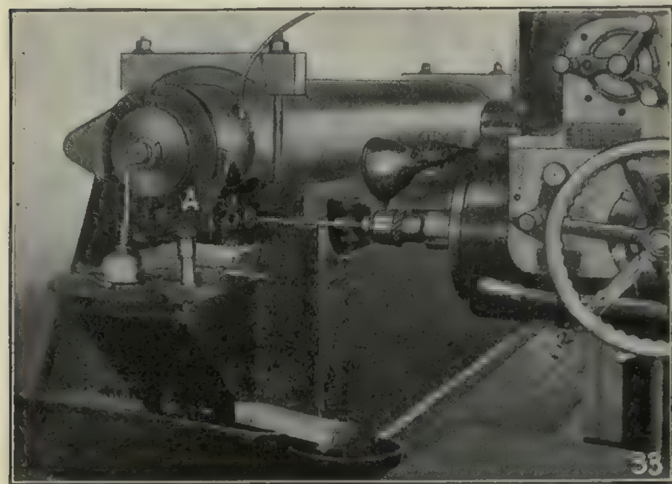


FIG. 33. DRILLING AND BORING FOR HINGE-PIN HOLE

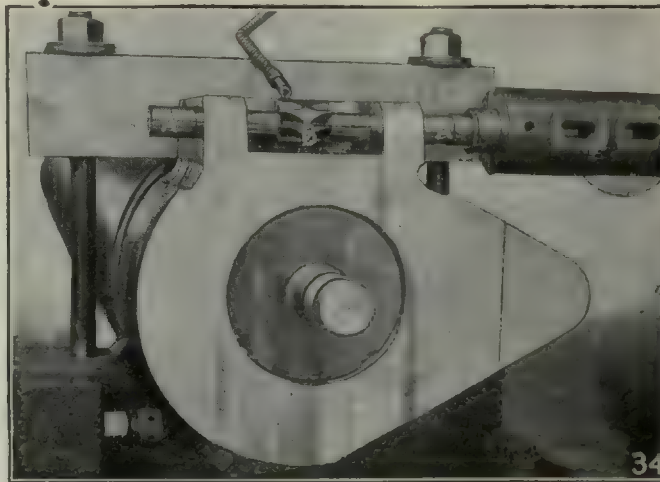


FIG. 34. RADIUS-MILLING BACK CORNER OF HINGE POCKET

The gaging devices *A* and *B* are made up of the main body *C*, which has on its back face three key slots *D*, which enable it to be placed in any one of three previously determined positions with respect to the center. When the gage is placed in position the milling cutter *E* is lowered until its cutting edges come into contact with the hardened-steel plunger *F*. This plunger is free to retreat a certain distance, but while so doing it moves a small indicating finger across the glass-covered dial *G*, which reads plus or minus thousandths from a central zero. By moving the cutter sideways against the corresponding plunger *H* of the gage *B* the distance laterally from the center of the gun bore can be fixed. By transferring the gaging device *A* to the rear side of the headstock and by turning the gage *B* end for end the cutter *I* may be similarly aligned for correct position. This type of gage will serve for other types of milling cutters, as illustrated in Fig. 26, which shows a form mill being set by means of an indicator located on top of the center head.

If the cutters are not to be equally spaced from the center certain changes can be made in the indicator either by setting the body into another of the key slots or by changing a plug *J*, Fig. 25, which fits inside the mechanism and controls the lever movement of the indicator finger.

A heavy milling cut on one of the slide guides of the gun body is shown in Fig. 27, a feature of which is that the indexing center for the breech end is provided with an additional support *A*, which rests on the table of the milling machine and takes up the heavy downward thrust of the milling cut and the weight of the body on the adjustable screws *B*.

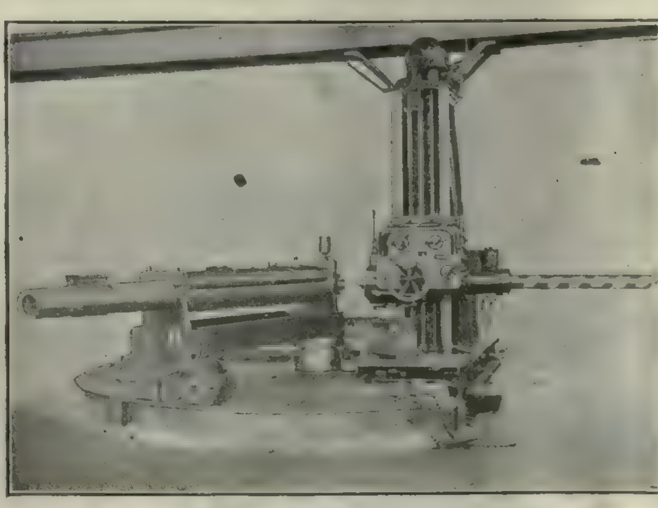


FIG. 35. SPECIAL PIVOTED GUN FIXTURE ON MILLING MACHINE

Cutting the grooves in the under side of the slide guides, Fig. 28, is another heavy milling cut. The form gage *A*, Fig. 29, used for aligning these milling cutters, is simple in design and bolts into place over the portion of the gun tube which was accurately machined for the shrinking of the locking hoop. Micrometer-dial gages *B* are used for setting up the milling cutter for the roughing and finishing cuts. Micrometer dials, not shown, are attached to the crossrail of the milling machine with adjustments that press against the milling-cutter spindle column castings and are used to gage lateral movement.

On account of the loading tray (a device which protects the breech threads from being injured by the shells) which lies in the bottom of the threaded portion of the breech it is necessary to offset and bore the threaded locking section of the breech block 3/8 in. below the center of the gun bore. To do this the cathead ring *A*, Fig. 30, is fitted by mounting the gun in a lathe, with the muzzle end held in a pot chuck *B* and the breech end supported by a special 3/8-in. offset center plug *C*. The cathead ring is turned outside to insure that it runs true with the centers, and after remounting with this support the threads are cut, Fig. 31.

The many recesses in the hinge pocket and breech end are finished in operations employing several large Landis vertical-column milling machines. During the work on the hinge pocket a special heavy cast-iron base *A*, Fig. 32, that was built in the toolroom holds the body while the end mill *B* is cutting out this recess. The gun body is then turned over and a large jig plate *A*, Fig. 33, is placed to guide the drills and boring bars used for finishing the hinge-pin hole.

For radius-milling the back corner of the hinge pocket, Fig. 34, the gun is revolved 90 deg.

from the first hinge recessing position, and the arbor A is slipped through the hinge-pin hole and carries the double-end mill B, which is held in place by a key and setscrew. This makes a satisfactory method of handling work of this character and insures a clean radius cut at each corner without the customary laborious work of chipping and filing them.

Fig. 35 shows the setting of a similar Landis vertical-column milling machine equipped with a special cast-iron runway and concrete base A, upon which the carriage B travels, being pivoted at the farther end C. This permits the operator to cut the various angles required in recessing for the extractor. It will be observed that the spindle-covering shield of the machine extends to the right far beyond its base, and to make this conspicuous to prevent it from being bumped by moving trucks or workmen it has been painted with a black-and-white spiral.

A Man's Pay Should Equal the Value of His Production

By JOHN S. WATTS

IF THE regulation forming the title to this essay can be exactly conformed to, we will be in a fair way toward the solution of the present unrest and dissatisfaction. That is, if we could definitely decide the relative values of all the various classes of labor (manual or brain), and so be in a position to state definitely that a specified kind of work performed in or during a period of time, was equivalent to a certain amount of money, and everyone was paid in accordance therewith, we would all be satisfied that we were getting an amount of remuneration equal to, or rather, that would purchase, our share of the world's production.

For if the relative value of our labor is truly calculated, and we all are paid that value, it is obvious that each worker's pay will be equal to his production, the total amount paid out to all the workers being equal to the total production, assuming that there is no so-called unearned increment.

The main defect in our present methods of payment is that there is no fixed relationship between the amount of money in circulation, or in the amount paid for the labor of producing, and the amount of goods produced or on the market, this being the cause for the fluctuation in the purchasing value of our monetary unit. The effect is that we agree to perform work for a sum of money, the value of which sum is problematical.

The dollar, therefore, has no fixed value in terms of produce, and neither has it at present any definite value in terms of productive labor; that is, the amount of work (manual or brain) which will earn a dollar varies both in quantity and quality in the same locality.

If the amount of production (that is, labor multiplied by hours, required to earn one dollar) varied automatically with the purchasing value of the dollar, the problem would be much less intricate, but it does not.

The dollar, therefore, which is our unit of value just as the inch is our unit of measurement, is about as useful a unit as a 12-in. scale would be that might shrink to 6 in., while still purporting to measure 12 inches.

It is manifestly impossible to fix the purchasing value of a dollar, as all commodities will vary in their relative value in times of shortage of one class and over supply of another. For example, if we make a certain quantity of wheat equal to one dollar, and another fixed quantity of potatoes to be worth the same amount; then when wheat is plentiful and potatoes scarce those who wish potatoes will certainly offer a premium for them, and the excess wheat would go unsold unless the price were reduced or some other inducement offered to persuade people to purchase it.

Therefore, it will be necessary to fix the value of the dollar in terms of a certain amount of a certain quality of work; and from that, the value of all other qualities of work in as near as humanly possible the exact ratio the other qualities bear to the first or standard quality in productive efficiency. By productive efficiency I mean the amount or value of production that the said quality of work will produce, divided by the value of the production of the standard quality of work.

The standard unit could be the value produced by the labor of an unskilled man, working for one hour, with some simple tool such as a spade, and without assistance from a skilled supervisor.

To elucidate this I will give a simple example of what I mean by productive efficiency and the fixing of the value of a man's production.

We will assume that the unit of labor value defined above is equal to one dollar; it follows that ten men doing this quality of work will produce 10 dollars in value in one hour. If a foreman is appointed over these men, and by reason of his superior knowledge and experience his supervision of the men results in their producing 12 dollars in value in the same time, and with the same tools and physical effort, then the foreman's productive ability is two dollars per hour, and his productive efficiency is 200 per cent. If the men's pay is one dollar per hour, the foreman's will be two dollars per hour.

It may be contended that the natural laws of supply and demand do regulate a man's wage in accordance with the value of his production, but, while this may be approximately true as to the total amount paid for the production of an entire business, it is decidedly not true as to the wages paid the various qualities or classes of labor engaged in that business.

For instance, the price of machine tools may be said to be fixed by the law of supply and demand, and hence the total pay of all the labor entering into their manufacture.

The division of this pay, however, among the various trades is not, I contend, fixed by the aforesaid law but by the strength of the trade's unions.

Compare the pay of the operator of an automatic machine, requiring only such skill as may be acquired in a day or two with the pay received by the draftsmen who design the machine, the latter spending many years acquiring the necessary knowledge. The pay of these two classes is practically equal because the operators have a union and the draftsmen have none.

Their productive values are nowhere near equal as

the designers have produced a machine which may double or treble the output of the operator, with less physical effort on his part than would be necessary to produce the same value in any other way.

It must be remembered that the true production of the operator does not equal the output of the machine, as this latter includes the production of the designers and mechanics who built the machine.

The true value of the operator's production will be the standard unit defined above plus a percentage added for the skill necessarily acquired on his part to operate the machine.

In choosing the above example I have no animus against the machine operators, nor does this apply any more against them than against any other trade with a strong union. All trades and professions are out for all they can get. And in the absence of any attempt at scientific determination of the respective relative values of the various kinds of work, who can say when a trade is getting its fair rate.

It is only when we can come to compare the amount of effort and brain work required to earn a dollar in one business with the ease with which a dollar can be earned in another trade, that we see the need for some way of calculating the true comparative values of the various kinds of labor, other than the method now in vogue of settling it by a trial of endurance between the employer and employee. The employers frequently put up only a half-hearted fight, as in the generality of cases they know they will finally pay up and simply add the extra cost to the price of their product. The rest of us pay in the end.

If, by reason of having a strong organization, a certain less skilled part of the population can obtain more than its share of the products there is no incentive for our young men to become skilled, which is what is actually occurring, and in time this will cause a lack of skill, and hence a lack of production.

Again, the present method of getting increased pay results in increasing the cost of living, which brings further demands for increases, and so on ad infinitum. The final result will be that those skilled professions without organizations to protect them will become so poorly paid that no one will be left to carry them on and chaos will result.

If it were known that wages were fixed in a true relation to the value of the production for which the wage was paid, the lowest intellect would see that only by increasing production by either or both increased physical effort and greater skill, could the cost of living be lowered, or what is the same thing, a larger measure of the good things of life for all of us be obtained.

The conclusion I arrive at is that it is imperative, if our civilization is not to be left to wreck itself on the rocks of ignorance and greed, that the channel of a fair day's work for a fair day's pay, be charted so plainly that "the wayfaring man though a fool may read."

It may seem, and probably is, a tall order to fix the true ratio between the value in production of say eight hours of pick and shovel work, and eight hours of navigating a liner. But in my opinion the problem has got to be solved and that soon, or in the near future the less thoughtful of the manual workers who are in the majority will take what of value there is by brute force, and being unable to control the intricate mechanism of our civilization, bring the whole structure to an end in barbarism.

An instance was given above of a suggested method of fixing the productive value of a foreman's work which should be the standard method and used wherever applicable. In cases where the production was too indirect to measure by that method, it would be possible to arrive at a fairly just rate by taking account of the length of time it took on the average to learn to do the class of work in question. Further percentages would be added for work in dangerous or disagreeable occupations.

While it is not to be expected that at first all rates of pay would be mathematically exactly in proportion to the true value of production, the law of supply and demand would operate to correct any slight errors by reason of the elimination of false methods of fixing rates of pay by strikes, etc.

I claim that elimination of strikes would follow the inauguration of this system, because if the whole community (through a competent commission) decides fair and just rates for all trades and professions, precisely as the rates of taxation, laws, etc., are decided and accepted by all, then any body of men who set out to demand more would have to convince the people of the justice of their demands or failing that fight the whole population.

At first sight it may appear as though the above method would result, by reason of paying the skilled men more, in the less skilled men getting a poorer living than they do now.

The actual effect will be the reverse, for the following reasons:

The production of all goods will be increased by reason of the continuous production due to cessation of strikes and lockouts, and with increased production we get decreased costs.

The more closely we come to paying to a man the actual value of his production, the greater will be the incentive to become skilled in producing value, and hence more will be produced, and there will be more to divide.

What We Can Do For 1920

THE New Year — 1920 — promises to be one of the most critical in history. The war is over and boundary lines are apparently settled for the most part. But the future of the world depends on far more than geography. It depends on the relations of men and of people—in the shop and office, in business, and between cities, states and countries.

All these relationships, however, get back to the personal—to the way in which we treat others and are treated by them. And the future depends on each one of us in no small measure.

Instead of the usual new year resolutions, let us try to make ourselves realize that we can each play a part in making the future better for all concerned.

Let us all remember that Duties are just as important as *Rights.*

That the world demands, and has a right to demand, *Service* in return for what we get out of it.

That unless we treat the other fellow as we would like to be treated, we cannot expect harmony and co-operation.

That without co-operation, we cannot hope to increase production which is so sadly needed.

And then let us earnestly resolve to give in full measure, the service that is required of us, so that we may have the right to expect the same of others.

Necessity for Keeping Grinding Wheels in Perfect Balance

By J. H. HOLLINGER
The Landis Tool Co.

On page 1228, Vol. 50, in the *American Machinist*, John H. Peckham writes under the above title, on the effect of unbalanced wheels. It is a well-known fact that the chatter is the worst enemy of the grinding machine. There are times when a piece of work may look perfectly smooth; its surface may not appear to have a blemish under the closest inspection, and yet the instant a neat-fitting bushing is rubbed over it imperfections begin to show up. The marks which appear are in the form of chatter but no instrument has been found delicate enough to measure it, and it has not been known to give any trouble. Nevertheless, we are constantly fighting this imaginary evil; wheels and pulleys are balanced, uniform belting is selected, and the machine made heavier throughout, all of which make for improvement.

There is one thing which should never be forgotten: "The nearer we come to perfection, the harder it is to get."

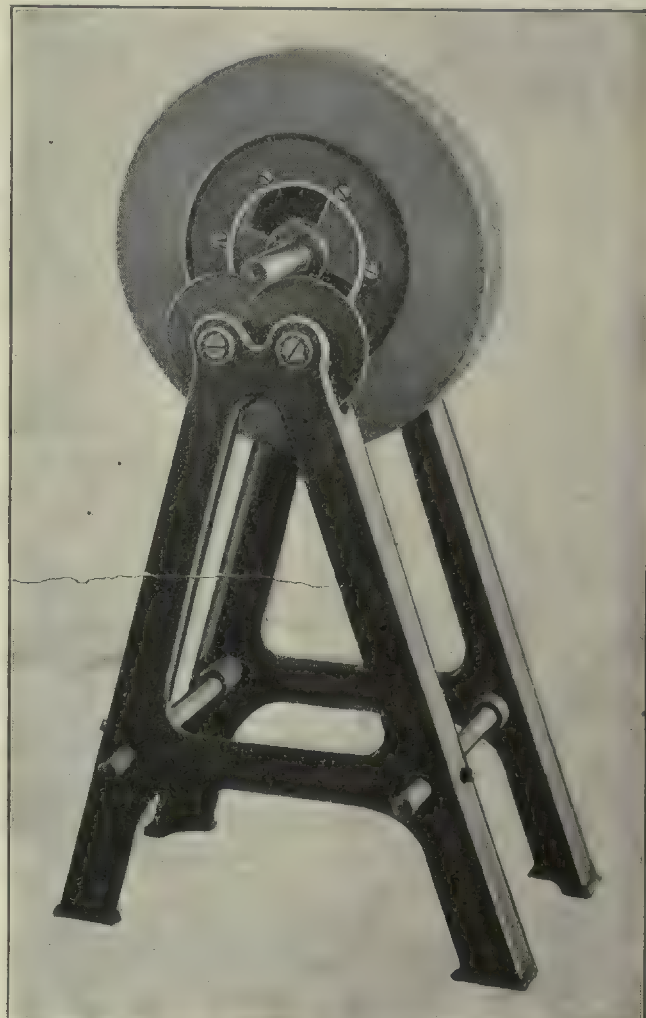
It is impossible to overcome wear; after a machine has been installed, adjustments are often not properly kept up and as long as the finish on the work is good enough it is let go at that; if the grinding machine is kept tuned up, first-class results can be looked for.

As an example, Mr. Peckham states that an 18-in. diameter wheel (width not given), 1 oz. out of balance and running 1360 r.p.m., exerts a force of about 25 lb. every revolution, and this continued pounding in the wheel-spindle boxes will in short time wear the boxes and spindle egg-shaped. While I am opposed to unbalanced wheels and am an enemy of vibration, I do not believe that an 18 x 2-in. wheel, running 1360 r.p.m. and out of balance 1 oz., will wear the boxes and spindle egg-shaped in a short time, or imperil the operator's life. It is a very rare thing indeed for a wheel on a precision grinding machine to break and I have no knowledge of any wheel breaking due to being out of balance 1 oz. The breaking of a wheel is generally caused through rough treatment by the operator. Jamming the wheel against a shoulder on the work, the driving dog or the head or foot stock should be avoided, as this not only weakens the wheel, but tears off the corners, making it impossible to do good grinding without dressing the wheel until the corners are sharp. To get the best results from a grinding wheel, the corners should be kept sharp and the sides true.

If the spindle has a good bearing in the boxes, and the adjustment is neat enough so they warm up to about 110 deg. F. and a uniform belt is used, good results will be obtained even though the wheel is out of balance 1 oz. The nearer the wheel spindle is run metal to metal in its boxes the better will be the results.

Mr. Peckham states that a wheel should be rebalanced after each 1 in. of wear. This may be good practice but could not be done where production is an important factor as the loss in time would make it prohibitive. It does not require much time to balance a wheel if the wheel center is designed for this convenience, but when an operator gets going on production and stops to balance the wheel, it takes time to get the machine set for sizing again and the production going the same as when he stopped. My advice to an operator is, do not stop to rebalance the wheel after 1 in. has been worn away as long as the finish is all right.

At a large manufacturing plant I recently saw large rolls ground to a mirror finish without chatter and without the wheel being balanced. While I do not recommend grinding without balancing the wheel, yet at this particular plant they are getting satisfactory results. When they are troubled with chatter they immediately take up the wheel-spindle bearings and their trouble disappears.



WHEEL PROVIDED WITH BALANCING BLOCKS

For the past 25 years the Landis Tool Co. has had provisions in its wheel centers for balancing. As shown in the illustration, two cast-iron blocks are fitted in an annular groove in the wheel center, and can be clamped in any position around the groove. The balancing stand shown has rollers on which the balancing arbor is placed. These are supported by ball bearings, ground and balanced.

A Forecast for 1920

THE *American Machinist* has always endeavored to help solve the great problems, not only in its own particular field, but also those which affect the country as a whole and our manufacturing relations to foreign markets.

Shortly after the beginning of the World War it was foreseen that the United States might eventually be drawn in. It was also seen that in any event, our own and other manufacturers taking munition contracts would need all the help and information available. With this in view the editors got busy and gathered hundreds of articles from arsenals and shops of the United States, Canada and abroad, which were literally textbooks for many a contract holder. In Sydney, Australia, where only a few of the earlier munition articles were available, they were lithographed by the hundred and distributed to various contractors for British supplies by one of the principal manufacturers there. Other examples showing the value of the paper to this country and our allies could be given almost without limit. So important was the work of the *American Machinist* considered, that it was the *only* technical or other paper allowed to go to England *in bulk*—all editorial and advertising pages complete—during the most trying period of the war when every foot of space was considered in transporting our troops and supplies.

This war work is only a sample of what the paper does and is always ready to do for the upbuilding of industry and the good of humanity as a whole. A number of our war and subsequent activities are mentioned in the sketch of Major Van Deventer given last week, and need not be repeated here.

The coming year will present many problems quite as serious in their way, as the problems of the war period. We must work toward the adjustment of the great labor problems and endeavor to pave the way to real industrial peace and an understanding between employers and employees. These two should be a *team* and neither lag back on the traces and let the other pull all of the load. The pay envelope should not be scant, neither should the worker's individual time or production be scant. The old Golden Rule should still be kept polished and in plain sight of both sides. To assist in the solving of problems along this line, we are arranging for a series of signed editorials by men prominent in industry and known for their fairness and foresightedness in dealing with their employees. No merely theoretical stuff will be considered for a second, but actual, live discussion of the relations of employer and employee will be given a prominent place. No executives can afford to miss getting the views of men in their own field who have met and are solving the difficulties of the present unsettled conditions.

We shall aim to get even closer than ever to our readers in our weekly issues, and have planned an extensive program full of contributions written and arranged to be of the greatest good to the greatest number. As always, the paper will be liberally illustrated in the most attractive way we can devise.

A management series, which we believe will be the most comprehensive ever published by any magazine, is now well under way. Our welding series will be continued, and every phase of electric welding will be covered in the same comprehensive way as have Thermit and gas-torch welding. Several law experts will contribute articles on industrial relations, written along lines so well liked by a large number of our readers. We have secured the promise of a considerable number of new tool developments which will be published in the *American Machinist* two or three weeks ahead of any other publication in the field. Some of these articles are now in our office and will appear within a few weeks. These new tool major articles alone will be of inestimable value to many, as our advanced description will enable them to get in touch with the makers at the earliest possible moment—a thing very important considering the slowness of machine-tool deliveries at this time.

Another important thing is that with this issue we are adding eight more pages to the editorial section. This will enable us to get a greater amount of up-to-the-minute information to our readers and is a very tangible New-Year gift to each reader of the *American Machinist*.

Last week we announced to our readers the new line-up of the editorial staff of the American Machinist. In order to bring us all into closer personal touch with each other, we present this week pictures and brief sketches of the three new principal editors.

AFTER nearly fifteen years of machine-shop experience, accident made Ethan Viall an editor. While in charge of the shop of one of the largest builders of a special line of machinery in Chicago, he contracted a case of double pneumonia and typhoid fever. Chicago is no place for a man to stay in who has anything the matter with his lungs, so the doctor recommended a winter in Menomonie, Wis.—a place well inland and at that time absolutely guiltless of car lines or movies and as bare of other entertainment as Philadelphia on Sunday. In order to have something to do evenings, Mr. Viall turned to writing on mechanical subjects. His first short article appeared in the *American Machinist* in 1907 and his second article in *Machinery* a few weeks later. This encouraged him and he began to write in earnest, although he spent the year 1908 in a large shop in Decatur, Ill. In 1909 he became Associate Editor of *Machinery*. He held this position until Jan. 16, 1911, when he joined the staff of the *American Machinist* as Associate Editor. In 1913 he became Western Editor, with headquarters in Cincinnati. In March, 1917, he was called to the New York office as Managing Editor, which place he held until made Editor.

Mr. Viall's shop experience has been wide and his nearly nine years' connection with the *American Machinist* has given him a large circle of acquaintances all over the United States. As a shop man he made a specialty of tools, dies and automatic machinery, and passed from machinist, toolmaker and foreman to superintendent and manager in several large shops. He is a native of Kalamazoo, Mich., and received his grammar and high-school education in Bloomington, Ill. Most of his shop and all of his technical school training was received in Chicago.

THE new managing editor, Kenneth H. Condit, pleads guilty to being over-educated, but has been trying to live it down ever since his last graduation—and especially since he joined the staff of the *American Machinist*.

He comes from New Jersey and got most of his training in Jersey institutions—Princeton University and Stevens Institute of Technology. Stevens turned him out as an embryo mechanical engineer in 1908 and Princeton gave him the degree of civil engineer in 1913. For three years between these two dates, he served as draftsman and testing engineer with Safety Car Heating and Lighting Co., and as assistant manager A. G. Spalding & Brothers, at their Newark salesroom and shop.

At the conclusion of his studies at Princeton, Mr. Condit was appointed instructor in civil engineering, a position which he held until the outbreak of the war. In May, 1917, he was given leave of absence to go to Toronto with two other members of the Princeton faculty to secure the information necessary for the organization of the U. S. School of Military Aeronautics at Princeton. He was commissioned first lieutenant July 5, 1917, and given charge of the work in airplane engines at this school for fourteen months. He was promoted to a captaincy and transferred to the Motor Liaison Division of the Air Service at Wilbur Wright Field. He remained at this post until discharged shortly after the signing of the armistice.

Mr. Condit joined the editorial staff of the *American Machinist* early in January, 1919.

THE other editor, Fred H. Colvin, was known to the readers of the *American Machinist* for many years before he became actively identified with the editorial staff in January, 1907. Away back in his apprentice days, he began writing for the *American Machinist*, his first contribution appearing in the issue of April 3, 1886, in the Department of Letters from Practical Men. Other letters and articles followed, and, though not directly connected with the paper until 1907, he was well acquainted with almost all of the former editors of the paper.

Going into the shop at the age of fifteen gave no time for any schooling but the advanced grammar grades, so that night schools, after a ten-hour work day, provided the only method of studying mechanical drawing, physics and other fundamentals. It is probably because of this lack of opportunity on his own part that much of his writings, especially his books, has been directed toward making these fundamentals clear to others similarly situated.

His editorial experience began with the first issue of *Machinery* in September, 1894. Leaving this in June, 1897, he became Associate Editor and Business Manager of *Locomotive Engineering*, which had been started by John A. Hill, in January, 1888, under the auspices of the *American Machinist*. Following a man like John A. Hill is no easy matter, and, as Mr. Colvin frequently expresses it, he "wabbled around in John Hill's shoes for five years."

All this previous experience laid a solid foundation for his work on the *American Machinist*, and there are comparatively few machine shops, even in out-of-the-way places where he is not known, either personally or through his writings in the *American Machinist*, or his books.

How to Get Machine Tools Available Under the Provisions of the Caldwell Bill

WITH this announcement the *American Machinist* finishes the strenuous campaign which was begun just a year ago to make surplus machine tools available for educational purposes. Vexatious delays have occurred and the final form of the bill differs in some respects from that of the one advocated in these columns. The main thing is, however, that the tools are now available. The remaining steps in the securing of them must be taken by the directors of the institutions desiring them.

The information that follows is primarily for the trade schools and technical institutions of the country. However, others interested in the disposal of the surplus material in the possession of the War Department will do well to note the provisions under which the schools may purchase their share of them.

The details of procedure as laid down by the authorities at Washington have just reached us and are printed in full for the information of those concerned.

Procedure for the Sale of Machine Tools

1. Inquiries—All inquiries pertaining to the above subject should be addressed to the Director of Sales, Munitions Building, Washington, D. C., who will act in coördinating this work. Selling bureaus and district offices will forward any such inquiries received by them to the Director of Sales.

2. Replies (Sending of Questionnaires)—The Director of Sales, upon receipt of an inquiry for machine tools from any educational institution, will reply direct by letter and inclose three copies of questionnaire which will be filled out by the institution and two copies returned to the Director of Sales.

3. Statement of Requirements and Filling Out of Questionnaire—The educational institution will fill out the questionnaire and on a separate sheet will state as nearly as possible what machine tools it requires. The questionnaire will be returned, in duplicate, to the Director of Sales properly certified.

4. Recording and Approval of Questionnaires — These questionnaires will be considered in the order in which they are received by the Director of Sales, who will pass upon the institution's eligibility under this act.

5. Notifying the Institution of Its Eligibility — If found eligible, the Director of Sales will forward to the institution notice of such decision, and as many purchasing coupons as that particular school will be entitled to. It will also advise the bureaus and district offices, through proper channels, to place the institution on their bulletin mailing lists and to forward at once their latest bulletins of machine tools.

6. Use of Coupons—The institutions will then be able to select from the bulletins such machine tools as they are entitled to purchase and will negotiate with the district office in the matter of obtaining the tools. No preference will be shown either commercial customers or educational institutions. In view of the fact that there are but a limited number of machine tools suitable for the use of educational institutions, an institution will be given ten (10) days after the date of receipt by the district office of notice from such institution that it desires to purchase a certain tool, in which to consummate such purchase. If the tool has not been previously sold, the district office will so advise the institution. The institution will then forward to the district office its order together with shipping instructions, certified check in full and a coupon for each machine tool desired, upon receipt of which authority will be issued to ship the machine, the institution paying all freight and transportation charges. This transaction will be considered as a sale by the district office and reported in the customary manner, but on a special form provided for that purpose.

7. Machine tools shown in these bulletins are described according to the best information obtainable, but the United States does not guarantee the accuracy of these descriptions or warrant the condition and fitness of such machine tools or their suitability for the use intended to be made of same. Arrangements can be made to examine these tools, by application to the district office where the tool is located.

8. Sale of machine tools under the provisions of the act of Congress shall not be made except in accordance with the above instructions.

The Questionnaire

For educational institutions desiring to purchase machine tools from the United States Government at 15 per cent of the cost to the Government as provided by the following act of Congress:

1. Act, approved Nov. 19, 1919, authorizing Secretary of War to sell machine tools to educational institutions at 15 per cent of cost:

That the Secretary of War be, and he is hereby, authorized under such regulations as he may prescribe, to sell at 15 per centum of their cost to trade, technical, and public schools and universities, and other recognized educational institutions, upon application in writing, such machine tools as are suitable for their use which are now owned by the United States of America and are under the control of the War Department and not needed for Government purposes. The money realized from the sale may be used by the Secretary of War to defray expenses, except cost of transportation, incident to distribution of the tools, and the balance shall be turned into the Treasury of the United States as miscellaneous receipts; Provided, That in the event any such material is offered for sale by said institutions without the consent in writing of the Secretary of War, title thereto shall revert to the United States.

2. When completely filled out, return this form in duplicate to the Director of Sales, Munitions Building, Washington, D. C. One copy will be retained by the educational institution.

3. These questionnaires will be considered in the order received by the Director of Sales. When an institution has presented satisfactory evidence of eligibility, the various district offices will at once be advised and the Director of Sales will forward to the institution numbered coupons covering the number of machine tools that the institution will be allowed to purchase. One coupon for each machine tool desired, together with certified check and shipping instructions, must accompany each purchase order. Each tool purchase must be handled as a separate transaction and individual certified checks must be furnished covering each tool purchased.

4. The following list of district offices will receive orders for machine tools:

Air Service

Buffalo, 2050 Elmwood Ave., Buffalo, N. Y.
Chicago, Army Building, 230 E. Ohio St., Chicago, Ill.
Dayton, care Maxwell Motor Co., East 1st St. and B. & O. R.R., Dayton, Ohio
Detroit, care Aviation General Supply Depot, Springwells, Detroit, Mich.
New York, 360 Madison Ave., New York City
San Francisco, Postal Telegraph Bldg., San Francisco, Cal.

Ordnance

Baltimore, Columbia Ave. and B. & O. R.R., Baltimore, Md.
Boston, 19 Portland St., Boston, Mass.
Bridgeport, 945 Main St., Bridgeport, Conn.
Chicago, 74th St. and South Ashland Ave., Chicago, Ill.
Cincinnati, Walsh Bldg., 3d and Vine Sts., Cincinnnati, Ohio
Cleveland, 22d and Prospect Ave., Cleveland, Ohio
Detroit, 35 Washington Blvd., Detroit, Mich.
New York, 1107 Broadway, New York City
Philadelphia, 1710 Market St., Philadelphia, Pa.
Pittsburgh, 40th and Butler Sts., Pittsburgh, Pa.
Rochester, 1048 University Ave., Rochester, N. Y.
St. Louis, Mo. State Life Bldg., St. Louis, Mo.
Toronto, Room 21, 43 Victoria St., Toronto, Canada

M. & E. M. Surplus Property, Zone Supply, P. S. & T.

Atlanta, Transportation Bldg., Atlanta, Ga.
Baltimore, Coca-Cola Bldg., Baltimore, Md.
Boston, 108 Massachusetts Ave., Boston, Mass.
Chicago, 1819 W. 39th St., Chicago, Ill.
Jeffersonville, Jeffersonville, Ind.
New York, 461 8th St., New York City

New Orleans, Audobon Bldg., New Orleans, La.
Omaha, Omaha, Nebraska
Philadelphia, 21st and Oregon Ave., Philadelphia, Pa.
St. Louis, 2d and Arsenal Sts., St. Louis, Mo.
San Francisco, Ft. Mason, San Francisco, Cal.
Texas, San Antonio, Texas
Texas, El Paso, Texas

SIGNAL CORPS

Boston, Textile Bldg., Boston, Mass.
Chicago, Army Bldg., 230 E. Ohio St., Chicago, Ill.
New York, 8-10 Bridge St., New York City

5. Bulletins, describing available machine tools, are published by the above district offices; the educational institutions will receive these bulletins and selections will be made from same. All negotiations will be carried on between the institution and these district offices. Machine tools shown in these bulletins are described according to the best information obtainable, but the United States does not guarantee the accuracy of these descriptions, or warrant the condition and fitness of such machine tools or their suitability for the use intended to be made of them. Arrangements can be made to examine these tools by application to the district office where the tool is located.

6. The price of machine tools will be 15 per cent of the cost to the United States. Terms: Certified check in full with order. Tools will be placed by the United States on cars at point where same are located, the institution paying all freight charges. Title to the machine tools will pass when so loaded. All machine tools are subject to prior sale. When the institution receives notice from the district office that the tool is available, it will forward its order, shipping instructions, certified check in full and one coupon.

7. Sales to educational institutions have no priority over commercial sales. Where several accredited institutions ask for the same tool, the district office will accept the first letter or telegram received. After such acceptance the machine tool will be held for ten days to enable the institution to complete negotiations and to deliver to the district office its order, shipping instructions, certified check and coupon, although the Government assumes no liability for a failure to do so.

8. Please answer the following questions fully:

a. Name of institution:

b. Address:

c. When founded:

d. Kind of school — state university, college or other school state school and land grant school combined, land grant school only, privately owned school, municipal, trade or other school, etc.:

e. President or principal officer:

f. Names of officers of institution who will be delegated to transact business with the Government:

g. Has your institution been legally recognized by the Federal, state or municipal board of education? (Yes or No): If so, attach copy of this recognition, such as an annual educational report. Also attach a copy of your last catalog.

h. Did your institution give special training for military purposes or otherwise from 1913 to 1919? (Yes or No): If so, attach letter describing courses, length, and average number of students attending. (Civilian and enlisted.)

i. Does your institution receive Federal, state or municipal aid? (Yes or No): State by attached letter nature and amount.

j. Have you made previous application for, or received any machine tools from the U. S. Government? (Yes or No): If so, attach letter showing under what authority such tools were obtained.

k. Total valuation of your institution: $ Total valuation of buildings and equipment devoted to engineering, vocational or manual training: $ Acreage: Number of buildings: Present indebtedness: $ Endowments: $ Tuition fee: $

l. Present number of students—resident: non-resident: Total: Number of students enrolled in engineering, vocational or manual training courses: Number of students given shop work at same period in engineering, vocational and manual training courses: Floor area in square feet of shops devoted to engineering, vocational or manual training courses:

NOTE—Machine tools now installed in your shops should be carefully listed on separate sheet and attached hereto, together with condition and approximate age.

Attached hereto a list describing approximately the style and size of machine tools desired.

Total number of machine tools hereby requested:

Reasons for which additional equipment is desired should be clearly stated by letter attached hereto.

I hereby certify that the machine tools requested above are to be used for educational purposes only, and will not be resold without the written consent of the Secretary of War and that all the above statements are true.

Name: Title:

Approved by postmaster or other Federal official:

Name: Title: Date:

What Is Doing in Europe?

By R. SANFORD RILEY
President, Sanford Riley Stoker Co.

We may well be disturbed over the industrial unrest now prevailing, but to one returning from a trip abroad there is an appearance of stability and happiness in this country that is very wholesome. Supplies of almost every nature are available; our buildings and equipment generally are well kept up; we have the most improved labor-saving machinery and in every way it looks a good place to live.

IN GREAT BRITAIN there are hopeful signs of a return to better conditions. With the great reaction from the self-sacrifice and coöperation demanded by the war there has been an outbreak of selfishness and disorder that is, perhaps, only the natural swing of the pendulum. A new idea of the value of labor-saving devices is one of the hopeful results of a scarcity of labor. Britishers formerly had little incentive to save labor because labor was not sufficiently costly to them. Now that they are obliged to pay a high price for labor they realize the advantage of American labor-saving machinery and the result is a desire to adopt our methods and equipment in order to give them an equal chance in the world's trade. This for the time being will result in a good business for American machinery

The labor unions of Great Britain have sometimes been opposed to labor-saving devices, but it now seems that even the most backward of these unions must realize that such machinery is essential for their own well being. Britain must always depend on trade with the outside world; therefore she must adopt some of the methods so highly developed in America. The public men of England are preaching the need of greater individual production, and they are being listened to now as they never were before.

In France and Belgium there is a great effort being made to renew the productive machinery. Many American firms have big contracts for replacing destroyed machinery. I saw many train loads of machine tools and other equipment on its way back to France and Belgium from Germany. I was interested to note that the occupied portions of Belgium were injured very little and the people were recovering quickly. Many of these people are now disclosing resources which the Germans

would have been glad to know about. The attitude of the Belgians toward their captors was naturally hostile and had rather a demoralizing effect from an ethical point of view.

The coal shortage was very marked and in Lens I saw something of the cause of this. The ruined mines there give a terrible impression of wanton destruction by the Germans. In that section alone there were 20 mines averaging about 1000 employees each, all ruined so they cannot produce coal for years to come.

In Germany I was impressed most of all with the purchasing power of an American dollar. Although their prices have been advanced in their own coinage, the rate of exchange was so favorable to the American dollar that the commodities actually appeared cheap to me. This purchasing power of the dollar is a great economic fact and will have its effect in the world's commerce.

Before arriving in Germany I had read many editorials and articles which might make one doubtful as to who won the war. In Germany, however, they know. From the highest to the lowest they realize that they have been defeated absolutely and completely. Of course, they will recover because they have a great capacity to work and all they need is something to work on. Their coal supply is very precarious. In fact, I was told that the best they could hope for is 30 per cent. of their normal needs.

This knowledge of defeat in Germany may be quite an influence in getting the people settled down to work again under peace conditions. They can attribute all the present troubles and high cost of living to this defeat and thus perhaps accept their lot more philosophically, whereas in the allied countries we may be subconsciously looking for the fruits of victory, and may be correspondingly irritated because there are none. We have no such "goat" on which to blame our troubles.

In connection with our efforts to expand our foreign trade and help the world get on its feet again we must remember that trade cannot always flow one way. For the past five years we have been sending commodities and receiving money or securities. We still have plenty of commodities to send, but under present conditions Europe has very little money to give us in return. If we would continue selling we must look about for opportunities of buying. France and England are beginning to realize that they must trade with Germany in order to get the indemnity imposed upon Germany. Our Ambassador in London, the Hon. John W. Davis, pointed out to me very forcibly that the commercial isolation of Germany is no more sound than the old idea of imprisonment for debt. It might be well for our merchants and manufacturers to think more along this line and see what we can do to establish a counter-current of trade that will build up all these European countries that have been unable to sell and have, therefore, nearly reached the limit of their buying capacity. For the good of the world the great currents of trade must be reëstablished in both directions.

With the return of machinery from Germany to France and Belgium, it is interesting to note that the commissions who have charge of this work found a remarkable collection of records. They found that every kind of equipment that was removed was carefully card catalogued, showing where it came from and where it went to. The owners of such machinery have been able to locate it without much difficulty, and it is being brought back to them. Some of it, of course, has been abused and badly worn, so that extensive repairs will be necessary.

My visit to Germany was mainly in the interest of the Norton Co., as one of its directors. We have had a plant at Wessling, near Cologne, since 1910, and were most interested to know what it looked like after the war. I found it about twice the size it was before the war and in good running order. Of course, it had a good deal of "ersatz" (the German word for substitute) such as paper belts instead of leather, etc. It was nevertheless turning out grinding wheels to the best of its ability with the poor quality of raw material available.

To offset the doubling of the plant, there was, of course, a corresponding debt, but it takes very little American money to pay off this debt. In fact, it is astonishing how much brick, mortar, and equipment we can buy with American dollars at this time. It seems to have been the policy of the Germans not to take over any such American-owned plants. We understood during the war that all plants had been "sequestered," but it was turned back to us, apparently on the theory that it was good business to have American capital remain invested in Germany.

In general I found the greatest interest in all such labor-saving machinery, both in machine shops and power plants. I believe we are going to see human labor valued and conserved as it never has been before in Europe.

A Tool for Measuring Angles

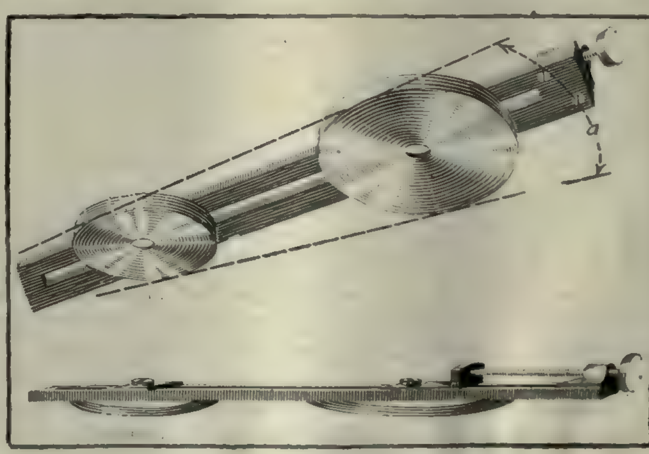
By Carl F. Mathisen

The instrument shown in the illustration can be used for laying out and measuring angles and if carefully made, with the measuring disks hardened, ground, and lapped, extreme accuracy may be obtained. It is more useful than the sine bar, as it can be used in cases that, with the latter, would be difficult or impossible. With four or five disks of various sizes almost any angle can be measured.

The setscrew is not absolutely necessary but conduces to the facility with which the tool may be set.

The principle is as follows: Let the diameter of the large disk be D; of the small disk, d; and the distance between their centers L. Then:

$$\text{Sin } \tfrac{1}{2}a = \frac{D - d}{2L}$$



TOOL FOR MEASURING ANGLES

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT NEWS
A weekly review of modern designs and equipment

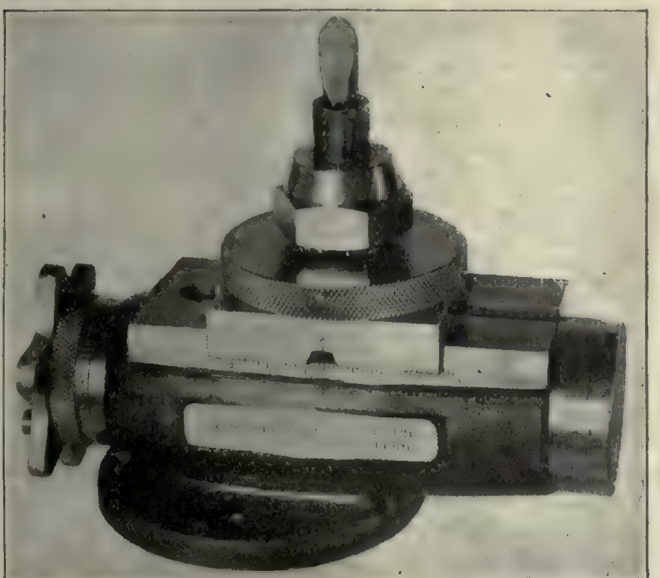
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

CONDENSED CLIPPING INDEX
A continuous record of modern designs and equipment

Ayre Micrometer Facing and Boring Machine

W. W. Ayre, 303 Fifth Ave., New York, is putting on the market a micrometer facing and boring head as illustrated herewith. This tool is intended for use on either a boring, milling, or drilling machine, or a turret lathe.

The cutting tool has a round shank and is held in a split chuck. The feed is by the usual star wheel and



AYRE MICROMETER FACING AND BORING HEAD

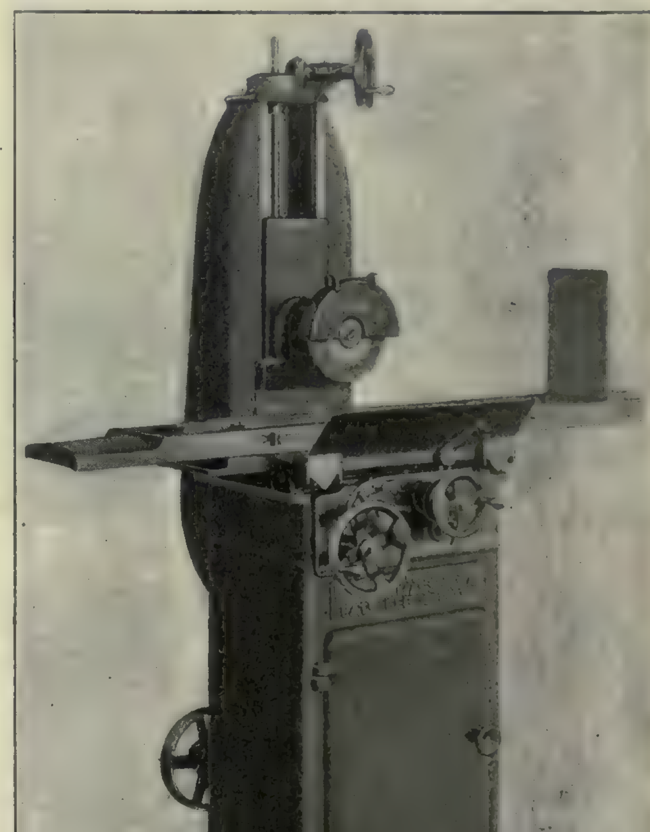
the screw is provided with a micrometer collar divided in thousandths of an inch. The main slide is graduated in inches and sixteenths and the amount the tool is off center can be seen by reference to the zero line on the tool block. The capacity for facing or boring is 6½ inches.

Reid No. 2 Surface Grinding Machine

The improved model No. 2 surface grinding machine manufactured by Reid Brothers Co., Inc., Beverly, Mass., has made its appearance in the market. The design shows that every precaution has been taken to prevent abrasive dust coming in contact with any wearing surface, a point that is prominent in the arrangement of the head.

The head is accurately fitted to the back column, its movement being controlled by the vertical screw.

It is, therefore, important that there should be no accumulation of dust and grit on the ways. As a protective measure in this respect the machine is equipped with a compact spring curtain to keep out dust and dirt. As a further prevention against flying grit, etc., guards at the side and end of the table are provided, and a substantial guard is also used to cover the wheel. The spindle is hardened, ground and lapped,



REID NO. 2 SURFACING GRINDING MACHINE

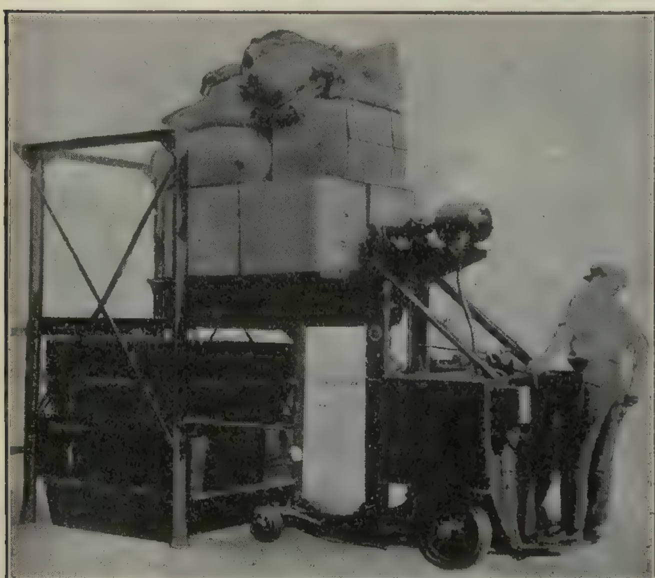
Specifications: Machine will grind work 18 in. long, 6 in. wide, and 11½ in. high. The table has three T-slots and is 46 x 8 in. in size; working surface, 18 x 6 in.; size of wheel, 7 x ½ in. with 1½-in. hole; countershaft, tight and loose, pulleys, 8 in. in diameter for 3-in. belt; speed, 360 r.p.m.; floor space of machine 65 x 30 in.; net weight, 1050 lb.; boxed for export, 1250 lb.; cubic feet of box, 48. Equipment furnished with machine; diamond-holder fixture, one wheel, wrenches and overhead works.

and runs in phosphor-bronze bearings adjustable for wear. Vertical adjustments are obtained by a handwheel graduated to one-half thousandth of an inch. The table travel is automatic in both directions, and is controlled by dogs operating against the reverse lever, which can be disengaged to permit movement of the table beyond the reversing point without changing dogs.

Quick starting and stopping of the longitudinal feed is accomplished by a centralized control in the handwheel shaft. The crossfeed is automatic in both directions, with a range of 0.007 in. to 0.084 in. feed at each reverse of the table. By a slight movement of an adjusting screw all the automatic crossfeed mechanism may be disengaged to permit the use of the hand feed.

Lakewood Tier-Lift Truck

The Lakewood Engineering Co., Cleveland, Ohio, has placed on the market a carrying and lifting truck as shown in the accompanying illustration. It is claimed for this truck that it will perform all the functions of a tiering machine as well as those of a load carrying truck.



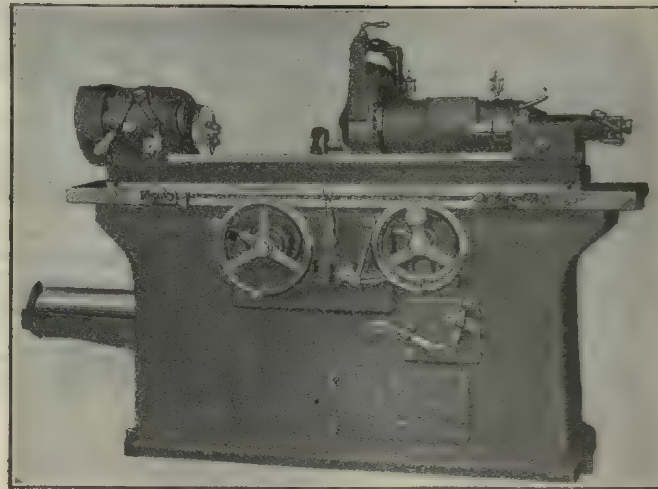
LAKEWOOD TIER-LIFT TRUCK

All four wheels are used in steering and it is said that the truck can turn in a radius of 92 in. The power is by storage batteries and motors, separate motors being used for traction and lifting. Three speeds, both forward and backward, are provided and the controller handle is conveniently located for travel in either direction. The lifting mechanism is operated by means of a specially designed controller providing for one speed in either direction. Ball bearings are used throughout. The capacity is two tons with a lift of 76 inches.

Fitchburg 8 x 36-In. Plain Cylindrical Grinding Machine

The Fitchburg Grinding Machine Co., Fitchburg, Mass., has placed on the market a line of plain cylindrical grinding machines, one size of which, the 8 x 36-in., is shown in the illustration.

The wheel spindle is made of tool steel and runs in bronze bearings, adjustment being provided for wear. The automatic crossfeed is operated at each reversal



FITCHBURG CYLINDRICAL GRINDING MACHINE

The specifications of the 4 x 36-in. machine are: Capacity, 8 in. diameter, 36 in. length; table will swivel 7 deg.; work centers, No. 4 Morse taper; wheel spindle, front bearing 3 x $7\frac{5}{8}$ in., rear bearing $2\frac{1}{2}$ x $6\frac{1}{2}$ in.; grinding-wheel pulley, 6 x $4\frac{3}{8}$ in.; grinding wheel, diameter 16 in., face 1 in. to 3 in., hole 5 in.; speeds, grinding wheel (2) 1400 to 1640 r.p.m., work (6) 64 to 340 r.p.m.; table feeds (6), 28 to 150 in. per minute; tight and loose pulleys on countershaft, 700 r.p.m.; floor space, right angle to spindle 52 in., parallel to spindle 115 in.; weight, net, 4600 pounds.

of the table and may be set to be self-releasing when the work has been ground to size. The table swivels on a central stud and can be set to grind tapers. The reversing mechanism is said to be positive and accurate. The coolant tank is cast in the bed and the pump is of the fan type. The work rest has fine adjustment and is provided with adjustable set collars for maintaining the size of the work.

The regular equipment includes a center grinding attachment and a wheel-truing device. This machine is built in six sizes ranging from 4x36 in. to 12x54 inches.

Statistics Show That Accidents Have Declined in the Steel Industries

The Bureau of Labor Statistics has completed a new study of the accident rates in the iron and steel industry, based particularly on a comparison of the five-year period before the war (1910-1914) and the war-time period (1915-1918).

Considering the unit as a whole, both the frequency and severity were less in the war period than in the pre-war period. A closer study of the figures reveals that the 1910 high-water mark was so much above any of the succeeding years that it alone was sufficient to account for much of the discrepancy. The frequency rate declined from 177.7 cases per thousand 300-day workers to 129.6 cases in the war period. The severity rate declined from 12.3 per worker to 10.9. In 1910 the figures covered 202,153 300-day workers of whom 3,273 were killed, 848 were permanently disabled—with an average disability per worker of 15.9 days.

In the first year of the war period, 1915, the total number of workers slumped to 116,224, with 87 deaths, 372 permanent disabilities and 13,481 temporary disabilities, and making a low-water mark of 119.9 disabilities per thousand workers and a disability record of 8.1 days lost per worker. In 1918 the industry had reached its high-water mark of employment, with 455,360 workers; 496 deaths; 1209 permanent disabilities and 52,896 temporary disabilities with a disability loss per worker of 10.6 days.—*Iron Age.*

Restriction of Trade in Patent Agreements

By E. H. Michaelis
Consulting Engineer

Under the above heading Chesla C. Sherlock writes an article in which he states that a patentee would find "the bottom dropping out of any elaborate system of selling and price fixing he may establish" because the Federal courts have taken a view of the rights of the patentee in regard to the setting of resale price and restricting the use of the patented machine or article, which would not stand, if taken into the Supreme Court.

This question is no doubt one of the most interesting in connection with the patent law, and therefore I take the liberty to call attention to the case "Dick versus Henry" which was taken to the Supreme Court of the United States. This case has probably occasioned more discussion at the bar, in the press and before Congressional committees than any other one. The decision of the court is set forth at such length, that it is impossible to quote it in full.

The action was taken by the A. B. Dick Co. as complainants for the infringement of two letters patent covering the rotary mimeograph.

All such machines were sold by the patentees under license which was attached to every machine and read as follows: "This machine is sold by the A. B. Dick Co. with the license restriction that it may be used only with the stencil, paper, ink and other supplies made by the A. B. Dick Co., Chicago, U. S. A."

Sidney Henry, the defendant, sold to an owner of a rotary mineograph some ink to be used in connection with this machine, knowing of the license restriction. This ink was not covered by the claims of the patent. The A. B. Dick Co. claimed that this was an infringement on their patent rights. The defendant contested this view, stating no patent law case but a general law case was in question, because the license restriction under which the owner of the machine bought it and by buying acknowledged as binding, was no part of the rights granted to the patentees by the letters patent issued to them.

The Court says in one place in its decision: "The books abound with cases upholding the right of a patentee owner of a machine to license another to use it subject to any qualification in respect to time, place, manner or purpose of use which the licensee agrees to accept. Any use in excess of the license would obviously be an infringement and the license would be no defense." Further on it says: "Is it true, that, where a patentee sells his patented machine for a specific and limited use, he does not thereby reserve to himself, as patentee, the exclusive right to all unpermitted uses, which may be made of his invention as embodied in the machine sold? Obviously, this is a question arising under patent law." And still further: "Of course the argument does not mean, that the effect of such condition is to cause things to become patented which were not so without the requirement (the license restriction). The stencil, the paper, and the ink made by the patentee will continue to be unpatented. Any one will be free to make, sell and use them and like articles as they would be without this restriction, save in one particular, namely they may not be sold to a user of one of the patentee's machines with intent, that they shall be used in violation of the license." The following quotation from the decision of the Court sets forth the main issue: "This larger right (the right to keep others entirely from using the patented article) embraces the lesser of permitting others to use upon such terms as the patentee chooses to prescribe."

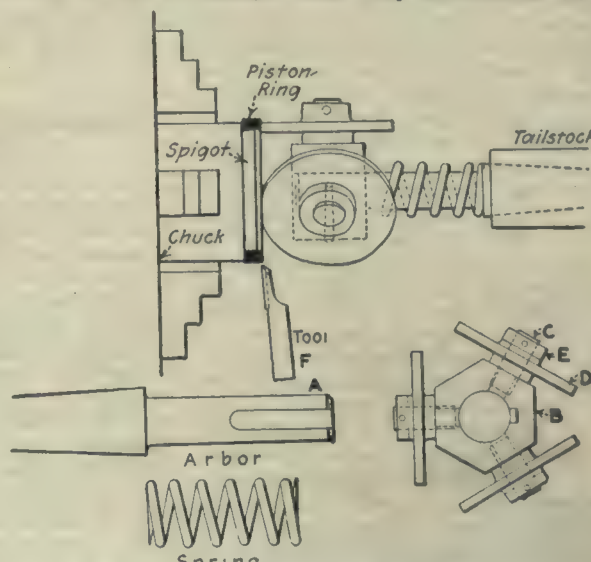
In conclusion I will mention that this decision of the Supreme Court was arrived at by a vote of six to three and that it was criticized very strongly in the press and at the bar. It stands, however, today as the law of the United States.

Holding Piston Rings for Sizing Them

By Stewart Reid
Brisbane, Australia

I have a small plant here in Brisbane for the manufacture of marine motors, wherein many difficulties have to be faced by reason of the lack of suitable equipment. The following is a description of a tool which we use to get the faces of piston rings parallel and of the right thickness, and, at the same time, leave a good finish.

After going through the usual operations of turning and boring, the rings are parted off, leaving from 0.005 to 0.012 in. for finishing. Then they are located on the



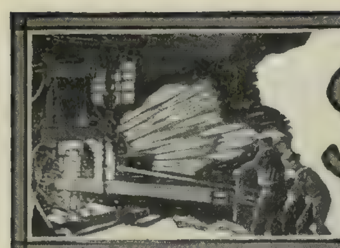
UNIQUE DEVICE FOR HOLDING PISTON RINGS IN THE LATHE

spigot, which is held in the lathe chuck and the tool is held in the tail spindle by which it is brought into contact with the side of the rings. A strong spring back of the body of the tool keeps the rollers pressing hard on the side of the ring during the cut.

The tool consists of an arbor *A*, one end of which is made to fit the tail spindle and the other end turned parallel to fit the body *B*, which latter is made out of any suitable piece of hexagon steel. A key between the body and the arbor prevents the tool from revolving. The body is drilled and tapped to take the pins *C*, upon which revolve the three disk rollers *D*. The rollers are held on by collars *E* which are held to the pins *C* by cotters.

After cleaning up one side of a lot of rings, the facing tool *F* is set to the right position to bring the rings to the required thickness, when the operation is finished.

I have found this tool a time saver, and at the same time we get interchangeable rings.



Sparks from the World's

By E. C. Porter,

Ten Phone Messages Go On Wire at Once

Experiments are being conducted by Major-General George O. Squier, chief signal officer of the army, and other experts which will prove the commercial practicability of sending ten or more messages simultaneously along one telephone wire for exceedingly long distances.

Tests on the method were made by Major-General Squier last year between Baltimore and Washington, and the American Telephone and Telegraph Co. had engineers working last May on a line between Baltimore and Pittsburgh. Experiments also have been made on the same line by Dr. Lee De Forest, inventor of the Audion bulb, between Toronto and Hamilton, Canada.

Briefly, the method of transmission consists of passing a direct current modulated by a microphone through an Audion detecter, which transforms it into a high frequency current which may have 1,000,000 or more cycles a second. This current then will follow a wire, not actually passing through it, but traveling in the direction of the wire through the ether. It is possible for ten and probably many more currents to use the same wire at the same time as their guide, and the distance they may travel in this way is said to be practically unlimited. The expense of ordinary telephony between New York and San Francisco is heavy because only one conversation may be carried on over the wire, but under the new system this one circuit will be available for a number of other conversations without interfering with the ordinary method of telephoning.

National Efficiency Society Appoints Executive Secretary

The National Efficiency Society at the meeting of its board of governors held on Tuesday, Dec. 23, appointed H. F. J. Porter its executive secretary. Mr. Porter was the founder and executive secretary of the Efficiency Society in 1912 and resigned in 1914 to return to his industrial engineering practice. In 1918 the Efficiency Society and the National Institute of Efficiency united under the name of the National Efficiency Society with headquarters at 119 West 40th St., New York.

The society believes that the recent movement toward closer co-operation between employer and employee in industry, through shop committees on which the employee is represented in the management, is the logical step toward higher productive efficiency in industry now so desperately needed, and has turned to the pioneer in this movement, Mr. Porter, who first introduced a shop committee in this country in 1903 and who has been identified with the movement ever since.

In the *American Machinist* for Sept. 28, 1905, Mr. Porter described fully in an article entitled "The 'Get-Together' Principle in a Factory Organization," the establishment of his first shop committee in the plant of the Nernst Lamp Co., a Westinghouse interest in Pittsburgh, Pa.

This was the beginning of a movement which now promises to be the leading one in establishing better relations between the antagonistic elements in the industrial field.

Acknowledgment of Season's Greetings

The *American Machinist* takes this means of acknowledging the receipt of Christmas cards from the following concerns, and extends to them its heartiest wishes for continued prosperity during the new year: Bullard Machine Tool Co., Moline Tool Co., Morse Chain Co., Hudson Motor Car Co., Cincinnati Planer Co., Henry & Wright Manufacturing Co., Cochrane-Bly Co., La Salle Tool Co., Chas. A. Schieren Co., Allied Machinery Co. of America, Seneca Falls Manufacturing Co. Inc., Norma Co. of America, E. Isbecque & Co., K-G Welding and Cutting Co. Inc., Wicaco Screw and Machine Works Inc., Chas. A. Strelinger Co., Union Twist Drill Co., Heald Machine Co., R. S. Stokvis & Zonen, Ltd.

New Officers for the Western Society of Engineers

The nominating committee appointed by the Western Society of Engineers has nominated the following men to serve as officers for the ensuing year: President, F. K. Copeland; first vice president, C. F. W. Felt; second vice president, J. L. Hecht; third vice president, Linn White; treasurer, S. F. Fowle; trustee for three years, J. H. Libberton.

The Western Society of Engineers has just finished an extensive campaign for new members which has resulted in increasing the membership 175 per cent or approximately 2,100 new members. The purpose of this membership campaign has been to build up a strong engineering society in the West which would be of sufficient strength to be of national importance.

Society of Automotive Engineers To Hold Annual Meeting

The annual meeting of the Society of Automotive Engineers, Inc., will be held in the Auditorium, Engineering Societies Building, 29 West 39th St., New York City, on Jan. 6 to 8, 1920.

On Jan. 6 the fifteen divisions of the standards committee will present reports of their recommendations for discussion and acceptance. The business session will begin at 10 a.m. on Jan. 7, and will be followed at 11:30 by a symposium on Needs and Tendencies of Engine Design; luncheon at 1 p.m. Beginning at 2 p.m. a number of papers will be presented on the subjects of Aluminum Pistons, Automotive Steam System, Automobile Body Design, Springs and Spring Suspensions, and the Measurement of Vehicle Vibrations. A carnival will be held in the North Ballroom, Hotel Astor, at 9 o'clock.

The Fuel and Research session will be held on Jan. 8 in the morning and afternoon with intermission for luncheon at 1 p.m. The 1920 S. A. E. dinner will be held in the Grand Ballroom of the Hotel Astor at 9 o'clock.

All-Electric Steel Mill to Be Constructed in Ohio

A company to operate the first all-electric steel mill in the country, construction of which is to be begun in February on a site between Girard and Warren, Youngstown, Ohio, has been incorporated at $1,500,000. L. J. Campbell, vice president of the Youngstown Sheet and Tube Co., has resigned to take charge of the new mill.

The plant, which is to be the base of a larger plant later, will have two electric smelters and 10- and 16-in. rolling mills. It will make the finer grades of steel, vanadium, chrome and nickel steel for use in automobile parts, locomotive parts and cutlery. It will employ 500 men at the start.

Firth-Sterling Steel Company Moves to New Quarters

The New England headquarters of the Firth-Sterling Steel Co., which has been located at 35 Oliver St., Boston, Mass., for a great many years, will move during January into its new warehouse at 85-91 West First St., South Boston, where a stock of blue chip, high-speed tool and die steels will be carried. The property being vacated by the Firth-Sterling Co. has been purchased by the Federal Reserve Bank as a site for its building.

Industrial Forge

News Editor

Directions for Boxing Machine Tools for Export Shipment

These directions for boxing machinery apply to orders placed by Construction Metallique, Belgium, for shipment to Antwerp.

They are intended to cover the subject in a general way only, and no attempt has been made to specify the form or overall dimensions of the frame of any case or the number or location of blocking pieces or stay braces between parts of machine or between the inclosing case and the machine proper which will be required to prevent movement of the machine or its parts within the completed case.

Well-Seasoned Lumber Must Be Used for Packing

The lumber for cases and skids must be well-seasoned spruce, or yellow pine, sound and free from large, loose or rotten knots, or any other defects that would impair it for the service intended; merchantable grade lumber will be satisfactory. Lumber for bottoms, tops, sides and ends must be tongued and grooved 1½-in. stock, except as otherwise stated.

Where the base of the machine or the machine itself does not exceed 450 to 500 lb. in weight, the floor of the case may be made of 1½-in. stock lumber; where the base of the machine or the machine itself exceeds 450 to 500 lb. in weight, the floor of the case is to be made of 2-in. stock lumber.

Two or more skids composed of 2 x 3-in. or 3 x 4-in. lumber must be supplied whenever the gross weight of the case and contents exceed 350 lb., and must be formed at each end so as to permit of easy moving on pipe rollers. Heavier skids must be supplied according to variance in weight.

Framing lumber 1½ x 3 in. or 2½ x 4 in. must be used in the interior of the case where the sides and ends join the floor; similarly where the ends join the sides, and where the top joins the sides and ends. This will be required only where the base of machine exceeds 500 lb. in weight; where the base of the machine does not exceed 500 lb. in weight, these framing or strengthening members will be of dimensions equal to the thickness of the lumber of the case proper.

When making up the frames for cases proper consideration must be given to the methods likely to be followed in hoisting the cases aboard cars and especially aboard the steamer. A matter that must not be overlooked, however, is the requirements of a rail shipment to tide-water, and the handling aboard the steamer, which will control the outside dimensions of any individual case.

The completed case must show close-fitting joints and be free from any projecting parts. All cases must be lined with "Keep Dry" brand of paper. After fully closed in, the entire case is to be well strapped with heavy box iron or strap iron; this must be done in such a manner that no board may become shattered or loosened at the end through rough handling while in transit.

Machines are to be shipped fully assembled, so far as it is practical to do so; however, all parts must be in a locked position, so that no matter how much the case is caused to oscillate while in transit aboard the steamer, no parts can work loose or suffer injury by movements within the case. Such parts as cannot be assembled with the machine must either be bolted fast to the sides or floor of the case, or inclosed in a smaller case strongly made. All machine parts must be held in position by means of blocking or braces securely fastened, and by using excelsior as a filler, such box or boxes must be bolted fast to the case. Whenever possible, each case is to contain one complete machine, including all regular equipment and with such other parts or supplies as is called for by the order or contract. Whenever possible, the machine must be bolted to the floor of the case, using machine bolts with extra nuts and plate washers underneath the floor.

Paint Finished Surfaces With Oil

All bright and finished surfaces are to be well painted with linseed oil and white lead paint, or anti-rust compound, or some other good protective compound which will be resistant to the corroding effects of salt air and salt water. Care should be exercised to use slushing oils which are free from acid.

It is the intention of these specifications to secure perfect delivery of machine tools and parts at final destination in Europe and so assembled that a minimum amount of time will be required to place the same in position and operation. Transportation conditions may be abnormal both as regards exposure to outdoor weather conditions and hauling during transportation; cases may not only have to protect contents within, but may have to support other cases piled many feet deep on top; the cases are likely to be placed in any position, such as on end, or upside down. All these conditions at their worst must be considered and guarded against in boxing machines.

Business Conditions in England

By Our English Correspondent

London, Nov. 21, 1919.

The decision of the British government to discontinue the unemployment donations to civilian men and women may, if persisted in, have a large influence on the industrial life of the country. While the donations will be continued for a while to ex-service men and women at the rate of 20s. a week for the former and 15s. a week for the latter (after a year at the higher rate), the dole to unemployed civilians is to be stopped immediately.

The latest figures show that at the middle of November the ex-service class to the number of 344,000 received out-of-work donations with 101,000 civilian men and about 34,000 civilian women. Included are some 40,000 men who were out of employment as the result of the molders' strike, the actual number of strikers being 95,000. An unemployment insurance scheme is expected from the government, but at the time of writing, at any rate, no bill has been introduced. Of course, certain trades, including the engineering trades, are already insured on a contributory system; in fact, the number of persons in occupations at present thus insured has been put at about 3½ to 3¾ million, out of a total approaching 14 million of insurable persons.

Great Britain has a scheme by which firms voluntarily undertake to employ men disabled in the war to the extent of 5 per cent. of their total force, the names of these firms being placed eventually on a roll of honor. The scheme is largely due to H. Rothband and the parliamentary committee concerned bears his name. At a recent meeting of the Ministry of Labor it was stated, according to an official communication, that some 7000 firms had completed plans, giving employment to nearly 70,000 disabled men, though vacancies were still being sought for 40,000 more. The government departments will absorb more than the 5 per cent. and up to the present about 170 public bodies have joined in the scheme. A proposal has been made that government contracts should be limited to the firms whose names appear on the roll. To bring this into force, however, a resolution of the House of Commons will be necessary, but it was intimated that the suggestion is being kept in mind.

The Ministry of Munitions and the Board of Admiralty have lately revoked orders under which establishments were declared to be controlled by them under certain sections of the Munitions of War Act of 1915, and the Amendment

Act of 1916. Firms thus decontrolled have been advised, not officially of course, to consider the effect of control on their working, and in particular to look into any loss of goodwill through loss of pre-war trade, allowances for extensions of various kinds, remuneration of directors and managers, outstanding claims, and liquidation of government contracts. In fact, a committee of controlled establishments exists to deal with such matters, and this committee will continue in being until the middle of 1920.

In the engineering world the throttling effect of the iron founders' strike becomes more and more apparent and throughout the country many firms are working short time and some are closing down, owing to want of castings. There is a faint hope that, before this matter can be published, the strike may be settled.

At the recent arbitration the engineering work people, who put in for a 15s. rise, were granted 5s. a week. The claim was at the same rate as that which the iron founders put forward, and there is just the possibility of the employing side making an offer of 5s. a week, and of the workmen accepting this offer; on the other hand, some indications suggest that nothing less than the granting of the original demand will be satisfactory. The strike, in fact, has spread. Originally confined to England, it is now being made operative over Scotland as well and men in English railway shops who belong to the railway men's union—not the iron founders'—have also been called out. Even when a satisfactory settlement has been reached it will be at least four or five weeks before engineering itself can resume at ordinary speed.

Workmen as a Body Not Producing

It cannot be said that workmen as a body are producing as much as previous to the war, though there are some exceptions; the writer heard of a ball-bearing factory which actually had increased the hourly output. Inquiries have suggested that in engineering, shipbuilding, coal mining and building, this lowering of activity is most pronounced. To it also is due some at least of the congestion and generally retarded services on the railways. The blame for low production is not always put on the work people. Misgivings are being expressed regarding organization and general direction and control in the shops.

For some time machine-tool firms have had no difficulty in filling their order books, their trouble of course having been to produce. Most firms, owing to lack of raw material and skilled labor, are quite unable to increase their output, and practically all in England are on short time, if not closed down, owing to the molders' strike. Toolmaking firms looking after the requirements of shipyard and marine-engine establishments are in a particularly happy position; they simply do not want anything likely to increase present inquiries—more work offers than can be coped with. The high prices obtainable for ships mean that the shipyards, etc., do not trouble greatly about the prices of any new tools they may be buying.

The effect of increasing costs of material and rising wages in industry was brought sharply to the notice of Londoners by the cessation from the London streets of the omnibuses of the National Steam Car Co., which is shutting down. The directors attended a select committee of the House of Commons and showed that paraffin (the fuel employed) had risen from 3¾d. a gallon in 1914 to 1s. 4d. now. Similarly, in less than a year increases of wages, awarded after inquiry as to cost of living, amounted to about £40,000 a year, based, it is stated, on a mileage of about 5,000,000, and a recent award of 4s. a week to certain employees meant a further £6,250 per annum. Allowing for depreciation at ¾d. a mile, the average daily loss from the beginning of November of this year was £356. The company is relatively small, operating about 133 buses, and, including the works at Chelmsford, the total number of workers and staff concerned in the stoppage is about 1100.

Olympia Motor Show

The Motor Show at Olympia, London, W., was attended during the 8 days by some 280,000 people. The show has never been a good place for the study of engineering details and this year the visitor simply went round with the crowd. A score of new firms made their appearance, but the chief sensation was caused by the sudden increase in price of two of the more-or-less mass-production organizations, the price increase being of the order of 20 per cent. All round, despite heavy taxation and high costs of all kinds, the rule is to spend. Probably at no motor-car show held in Great Britain have so many orders been offered as at the last.

The armament firms of Great Britain have necessarily revised their programs in an extremely radical manner, and this is particularly evident of Armstrong, Whitworth & Co., Ltd. At Scotswood, near Newcastle, the firm had shops which during the war produced 14½ millions of shells of all sizes, up to projectiles weighing more than a ton. These shops have now been entirely rearranged, reëquipped and reorganized for the production of locomotives, and the completion of the first main-line locomotive was the occasion of a banquet and a demonstration of the engine on Nov. 12, just a year after the armistice was signed. For the purpose of the gathering the engine was driven a short distance by Sir V. L. Raven, chief mechanical engineer of the Northeastern Railway for which the locomotive had been built. These new locomotive works are described as the largest in the British Empire; in fact, it has been claimed that before long they will be the largest self-contained locomotive works in the world. At Manchester, too, evidence of the changy times has been provided by the same firm. The sections of their works which were formerly producing mainly 8-in. howitzers and 18-pdr. guns are now devoted to machine-tool production, while a large shell shop has been given up to small-tool production—mainly milling cutters and reamers, twist drills, screwing apparatus, gages of all kinds, and special tools. Taking twist drills only, the range produced is from 0.05 in. up to 3 in., with corresponding metric sizes, and the weekly capacity of the plant is say 10,000 drills of average size. Generally, carbon-steel drills are not made above ⅛ in. in diameter nor high-speed steel drills below. The drills have a uniform taper in diameter of 0.0005 in. per inch length of flute, and the limits for diameters have been given as follows: up to ½ in. +0 −0.0008 in., above ½ in. and up to 1 in. +0 −0.0012 in., above 1 in. up to 2 in. +0 −0.002 in., and for sizes beyond, +0 −0.003 in. The output of the crucible steel department, which is almost adjoining, is about 2000 tons of high-speed steel per annum.

The Sunderland gear planing machines as produced by J. Parkinson & Son, Shipley, are already well known to American readers of this journal. The range of machines available has lately been increased. Up to the present they have been in sizes which at the upper limit will produce spur gears of 8 ft. 6 in. in diameter by 10½-in. face by 1¼ diametral pitch or 2½-in. circular pitch. A steel well, for example, with 80 teeth of 2½-in. circular pitch and 6-in. face has been cut in 18 hours. Now, to meet the requirements of the automobile industry and generally of the lighter branches of mechanical engineering, a machine is being manufactured to produce gears of practically any diameter up to 12 in. by 4-in. face and 5 diametral pitch or 5 module or ⅝-in. circular pitch. This machine has a double cutter box. With four wheels mounted in pairs, spur gears of cast iron, 58 teeth, 2-in. face, 5 d.p. have been cut in one hour; that is, an average of 15 min. for each wheel. Similarly, spiral gears of phosphor-bronze with two wheels mounted at once, one cutter used, the wheels being of 6⅝ in. in diameter, 28 teeth, ¾-in. face, 12 d.p. normal pitch and 60 deg. spiral, have been cut at the rate of 40 min. for each wheel. Spurs of special gear steel with 30 teeth, 7 diametral pitch, 1 in. face, cut twice round for good finish, four blanks being mounted at a time and two cutters used, take 6 min. for each wheel.

Government Passes Anti-Dumping Bill

The government has passed its anti-dumping bill, and it proves to be in certain respects more drastic than had been anticipated. While British manufacturers were to be protected from the competition of goods produced abroad and sold in the United Kingdom below the actual cost of production, these being the terms of the election manifesto by the heads of the prevailing coalition, the attempt is now sought to prevent foreign-produced goods being dealt with in Great Britain at selling prices below those prevailing in the country of origin.

Condensed-Clipping Index of Equipment

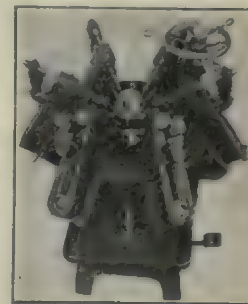
Patented Aug. 20 1918

Drilling Machines, Crankshaft Oil Holes
The Langelier Manufacturing Co., Providence, R. I.
"American Machinist," Sept. 25, 1919.

For drilling simultaneously $\frac{1}{4}$-in. oil holes in crankshafts. Drilling speed, 1800 r.p.m.; drilling lubricant supplied by rotary pump; lubricant filtered after using; Jacobs chucks hold drills; capacity of machine, 12 crankshafts per hour.

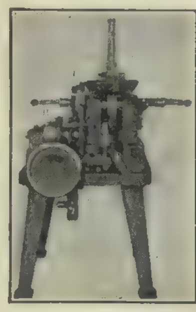
Drilling Machines, Piston Oil-Holes
The Langelier Manufacturing Co., Providence, R. I.
"American Machinist," Sept. 25, 1919.

Drills simultaneously all oil holes in trunk piston. Has six two-spindle driving units each with a $\frac{1}{2}$-hp. motor. Drills spindles inclined at an angle of 30 deg. to the horizontal. Machine has pump, tank and strainer, and a capacity of three pistons per minute.

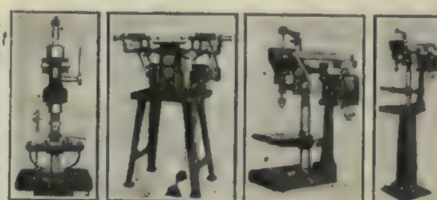


Drilling Machines, Commutator Brush Connection
The Langelier Manufacturing Co., Providence, R. I.
"American Machinist," Sept. 25, 1919.

Two-spindle automatic drilling machine for drilling holes in the flexible connection through copper commutator brush. Work is fed through vertical magazine. Drill spindles driven by two 1-in. belts at 3200 r.p.m.; drive shaft driven at 600 r.p.m. by 3-in. belt.



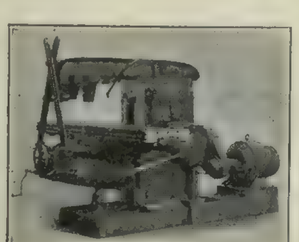
Drilling Machines
Langelier Manufacturing Co., Providence, R. I.
"American Machinist," Sept. 25, 1919.



At the left—Multiple-spindle, sensitive drill for drilling phonograph gear; vertical table adjustment; screw chuck, and forced lubrication. In the center—a two-spindle horizontal machine for drilling typewriter parts; has a motor drive and both foot and hand feed. The two at the right—standard bench drills equipped with vertical motor drives; furnished with or without pedestal.

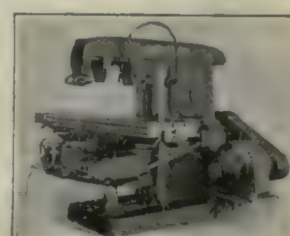
Milling Machine
Cincinnati Milling Machine Co., Cincinnati, Ohio
"American Machinist," Sept. 25, 1919.

Size No. 4 plain; table, 68 x 19 in. with $\frac{5}{8}$-in. T-slots; power quick traverse; drive pulley, 16 in.; belt, 5 in.; horsepower of motor, 15; taper hole in spindle, No. 14 B. & S.; hole through spindle, $1\frac{1}{4}$ in.; floor space, 105 x 130 in.; net weight belt drive, 8900 lb.; belted motor drive, without motor, 9200 lb.; geared motor drive, without motor, 9600 lb.



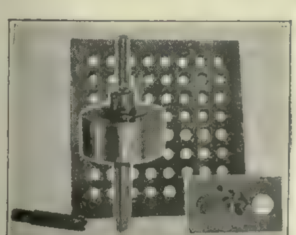
Milling Machines
Cincinnati Milling Machine Co., Cincinnati, Ohio
"American Machinist," Sept. 25, 1919.

Size No. 4 universal; table 68 x 19 in. with $\frac{5}{8}$-in. T-slots; power quick traverse; drive pulley, 16 in.; belt, 5 in.; horsepower of motor, 15; taper hole in spindle, No. 14 B. & S.; hole through spindle, $1\frac{1}{4}$ in.; floor space, 105 x 130 in.; net weight belt drive, 9600 lb.; belted motor drive, without motor, 9900 lb.; geared motor drive, without motor, 10,300 lb.



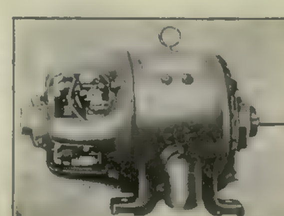
Drilling Device, Square- or Hexagon-Hole
The Watts Bros. Tool Works, Turtle Creek, Penn.
"American Machinist," Sept. 25, 1919.

The equipment consists of floating type chuck, a special drill and guide plate, and is intended for use in ordinary drilling machine or lathe and recommended for work that cannot be broached. The tool is an end cutter and works similar to an end mill. The guide plate is clamped to the work and acts as a jig, the floating chuck permitting necessary lateral motion of the tool when cutting. The device is limited to depths of two and a half to three times the diameter of the hole. It is furnished in four sizes with capacities ranging from $\frac{3}{4}$- to $1\frac{1}{2}$-in. holes.



Direct-Current Motors
The Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
"American Machinist," Sept. 25, 1919

A line of commutating-pole direct-current motors designated as the Allis-Chalmers type E; the ratings and speeds of the constant speed motors are identical to those of 60-cycle induction motors. The adjustable-speed motors have a speed range of two to one, three to one, or four to one; motors are from $\frac{1}{2}$ to 50 hp. and furnished as open type, semi-inclosed or totally inclosed.



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Coal Production Reaches 10,413,000 Tons for Week

The weekly report on coal production compiled by the Geological Survey shows that the output for the week ended Dec. 20 reached 86.4 per cent of the average in the month before the strike was called. The total coal mined amounted to 10,431,000 tons as compared with a weekly average in October of 12,089,000 tons, which was an unusually high average.

Personals

B. M. BLACKWELL, recently head of the steel foundry of the Hart-Parr Co., Charles City, Iowa, has been appointed head of the steel foundry and pattern shop of the McDougall-Duluth Co., Duluth, Minn.

L. R. MEISENHALTER, of Philadelphia, has accepted the position of special representative of the Houston, Stanwood & Gamble Co., Cincinnati, Ohio. Mr. Meisenhalter has disposed of his interests in the L. R. Meisenhalter Machinery Co.

A. W. FITZPATRICK, for several years in charge of the service department of the Hart-Parr Co., Charles City, Iowa, has been appointed manager of its new tractor educational department. Mr. Fitzpatrick will be assisted by George Brochmeyer.

DAVID L. JULIAN, formerly connected with the E. J. Manville Machine Co., Waterbury, Conn., but for the past year and a half with the Columbus Bolt Works, Columbus, Ohio, is returning to the first-named company to accept a position as assistant superintendent.

Trade Catalogs

Thor Pneumatic Tools. Independent Tool Co., 600 West Jackson Blvd., Chicago, Ill. An illustrated circular of its pneumatic tools; specifications also included.

Pressure Volume and Indicator and Pitot Tubes. Bacharach Industrial Instrument Co., 422 First Ave., Pittsburgh, Pa. Pamphlet P summarizes the company's experience in the field of pitot tubes and orifices; pamphlet F describes a new pressure volume indicator suitable for either permanent installations or testing purposes.

Precision Heatmeter. The Brown Instrument Co., Philadelphia, Pa. This bulletin describes a new instrument for adjusting a millivoltmeter for any charge in resistance of the circuit of thermocouple leads and instrument.

Gisholt Machines. Gisholt Machine Co., Madison, Wis. A single folder briefly describing and illustrating the company's various machines.

Production and Inspection Tools. Taft-Peirce Manufacturing Co., Woonsocket, R. I. Bulletin No. 110, pp. 23, 10½ x 8 in. This is devoted to Taft-Peirce production and inspection tools. Thread, plug and special cutters are described in another bulletin which may be had upon request.

Optical Pyrometer. The Leeds and Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Catalog No. 86-B, pp. 28, 10½ x 7¾ in. A complete description is given of the construction, practical applications and physical theory of the optical pyrometer.

Condensite. Condensite Company of America, Bloomfield, N. J. This bulletin describes condensite, its properties, how it is molded, designed and also how to specify it.

Colonel A. L. Lamar has been designated by the Director of Sales to take direct charge of the execution of the contract with the French government for 25,000 machine tools. It was Colonel Lamar who engineered the sale to the Belgians of $5,000,000 worth of the War Department's surplus machinery.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A former machinery manufacturer in Hungary desires to secure an agency for the sale in Hungary and Balkan States of machine manufactures. Ref. No. 31,342.

An American firm in Poland, which is planning to erect a machine shop, desires to secure an agency, purchasing goods outright, for the sale of machine tools, agricultural machinery, machinists' tools, and electrical equipment. Quotations should be given f.o.b. New York. Payment, cash. Reference. Catalogs and price lists are requested. Ref. No. 31,346.

An American concern which is soon to install machine shops in Russia desires to secure an agency for the sale in southern Russia of machine tools and overhead equipment for machine shops. Ref. No. 31,331.

The purchase is desired by a manufacturer in Belgium, whose factory was looted during the war, of lathes, shears, forging presses for bolts and nuts, bolt-cleaning machines, and screw-cutting lathes for belts and nuts. Reference. Catalogs and price lists are requested. Ref. No. 31,341.

An engineer in Italy desires to secure the agency for the sale of agricultural and industrial machinery, metals, etc. Correspondence should be in Italian or French. References. Ref. No. 31,330.

An engineer in Belgium desires to secure the exclusive agency for the sale of machine tools, material for electrical tramways, and for steel construction. Quotations should be given c.i.f. Antwerp. Terms, credit of 90 days. Correspondence may be in English. Reference. Ref. No. 31,547.

A company in Denmark desires to secure an agency for the sale of pig iron metals, especially steel, tool steel, machine tools, mining machinery and leather. Quotations should be given c.i.f. Swedish port. Correspondence may be in English. Ref. No. 31,385.

Representative is desired by a business man in France for the sale of machinery. Correspondence should be in French. Ref. No. 31,493.

War Contracts Liquidated by the War Department

War contracts liquidated by the War Department up to Dec. 6 totaled 18,233 formal contracts valued at $1,224,555,000 and 4,723 informal agreements valued at $924,919,999. It has cost $257,494,000 to liquidate these contracts.

There are 4,775 contracts remaining to be liquidated. Of these the value of 3,377 is known and amounts to $1,720,029,000.

Business Items

H. W. Johns-Manville Co. has announced the removal of its Des Moines office to 213 Ninth St.

The National Clutch Co., Inc., Irvington-on-Hudson, N. Y., has changed its name to the National Ignition Co., Inc.; no other changes have been made in its personnel.

The Hyatt Roller Bearing Co., New York City, has announced the opening of a western branch office which will be located at 309 Marshall Building, Cleveland, Ohio.

Catalogs Wanted

The Bridgeport Drafting and Engineering Co., 400 Warner Building, Bridgeport, Conn., has installed a catalog filing system, and would like to hear from concerns handling tool, shop equipment,, structural steel and sheet-metal work.

Forthcoming Meetings

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The motor-truck sections of the 20th Annual Automobile Shows of 1920 will hold an exhibition in the 8th Coast Artillery Armory, New York, Jan. 3 to 10, 1920, and in the International Amphitheatre, Chicago, Ill., Jan. 24 to 31, 1920.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Society of Automotive Engineers will hold its annual meeting in New York on Jan. 6 to 8, inclusive. For further information of program, address the meeting committee, 239 West 39th St.

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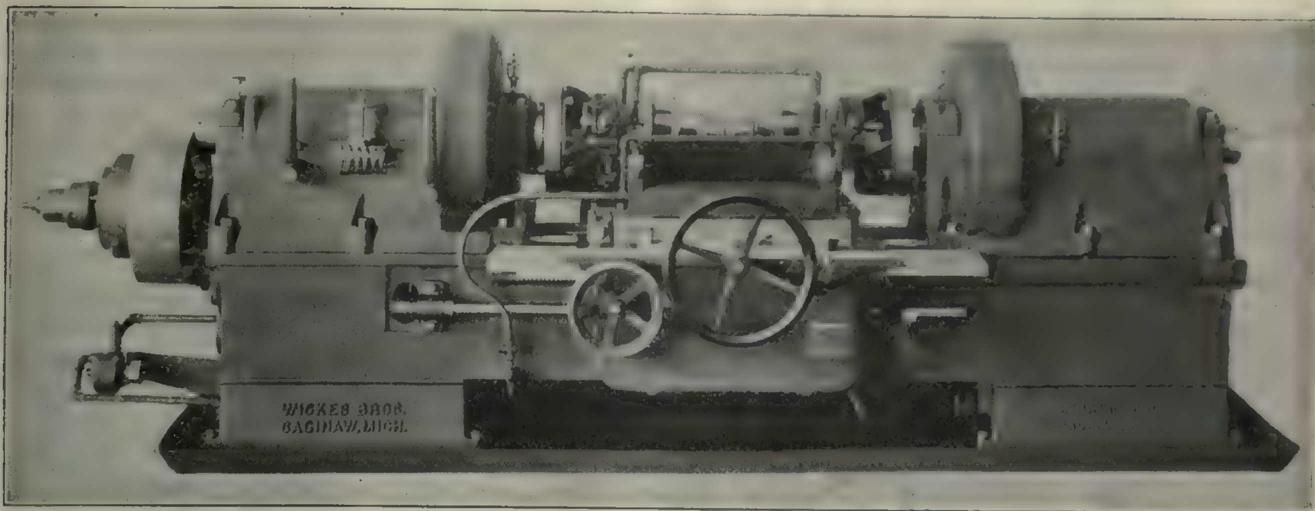


The Wickes Crankshaft Lathes

By J. V. HUNTER
Western Editor, *American Machinist*

Manufacturers of machine tools are vieing with each other in bringing out tools for increasing production, especially in the automotive field. In this article two tools designed for the high production of crankshafts are described and also illustrated.

A LATE addition to the many high-production machines being put on the market is a crankshaft lathe built by Wickes Bros., Saginaw, Mich. It is the purpose of this machine to expedite the work of turning crankshafts, whether they have one or a dozen throws. However, it goes further than this and can be readily adapted to facing off the cheeks of the webs. The machine is built in two standard types — one known as the "Duplex" for turning two pins simultaneously, and the other, the "Universal," for turning only one pin at a time. The advantage of the universal over the duplex machine exists only when the production requires 60 or less crankshafts per day, this representing its average daily capacity on six-throw crankshafts. For greater capacity it is advisable to use the duplex machine and install a sufficient number to care for the production requirements of the plant. As machines of this type are tooled for turning two specific pins it is advisable to install them either in units of two for a four-throw crankshaft, or three for a six-throw shaft. Aside from the pot-chucks and the tooling, these two machines are practically identical.

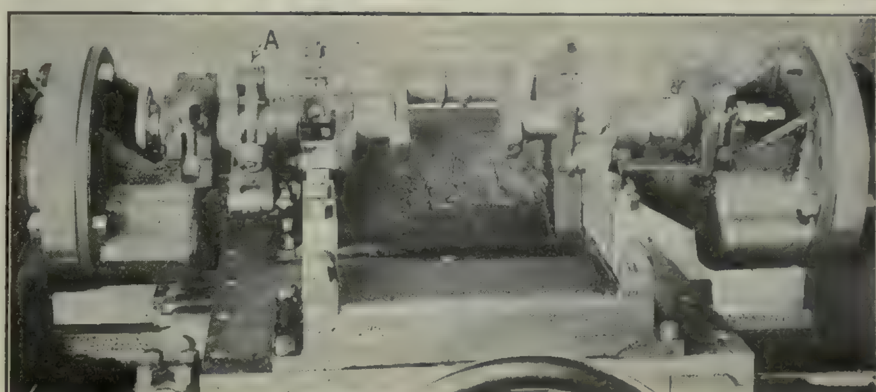


FIG. 1. TOOL SET-UP ON DUPLEX LATHE

The duplex machine is built with double-end drive to minimize the "lag" or torsional deflection which results from driving entirely from one end. With single-end drive this "lag" begins to show its effect after the first pin has been turned and will usually increase with each successive pin turned until the center is reached, after which the "lag" will decrease.

The shaft is not carried on centers but by substantial bearings in the pot-chucks. The duplex machine as shown in the headpiece is tooled for turning pins Nos. 1 and 6, while Fig. 1 is a close-up view of the tooling for pins Nos. 2 and 5. The tool carriage of the duplex machine consists of a double pair of toolposts, each pair situated in line with the pin they are to turn and spaced from 6 to 7 in. apart so as to allow room for inserting and removing the work. A broad-nose tool is carried in each front post and is of sufficient width to turn the full lengths of the pins, with the exception of about $\frac{1}{4}$ in. on each end in addition to the small portion devoted to the fillet. This portion together with the two end fillets is turned by a double tool carried in the rear toolpost.

The machine is fitted with an electrically operated rapid cross-traverse on the carriage which traverses the tools at a speed of 1 in. per second. This movement is claimed to be fool-proof, as the operating switch automatically opens upon removal of the operator's hand.

In operation on a six-throw crank, for example, it is customary to turn first the two bearings, styled Nos.

1 and 6, one of which is afterward used as an index of angular position in turning the remaining four bearings. The indexing is accomplished by a clamp on one of the pot-chucks, lined with hardened-steel pads, which grips the finished No. 1 pin at *A*, Fig. 1, and secures the proper angular position of pins Nos. 2 and 5. When finishing the Nos. 3 and 4 pins, the shaft is held at the inner line-bearings by clamps and angular position given to pins Nos. 3 and 4 by a clamp holding the No. 1 pin.

For feeding the tools into the cut the tool block is provided with power-traverse feed, but in practice the operators find they can work faster with hand feed. After finishing the cut with the front tools the rear the carriage reaches a stop at the end of the cut on each successive pin, the rear tool is in correct position to be brought forward to finish the fillets. The pot-chucks for holding the shaft are fitted to revolve on the faceplates and have pins for indexing in three different positions.

The duplex and universal machines are sold fully equipped for the job. The spindles are high-carbon steel forgings and run in bronze bearings. They are provided with ball-thrust collars and are driven by large herringbone gears. The spur gears in the headstock are of 3½ per cent. nickel, heat-treated steel. The main drive shaft is of the same material, turned and ground to size.

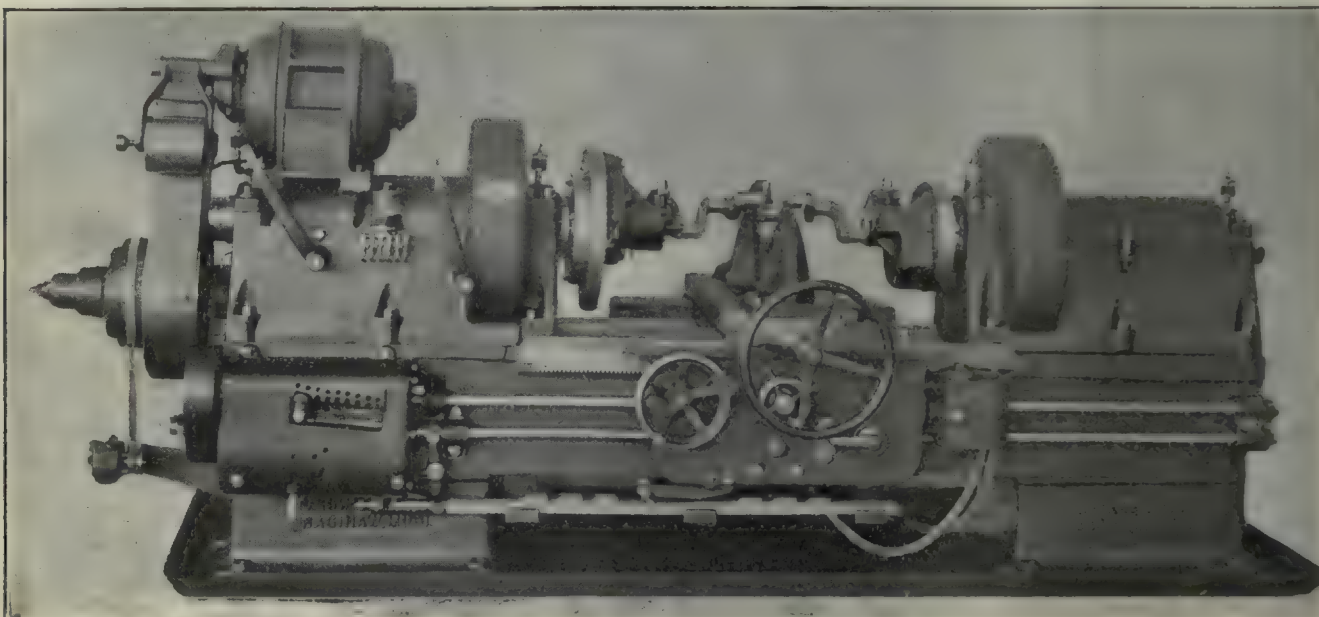


FIG. 2. WICKES UNIVERSAL CRANKSHAFT LATHE

tools are brought up by means of the rapid traverse, for cutting the fillets.

Previous mention has been made of the use of this machine for turning the cheeks of the webs, and for this the rapid traverse is of great value. When only a rough cut is used for cheeking this is begun on throws Nos. 1 and 6 with a double tool in the front toolpost that cuts both sides simultaneously. Provision is made so that without removing the shaft it may be re-indexed and roughing cuts taken on throws Nos. 2 and 5 by the rear tool. This is followed by operations on another machine for the remaining throws.

Where both roughing and finishing cheeking cuts are required it is customary to make the first with the front tool and the latter with the rear tools; in which case only one pair of cheeks can be finished in each set-up. For another method the carriage is fitted with a double cross-slide operated by a right and left feed screw so that both the roughing and finishing cheeking tools are fed in together—one from the front and the other from the rear, with the roughing tool taking its cut slightly in advance. An automatic trip throws out the feed on the roughing cut ahead of the finishing cut, while the latter proceeds to the finish.

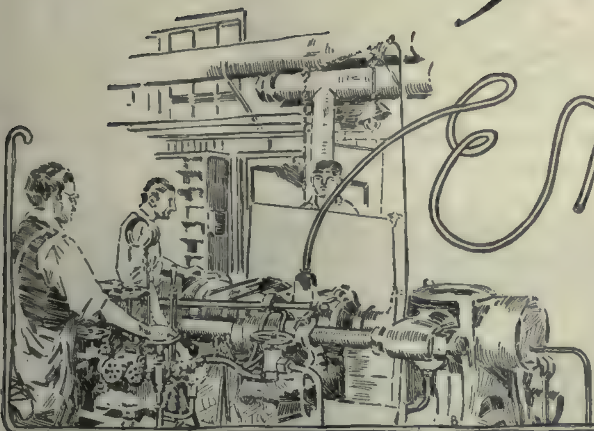
The universal machine, Fig. 2, is similar to the duplex, except for the tooling and pot-chucks. The machine turns one pin at a time and usually uses a narrow tool in front, which is fed across the pin. Sometimes this tooling is varied by the use of a double tool which approximately reduces this cutting time one-half. When

A heavy nickel-steel drive shaft runs lengthwise through the center of the bed connecting the drive of the two headstocks and runs in phosphor-bronze bushings. The herringbone pinion driving the spindle gear of the right-hand headstock is provided with an adjustment to align its faceplate with that on the left-hand head.

Two speeds, 75 to 100 r.p.m., may be obtained by shifting sliding gears. All bearings, except the spindle bearings, are lubricated by a gang oiling system with six sight-feed oilers, which is shown at the front of the headstock in the headpiece. The lathe can be started or stopped by a lever on the apron or another on the headstock. One motion starts the machine and the reverse throws in an automobile type of brake which brings the spindle to an almost instantaneous stop. The clutch is of the Hillard double-disk type which has no predetermined point of contact.

The cross-slide is taper-gibbed at three places on the carriage, and the carriage is taper-gibbed at two places on the bed.

The drive pulley runs at 400 r.p.m.; is 20 in. in diameter, and has a 6½ in. face. It is equipped with Hyatt roller bearings. Both the duplex and universal machines are usually motor driven through a short belt provided with a tightener, as shown in Fig. 2. The motor is 15 hp. with a speed of 1200 r.p.m. The machine is furnished with or without a feed box as may be desired, and, when so equipped, has 36 feeds. The weight is 12,000 pounds.



The Extrusion of LEAD PIPE

By
Ellsworth Sheldon
ASSOCIATE EDITOR, AMERICAN MACHINIST

II. Directional Control

Bending lead pipe is easy, but bending without distorting it is quite another problem when the bends are to be produced in large quantities. Until the invention of the Du Bois trap extrusion machine, by means of which the direction of extrusion is under close control of the operator, the making of traps and bends was a much more complicated process than it is now.

A MODIFICATION of the extrusion process is used in the manufacture of the traps which are used on all waste pipes, to form a water seal against sewer gas entering the buildings which they serve. A drawing of the machine[1] for extruding these traps is shown in Fig. 11 and a photograph of the machine in operation in Fig. 12. It is a horizontal hydraulic press with two opposed cylinders and a double-end mold located between them. In this figure *A* is the mold and *BB* are the hydraulic cylinders. The control apparatus is located at *C* and consists of valves for admitting and discharging water to and from each cylinder separately, and a control valve operated by the lever *D* which admits water to both cylinders simultaneously but in quantities varying according to the position of the lever.

[1]This machine was fully described on page 153, vol. 40 (Jan. 22, 1914), *American Machinist.*

Fig. 13 shows a section of the mold of the trap machine. These molds are of different sizes and are interchangeable. They rest upon the tie rods which hold the two hydraulic cylinders together and are located by nuts threaded upon these rods. As the pressure upon a mold is practically balanced, the only duty devolving upon the nuts is to hold the mold against the preponderance of pressure required to curve the extruding pipe.

A partition divides the two cylindrical receptacles which form the mold, this partition extending partly into the outlet through which the lead is extruded. The die is held in the outlet by fillister-head screws, or, in smaller machines, threaded into the opening, and the core fastens into the top of the partition, its upper end coming flush with the top of the die.

The core is of a peculiar fluted section and there are wings or partial partitions on the inner walls of the extrusion chamber, the effect being to partly divide the flow of metal into four streams which join just before reaching the die. Now, if the pressure is equal upon the two cylinders, an equal amount of metal will flow from each side and the result will be a straight pipe, but if there is a preponderance of pressure and consequent flow of metal from one side or the other the pipe will curve sharply away from the side of greatest flow.

With the machine in Fig. 12 extruding pipe of a

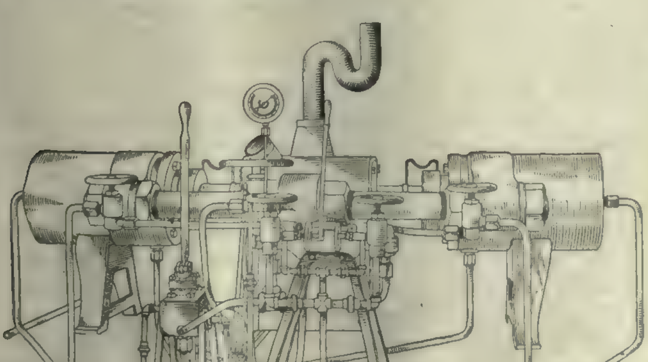


FIG. 11. DRAWING OF TRAP-EXTRUDING MACHINE

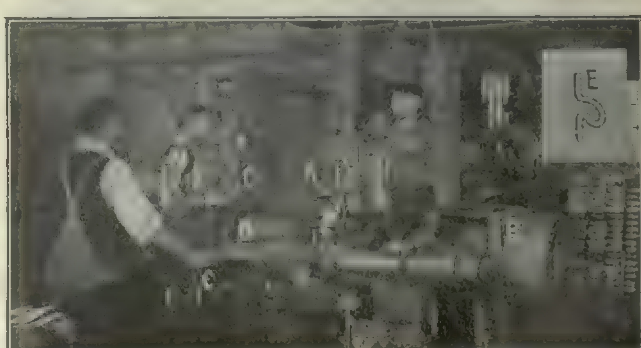


FIG. 12. TRAP MACHINE IN OPERATION

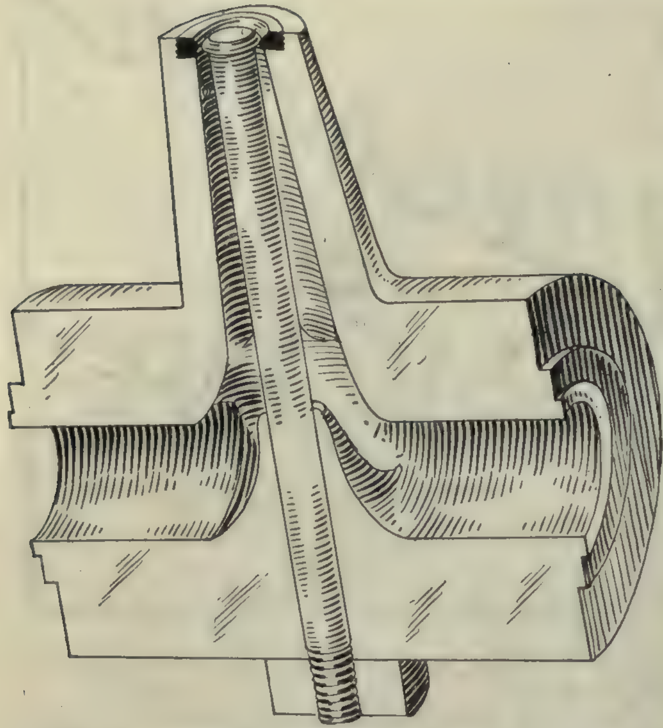


FIG. 13. SECTION OF MOLD OF TRAP-EXTRUDING MACHINE

diameter of one inch, it is quite practical by throwing the control lever to its extreme position and holding it there, to coil a continuous helix of pipe as small as 4-in. mean diameter. It would be necessary only for the helper to seize the first turn of pipe in his tongs as it came from the machine and draw it toward him to bring it into helical form and prevent it from piling up on itself in the form of a spiral.

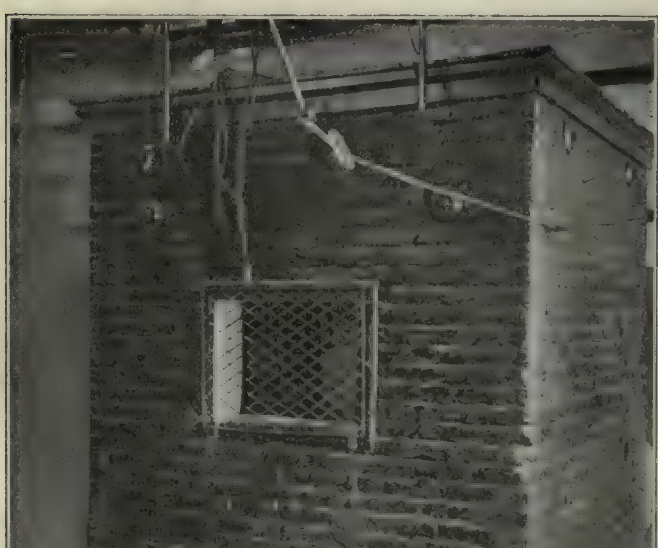


FIG. 14. OVEN FOR HEATING THE CABLE

To form a trap, the operator moves the control lever first in one direction and then the other, being guided solely by the appearance of the extruding pipe which will follow the movements of his hand as obediently as if endowed with intelligence.

It requires a considerable degree of skill to manipulate the trap machine, as it is solely a matter of the hand and eye working in conjunction; there is no mechanical guide for the operator.

Any bend or combination of bends within the single plane may be made, the limit being when the part already extruded becomes so heavy that its own inertia could cause it to distort when following the quick

FIG. 18. A 10-TON SLAB OF LEAD

changes in direction caused by the machine. The "bag trap" shown at E, Fig. 12, is a good illustration of what can be done, the only movement necessary to produce this piece being a leisurely movement of the operator's hand on the control lever. The sole duty of the man standing back of the machine is to grasp each piece with the tongs and when it is extruded to the correct length, saw it off, which he does with three or four quick strokes of a common rib backed saw. The flow of pipe does not stop for an instant until the mold is exhausted.

Correcting Tendency To Bend in Wrong Plane

If the lead is of even temperature all the way round the outlet and the die is perfectly polished there will be no tendency for the pipe to bend in any plane other than parallel to the hydraulic cylinders, but these conditions cannot always be maintained and sometimes there will be trouble from bending in a direction at an angle to the one desired. The job of the third operator who is leaning upon one of the cylinders is to keep his eye on the extruding pipe and if it shows a tendency to deviate in a wrong plane from a vertical path he promptly dashes water upon the outside of the curve with a swab which he holds for that purpose, and the refractory pipe will straighten up as if by magic. The sudden cooling of the lead upon the side that is flowing too fast is what accomplishes the result.

The number of traps that can be made at one filling of the mold depends upon their diameter, length, and thickness of wall. When a mold is emptied, the rams are drawn back (by hydraulic pressure), stopping just within the cylindrical part of the mold. In this position a pouring gate is exposed, which allows the mold to be refilled from a ladle.

Another application of the extrusion processes is the

covering of cables of telephone, electric lighting, and other wires that run under the streets of our cities or sometimes in aërial lines across country.

The cable-covering machines are hydraulic presses similar in principle to the pipe presses, but inverted. In the pipe press the mold is carried on the press ram and moves upward with it, while in the cable-covering machine the mold is stationary and the plunger which forces out the lead is attached directly to the ram of the press. The extrusion in this machine is through an opening in the side of the mold instead of through the plunger, which in the cable-covering machine is solid.

A corresponding hole in the opposite side of the mold admits the cable, and the inside of the mold is so formed that there is no tendency for the lead to escape in that direction. The cable itself passes from a reel at the rear of the press through the mold (coming out of the opening, where the lead is extruded), and is kept under tension by a power-driven reel in front, the flow of lead forming a pipe around the cable which easily carries the latter forward with it. The cable itself takes the place of the core of the pipe machine.

"Impregnating" the Cable

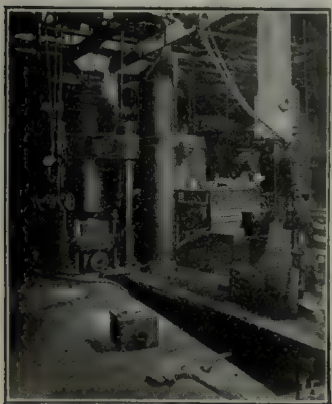
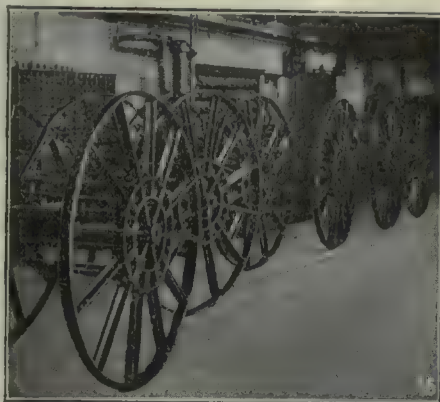
Before coming to the covering, or "armoring" presses, the cable, reel and all, is immersed in a huge vat of impregnating fluid resembling boiling pitch. The object is of course to saturate the fiber covering of the individual wires and units with a material impervious to moisture and resistant to ordinary causes of deterioration.

The cables are suspended in the hot solution for several hours until they are thoroughly impregnated, when they are ready for their lead covering. As it is not always practicable to send a cable directly from the impregnating vats to the armoring presses, and as the impregnating compound becomes stiff and unyielding when cold, it is necessary to provide means of reheating the cable immediately before it receives its lead armor.

For this purpose there is located back of each press a steam-heated brick oven large enough to receive a reel of cable. One of these ovens is shown in Fig. 14, while in Fig. 15 may be seen one of the armoring presses with its melting furnace. The next press to the right in this latter picture is partly hidden behind the post, but a corner of its heating oven may be seen in the background.

The hydraulic cylinder of the press is at the top of the machine and the lead mold at the bottom with the opening from which the cable is extruded at about the floor level. A sunken tank in front of the press is kept full of water through which the cable passes for the double purpose of cooling the lead covering before it is wound on the receiving reel, and for seeking out possible defective places in the armor.

Each section of the cable is subjected to electrical test after coming from this operation and if a defect exists in the covering that allows water to penetrate to the wires, it will be disclosed and remedied at this time instead of making trouble after the cable is in service. Figs. 16 and 17 show respectively the iron reels on which the cable is wound, and the impregnating vats. These reels are the ones that carry the cable in the heating ovens back of the armoring presses. As the cable with its lead covering comes from the presses it is wound directly onto the wooden reels upon which it is shipped.


FIGS. 15, 16 AND 17. REELS, VATS, AND OVENS USED IN IMPREGNATING CABLES
Fig. 15—The cable-armoring press. Fig. 16—Iron reels on which the cable is wound to be impregnated. Fig. 17—The impregnating vats.

Contrary to what might be expected, the lead in the mold is not in a molten state either in the trap machine, pipe or armoring presses; in fact, in the case of the two latter it is perfectly practical to extrude cold metal, the only difference being the higher pressures required. The flowage of the metal in the die generates a considerable degree of heat, so that molten metal instead of cooling in the die would come out in a shower rather than in a continuous piece.

After the molten lead has been run into a mold, a certain time is allowed for it to solidify, the aim being to extrude it at that temperature where it is in a plastic state, taking form readily and yet possessing sufficient cohesion to allow it to maintain its shape.

In the trap machines it is necessary to keep a gas flame on the mold in order to maintain the best working temperature, while on the pipe presses quite the contrary condition prevails and many of the molds are water jacketed.

Rolling Sheet Lead

The rolling of sheet lead presents some interesting problems, not the least of which is the handling of the heavy weights involved. In Fig. 18 may be seen the cast ingot ready for the mill. This picture also shows the permanent mold for casting, the furnace in the background for melting the metal, and the means provided for handling the mass of lead.

This ingot is 6 x 19 ft. in size and nearly 6 in. thick; it therefore weighs in the neighborhood of 10 tons.

Four hooks, marked AAAA in the picture, are set

into corresponding recesses in the mold before pouring the metal. A valve inside the kettle, which may be seen back of the mold, allows the molten lead to flow out of the spout B directly into the mold.

When the latter is level full and the flow stopped, all dross and impurities are carefully raked off the surface and the slab allowed to set. The pouring is so timed that the slab will have assumed the proper working temperature at about the time the mill finishes rolling the previous piece.

The frame *C* is now connected with the hooks *A*, the crane attached and the slab lifted out and deposited on skids where the top surface is scraped to remove any dirt or other foreign substances that would otherwise be imbedded in the metal when passing through the rolls.

The mill is shown in Fig. 19. The lower main roll and each alternate small roll on the bed of the machine

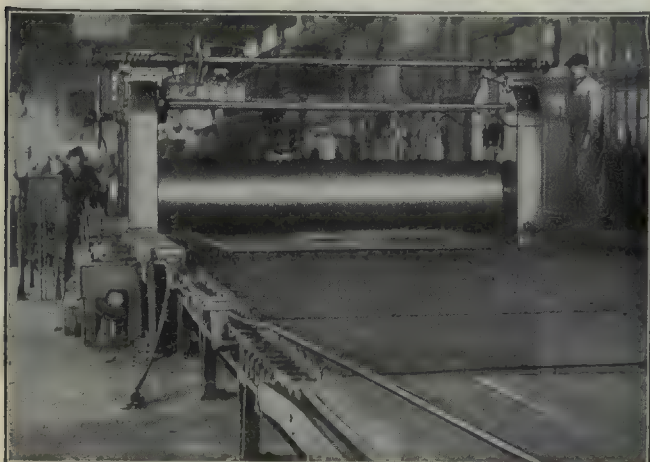


FIG. 19. ROLLING THE SLAB INTO SHEETS

are positively driven by a powerful reversing motor under control of the operator at the left of the machine. The crane picks up the 10-ton slab shown in Fig. 18 and places it on the small rollers, which pass it back and forth between the reducing rolls until it is brought to the requisite thickness.

The upper reducing roll is raised and lowered by an independent motor, and when the slab is first put into the mill this roll is set down 0.015 or 0.020 in. at each pass, the amount of reduction being gradually lessened until on the final passes the reduction may not exceed 0.001 in. per pass, but by this time the slab will have been reduced to sheets $\frac{1}{8}$ in. in thickness. Four such slabs can be reduced to $\frac{1}{8}$-in. sheets in one day.

For their kind assistance and coöperation and for the facilities placed at his disposal in securing photographs and information relative to the machinery and processes described in this article, the author is indebted to T. G. W. Fine, of the United Lead Co.; A. R. Von Keller of the National Conduit and Cable Co., and Milton Lissberger, of Marks, Lissbergers Sons.

Circular Milling on a Straight Table

By Frank C. Hudson

The motor vehicle has so many parts which present new machining problems that they afford great opportunity for special fixtures and for the adaptation of standard machines, in cases where the quantity of the product is not sufficient to warrant having special machines built for the purpose. A case of this kind is

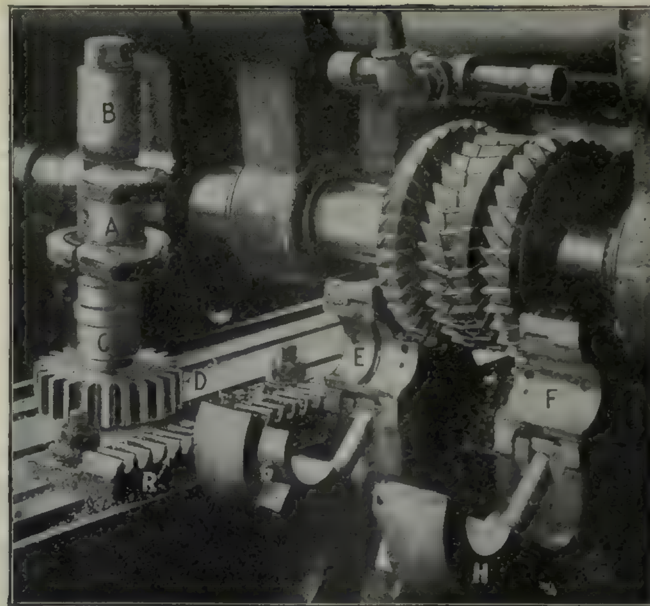


FIG. 1. THE CUTTERS AND FIXTURE

shown in a special fitting for a Pierce-Arrow truck, where it is only necessary to finish the piece on a part of its circumference and the inside of the cheeks.

The first operation bores a hole through the barrel of the piece, *A*, Fig. 1, which is then placed on the mandrel shown together with the journals *B* and *C* at each end of the work. This mandrel contains also the gear *D*. This assembly fits into the bearings *E* and *F* and is held in position by the clamps *G* and *H*.

These clamps carry a half bearing, and when swung into position are held by bolts as shown in Fig. 2. With the work mounted in the position shown, the gear *D* meshes into the rack *R*, which is bolted to the table of a Kempsmith milling machine. It can readily be seen how the action of the gear and rack will revolve the work against the milling cutters by simply throwing in the regular longitudinal feed on the table. Various modifications of this can readily be devised to handle work of a similar nature.

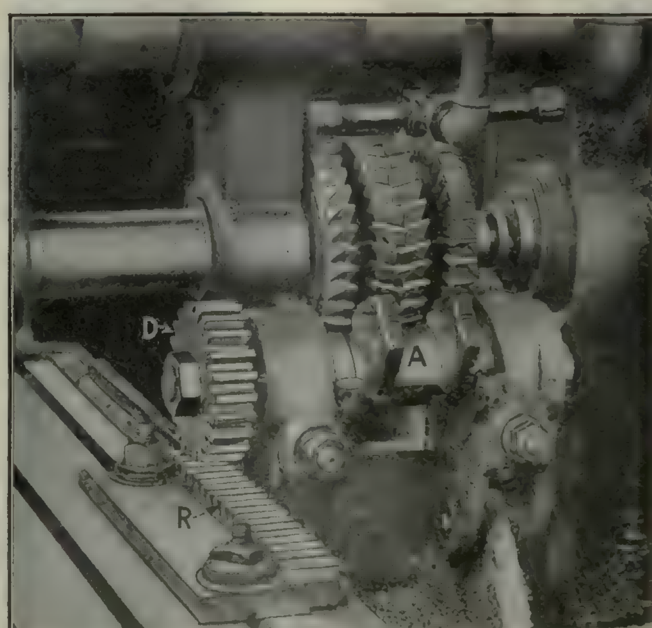


FIG. 2. THE FIXTURE AT WORK

Extracts From Chordal's Letters

In this letter Chordal tells about a very ingenious device for counting revolutions, the action of which is surprising. He also tells us something about the genesis of a well-known positive-pressure blower which goes to show tnat a device may eventually be used for a purpose entirely different from that intended by the inventor. An instance of a limiting factor in the use of labor-saving machinery and the passing of an old-time household article are also mentioned.

Mr. Editor:

* * * There are lots of different kinds of revolution counters to be put on machines to indicate the speed at which they are running, these devices consisting of some sort of mechanism which is connected with the machine whose speed is to be counted. But there is a new-fangled revolution counter, a "tachometer" as it is called, which is peculiar in that while it has to be connected with the machine whose speed is to be counted, the connection does not necessarily involve any mechanical moving parts, and it will answer if the tachometer is simply set or hung on the machine.

* * * The tachometer is based on the theory that if you have a lot of elements which can vibrate and each has some different rate of natural vibration, a certain one of them will vibrate only in response to vibrations at that given rate. We often notice at home in the evening that a certain window pane will vibrate when a certain locomotive passes. This means that the rate of vibration of that window pane is the same as the rate of repetitions of the exhaust or some other rattle of that particular locomotive. Some other locomotives, or that particular one, running at some different speed, will cause some other window pane to rattle.

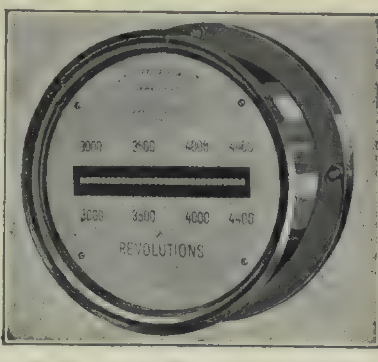


FIG. 1. A VIBRATING TACHOMETER

* * * The tachometer that I am speaking of is illustrated in Fig. 1, in which we see the ends of a series of flexible tongues, and if we notice which tongue is vibrating, the scale on the instrument will show the speed of the vibration of the machine whose rate of vibration this particular tongue responds to. Fig. 2 represents a turbo-generator with a tachometer setting upon it, or merely bolted to it. While the revolving member of a turbo-generator is gotten into as nearly a perfect balance as is practicable there is still some little shake about the thing, and the tachometer will recognize this shake and its particular tongue, which is appropriate to that rate of shaking, will vibrate, and the rate can be read upon the scale. As speed changes, that particular tongue will cease vibration and some other tongue will vibrate and indicate the speed. In a turbine subject to variations in speed the face of the tachometer may be watched and it will be observed that one of the tongues vibrates and then quits and another starts to vibrate, and so on, the changes of speed of the turbine being indicated as the zone of vibration runs along or changes position on the series.

* * * The makers of this very peculiar tachometer make a little demonstrating instrument, Fig 3, to illustrate its workings. In this little demonstrating instrument there are six flexible steel tongues of different lengths, and their bent free ends are colored white so that their vibration may be readily appreciated. The shortest tongue is about 2½ in. long, and the longest one, about 2¾ in. long, intermediate tongues being of intermediate lengths. The tongues are about $\frac{1}{32}$ in. in thickness and about ⅛ in. wide. The roots of these tongues are anchored in a fixture mounted fixedly on a ring which is provided with a handle, and in this ring freely revolves a little wheel. The wheel has a hole at one portion of its rim so that the wheel is thrown out of balance, and the spindle is arranged to be started into rapid motion by a string, the same as a boy spins a top.

* * * You take this little instrument in your hand and set the wheel spinning. Being out of balance the result is that a little shake or vibration is given to the whole instrument. We do not know and do not care at present about the rate of rotation of the wheel. It runs so fast that none of the tongues vibrate. After a while, as the wheel slows down, its rate of rotation will correspond with the natural rate of vibration of the shortest tongue, and that shortest tongue will vibrate. As the speed of the wheel slows down the first tongue ceases its vibration and the second tongue starts in, and so on till finally only the longest tongue vibrates, and finally its vibration will stop, the rate of turning of the wheel having gotten below the rate of vibration of any of the tongues.

* * * If we would go to the trouble to do it, we could ascertain what these various rates of vibration are and we could mark each of the tongues accordingly. That is all there is to this new-fangled tachometer which is really a simpler instrument than this demonstrating device, for you might take the wheel entirely out of the demonstrating device and then merely lay the device on the steam turbine or other machine, and if there were tongues enough and they had been marked, some particular one of them would vibrate and show the speed at which the turbine was running.

* * * Now the question is how much of a vibration is there about these tongues. A Cornell professor of mechanical engineering examined one of these demonstrating instruments in my office and, in advance of trial, he understood its principle perfectly. But he was asked how far the ends of these tongues would vi-

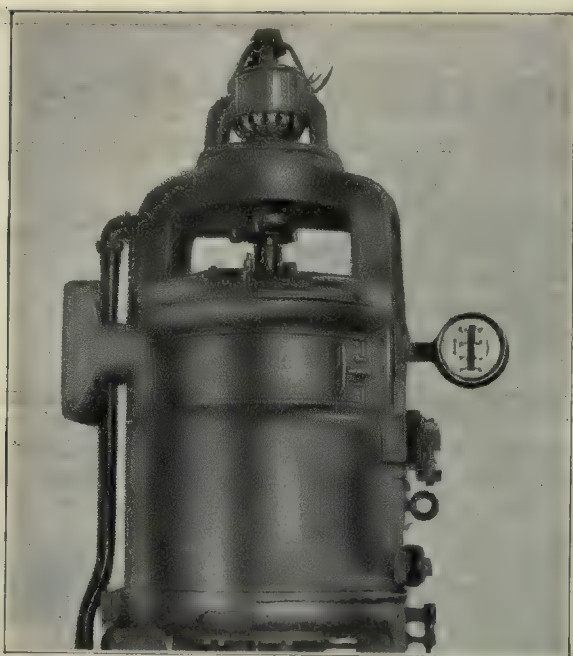


FIG. 2. THE TACHOMETER APPLIED TO A TURBO-GENERATOR

brate, and this set him thinking. He hazarded a guess at ¼ in. but seemed a little dubious about the vibration being that much, his theory being, first, that the instrument would not have the power to produce that much vibration and, second, the steel of which the tongues were made would not stand the punishment for any length of time. The instrument was then put through its paces, in the manner which I have described, and when the shortest tongue started in, lo and behold, it vibrated 2¼ in., and when it came the turn for other tongues their vibrations would be from 1½ to 2½ inches.

* * * Notwithstanding this very extended amplitude on the part of the tongues, I have never heard of a case of their breakage due to punishment.

* * * Mr. Johnston, the president of the Roots company, was telling me yesterday something of the early history of the Roots blower, a type of blower which is found the world over, the name Roots being applied to this well-known type.

The Roots blower consists of two impellers revolving in a casing and driven by external gears on their shafts, the lobes of the impellers sweeping the interior of the casing and touching each other as they revolve.

* * * At present Roots blowers are made with metallic impellers, but when they were originated by the Roots Brothers many years ago, their peripheries were formed of wooden staves fastened to spiders mounted on the shafts.

* * * It seems that the Roots Brothers invented this machine as a water motor, to take the place of big overshot wheels, etc. One of the machines was built and tried, but its wooden impellers swelled and choked, and required redressing. After they were dressed the machine was run idle to test its running, and Mr. Mullikin, the foundry foreman, happened to be standing near the outlet side of the machine and he got the benefit of the air blast. He at once said that that would be a good machine for the foundry to blow the air for the cupola.

* * * The machine was not a success as a water motor, and Mr. Mullikin's little speech proved to be a prophecy, for the Roots blower has for many years proved an eminent success in handling air and other fluid.

* * * Mr. Bookwalter was interested in the manufacture of harvesters, the Champion machine, I believe, but spent several years in travel, and at one time the Maharaja of Something in India, was showing Mr. Bookwalter his immense wheat fields while harvesting was going on. There was an army of native harvesters working by hand with cradles or sickles, binding the grain with straw bands made from the grain as cut. It was a wonderful sight for Mr. Bookwalter, who called the attention of the Prince to the fact that one of the Springfield machines would take the place of this whole lot of laborers and cut about 25 acres a day. "I know all about that," said the Prince. "I have seen your machines at work, and I have been in the Springfield factory and have seen them making the machines. They are wonderful machines, but how much does the twine cost for each acre cut?" Mr. Bookwalter was able to at once figure this matter out and told the Prince how much the twine cost, and then the Prince announced that the cost of this binding twine per acre was more than his entire present cost per acre for harvesting and, besides, what would these men do? They know nothing, they could not be mechanics or book-keepers, even if there would be some of such work to do.

* * * Those of us who are old enough can remember the days of the flail, before the threshing machines became fashionable. Did you ever try to handle one of these flails and, if so, did not you find it more awkward than the bricklayer's trowel? However that may be, you will now find very few men who know how to handle the flail, and I doubt if you could get a flail through a Chicago mail order house. The threshing machine has chased the flail out of existence.

* * * Happening to catch Mrs. Gordon doing some sewing with one end of her seam pinned to her knee, I called her attention to the sewing bird, the little metallic affair, bird shaped, that you clamp on the edge of the table and cause to open its mouth by pressing on the tail, the little bird holding the distant end of the seam. I promised the lady I would get her a sewing bird next day, and I started in with good intentions. No store that I visited had ever heard of the thing, and I later tried a number of stores in large cities, but it was no go. When I asked for a sewing bird the clerks would think I was kidding them. Getting in earnest, I advertised in the home papers, with the result that several old residenters brought in crude home-made sewing birds which they had had around home for generations. At Wanamaker's store, in Philadelphia, they told me that these sewing birds were French

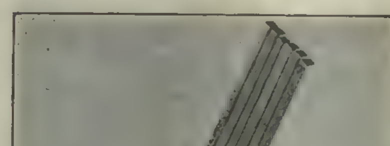


FIG. 3. INSTRUMENT TO DEMONSTRATE THE PRINCIPLE OF THE TACHOMETER

and that their last importation had been about 20 years before the time of my inquiry. They later wrote me that they had imported a new lot, and I got one of them, and, about five years after my promise, I had the pleasure of giving it to Mrs. Gordon. It was the same old silver-plated looking bird of my boyhood, with a red pincushion on its back. The sewing machine had, in effect, chased these sewing birds out of existence, and I have often wondered how Wanamaker came to import the new lot, or what had kept alive their manufacture in France, though I can understand that in Europe the sewing machine is not the universal household implement that it is with us.

* * * Bert had gotten a roller trackway for unloading pig iron at the shop. The affair consisted of sections about 12 ft. long and a foot wide, with a series of rollers about 3 in. in diameter and 4 in. apart. One end of one of these sections would be poked into a railroad car, the other end of the section resting on a trestle where it joined a succeeding section, and so on until the sections reached out into the yard where the pig iron was piled. The affair would be down grade so that a man on the car would place a pig and start it down, while a man at the distant end would pick it up and pile it.

* * * When Bert stated to the yard foreman that this thing was coming the foreman kicked like a steer. He saw no use for the thing, and there was no reason why the men could not pick up the pigs of iron from the car and carry them off and pile them up. A strike came very near resulting from the introduction of this useful contrivance. But the thing came and it was put into use and it stayed in use, until after years of use, sections became broken, and it took time to get new ones from the factory. And then Bert had the time of his life arguing with the yard foreman who said that nothing could be done until these new parts came. Bert suggested that all that was necessary was to pick the pigs up from the car and carry them out into the yard and pile them up, the same as they used to do. But the yard foreman saw the possibilities of a strike.

Yours very truly,

CHORDAL.

Tap Drills, Clearances and Tolerances

By WALTER J. RUDOLPH

Chief Engineer, Imperial Brass Manufacturing Co., Chicago, Ill.

The procedure recommended in this article for selecting tap drills for screw threads is based upon modern practice and takes into account several factors whose importance is recognized but which are not always allowed for in making a choice. Tables of clearances and tolerances are also included.

THE solution of the problem of cutting threads as it affects manufacturing in general, depends upon the selection of the proper size of tap drill for the internal thread and upon the clearance and tolerances applied to both threads. The lubricant used and the style of tool will have little effect, if any, when these other features have not been correctly taken care of.

The size of drill to be used depends not only upon the size of the thread but also upon the material to be threaded. The smaller the shank of the tap, the larger should the tap drill be so that the amount of material to be cut away will not present too great a resistance to the shank. The length of thread must also be considered as the long thread offers much more resistance than the short one. At the same time the shorter length of thread must be fuller or more perfect because of the smaller number of threads which are engaged. In Table I two classes are recognized, the short thread having a length equal to or less than its outside diameter, and the long thread including all other cases.

Likewise, two kinds of materials are specified, those easy to tap, such as cast bronze, iron, steel, aluminum, and wrought-and cast-brass, and those hard to tap, such as wrought bronze, aluminum, iron, steel, and wrought- and cast-copper. With the cast materials, a smaller drill may be used because of their granular structure which cuts and chips away rather readily and consequently makes the work of the tap easier while at the same time it makes necessary a more perfect thread because of its weakness. The more tenacious wrought materials are fibrous and difficult to cut and will require a larger drill to save tap breakage. They also are stronger and will not require so perfect a thread. It must also be remembered that these materials are more likely to tear if too full a thread is attempted.

Some Variation Expected

Some variation from these classes will of course be expected such as very soft brass or very hard steel, in which cases a larger drill would be used to prevent tearing.

The tap drills of the table will be found to give theoretically from 63 to 85 per cent. of full thread figured from the root of the thread to the tap drill. Actually these amounts will be increased from 5 to 15 per cent. because of the tendency of the metal to flow and fill up the root of the tap.

In the first column the lettered classes are purely arbitrary and are introduced for convenience only.

As an example of the use of the table, suppose we have to tap a $\frac{5}{16}$-in., 18-threads-per-inch hole in cast brass $\frac{1}{2}$ in. thick. This would fall in class G and as the material is easy to tap and the thread is long we should select a drill which will drill a hole of a size to produce 75 per cent. of full thread. To do this we determine the pitch diameter of the thread, *Pd* and double depth of thread *Dd* from tables or in any other convenient way.

Let *Pc* represent per cent. of thread specified in table and *Td* the diameter of tap drill. Then

$$Td = Pd - [(Pc - 50\%) \times Dd]$$

Td usually works out to a size which does not correspond to any standard drill. In most cases, however, a special tool is used which can be made exactly to size. If it is necessary to use a standard drill the nearest size to the calculated value should be chosen. This calculation applies to machine tapping. For hand tapping the value of *Pc* can be increased 10 per cent. be-

cause the operator can feel the pull of the metal and relieve it somewhat.

In view of the lack of a generally accepted standard of fits to be applied to internal and external threads, Table II has been prepared on the basis of modern manufacturing practice.

Class A or wrench fit would be applied to those cases where alignment is governed by the threads engaging with each other and should be a very exact job.

TABLE I. DATA FOR USE IN CHOOSING TAP DRILLS

Class	Diameter, Inches	Number of Threads per Inch	Per Cent. of Full Thread: Materials Hard to Tap, Short	Materials Hard to Tap, Long	Materials Easy to Tap, Short	Materials Easy to Tap, Long
A	Not less than 1¼ in.	8 thr. or less	76	72	81	77
B	Not less than 1 in.	10 thr. or less	75	71	80	76
C	Not less than ¾ in.	12 thr. or less	74	70	79	75
D	To ½, inc.	16 thr. or less	72	67	76	72
E	Over ½	16 thr. or less	74	70	81	78
F	To ¼, inc.	20 thr. or less	68	63	73	68
G	To ½, inc.	20 thr. or less	76	72	79	75
H	Over ½	20 thr. or less	81	78	83	81
I	To ¼, inc.	24 thr. or less	68	63	74	70
J	To ½, inc.	24 thr. or less	76	72	81	78
K	Over ½	24 thr. or less	81	78	83	81
L	To ¼, inc.	30 thr. or less	74	69	79	75
M	To ½, inc.	30 thr. or less	78	75	81	78
N	Over ½	30 thr. or less	80	78	83	81
O	To ½, inc.	More than 30 thr.	81	79	83	81
P	Over ½	More than 30 thr.	83	81	85	83

A class B or tight fit is one that would require a maximum of hand exertion to turn one thread into the other and would be used where a close fit is required without the use of a wrench.

Class C or hand fit is used for parts where the assembly depends somewhat upon the thread for the location of the respective parts. This class allows the threads to be turned by hand and also permits of machine assembly.

Class D or average fit applies to the general run of work and allows a tolerance to be applied which is practical for production purposes.

Classes E, F and G can be applied where a loose fit is permissible or possibly necessary.

Any fit looser than those specified would have to be treated as special with the type of work as the governing factor. The coarser the fit, the greater the tolerance that can be applied.

Figuring the Fits

In figuring fits, the first step is to specify the internal thread 0.002 in. larger than the pitch diameter because most commercial taps produce such a size after the keenness of the edge has been taken off. The external thread can then be based upon the class of fit as it is easier to change, most dies being adjustable while very few taps are.

TABLE II. SCREW-THREAD CLEARANCES AND TOLERANCES

Class of Fit	Average Clearance, Inch	Variation: External	Variation: Internal	Extremes: Least Tol.	Extremes: Greatest Tol.
A wrench	0.002	+0.0005 −0.0005	+0.0010 −0.0005	0.0010	0.0035
B tight	0.003	+0.0005 −0.0005	+0.0010 −0.0005	0.0020	0.0045
C hand	0.004	+0.0005 −0.0005	+0.0015 −0.0005	0.0030	0.0060
D average	0.005	+0.0005 −0.0010	+0.0005 −0.0005	0.0040	0.0075
E easy	0.006	+0.0005 −0.0010	+0.0020 −0.0005	0.0050	0.0090
F loose	0.007	+0.0005 −0.0015	+0.0020 −0.0005	0.0060	0.0105
G coarse	0.008	+0.0005 −0.0015	+0.0020 −0.0005	0.0070	0.0115

The next step is to apply a proper tolerance to both threads as they are seldom, if ever, exactly to size. The tendency should be to keep the thread as near to size as possible and not to take advantage of the full tolerance.

The first two columns of Table II give the classes of fits and the recommended clearances. The column under "Variation" gives the plus and minus tolerances applicable to each fit. It will be noted that the greatest tolerances are applied where they can be utilized to the best advantage. The last column under "Extremes" gives the exact figures in either direction and shows that the parts would still fit together if the extremes were carried out in opposite directions.

Larger tolerances are allowed for internal threads because of the lack of adjustment facilities in the tools used and because of the comparative difficulty of exact measurements.

An Unusual Belt Drive

By B. M. Davis

The halftone shows an unusual belt drive which has been in commission for several years and has given complete satisfaction. It drives three floors of a machine shop in Waterbury, Connecticut.

There are three belts on the main pulley of the engine. The one at the front drives a line shaft in the basement of the building. The center belt passes under the front idler pulley on the jackshaft, over the large pulley above and back to the main pulley again.

AN UNUSUAL BELT DRIVE

The large pulley above is mounted on the end of the line shaft on the first floor. The idler for this belt is keyed to the jackshaft and the two turn together.

The belt at the back passes under the back idler pulley and over the pulley mounted on the end of the line shaft for the second floor. The back idler runs free on the jackshaft but as the front idler is keyed to and turns the shaft practically at the same speed as the back idler there is no "loose pulley trouble" here, the freedom of the back idler merely being necessary to take care of slippage of either belt. The jackshaft runs in boxes which can slide on the angle brackets. At the back of the columns to the left, a hand-operated gear affords means for adjusting the jackshaft bearings for the purpose of tightening the belts in case such adjustment becomes necessary.

Leading the belt in this manner gives about 75 per cent. contact on the driven pulleys.

Time-Saving Tube and Rod Chart

BY MELVIN D. CASLER*
Production Engineer, National Conduit and Cable Co.

This article describes the construction and operation of a chart for calculating the weights of all sorts and shapes of rods and tubes. It should be a great aid to production men in speeding up calculations and also to designers, particularly in computations on tube reductions.

THE accompanying chart, Fig. 1, gives the weight per running foot of tubes and rods of any material and of any cross-sectional shape. It is also a reduction chart and tool chart as it shows directly the percentage of metal reductions in drawing from one set of dimensions to another, or from one shape to another, and will give both plug and die diameters as well as the corresponding gage and unit weight.

The straight parallel rulings indicate the outside diameters of tubes or rods of any shape or material—a rod being considered as a tube with an inner diameter of zero and a gage of one-half its diameter.

There are two sets of curved rulings—one representing the various gages, or tube wall thicknesses, and the other the corresponding inner diameters.

A tube of a certain outer diameter and gage is indicated on the chart by the point where those diameter and gage lines intersect; and that point also gives the corresponding inner diameter. Thus the intersection of the 1.0-in. outer diameter line with the 0.05-in. gage line occurs on the 0.9-in. inner diameter line.

The arm AB swings about the pin P which is rigidly fixed in the chart and the graduations of the arm record weights per running foot of any tube or rod denoted by the intersections of the chart graduations as explained above. The arm is pierced with holes, C_1, C_2, C_3, C_4, on a prolongation of its graduated edge. Hole C_1 is so located that when slipped over the pin P the unit weights recorded are those for round brass tubes or rods. The accompanying chart shows arm AB in this position. For example, it is seen from the position shown that the weight of a round brass tube having an outer diameter of 0.2 in. and a gage of 0.03 in. is 0.059 pounds per foot. If hole C_2 is placed over the pin the swinging arm will record weights per foot of round copper tubes or rods. Hole C_3 will likewise give weights of hexagonal brass tubes or rods and hole C_4 the same for brass squares.

The principle on which the chart is based is as follows: The straight-line chart rulings and the graduations on the swinging arm are both plotted to logarithmic scales; the spacings on the arm being one-half the corresponding spacings on the chart. Hence it follows that any interval on the chart normal to the straight rulings represents a constant factor and that an equal interval on the arm represents the square of that factor. Since the weight per foot of a solid rod varies directly with its cross-sectional area and that area varies with the square of the diameter, it follows that if we place the graduated edge of the swinging arm on any line normal to the straight-line rulings of the chart in such a position that some particular outer-diameter line shall be opposite the proper weight per foot of a solid rod of that diameter as denoted by the arm graduations, then with the arm in this position every outer-diameter line will intersect the graduated edge of the arm at a point indicating the weight per foot of a rod of that particular diameter.

In plotting the gage curves of the chart, the location of the hole C_1 in the arm AB is fixed at any convenient point on the prolongation of the graduated edge of AB and this graduated edge is then so placed on the line DE as to give the correct weights per foot of round brass rods in accordance with the preceding paragraph. The location of the pin P in the chart is fixed coincident with the hole C_1 in the arm AB with the latter in the above position. Then whenever the hole C_1 is slipped over pin P the arm will give weights per foot of round brass rods when swung to the line DE.

A pin P' may be located on line FG at the same relative position on FG as that occupied by the pin P on the line DE. Then when the hole C_1 is placed on the pin P' the arm will give rod weights when laid along FG.

To read the weight per foot of a round brass tube, the arm is swung so that its graduated edge passes through the intersection of the lines representing the known diameter and gage. That intersection will then register the correct weight on the graduated edge of the arm. The curved gage lines on the chart are plotted to satisfy this requirement.

The unit weight of brass assumed in computing the chart lines was 0.3064 lb. per cubic inch. If d represents the outer diameter of a round brass tube, g the gage and w the weight per foot; then

$$w = \pi \times (d-g) \times g \times 12 \times 0.3064 = 11.55\ g\ (d-g).$$

The gage curves of the chart are plotted from this formula with center C_1 on the pin P. For instance, to plot the curve representing a gage of 0.1, we have

$$w = 1.155\ (d-0.1) = 1.155\ d - 0.1155.$$

For a gage of 0.1, the smallest possible diameter is 0.2—at which diameter the tube becomes a rod. If $d = 1.0$ in., $w = 1.0395$ lb. If $d = 2.0$ in., $w = 2.1945$ lb., etc. Hence, the graduated arm is swung about pin P on center C_1 until the graduation 1.0395 of the arm falls on the outer-diameter line on the chart labeled *1.0*. The point where these two graduations coincide is a point on the gage line *0.1*. Another point on this same gage line is where the graduation 2.1945 of the arm falls on the outer diameter *2.0*, still using center C_1. In like manner a series of points is plotted on each gage line and the points connected by curves. For accurate results in actual use intermediate lines and graduations are plotted as closely as the size of the chart will permit.

These same curves will give the weights per foot of tubes or rods of any other material than brass and of any other shape than circular by locating new holes C_2, C_3, C_4, etc. on the arm AB at the proper distances from the center C_1. This feature results from the fact that for any particular outer diameter and gage, the weight per foot of any material or any shape each bears a definite ratio to the weight per foot of a round brass tube of that same outer diameter and gage. This ratio for polygonal shapes, of course, assumes that the outer diameters of any particular shape are always expressed as homologous diameters. That is, if the center C_3 is

established for hexagon diameters normal to the flat sides of same, then the diameters of hexagons must always be expressed as the normal diameter from flat to flat, etc.

The scale on the arm *AB* being a logarithmic scale, one set of values on the same may be converted to a second set bearing a constant ratio to the first by simply moving the scale along a distance corresponding to the value of the ratio. For instance, if we wish the scale to give weights *1.1* times the weights already established for round brass tubes, we would locate a new hole in the arm *AB* on the prolongation of the graduated edge at a distance from the hole C_1, in the direction of

(*d* in the case of the hexagon being the outer diameter normal to two opposite flat sides). A solid hexagonal rod is, of course, only a special case of a hexagonal tube with a gage equal to one-half the outer diameter. Hence, the ratio of the unit weight of a hexagonal rod to that of a round rod of the same diameter is also 1.103. In like manner the following additional ratios are established:

$$\frac{\text{Square}}{\text{Circle}} = 1.273. \qquad \frac{\text{Octagon}}{\text{Circle}} = 1.055.$$

The unit weight of copper is assumed as 0.3215 lb. per cubic inch. The ratio of the unit weight of copper to that of brass is thus

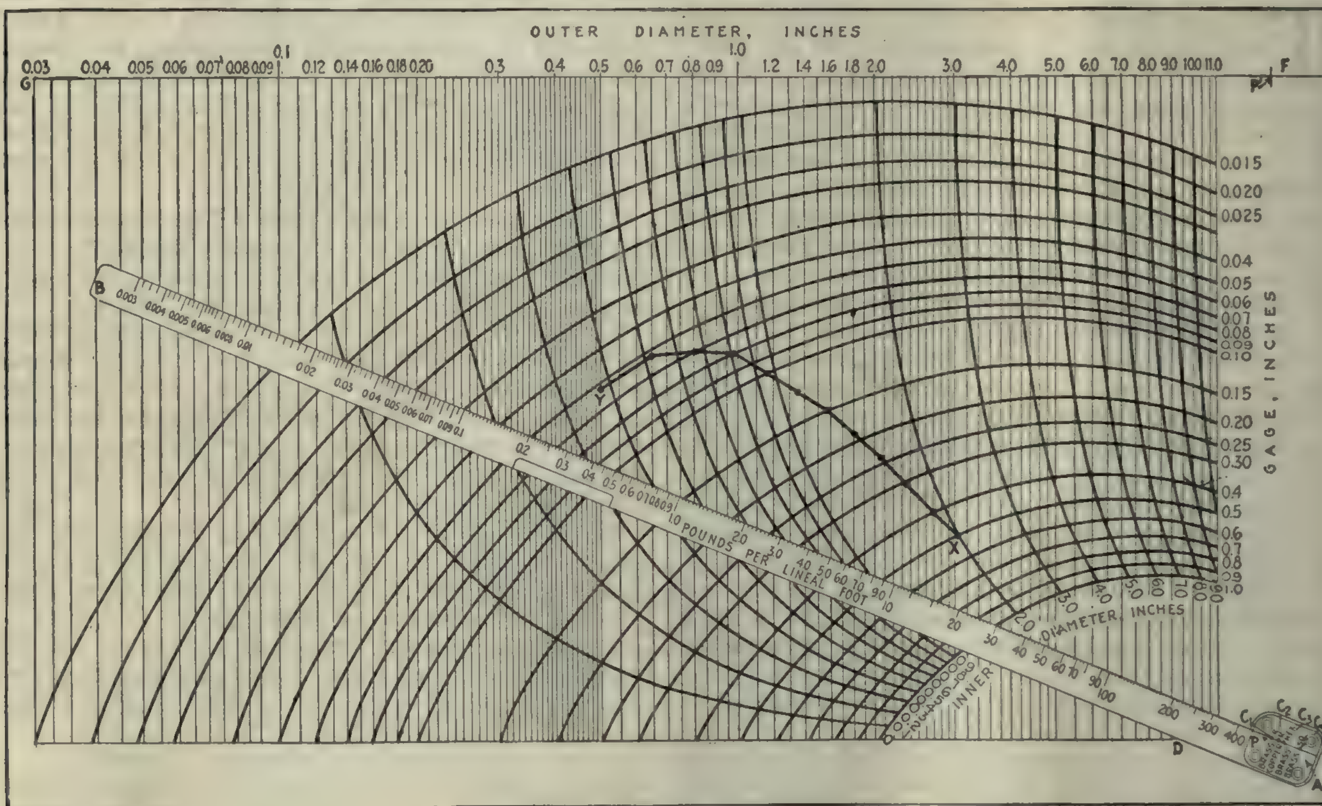


FIG. 1. TUBE AND ROD CHART

increasing weights, equal to the space on the scale between the graduations *1.0* and *1.1*. Then with the fixed pin *P* in this new hole, the weight registered on the *AB* scale by any point on the chart would be *1.1* times the weight registered by the same point with pin *P* in hole C_1.

The weight per foot of a round brass tube was derived above as

$$g \times (d-g) \times \pi \times 12 \times 0.3064.$$

The weight per foot of a hexagonal brass tube would likewise be

$$g \times \frac{\text{outer periphery} + \text{inner periphery}}{2} \times 12 \times 0.3064 =$$

$$g \times \frac{6\,d \tan 30^\circ + 6\,(d - 2g) \tan 30^\circ}{2} \times 12 \times 0.3064 = g \times$$

$$\frac{6 \tan 30^\circ}{2} \times (2d - g) \times 12 \times 0.3064 = g \times (d - g)$$

$$\times\ 6 \tan 30^\circ \times 12 \times 0.3064.$$

The ratio of the weight per foot of a hexagonal brass tube to that of a round brass tube of equal diameter and gage is thus seen to be

$$\frac{6 \tan 30^\circ}{\pi} = \frac{6 \times 0.57735}{3.1416} = 1.103$$

$$\frac{0.3215}{0.3064} = 1.049.$$

Therefore, the weight per running foot of a copper tube or rod of any shape should be 1.049 times the weight of a similar brass tube or rod.

The table gives the resulting relative weights, the weight of a circular brass tube or rod being taken as unity.

RATIO BETWEEN WEIGHTS OF BRASS AND COPPER RODS OR TUBES

	Brass	Copper
Round	1.000	1.049
Octagon	1.055	1.107
Hexagon	1.103	1.157
Square	1.273	1.335

The table could, of course, be extended to include additional shapes as well as tubes or rods of steel or of any other material.

After having established the center C_1 for round brass tubes and rods, the center C_2 for round copper, C_3 for hexagonal brass, and C_4 for square brass, are located on the prolongation of the graduated edge of the arm at the proper distances from C_1 in the direction of increasing weights. The distances from C_1 to C_2, C_3 and

C_4 are equal to the distances from graduation 1.000 on the edge of the arm to the graduations 1.049, 1.103 and 1.273 respectively in accordance with the above table. These various centers will then give the unit weights of both tubes and rods in the same manner as already demonstrated for brass rounds. The diameters of octagons, hexagons and squares must always be expressed as the normal diameters between opposite flat sides as the above relative weights are established on that basis.

It is apparent from the foregoing that a center may be established on the arm *AB* for any family of tubes of similar cross-sections whose cross-sectional metal areas can be expressed by the formula $Kg\ (d - g)$; K being any constant, g the gage, and d some particular dimension of the shape in question. Whatever this dimension d may be, it will always be represented on the chart by the straight rulings labeled "Outer diameters," and the ratio used in locating the distance of the new center from C_1 would be $\frac{K}{\pi}$. The chart is, of course, limited to combinations of d and g, in which g is not greater than one-half d.

In the case of solid rods, a center may be established for any family of similar cross-sections; because the solid areas of such sections always vary as the squares of homologous dimensions and may be expressed as Kd^2 if the shape of the section is known—K being a constant and d some certain dimension of the section, represented on the chart by the same lines as round rod diameters. The graduated edge of the arm *AB* would always be placed on line *DE* or *FG* for rods and the ratio for locating the center in the arm *AB* would be $\frac{4K}{\pi}$.

The unit weight of any shape cross-section whatever would, of course, be the same as that of any other shape of equal cross-sectional area. Hence, the weight per foot of any shape tube or rod for which no center is provided on arm *AB* could be obtained from the chart by reading the weight of a solid square rod of the same material whose side equals the square root of the known cross-sectional area.

If extreme accuracy is desired the pin *P* should be mounted as a shifting center attached to the chart in such a manner as to permit adjustment to compensate for expansion and contraction of the chart due to atmospheric changes; and several arcs representing certain definite unit weights should be shown across the face of the chart from some particular center, as C_1, for adjustment purposes.

On a logarithmic scale such as that on arm *AB* the distance between graduations *0.9* and *1.0*, for instance, is of course, the same as that between *9.0* and *10.0* or between *90* and *100;* and any two readings on the scale which are that same distance apart differ in the same ratio—that is, the smaller is 90 per cent of the larger; or in other words, the smaller represents a 10 per cent. reduction of the larger. The cross-sectional area of a tube or rod varies directly with its weight per foot and hence a 10 per cent reduction in weight per foot represents a like reduction in the metal area of the cross-section. Therefore, considering, as an illustration, any two arcs swung from the center *P* and spaced a distance apart equal to the space between graduations *8* and *10* on the arm *AB*, a tube represented by any point on the arc furthest from *P* would have a metal cross-section 20 per cent less than any tube represented by any point on the arc nearest *P*, and the intersection of these two arcs with the line *DE* would indicate the diameters of two solid rods—the metal area of the smaller of which would represent a reduction of 20 per cent from that of the larger.

Hence, the arm *AB* may be replaced by an arm *MN*, Fig. 2, on which is mounted a sliding reduction scale *S* for the planning and investigation of reductions of metal area in drawing or rolling operations.

The distance from *0* to *10* on the scale *S* represents a reduction of 10 per cent and is equal to the distance from *9* to *10* on scale *AB*. Likewise, the distances on scale *S* from *0* to *20*, *30*, *40* and *50* represent those percentages of reduction and are equal to the distances on scale *AB* between graduation *10* and graduations *8*, *7*, *6* and *5* respectively.

Scale *S* is mounted on arm *MN* so as to slide on same and the holes C_1, C_2, C_3, and C_4 in the arm are all the continuation of the graduated edge of scale *S*.

The distances between the holes C_1, C_3 and C_4 of arm *MN* are the same as those between the similarly lettered

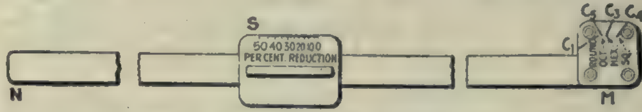


FIG. 2. REDUCTION SCALE ARM

holes of scale *AB*, while the distance from C_1 to C_2 is equal to the distance between graduations *1.000* and *1.055* of scale *AB* so that if center C_1 is used for round tubes or rods, C_2, C_3 and C_4 represent the corresponding centers for octagon, hexagon and square shapes respectively. If the arm *MN* and scale *S* are to be used for a series of reductions in which no change of shape is to occur, it is, of course, immaterial which of the four holes in the arm is placed on the pin *P*; but if a tube or rod is to be changed from a round shape to hexagonal shape for instance, the reduction percentage would be arrived at as follows: Place the arm *MN* on the chart with the pin *P* in hole C_1; slide the scale *S* along the arm and swing the arm on the pin *P* until *0* of the scale *S* is on that point of the chart representing the initial diameter and gage of the round tube or rod. Leaving scale *S* in this position on the arm *MN*, slip the hole C_3 over the pin *P*. If the arm *MN* is then swung about the center *P*, any point of the chart on the arc described by graduation *20*, for instance, of scale *S* would represent a hexagonal tube or rod whose metal area is 20 per cent less than that of the initial circular tube or rod.

Let us suppose that the metal area of the tube or rod is then to be further reduced 10 per cent and the shape changed to a square. With the hole C_3 still on pin *P* slide the scale *S* on arm *MN* until graduation *0* of the scale comes to the point representing the hexagonal tube or rod. With the scale in this position on arm *MN*, if the hole C_4 is placed on the pin *P* any point of the chart on the arc described by graduation *10* would give us the result sought; that point being selected which gives us the desired gage or outer diameter or inner diameter as the case may be.

Arm *MN* and scale *S* may, of course, be similarly used to investigate the reduction percentage necessary in drawing from any known or proposed shape, diameter and gage to any other.

The sliding scale *S* may be mounted on the arm *AB* if desired, thus combining weight scale and reduction scale. If any particular reduction percentage is used quite frequently one whole edge of the arm *MN* or the unused

edge of arm *AB* can be divided into equal spaces representing that percentage—or one edge of *MN* could be divided to represent one percentage and the other edge a second percentage and the reverse side of the arms could be used for still more percentages. The centers C_1, C_2, C_3 and C_4, however, should always be in line with the graduated edges for which they are used.

After the gage curves are plotted on the chart, the corresponding inner diameter curves are readily located from the fact that the curve for any particular inner diameter passes through the intersections of the various gage curves with those outer-diameter lines, representing outer diameters equal to the known inner diameter plus twice the gage.

Value of Inner Diameter Curves

These inner-diameter curves are useful in planning a series of tube reductions because of the fact that such reductions should be planned, if possible, so that each successive inner diameter will be smaller than the previous inner diameter by not less than a certain minimum difference in order to allow the plug for forming the new inner diameter to be slipped freely inside of the tube before reduction.

These curves will also indicate the necessity of an expansion of inner diameter under certain circumstances and will enable the point at which such expansion is to be made, to be intelligently planned in advance. In some cases it might be preferable to reduce the inner diameter a reasonable amount in each draw even if this treatment necessitates an expansion at some point in the process; rather than to attempt a series of draws, each one of which might reduce the inner diameter by such minute steps as to lead to excessive trouble in inserting the inner plugs.

The line *xy* on the chart pictures a typical tube reduction from an outer diameter of 3.0 in. and gage of $\frac{1}{4}$ in. to an outer diameter of $\frac{1}{2}$ in. and gage of $\frac{1}{16}$ in. with no change in shape. The line shown represents a 30 per cent reduction at each draw except the last and a constant inner diameter reduction at each draw.

Each dot represents a step in the process and each straight line joining two successive dots represents a draw. The outer and inner diameters at each of these dots indicate directly the die and plug to be used in the preceding draw. The dots in practice would be shifted slightly from the rigid course shown in order to use certain standard dies and plugs and minimize the number of special tools.

The Mechanics of the Future

By Joseph T. Taudvin

Continuing the line of thought that has been under discussion for some time in the *American Machinist*, regarding the merits of various apprentice systems, I would like to know what our American-born boys are doing in regard to the machinist trade.

If one would stop a moment and look over the boys and young men who predominate in our apprentice and technical high schools and the various evening trade schools, he will be surprised to note that over 50 per cent. are foreign born.

Personally, I have no fault to find with these boys. They are our coming mechanics, but I would like to see more native-born boys entering the trade. The day is fast approaching when the personnel in the machinist trade is going to be cast along more distinct lines than it is today. Our colleges and technical schools are turning out so many "M. E.'s" that the trade will not be able to absorb them.

It means two distinct classes; the superintendents and foremen will be technically trained men and the men at the bench and machine will be classed as "operators." This will not necessarily mean low wages for the men, but it will mean higher salaries for superintendents and foremen in proportion to what they are now receiving, and it will also make it more difficult for the workman to work up to the higher positions, because he will not be equipped with the necessary technical education.

The young man who considers entering the field of mechanics should seriously consider this question, unless he would be content to remain an operator or hold a minor position.

One has only to glance over the "Want Ads" in the *American Machinist* and other mechanical papers to note the qualifications required of the candidates for various positions. You will note, especially in advertisements for superintendents and general foremen, that invariably it will say, "Technical education necessary," "Must be a technical graduate," etc.

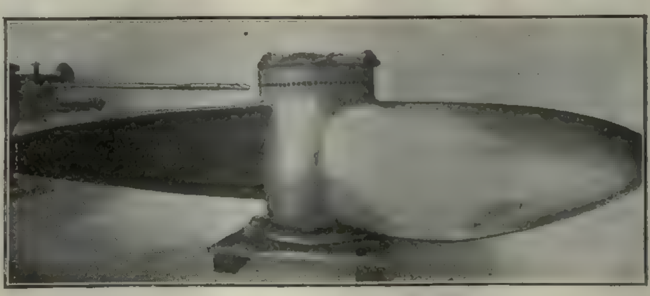
This simply shows the trend of the times and it would be well for any young man to be prepared if he wants to qualify for a good paying job in the mechanical field.

Special Work on Manganese Bronze Propellers

By Geo. F. Paul

One of the principal difficulties encountered in casting propellers from manganese bronze is the excessive shrinkage of the metal. To obviate the trouble it has been found best to allow considerable excess metal which it is necessary to cut away as a part of the machining operations.

To do this work the unit is mounted on the floor in such a way that it can be turned upon its axis and a



CUTTING OFF HUB OF PROPELLER

series of holes drilled to encircle the hub. These holes run together a short distance from the outside, and, consequently, the final removal of the head can be easily accomplished wth hammer and cold chisel. The drill is mounted in an extension socket, which is operated from a radial drilling machine or from a turret lathe or other convenient tool.

The propeller shown in the accompanying illustration is 17½ ft. in diameter. The casting as it comes from the sand weighs 31,000 lb., but is reduced to 28,000 lb. when the propeller is finished ready for installation.

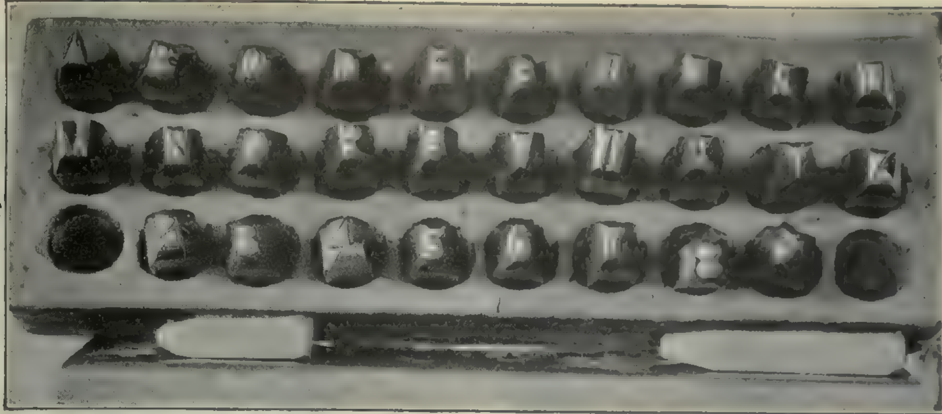


FIG. 1. SET OF PUNCHES FOR LETTERS AND FIGURES

How Hand-Cut Steel Stamps Are Made

By S. A. HAND
Associate Editor *American Machinist*

Many mechanics suppose that all steel stamps are made by forcing the annealed end of the blank into a hardened block containing an impression the reverse of the stamp to be made. Such a process may be employed in making the cheapest grades of stamps. However, in making stamps of the better grade, known as hand-cut, much skillful hand work is necessary, and the tools and methods used are herein described.

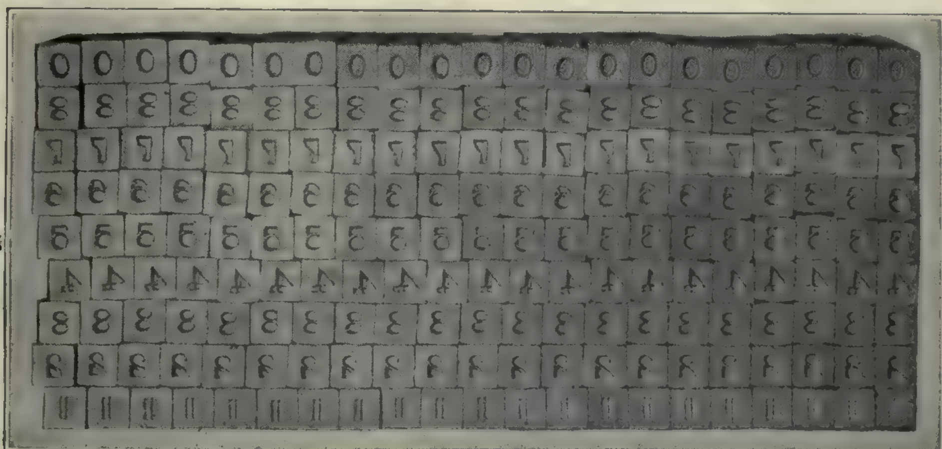


FIG. 2. FIGURE STAMPS AFTER PUNCHING

SO-CALLED hand-cut steel stamps for stamping letters or figures on metal are made of the best quality of crucible steel. The blanks are cut off in multiple in a power hacksaw which leaves the ends square enough and smooth enough so that no further finishing is necessary until after the next two operations. The next step is to scribe lines on one end of the blank with a pair of hermaphrodites to be used in positioning the punch for forming that part of the character which is below the surface. A series of such punches for making a complete set of letters and figures is illustrated in Fig. 1, while in Fig. 2 may be seen several sets of figures that have been punched.

The evolution of making a stamp for the capital letter E is shown in Fig. 3 and the following explanation should give the reader an idea of the processes necessary to make a complete stamp. *A* shows the blank after the lines have been scribed. In this condition several blanks are placed on end in a vise of the type used on planing machines but so massive in construction as to practically absorb the shocks from hard blows with a heavy hammer. Here a punch having the contour of the sunken part of the character to be made is held on top of one of the blanks and located by the scribed lines before referred to. It is then struck several blows with a very heavy hand hammer, the number of the blows depending on the depth of depression wanted.

Referring to Fig. 3, *B* shows the appearance of the blank after being punched. The operation of punching throws up quite a heavy burr which is removed by hand filing, and after this has been done, the sides are ground to a long bevel as illustrated at *C*. This is done on a wet grinding machine, the blank being held and guided entirely by hand, and while performed with great rapidity, requires considerable skill; otherwise too much stock may be ground off to allow for the proper formation of the character in the subsequent operations.

The next step is to file a short bevel on three sides

as shown at *D*. This sharpens up the lines at the top, front and bottom of the character, their thickness depending on the style of the character and the nature of the material on which it is to be used. It will be readily seen, however, that the thickness of these lines is entirely under the control of the man handling

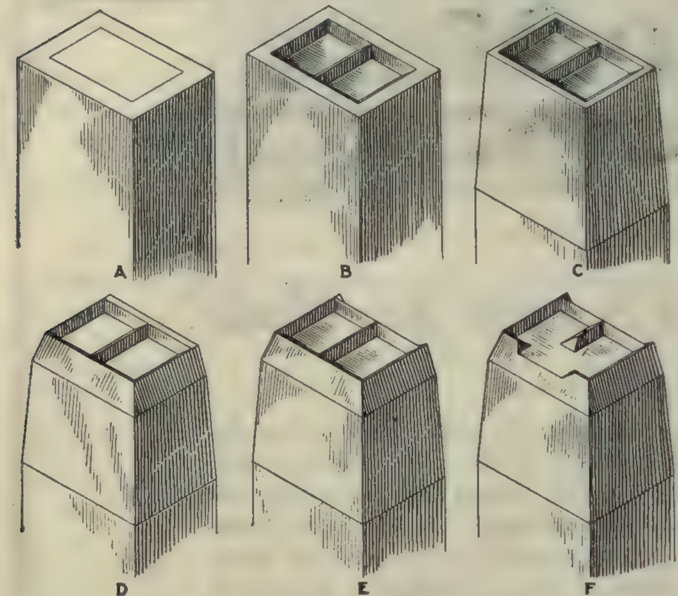


FIG. 3. EVOLUTION OF A STAMP

the file. Then the blank is so beveled at the back of the character as to bring the rear line to the same thickness as the others and also to form the two short lines that extend to the rear. The result of this is shown at *E*. Finally, the lines that are not wanted are cut away, leaving the character completely formed, as may be seen at *F*. It will be readily seen that this ~~letter could~~ easily have been made into a capital F by cutting off the lower short vertical line at the front of the letter and part of the bottom line.

If, after filing, it should be necessary to sharpen up any of the inside corners or to do any work on the interior of the character, a hand graver is used.

The maker's name and trade mark are stamped on the side of the shank under a hand-operated drop press.

For hardening, the stamps are heated in a gas-fired muffle furnace and quenched in water. The temper is then drawn to a straw color on an open plate heated by bunsen burners and the stamps again quenched in water.

FIG. 4. ALPHABET STAMPS READY FOR USE

In making stamps smaller than $\frac{3}{16}$ in. all filing and cutting with a graver, a magnifying glass such as used by watchmakers, is constantly employed.

When in use, stamps often have parts of their character lines broken and the makers say that this may be the result of not holding the face of the stamp flat on the work when striking it with the hammer but more often by trying to deepen the impression in the work by striking the stamp several blows in succession and that if the character lines of the stamp are not seated in those of the impression previous to each blow they are very likely to be fractured.

The manufacture of the stamps is wholly a series of hand operations, each one of which requires great skill and good sight on the part of the workman.

The description of the processes as outlined in this article was obtained during a visit to the plant of the Hoggson & Pettis Manufacturing Co., New Haven, Conn.

A Little Question of Trigonometry

By H. V. Reed

A much simpler solution of the problem on page 713, Vol. 51, is as follows:

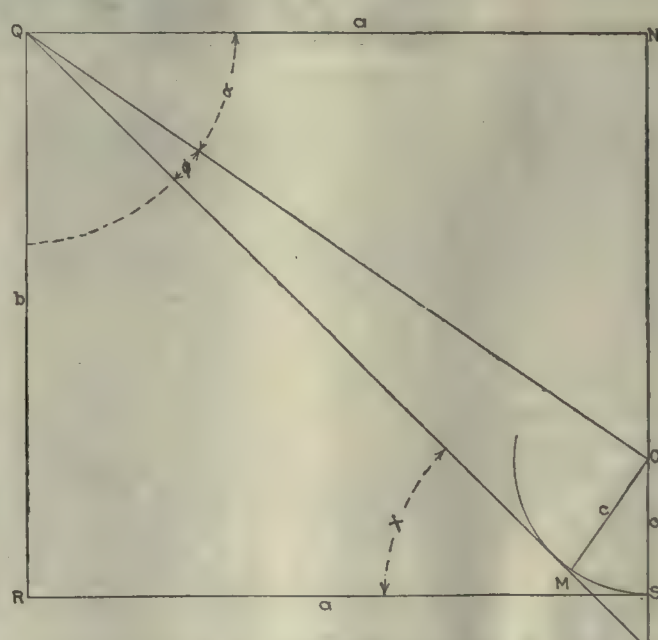
Referring to the figures, it will be evident that

$$QR = b$$
$$NQ = RS = a$$
$$OS = MO = C$$
$$NO = b - c$$

In triangle *NOQ*,

$$QO = \sqrt{a^2 + (b - c^2)}$$
$$\sin \alpha = \frac{NO}{QO} = \frac{b - c}{\sqrt{a^2 + (b - c^2)}}$$
$$\text{Also, } \sin \phi = \frac{MO}{QO} = \frac{c}{\sqrt{a^2 + (b - c^2)}}$$
$$X = \alpha + \phi$$

[The editor takes this opportunity to thank the numerous other contributors who sent in solutions similar to Mr. Reed's. His is published because it arrived first.]



A TRIGONOMETRY PROBLEM

Application of Sandblast to General Foundry Work–II

BY H. D. GATES

Ample protection for operators should stand foremost in the minds of the designers of sandblast equipment. This is accomplished to some extent by providing mechanical means of handling material, with accompanying savings in labor cost and time.

THE trend toward rooms that entirely remove the operator from the sandblast inclosure has developed devices of different types to meet every demand. These rooms consist essentially of a sight screen through which the operator may see his work, while below are openings closed by sectional flexible curtains, through which the operator directs the nozzle on the work to be cleaned. An exhaust is provided to remove the dust, so as to permit free observation of the work. Where long or heavy work is to be cleaned, the equipment is arranged as shown in Fig. 9. In this way pieces 20 to 30 ft. long are readily cleaned in an enclosure but little more than half their length. When the output of the foundry does not include work larger than the area of one-half of a 90-in. diameter circular table, a semicircular cabinet, Fig. 10, with a turntable mounted on dust-proof ball bearings offers an ideal equipment. Installations of this kind are easily equipped with abrasive separators, dust exhaust, and storage bins.

All the installations described provide for the sandblast to be located at the floor level. Where floor space is at a premium, the sandblast can be located in a concrete hopper below the floor and the abrasive for re-use passed to the separator by gravity. This type of installation eliminates the use of the elevator and conveyor. General utility and ease of access has recommended the floor-level type where floor space will permit.

While the above installations with the hose machine will clean any and every character of work possible with any other type of sandblast, the fact must not be lost sight of that economy of cleaning with this device decreases as the size of the pieces become smaller, requiring added time and labor for individual handling.

MECHANICAL HANDLING

For the plant that has a tonnage of small work sufficient to warrant special equipment, the barrel sandblast, or the rotary-table sandblast, or both in combination, will be found time and money savers and are of further advantage in that their operation is entirely hygienic and relieves the operator from any contact with the dust-laden air.

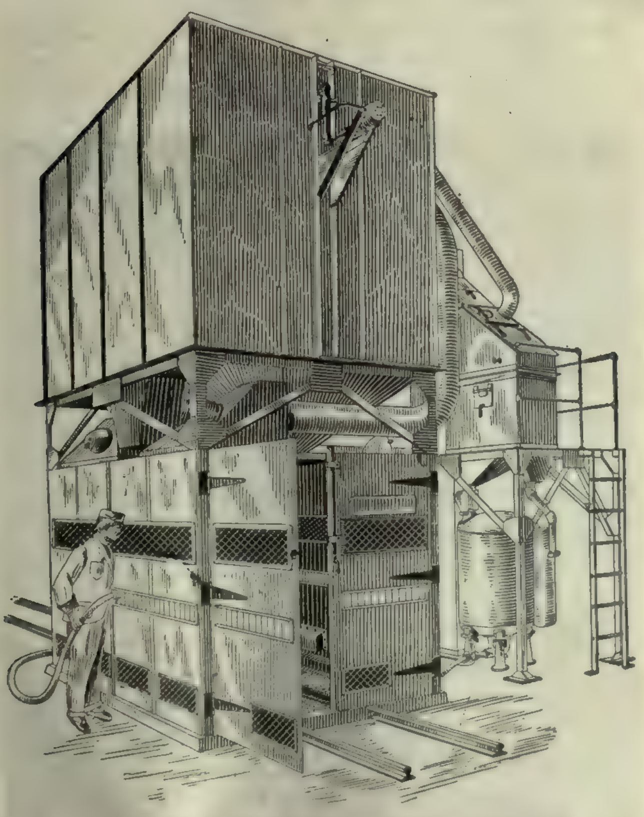


FIG. 9. A SANDBLAST INSTALLATION SUITABLE FOR LONG AND HEAVY WORK IN WHICH THE OPERATOR WORKS OUTSIDE THE INCLOSURE

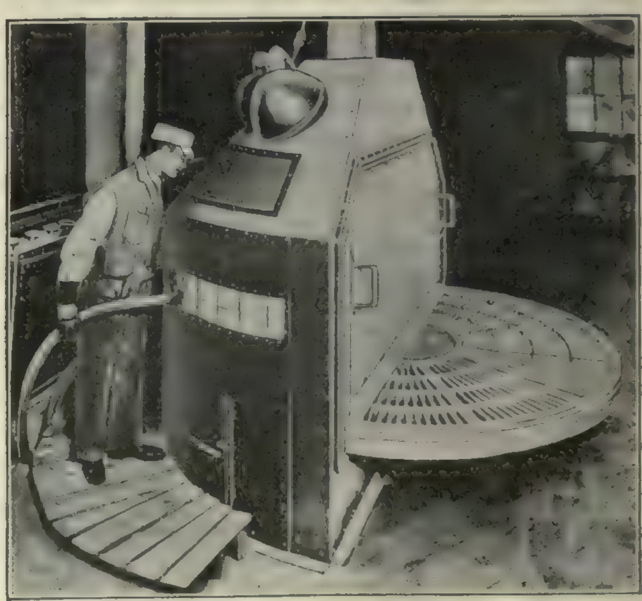


FIG. 10. A REVOLVING TABLE SANDBLAST CABINET DESIGNED FOR CLEANING MEDIUM-SIZE CASTINGS

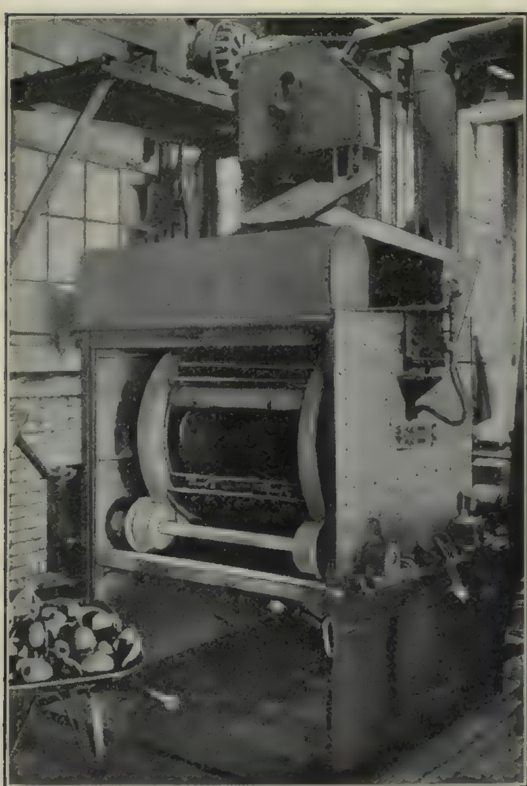


FIG. 11. THE REVOLVING-BARREL OR DRUM TYPE OF SANDBLAST MACHINE

The barrel sandblast, Fig. 11, consists of a slowly revolving drum, a detail of no little importance, necessary so as not to damage square corners or ornamentations, within a steel case, into which are introduced sandblast nozzles that blast the pieces as they are turned over. The construction of the drum is such that in turning every surface comes in contact with the sandblast. These units are self-contained, the spent abrasive falling through perforations in the drum and thence to a hopper, from which it is raised by a elevator, cleaned and screened, and delivered by gravity to the nozzles for re-use. In this type of machine the interior of the drum is entirely unobstructed and it will receive pieces up to the limit of the door opening size. Machines of the suction type have a manifold running through the center with a series of nozzles, and as the abrasive falls through the drum perforations it is passed through a series of screens to feed boxes, from where it is raised by suction to the nozzle and, in combination with the air, projected onto the work. Machines of this type are more efficient for smaller pieces, such as valve bodies, pipe fittings, etc., from which cores are to be removed.

For work of a fragile nature, such as stove plate, precision work, or pieces whose shape and size will not permit rolling within the drum, the automatic revolving-table sandblast, Fig. 12, is of greatest utility.

In this device a grated top table *A* is half exposed and half contained within a steel case *B*, wherein the blasting operation takes place. The opening at the front of the case to permit free passage of the castings is closed by multiple, flexible, sectional curtains *C* that retain the flying abrasive and dust during the passage of the work. The pieces are loaded onto the exposed half of the table by the operator, and as they emerge from the blasting chamber they are turned, as necessary, to bring all parts under the blasting action, until thoroughly cleaned, when they are removed and new work loaded. This type of table will handle material as fast as a man can load and unload it.

The cleaning is done by multiple nozzles which oscillate so that the pieces are blasted from all angles. The blast action is of the direct-pressure type, the nozzles being fed from a direct-pressure hose machine beside the table. Operation is continuous, the spent abrasive falling through the grated table top, being carried by an elevator to the abrasive separator *D* that cleans the abrasive and delivers it to the sandblast *E* for reloading.

The above devices are equally adaptable for the cleaning of brass and aluminum, as well as iron and steel, and are recommended to brass foundries of sufficient tonnage to warrant cost of installation and operation.

For the Small Foundry

There is, however, as much advantage in the cleaning of brass or aluminum castings with the sandblast as in the ferrous metals, and when cleaned on the gates the result is economy of time and labor and clean scrap. For the small jobbing brass foundry a unit such as shown in Fig. 13 meets the requirements from every point of view. The initial cost is not large, floor space required is small and, being of the suction type, it is self-contained and continuous feeding, as well as hygienic, the operator not being exposed to the dust-laden air.

These cabinets, which are made in various types and sizes, are equipped with either stationary or flexible nozzles. In larger sizes the nozzle is supported by an arm adjustable in all directions and reaching every part of the cabinet. With the stationary nozzle the pieces are turned under the blasting stream, while in the larger type with the adjustable arm larger and heavier pieces can be cleaned, the nozzle being moved as required, instead of turning the work.

Regardless of the type of equipment used, adequate means of ventilation for the removal of dust must be provided. This is accomplished by exhaust fans of

FIG. 12. A REVOLVING-TABLE SANDBLAST SUITABLE FOR SMALL AND FRAGILE WORK

proper capacity. The disposal of the dust is a point which demands serious consideration. If the plant is isolated, the dust can be discharged into the open, but where harmful effect might result either to the shop or the neighborhood it is advisable to separate the dust from the air. This can be efficiently done by either the common centrifugal separator modified to meet surrounding conditions, which will suppress about 90 to 95 per cent. of the dust, or the cloth screen type of arrester, which suppresses all the dust.

Kinds of Abrasives

Various kinds of sand are now mined and graded for sandblast use. Sands which are hard, sharp, clean, with the least disintegration, not only show longest life and highest abrasive quality, but create less dust. River or bank sands are rarely economical even at lowest first cost. Ocean sands are quite satisfactory, but undoubtedly the white silica sands, where available, are most desirable. In fact, by their hardness and uniformity they undoubtedly prove most economical at a higher first cost.

Metal abrasives in the form of chilled shot, crushed steel, etc., are produced by different manufacturers, each making claims for their superiority. Of the life of the metal abrasives over sand there can be no question, and this will range from 20 to 60 times. Disintegration is at the minimum and almost no dust is created from the metal abrasive itself.

In this connection, however, the much higher first cost demands an absolutely tight inclosure throughout, as any daily loss, even though small, will soon wipe out the saving in efficiency. The selection of sand or metal abrasive will present several features for consideration. If the work to be cleaned is reasonably free from sand, considerable advantage in operating conditions will be found by the use of metal abrasives, owing to their creating practically no dust by their own disintegration. If the work is cored or carries a large volume of sand, the advantage from the metal abrasives in this connection will obviously be greatly decreased, and the dust created by the disintegration of the blasting sand itself will not materially increase the dust volume arising from the castings.

Where pieces are to be galvanized or plated, some complaint has been registered against the use of metal abrasives, in that the fine metallic dust adhering to the pieces prevent satisfactory results in plating. For general foundry output, however, the character of the work itself, with the delivered cost of the various abrasive, will readily determine the economy of one over the other.

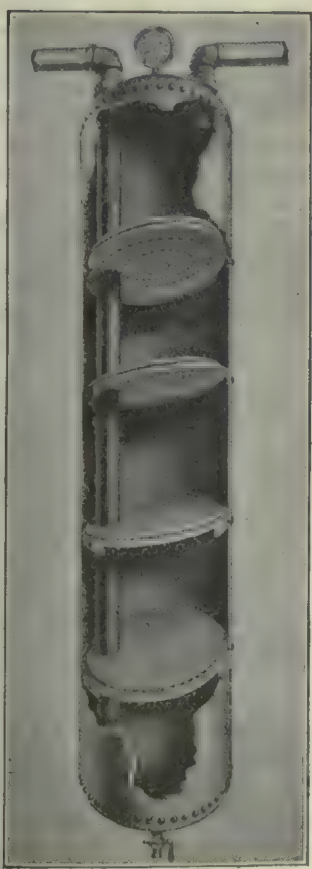


FIG. 14. TYPE OF MOISTURE SEPARATOR RECOMMENDED BY THE UNITED STATES EMERGENCY FLEET CORPORATION

All modern sandblast devices can use, with equal facility, either sand or the various metal abrasives.

Dry Air an Important Detail

One of the frequent causes of unsatisfactory operation of the sandblast is the presence of moisture in the air line, which, if in sufficient volume to make the sand at all plastic, will naturally prevent an even, steady flow of the abrasive. When metal abrasives are used, the mixture of moisture with the fine metallic dust frequently tends to rust the abrasive into a solid mass. Any device that will eliminate the moisture will be of a decided advantage not only in connection with the sandblast but with all pneumatic tools. The United States Emergency Fleet Corporation in a recently issued Standard Practice Bulletin describes a satisfactory device for this purpose, and from which we quote:

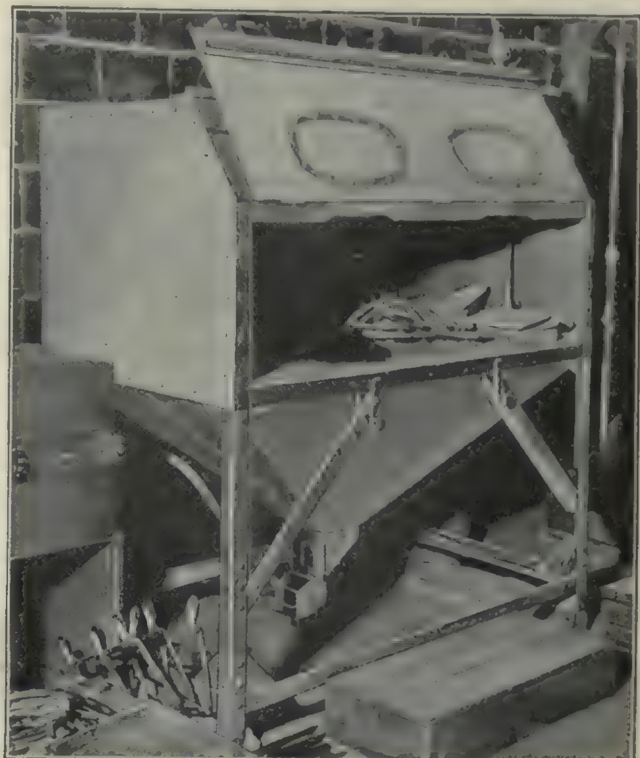


FIG. 13. A SMALL SELF-CONTAINED SANDBLAST FOR SMALL FOUNDRIES AND SUITABLE FOR CLEANING BRASS, IRON AND STEEL CASTINGS, FORGINGS AND STAMPINGS

"It is the object of this communication to call attention to the importance of a second step which should include provision for effectually separating and draining the water of condensation from the piping system.

"The water cannot be properly taken care of merely by placing drain cocks on low points in the ordinary piping system, but should be removed by special separating tanks or chambers located at these points and near the distributing manifolds.

"The separating chambers should be large enough to lower the velocity of the air to a point where entrained water or dirt will not be carried through with the air current, and should be fitted with bafflers or connections which will change the direction of flow, so as to precipitate the entrained matter."

An illustration (Fig. 14) of this device is shown, and its installation on the air line near the various tools

will assure freedom from moisture troubles and will save in lost time their first cost in a comparatively short period.

While the material advantages of sandblasting are few in number, yet their importance is of no small consequence. Sandblasting removes the entire destructive scale from the casting which on the contrary is intensified by rumbling and cleans castings that, due to their fragile nature, cannot be rumbled. The appearance of castings is very much improved, and whether castings are to be galvanized, painted, plated or machined, the surface produced by thorough sandblasting assures perfect results with minimum costs.

Cost of Making a Pair of Offset Centers for a Crankshaft

By W. D. Forbes

On page 605, Vol. 51, of the *American Machinist* Wesley McArdell comments on the methods I used in making a pair of offset centers for turning an engine crankshaft, a description of which appeared on page 300 of the same volume.

Considering the awkward way in which the work was done, he thinks the time taken was not bad. He considers that some of the work was done in a unique way, and describes how he would do it, but fails to give an estimate of the time required.

If Mr. McArdell has ever made such a pair of centers of about the same size, I would be interested to see his time cards; or, if he never made them, his estimate of the time that should be taken would be of equal interest.

The use of the machines specified in my article for the work assigned to them seems to me to be perfectly legitimate. If a boring mill is evidently well suited to a certain job why not do that job on a boring mill? Almost all machine-shop work can be done on a lathe; yet we have planing, milling, and grinding machines, etc.

I maintain that the work as described by me is simpler than Mr. McArdell's methods. The main point is to accurately locate the holes for the crankshaft and centers a given distance apart and still keep them parallel. This measurement is not one where tenths of thousands count and the screw in either boring mill or milling machine would be equally serviceable for the spacing.

Leaves Plugs Without Centers

The way in which Mr. McArdell would make the tool-steel plugs would leave them without centers. Besides, working back of a shoulder as he describes demands very close calipering to make a fit, and if, after cutting the piece off, it is found to be not just right, it would be more difficult to correct it because of there being no center in one end. Most machinists will admit that to leave centers in a lathe job is the usual practice.

Mr. McArdell also advocates holding the bar in a four-jawed chuck. I have no doubt that on mature reflection, he would admit a three-jawed chuck would hold it as well as a four-jawed one.

A few days after my article appeared in the *American Machinist*, one of the best toolmakers in my town came to see me and he asserted that the 13 hours taken for the work was about four hours too much. I tried to get him to write his way of saving this time, but, with the diffidence that so often deters an otherwise competent man from expressing himself and thus deprives the readers of technical magazines of many valuable suggestions, he declined. I could not get him to understand that it was ideas—not words—that the *American Machinist* required; so long as the former were made clear the editors would look after the wording.

As I could not induce him to write, I am sending you the details of his method. He said: "I would cut the bar to the length of the two pieces; prick-punch one side for a witness mark; clamp it to an angle plate on the planing machine with the prick-punched side to the angle plate and finish one edge only. Thus I would save most of the planing work.

Boring the Holes

"After parting the piece in the middle I would set up the two slabs on the horizontal boring mill with the prick-punched faces together, the pieces resting upon the planed edges on the table of the machine. With a starting drill in a taper socket fitted to the spindle of the machine I would start the center of the large hole; then put through the large drill and finish the hole to exact size with the boring bar.

"Shifting the table over the proper amount to give the required distance between centers, I would again use the starting drill, but would make this hole at least 1¼ in. in diameter, as I like something good and stocky if possible and there is no reason for a small diameter here. I would just clean this hole with the boring cutter, paying no attention to size. All I would want is a true hole. This would give me the four holes in line and properly located.

"For the centers I would cut each piece to length, but I would not make it more than half the thickness of the slab plus the length of the head, as I see no reason for greater bearing. I would center these two tool-steel pieces; finish them all over; and hold them in a draw-in chuck while enlarging the countersink in the large end to a proper size and depth. While in the chuck I would drill a small hole almost through the length, then I would harden the large ends and carefully clean out the centers.

Provisions for Oiling

"When I had forced the centers into the webs I would drill a small hole down through the webs and the shanks of the centers, and use these holes for oiling. I have found this dodge to work very well and it takes very little time to do the drilling. Only one of the centers would require oil, but it would pay to finish both in this manner, for, if one begins to cut, the webs can be changed or the centers knocked out and transposed. The corners and edges I would touch up on an emery wheel and save most of the vise work.

"I know the job would not look as nice as if planed all over and I like to see jigs and tools look nice, but such things as these will not be better handled if bright and I know I would be at least four hours ahead of your time of 13 hours."

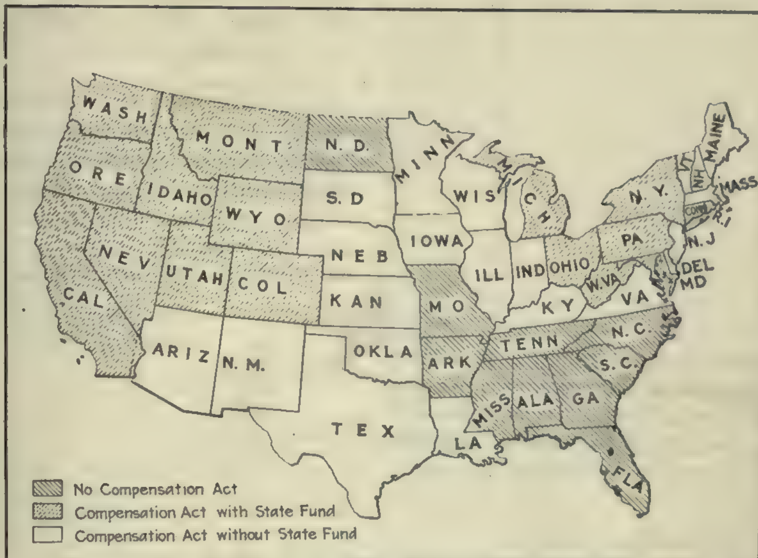
Referring once more to Mr. McArdell's criticism: The soft plug he refers to is well known to all mechanics but it has to be made, although a piece of rod brass cut off at little cost might answer very well. I have found, however, in any position like the one in question the slotted relief saves trouble.

A Workman's Compensation Digest

By CHESLA C. SHERLOCK

We have published several articles from the pen of Mr. Sherlock dealing with the technical features of the workman's compensation acts. In this digest of the practice in those states which have compensation acts, the author sums up the available information and presents it in tabular form for the benefit of the man who hasn't the time to dig it out for himself.

TO really understand the workmen's compensation acts is practically impossible, unless a digest is made of the acts and a comparison made between them. This is especially true of the large employer who does business in several different states. Without the aid of a digest he will never know so very much about the inner working points of the system. To this end, the accompanying digest has been prepared. It was intended to give the employer a handy working reference of the more important points arising under the compensation acts, all touching intimately upon the question of the employer's liability. Other matters, of a more technical nature, have been considered from time to time in the past. The accompanying map will give a fairly accurate outline of the spread of the compensation idea over continental United States. Only ten states remain without a compensation act of some nature, and the chances are that by the time this appears in print one or two, possibly more of them, may have changed their character. This progress has all been made within the last nine or ten years.



THE GROWTH OF THE COMPENSATION IDEA

While the principles underlying the workmen's compensation acts are the same everywhere, the indifference and carelessness with which some of these laws have been framed and enacted has resulted in a wide difference of liability being recognized in different states. The first statute adopted in the United States, that of New York, was closely patterned after the English act of 1906.

The other states to follow New York's example borrowed their acts largely from New York, adding amendments as it suited their whims. The result soon became a mixture of the original English act and a number of fantastic amendments which so completely changed the character of the law in different localities as to work hardship upon the workman it sought to protect.

The industrial conditions, speaking in a broad sense, are practically the same the country over. At any rate, the value of a workman's life or limb should not be higher in one community than another, if you want to look at the matter in an impartial light. Yet, many workmen would be vastly better off if they were injured in New York, for instance, than in Kansas. There is a difference, in liability, between those states of all the way from 16⅔ to 41⅔ per cent. in the employer's liability for accidents occurring in those states.

The difference, however, does not rest entirely with the workman who happens to be injured; it rests likewise with the employer—especially the employer who happens to transact business in more than one state.

The misunderstandings which arise in the compensation field among employers are very largely due to a misunderstanding as to this liability. The statutes, unfortunately, are not the same everywhere, and this only emphasizes the need of every employer to acquaint himself with his measure of liability wherever he may happen to be doing business. Practically every state has what is called a "waiting period"; that is, the length of time which must elapse after an accident before the workman can collect compensation from his employer. This waiting period varies in the respective jurisdictions, but its average length is two weeks. See Table I.

The purpose of the waiting period is two-fold. First, it is to give the employer an opportunity to investigate the accident and satisfy himself as to the genuineness of the injured workman's injury, and to discourage malingering on the part of said workman. The second purpose of the waiting period is to give the employer a leeway of time before compensation liability attaches so that he will not be hit so hard financially. The law requires the employer, after the accident, to furnish immediate medical, surgical and hospital relief. It is thought that this burden, together with immediate payments of compensation would be unequal. Since the employer and workman are to share the loss occasioned by the accident, it was deemed equitable that the workman should wait for a time for his compensation.

It is well for employers to note a point here that will be considerably to their advantage. Unless the workman is still incapacitated at the end of the waiting period, and unable to return to work, or still suffers an impairment of his earning capacity, no compensation liability except the medical and hospital attention attaches to the employer.

This, of course, is not true in a case where a workman suffers what is known as a "schedule injury," which may be better illustrated as saying a loss of a finger, arm, hand, leg, sight of one or both eyes, or any other form of permanent disability. These injuries are to be compensated at the amount scheduled in the statute regardless of the time elapsing before the workman can return to his work, the law *presuming* that he has been impaired in his earning capacity to the extent mentioned in the schedule.

TABLE I. WAITING PERIOD

	Weeks
Arizona	2
California	2
Colorado	3
Connecticut	10 days
Illinois	1
Indiana	2
Iowa (absorbed)	2
Kansas	2
Louisiana	1
Maine	2
Maryland	2
Massachusetts	10 days
Michigan	2
Minnesota	1
Montana	2
Nebraska	2
Nevada	2
New Hampshire	2
New Jersey	2
New York	2
Ohio	1
Oklahoma	2
Ontario	1
Oregon	None
Pennsylvania	2
Rhode Island	2
South Dakota	2
Texas	1
Vermont	2
Washington	None
West Virginia	1
Wisconsin	1
Wyoming	10 days

But in an ordinary case, if a workman is incapacitated only for the waiting period or less, no compensation is due, although the writer has known employers who paid compensation amounting to several hundred dollars in the course of a year which they were not legally liable to pay.

Beginning of the Waiting Period

Contrary to the general opinion, the waiting period does not necessarily commence to run at the same time the accident occurs, although it may commence to run at that time, and, in fact, generally does. The waiting period technically commences to run only when the workman is incapacitated for work and then the employer's liability for the payment of compensation does not commence to run until after the waiting period has expired.

Let us take a specific case by way of example. Let us suppose that a workman is injured in New Jersey. He receives a fall while engaged in his employer's business which does not at the time incapacitate him from work, but a week later, by reason of his injury, he is forced to quit work.

At this point the waiting period of two weeks in New Jersey commences to run. If he needs medical attention or hospital attention, the liability to furnish it attaches at once to the employer. But outside of that, no liability has attached to the employer.

The workman is given two weeks' good care and attention. At the end of the two weeks, he is not completely recovered, but he is practically so. It is then that the employer's liability for compensation arises and that liability is based on the exact length of time after the waiting period that the workman is unable to return to work. If he returns to work three days after the waiting period has elapsed, then the employer is liable for only three days' compensation and not for three weeks and three days' compensation, as many employers would suppose.

A glance at Table I will show that the length in which the waiting period runs varies greatly in the different states. The chances are that it will be changed some more by the legislatures of the respective states, for there has been a tendency on the part of many to criticize the waiting period as being unnecessary, or at least too long.

Objections to the Waiting Period

There can be no doubt but that it does work a hardship on many workmen to have to wait three weeks before they receive any compensation, in many of the states, and then have the compensation amount, on an average, to only one-half of their average wages for the same period.

The average workman, even in the era of high wages, lives by a "hand to mouth" route and an accident generally catches him at a time when his resources are of the very lowest character. I have witnessed this again and again.

They have one big, outstanding objection to the waiting period and they have succeeded in making their objections heard in many jurisdictions. To the honest workman, there probably is no necessity of a waiting period, while for the small employer, especially the employer who is attempting to carry his own compensation risk, there certainly is a great need for it.

TABLE II. MEDICAL LIABILITY

	Amount	Time
Arizona	None	None
California	....	90 days
Colorado	$100	30 days
Connecticut	...	30 days
Illinois	200	8 weeks
Indiana	...	30 days
Iowa	200	4 weeks
Kansas	...	None
Louisiana	150	2 weeks
Maine	30	2 weeks
Maryland	150	....
Massachusetts	No limit	....
Michigan	...	3 weeks
Minnesota	200	90 days
Montana	50	2 weeks
Nebraska	200	21 days
Nevada	...	4 months
New Hampshire	...	None
New Jersey	50	2 weeks
New York	...	60 days
Ohio	200	....
Oklahoma	...	15 days
Ontario	...	None
Oregon	250	....
Pennsylvania	75	....
Rhode Island	...	2 weeks
Texas	...	2 weeks
Vermont	75	1 week
Washington	...	2 weeks
West Virginia	150	None
Wisconsin	...	90 days
Wyoming	...	None

But of all the states in the union having compensation acts, only two, Oregon and Washington, have seen fit to dispense entirely with the waiting period. While it varies in the others as to time, the fundamental features of the example applied to New Jersey, above, applies in all the other states.

Iowa, however, occupies a unique position among the states in regard to the manner in which she has handled her waiting period. The period is left at two weeks, in order to secure all of the advantages of the long waiting period to employers; but if the workman's incapacity lasts more than seven weeks, he receives

extra compensation to cover the loss sustained by the two weeks waiting period in the beginning.

This is accomplished by "absorbing" the waiting period in the fifth, sixth and seventh weeks of incapacity, the workman receiving one-third of the two week's compensation during each of those weeks.

If a workman is drawing $9 per week compensation, he would receive that $9 compensation and in addition $6 in the fifth, sixth and seventh weeks of incapacity, so that at the end of that time, he would be entirely reimbursed for the loss occasioned by the waiting period.

The workman who is not incapacitated for seven weeks or even five weeks oftentimes raises a loud objection to this arrangement; but it is pointed out by the advocates of this method that he is no worse off than if he was under the ordinary plan. While not being incapacitated that long, he is able to return to work, drawing full wages, and does not need the extra benefit so much as the man who cannot return to work at once, but who must linger longer upon his compensation payment. The plan seems to be feasible for other states and it will doubtless do much, if adopted, to settle the disputes so often raised over the waiting period.

Only One Waiting Period in Each Case

Another point concerning the waiting period must be noted before we pass on to a consideration of other problems. It is a well settled rule of compensation practice that no more than one waiting period can be

TABLE III. PERCENTAGE OF PAYMENT

Massachusetts	66⅔
New York	66⅔
Ohio	66⅔
California	65
Wisconsin	65
Kentucky	65
Texas	60
Iowa	60
Indiana	55
Ontario	55
Arizona	50
Colorado	50
Connecticut	50
Illinois	50
Louisiana	50
Maine	50
Maryland	50
Michigan	50
Minnesota	50
Montana	50
Nebraska	50
Nevada	50
New Hampshire	50
New Jersey	50
Oklahoma	50
Pennsylvania	50
Rhode Island	50
Vermont	50
West Virginia	50
Oregon	$30 to $60 per month
Washington	$15 to $60 per month
Wyoming	$15 to $35 per month
Kansas	$25 to $50 per month

deducted from the workman's compensation for any one injury.

Employers are fully aware of the fact that an injured workman will often attempt to return to work several days before he is physically able to do so. Oftentimes he suffers a relapse after working a day or two before being able to resume his employment permanently. And I have known workmen to try this many times before being able to take up the old work. This does not mean that every time a workman suffers a relapse that the employer can commence to deduct a new waiting period and thus either cheat the workman out of any compensation at all, or else practically force him to become a malingerer in self-defense.

The proper way to arrive at the amount due the workman is to add up the total number of days lost from work due to the injury in such a case and then deduct the number of days allowed by the waiting period and pay compensation for the balance remaining. This is fair to the employee and fair to the employer and when explained to the employee will make him a much better workman than to attempt to indulge in petty technicalities to escape the payment of a few dollar's compensation.

While Table III on the percentages of wages upon which compensation is to be paid, is valuable for employers, Table IV, which contains the minimum and maximum amounts which the employer is liable to pay, is probably more valuable.

The amount of the medical aid for which the employer is liable varies probably more than any other feature

TABLE IV. MINIMUM AND MAXIMUM PAYMENTS

	Minimum	Maximum
Arizona	.....	.....
California	$4.16	$20.83
Colorado	5.00	8.00
Connecticut	5.00	10.00
Illinois	6.00	12.00
Indiana	5.50	13.20
Iowa	6.00	15.00
Kansas	6.00	15.00
Louisiana	3.00	10.00
Maine	4.00	10.00
Maryland	5.00	12.00
Massachusetts	4.00	10.00
Michigan	4.00	10.00
Minnesota	6.50	11.00
Montana	6.00	10.00
Nebraska	5.00	10.00
Nevada (month)	20.00	60.00
New Jersey	5.00	15.00
New York	5.00	15.00
Ohio	5.00	12.00
Oklahoma	6.00	10.00
Ontario	.....	21.15
Oregon (month)	.....	50.00
Pennsylvania	5.00	10.00
Rhode Island	4.00	10.00
Texas	5.00	15.00
Vermont	3.00	12.00
Washington (month)	.....	35.00
West Virginia	5.00	10.00
Wisconsin	4.69	9.37

of the compensation acts, as a glance at Table II will show.

The legislatures of the states have recently passed amendments covering this feature, the majority of them increasing either the total money amount for which the employer is liable, or else extending the period of time over which the liability for the amount previously designated in the statute is to apply.

The Iowa legislature has increased the amount up to $200, in the discretion of the industrial commissioner, just doubling the amount previously granted. This is to extend over the first four weeks of incapacity and without that period the workman must furnish his own medical attention.

Employer's Maximum Liability Fixed

It is understood, of course, that the latter table governs, so far as minimum and maximum payments are concerned, the percentage table governing whenever practical. This is deemed necessary by the statutes because it was thought worth while to have the employer's maximum liability definitely fixed in order that he could have a definite basis of liability upon which to base his application for insurance elsewhere if he did not care to carry the risk himself, or was not permitted to do so by his state laws.

The map is principally worth while to employers doing a national business in that it shows at a glance just

what states have state fund insurance and what states permit employers to carry their own insurance, under reasonable regulations, or else insure it in private companies.

Obviously, where the state fund is in use, it is up to the employer to insure his compensation risk with the state fund and, indeed, this is made compulsory in most of the states having that basis of insurance.

It is not our purpose to enter into the merits of this subject, but state fund insurance has always met with instant approval on the part of the working classes because it insures them absolute protection in case of injury, in that the faith and credit of the state is back of their claim, while oftentimes private companies have fallen into the hands of receivers at the wrong time and compelled workmen to go without their full payment. In the latter instance, of course, the employer is still liable, being the person primarily liable, and the workman can ultimately recover compensation if his employer is financially able.

Increased Production by the Use of Proper Gages

By GEORGE T. TRUNDLE, Jr.

The intention of this article is to show that gages are extremely necessary wherever the quantity of production warrants making them. One of the factors in determining what this quantity should be, in order to render the use of gages economical, is the amount of scrap made in the manufacturing department by mistakes in reading scales, micrometers and other measuring instruments.

FROM the writer's experience, he thoroughly believes that gages will increase production rather than decrease it. The first problem in the manufacture of any device is to prepare a complete set of drawings and specifications in which the tolerances are designated. In establishing tolerances, there are so many things that must be watched, both from the manufacturing and the engineering standpoint, that the men undertaking this task should have: First, a thorough knowledge of the device to be manufactured; second, a thorough knowledge of the manufacturing methods used in that particular plant.

The writer has studied, with much interest, the article by Fred. H. Colvin, under the heading, "Standardization and Interchangeability: Factors Which Help or Hinder According to the Work in Hand," published in the *American Machinist*, page 1143, Vol. 50. The article is educational and should be read by every engineer and production manager.

Accuracy in Dimensions

On every device or machine, whether the parts go from the foundry direct to the assembling room or undergo various machining operations, there are some dimensions that require a certain degree of accuracy and this accuracy should be controlled by gages. It is not necessary that all gages should be made by high-grade toolmakers and held to one ten-thousandth of an inch. Neither do they need to be polished as though they were to be used for watch charms or ornaments. What we must have, however, are practical gages.

There have been instances where gages made with a hacksaw and file from sheet metal have not only saved many thousands of dollars, but their use has increased production. So, in speaking of gages, I mean practical gages.

Inspection and gaging of castings should start in the foundry. If a pattern becomes badly distorted, it is a waste of labor and money to continue making castings from it. The same conditions are true if there should be a change in the methods of molding, even though the patterns are perfect, that will cause the castings to warp so that they cannot be used. Many such castings have been returned to the foundry for this reason, though sometimes this condition was not discovered until numerous machine operations had been performed on them entailing great loss to the manufacturer. Very simple gages in most cases in the hands of a competent inspector in the foundry would eliminate this loss.

Cutting off rods to length, with a tolerance of plus or minus ten one-thousandths of an inch, is a very simple operation, no great accuracy being required. Give the job to an operator on a hand screw machine, without gages, and he will either spend time watching the length or the variation will be beyond the liberal tolerance allowed. I have known many instances where such lengths have varied one-eighth of an inch in either direction. The use of a simple snap gage, either a standard gage adjusted in the gage department or one made of sheet steel, would increase production and relieve the foreman of the worry as to whether the parts will be made correctly.

The point that I wish to bring out is the fact that a gage with fixed dimensions will save both the operator's and the foreman's time. There are times when there are numerous dimensions on a part to be machined; the operator must keep a blueprint directly in front of him or attempt to carry the dimensions in his head, unless he is provided with gages. Reading blueprints takes time, measuring by a scale and micrometer takes time, and there is always the possibility of mistakes. The attempt of the operator to carry the dimensions in his head is only inviting trouble.

Interchangeable Manufacturing

We want to send parts to the assembling room in lots where they must interchange with other parts and to send out repair parts that must fit. In order that these parts shall be right, the men establishing the tolerances must be familiar with both the device and the manufacturing facilities at hand and the one thing that they must be extremely familiar with is the parts that are liable to require replacement from wear.

In establishing tolerances, much thought should be given to the neutral point or clearance. For a hole

one inch in diameter with a plus tolerance of 0.002 in., the general practice is to make the shaft 0.999 in. with a minus tolerance of 0.002 in. Now, if the shaft comes to the minimum size and the hole to the maximum, there will be 0.005 in. clearance. In providing gages for this, we might make one plug gage for the hole 1.002 in. which must not go, and another one 1.00 in. which must go. One ring gage for the shaft we might make 0.999 in. which must go, and another one 0.997 in. which must not go.

If the neutral point is watched carefully, interchangeable manufacture can be accomplished with very little selective assembling. On most machines and appliances, the number of very accurate dimensions is small compared to those that do not require such accuracy; we must therefore lay stress on these points in our manufacturing department, make good gages, provide efficient inspection and do a given amount of selective assembling. It is oftentimes a waste of energy and money to scrap parts that are slightly outside of the tolerances allowed.

There should always be two sets of tolerances, one for the factory and one for the final-inspection department.

The tendency in the manufacturing department, where everyone is under tension to get out production, is to let a machine run just so long as the gage will pass the job. It is not long until the tool will wear or some slight change in the machine adjustment will cause the piece to be slightly off gage, either large or small. If large, it can in most cases be salvaged; if small, it must either be scrapped or we must do selective assembling. Had the inspector insisted on the machine being set more nearly half way between the two tolerances, the machine would operate longer and this defective work would have been reduced to a minimum.

Gages for Threads

The one point in manufacture that we have learned the most about during the war is threads, and it is my opinion that this is one of the most important points in production. However, I have never been convinced that a no-go thread gage is necessary. I maintain that, for a female thread, we should use a go thread gage and a no-go plain plug, and, for a male thread, a go thread gage and a no-go plain ring. This brings up a problem that is not yet thoroughly developed; what should be the drill size for a tapped hole? In other words, should we have 75 per cent. thread or 80 per cent.? Male threads are not so troublesome because the die must be given sufficient clearance and thread-milling has been so developed that extreme accuracy can be obtained by its use.

Between the male and female threads, there should be no neutral point unless the parts must be assembled by hand without the use of a screwdriver or wrench.

In summing up: Gages reduce manufacturing cost, eliminate spoiling material, increase production and give us more nearly interchangeable manufacture than is possible for us to accomplish in any other way.

I do not advocate as extensive a gage department as we have been compelled to maintain during the war, but in every manufacturing plant there should be an inspection department properly supplied with such gages of the requisite degree of accuracy as may be necessary, and with men to assist the foreman in controlling the quality of production.

A Remarkable Cylinder Welding Job

By L. M. Malcher

Superintendent, Welding Shop of Oxweld Acetylene Co., Chicago, Ill.

One of the 5000-hp. Allis-Chalmers twin tandem compound reversing steel rolling mill engines at the Farrell works of the Carnegie Steel Co., Farrell, Penn., that had been doing its full share in helping to win the war broke down two weeks after the signing of the armistice. In the accident, besides other parts, the left-hand low-pressure steam cylinder, Fig. 1, 70 in. inside diameter, was badly fractured, as a result of the breaking of a connecting-rod at the moment of reversal.

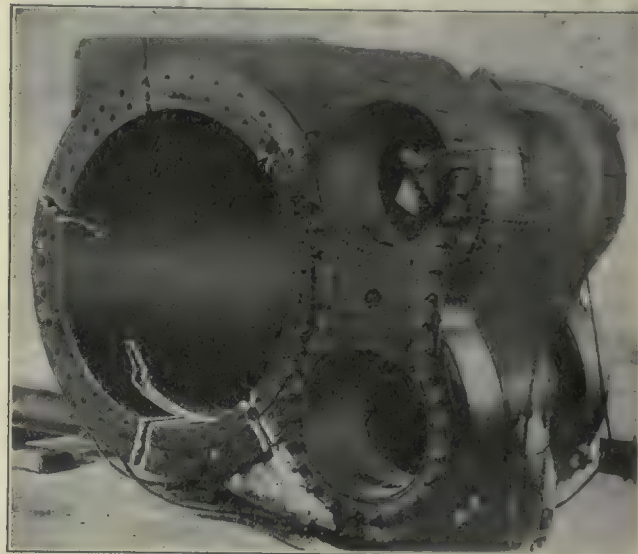


FIG. 1. WRECKED LOW-PRESSURE CYLINDER
The seven cracks ranged from 1 to 8 ft. in length and 2½ to 3⅝ in. in depth and are shown V-grooved by chipping preparatory to welding.

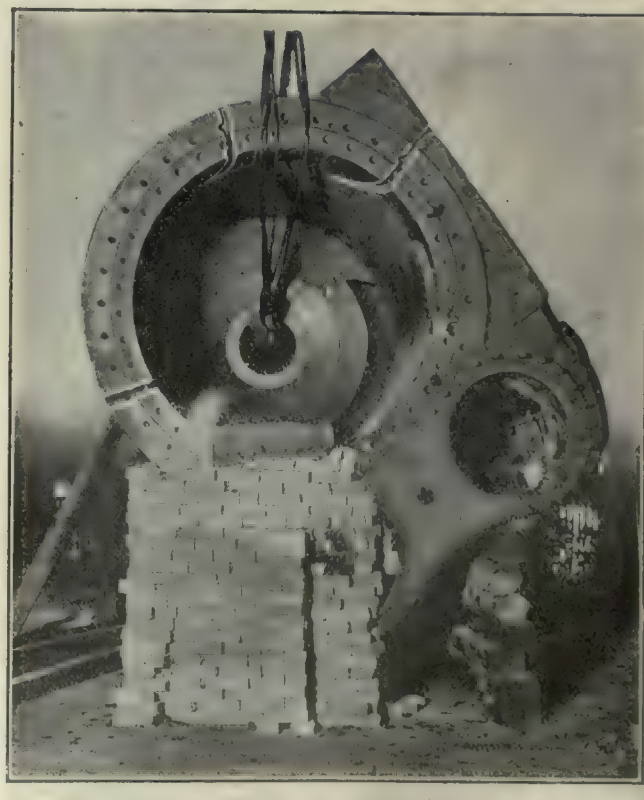


FIG. 2. PREHEATING CRACK IN LOW-PRESSURE CYLINDER BY MEANS OF CHARCOAL FIRE

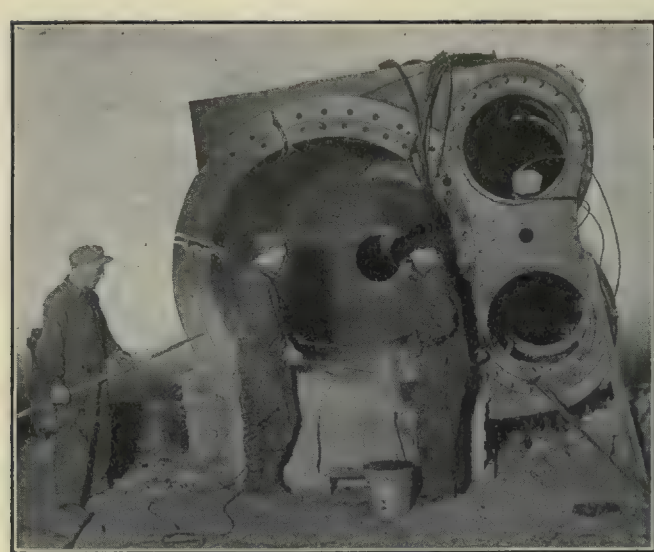


FIG. 3. WELDING THE LOW-PRESSURE CYLINDER

Asbestos paper was used to protect workers and retain heat from preheating fire. Note the extra long torches and rods required for the long cracks.

It would have taken at least three to three and one-half months to obtain a new cylinder, in case the broken one could not be repaired in a shorter time; besides throwing 360 men out of employment. The broken cylinder was of such size and the damage done was of such character that a decision whether the cylinder was to be renewed or repaired involved a risk on the part of the management.

Although it was decided that consideration of expense between the cost of purchasing a new cylinder and the repairing of the old one were of secondary importance, the cost of repairing was estimated to be about one-third that of a new cylinder.

Decide to Make Repair

The officials of the company after having made a careful investigation quickly decided in favor of oxy-acetylene welding. They called upon the job welding shop of the Oxweld Acetylene Co., Chicago, Ill., to meet the emergency. Three expert welders, accompanied by all necessary equipment, went immediately to Farrell and completed the job under the direction of the writer.

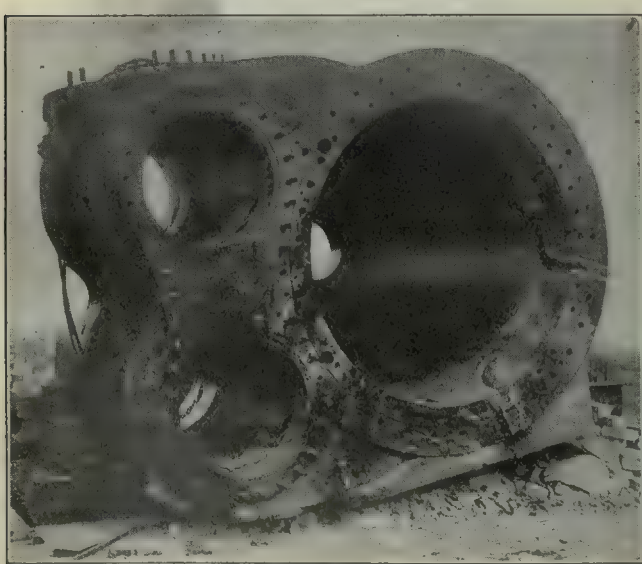


FIG. 4. WELDING OF LOW-PRESSURE CYLINDER COMPLETED

The fractures of the cylinders were what are commonly known as "end breaks"; that is, the cracks are on the extreme outside end of the casting. As a rule it is only necessary to preheat the casting locally and while the heat will radiate into the casting to some extent, the intensity is not enough to harm any portion by warping or shrinkage. The total time consumed in repairing the low-pressure cylinder, including chipping, preheating and welding, was 72 hours.

While dismantling the engine a fracture was discovered in the right-hand, 42-in. diameter, high-pressure cylinder. This fracture also was repaired in about 18 hours. It took just seven days from the time the order was placed to complete the entire job.

The data covering this work is given in detail in the accompanying table.

	Low-Pressure Steam Cylinder	High-Pressure Steam Cylinde
Cylinder bore	5 ft. 10 in.	3 ft. 6 in.
Stroke	4 ft. 6 in.	4 ft. 6 in.
Weight of cylinder	13 tons	5 tons
Thickness of iron casting	$2\frac{3}{4}$ to $3\frac{5}{8}$ in.	$3\frac{1}{2}$ to 6 in.
Total length of weld	22 ft. 2 in.	4 ft. 6 in.
Preparing and preheating casting	27 hr.	$9\frac{1}{2}$ hr.
Welding casting	45 hr.	$8\frac{1}{2}$ hr.
Oxygen consumed	2,850 cu.ft.	650 cu.ft.
Acetylene consumed	2845 cu.ft.	650 cu.ft.
Cast iron welding rods	390 lb.	110 lb.
Flux	25 lb.	10 lb.
Number of welders	3	3
Period of welding shifts	10 and 30 min.	10 and 30 min

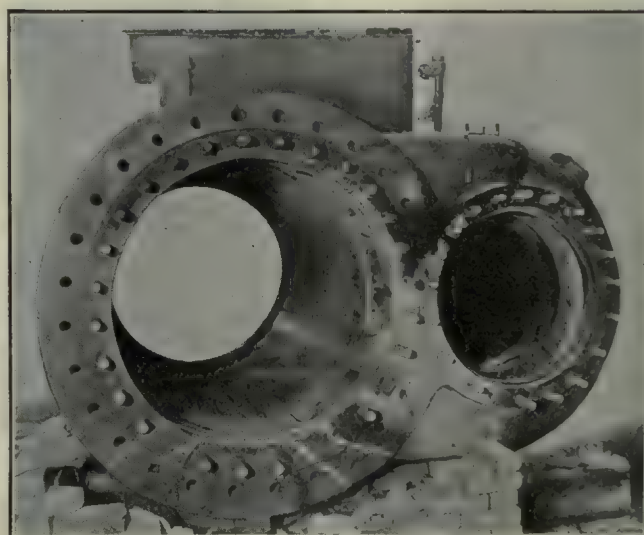


FIG. 5. FLANGE WELDED ON THE 5-TON HIGH-PRESSURE CYLINDER

Weld $4\frac{1}{2}$ ft. long, $3\frac{1}{2}$ to 6 in. deep

While welding inside of the cylinder castings the men relieved one another every 10 min. because of the extreme heat deflected back on them during the welding operation. On the outside welding, however, the heat was not so intense and the men relieved one another every 30 minutes.

After the engine cylinders were machined, it was almost impossible to determine where the cracks had occurred.

The total cost of the complete repair represented but a small fraction of the replacement cost but even this saving is insignificant when compared with the disorganization which would have resulted from the laying off of a large body of trained workmen and with the enormous loss that would have been entailed in a stoppage of production.

Making Special Snap Gages

BY JOHN TECKEER

This article shows fixtures and describes methods of using them for grinding large and small snap gages so that they come out right the first time and do not have to be remade on account of warping. A method of regulating the pull of a magnetic chuck is also given.

AS STANDARD snap gages sometimes fail to meet all the requirements of certain jobs it is often necessary for the toolroom to make up special quantities of them for such cases.

Two common types are shown at *A* and *B* in Fig. 1. The first operation in their manufacture consists of shaping to thickness, leaving from 0.008 to 0.010 in. to take care of grinding. They are usually made of machine steel, $\frac{1}{8}$ in. oversize, and time can be saved by putting the whole batch through a series of cuts. Set the first chip to remove 3/64 in. and run all the gages through without changing the setting of the tool. Then take a $\frac{3}{64}$-in. cut off the other side in the same way and finally a finish chip off each side.

Lay out the holes on one gage, drill them and use this one as a jig for drilling the others one at a time. As a rule this gives better results than ganging the gages together and drilling them all at once.

Next pin together through the drilled holes as many of the gages as can be chucked conveniently, usually enough to make up a total thickness of 2 in. Square up the ganged gages, mill the slots, round the corners on one end and bevel them on the other. Then separate them and file, mark and harden each.

Straighten the Gages if Necessary

When the gages have been hardened they should be straightened if necessary and the sides surface-ground. They should then be ganged and ground with a cup wheel as shown at *C*, Fig. 1. The use of the cup wheel gives better results than can be obtained with the side of a wheel as shown at *D*, Fig. 1, on account of the difficulty of obtaining as straight or as parallel sides by the latter method and also because of the possibility of poor spindle alignment. The number of gages ganged is limited by the width of the gage opening and the inside diameter of the cup; in other respects this method has the advantage.

It is sufficient to leave a total of 0.0002 or 0.0003 in. for lapping, which should be done before the gang of gages is disassembled, as it is easier and quicker to lap eight or ten thin gages together than to do each one separately. In lapping, use a carborundum or india stone that does not scratch, and stone in one direction until the grinder marks disappear. Occasional checking with a straightedge will be necessary until the operator becomes experienced.

Try your size block thoroughly and honestly and watch the corners. If too tight, stone in the opposite direction and thus prevent rubbing low spots in your gage. The surface can easily be followed by crossing the previous lines made by the stone. Watch the corners to prevent bell mouth. A cast-iron hand lap and fine carborundum or alundum will take out the last 0.00005 in., leaving the surfaces well finished, straight and parallel. For one who has had little experience it is advisable to grind the lap the size of the opening and carefully work it through until the opening is lapped to size. It then requires an effort to make the jaws anything but parallel. For the experienced hand these laps can be any convenient size, and he can lap each size separately, confident of the resulting accuracy of the gage. The lap should be ground opposite the way it will be used, as it will cut easier and not line the work. When the gages are lapped, separate them and break the sharp corners.

In Fig. 2 *E*, *F*, and *G* are gages well suited to meet the requirements of gaging a thin, wide unit and are simple to make. Satisfactory results are obtained by using cold-rolled steel for the various parts which are ganged, milled to length and the bevels and rounds milled on opposite ends. An inexpensive drill jig is made to insure duplication from which the parts come rapidly and eliminate hours of laying out. As many parts as the magnetic chuck will hold are then ground, taking about 0.005 in. off each side, which insures the carbon penetrating and leaves a clean, black surface after hardening. The parts are ground and lapped only on the gaging surfaces.

Trouble in Grinding Blocks Less Than $\frac{3}{16}$-In.

In grinding blocks less than $\frac{3}{16}$ in. thick you may have trouble, and as the thickness decreases the certainty of trouble increases. Thin pieces tend to curl away from the chuck on the ends, thus grinding the ends low and making it difficult to obtain a straight surface on either side. This of course applies to any hardened thin piece and the same remedies will answer for all. The trouble lies partly in the use of the magnetic chuck, but mostly in the heating due to the emery-wheel action.

To get perfect results we must first find a method of reducing the attraction of the magnetic chuck so that it will not pull the piece hard on its surface, with the resulting displacement after it is released, and second, adopt a wheel or method of using a wheel that will not heat the work.

Various methods of reducing the attraction of the chuck are used with more or less success, but one method to avoid is that of sealing the work with beeswax or shellac. I have even seen a piece tacked with solder. While this method does overcome the chuck trouble it puts you in bad with the emery wheel, and without your knowledge until the work is taken out, when the released strains pull the piece anything but flat.

A piece of gage stock or anything suitable, 4 in. or 5 in. square and slightly less in thickness than the piece to be ground, should be placed on the chuck, the switch thrown in, then pulled out and contact made at the opposite poles to demagnetize the chuck. It will be found that the large piece clings tightly, and a very slight attraction is still felt from the chuck. This is the ideal

condition giving a positive stop against which to place the center block and just attraction enough to hold it. Other methods of applying the same principle can be devised, such as the use of parallels of different heights, which will give the same result, but mention of this one method is made because of its simplicity and satisfactory results.

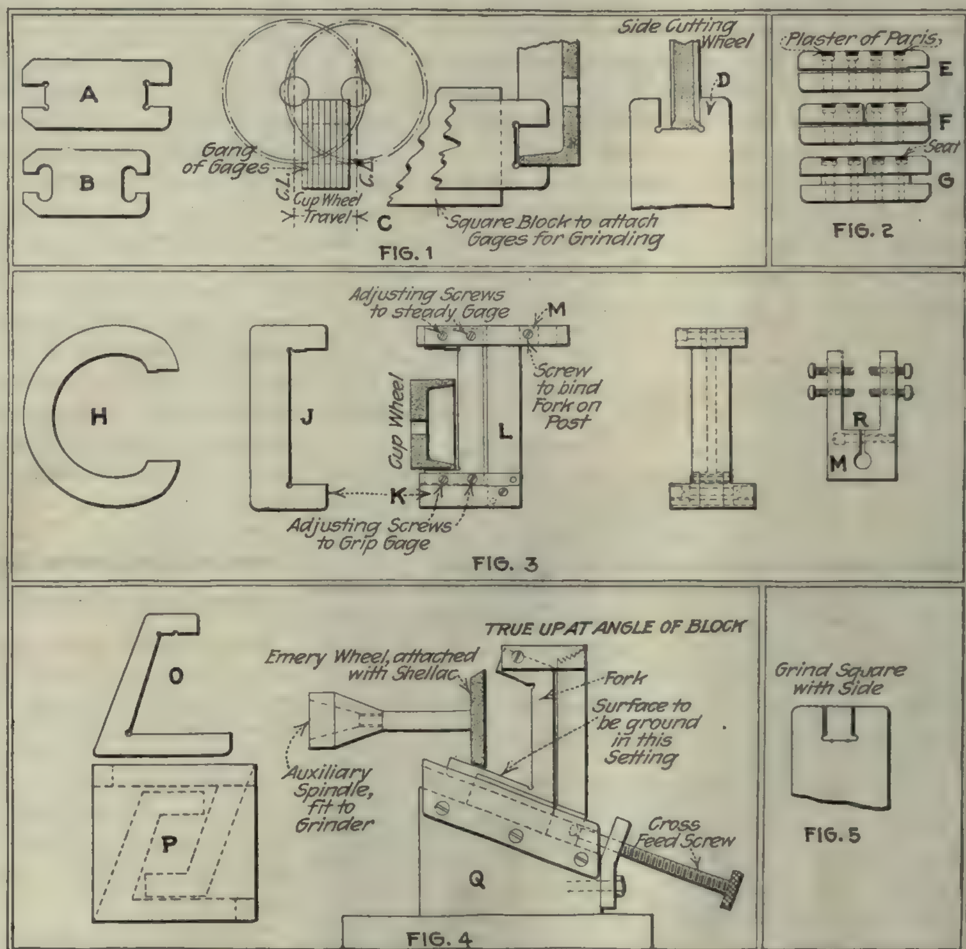
To reduce heating the best results are obtained by using a coarse, soft wheel as a rougher and finishing with a finer-grained though equally soft wheel. These wheels should have nicks ground in their periphery about 2 in. apart, as they help to reduce the heating tendency. The wheel face should be cut away to about ⅛ in. wide and used with care. When grinding the pieces keep trying them for straightness and turning the sides alternately to the chuck. It is quite possible to grind very thin pieces in this manner, with sides straight and parallel. However, the finishing must be done with cuts which vary with the thickness of the piece and may be less than 0.0001 in. deep. When the gages are assembled and have passed inspection seal the holes with plaster of paris, which is easily mixed and applied and seals against tampering.

In Fig. 3, *H* and *J* are types of the large snap gage and may have openings of 12 in. or more. These can be satisfactorily ganged in all operations previous to the grinding, which should be allowed only on the gaging surfaces. One particular annoyance with these large gages is that the surfaces do not come from the grinding machine parallel to each other due to springing them slightly in the clamping. The necessary precaution in clamping can be reduced to a minimum if a fixture is made similar to the sketch at *K*, Fig. 3. With this the grinding is done rapidly and accurately. A cup wheel is used as shown, thus permitting the surfaces to be ground flat and parallel right up to the corner. In this case you again have the advantage of the graduated handwheel for measuring and grinding to the desired size. Leave 0.00015 in. on each surface and lap as previously outlined.

The fixture is made of three parts—a stout center stud L of a length to accommodate the range of your grinding machine, a base *K* screwed and doweled permanently in place, and a sliding fork M with a binding screw to clamp it to the center stud and adjusting screws to support the upper end of the gage. When the gage is pinched on the bottom and squared up the adjusting screws are brought in contact, but not enough to spring the gage either way. The gage is then steady to grind and parallel surfaces may easily be obtained.

Another type, and one that presents a more difficult grinding problem, is shown at *O*, Fig. 4. This type is best handled by cutting the stock in lengths and widths to permit of two gages being cut from each piece, as seen at P, Fig. 4. The job is then carried through, as previously outlined, up to the grinding.

An auxiliary spindle and inclined block are used for making this type of gage. The same type of holder (in



FIGS. 1 TO 5. MAKING SNAP GAGES

Fig. 1—Small snap gages. Fig. 2—Gages for thin, wide pieces. Fig. 3—Fixture for large gages. Fig. 4—Special Gages and Fixture. Fig. 5—Built-up snap gage.

some cases the same holder) used on the other long gages can be used to hold it. The slight changes necessary can be seen in the sketch at Fig. 4. The inclined block is the same width as the holder base and has a side plate attached on each side with a projection lapping over the top of the holder base. This makes a simple and satisfactory slide in which the holder travels while grinding the long surface of the gage.

Grind the long surface first, then remove the gage and holder intact from the angle block, which can be done by removing the pin attaching the feed screw to the holder base and sliding the holder out of the upper end. Place the holder direct on the magnetic chuck and grind the top step to measurement similar to the manner shown in Fig. 3.

To use the fixture advantageously where a number of gages are to be ground two grinding machines are nec-

essary, due to the inconvenience of changing the wheels for each operation, or better still have two fixtures and two men, each carrying through one side of the job.

A method of building up snap gages for gaging thin, narrow pieces is shown in Fig. 5. In this case the large opening in the gage body is ground on a parallel block, as shown in Fig. 1, to any convenient size. The insert is then fitted, removed and the gaging sides ground parallel to the sides of the body piece.

This is done by first grinding the top of the assembled gage square to the sides, removing the insert and squaring up its sides to the ground surface.

After grinding replace this insert and measure the opening. Then, knowing the amount to be taken off, remove and grind to measurement. Replace, check and sweat in place. The small holes help in sweating. A piece of machine steel ground a snug fit in the slots will make an excellent lap and will clean out 0.0002 or 0.0003 in. easily and give well-finished, parallel jaws.

Foundations

By W. Osborne

A number of the men were sitting around during the noon hour and the talk naturally drifted to consideration of a strike then in progress.

These men were part of a gang that was building an improved road, and as such work had not as yet been "organized" their opinions may be considered as the expressions of their thoughts.

After various views had been voiced, some one asked "Old Charley" to tell what he thought.

Charley was the "handy man" of the combination. He kept the machinery in repair. He was looked up to

as being a man who could fix anything that could be fixed, and as one who could get along with any man that any other man could get along with.

Charley did not seem disposed to take part in the discussion.

"Don't you have any ideas, Charley?" banteringly exclaimed the youngster who ran the concrete mixer.

"What is the use of turning over an idea to a fellow like you who can't reason with it, when he has it? You take an idea and put it in your memory, and when you want it you can't find it. You can't reason out how to fix a wheelbarrow so it will work right."

The laugh that followed this reply from Charley indicated that the youngster was not very mechanically inclined, but it took more than a laugh to silence him, for he came back with, "This isn't a machine that we are talking about. It's a strike. Forget your 'essential fundamentals' and your 'basic principles,' and that other stuff that you like to get off when I ask you a simple question about machinery and tell us how you think it is going to turn out."

"Huh!" snorted Charley. "You want your mental food chewed for you about this just as you do about everything else. Well, young fellow, all you're going to get from me on this subject is more of them 'essential fundamentals,' and more than likely they will give your reasoning powers indigestion.

"All permanent human association is founded on 'service' or 'mutual helpfulness' and it started when the first two human beings worked together. It has continued down to the present time and is the foundation of the family, the tribe, the state and the nation. It is the foundation of religion. No matter how poor the thing that was built on the foundation, the foundation was that, and it was right.

"What is the foundation of strikes and of the labor movement that glories in them? It is 'coercion' or 'bulldozing.' Some day, an 'organizer' will come along and he will tell you that he is going to organize the road builders; and he will tell you to get busy and get in; and, if you don't move to suit him, he will tell you that you will not be allowed to work at this or any other work that is 'organized'; and he will tell you that when all the road workers are organized you can make the contractors come across with any wages and hours that you ask for."

"From what I can see he won't be very far off at that," replied the youngster.

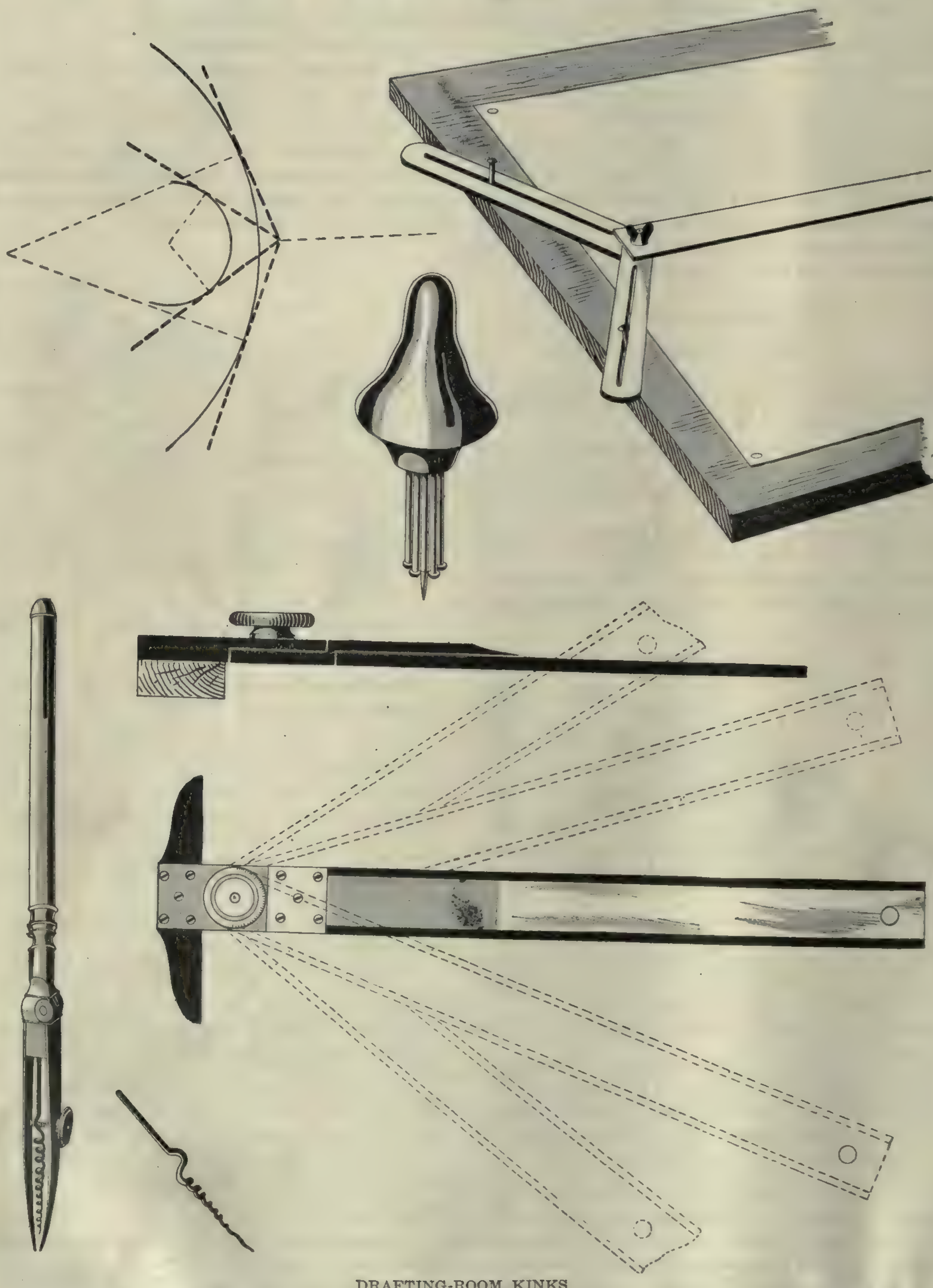
"You are right for a little ways," said Charley. "As long as the rest of the world is too busy to pay any attention to you, and the contractors can pass it along without any trouble, it will work; but your foundation is wrong for all of that, and if you build big enough on it it is going to let you down. If this sort of 'organization' is good for one class it is good for every class. If the 'strike' is a good weapon for one class it is a good one for every class. Just keep on thinking.

"Carry it to the point where every one has to look to an organization for their rights and you are reversing the process that has built up civilization. One would hardly expect that it would keep on going backward until it would land us back in the stone age, but if you and I cannot do any thinking for ourselves it may go a longer ways back than we will like."

Just then the whistle blew and the gang started in on the afternoon work.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS

Results of a Series of Tests of Water-Quenched Free-Cutting Steel

BY C. P. MILLER

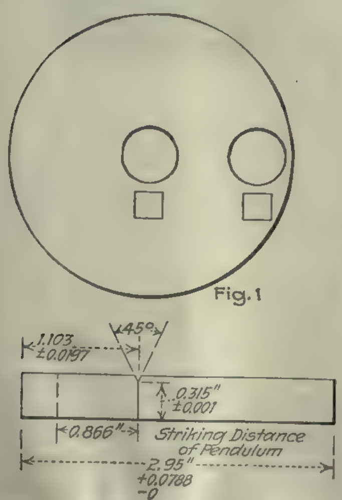
Steel used for screw-machine stock is usually used in an untreated condition, as received from the mill, and the purpose of this article is to present the results of tests upon it both untreated and water-quenched, and to show the great improvement in the physical properties of the latter treatment.

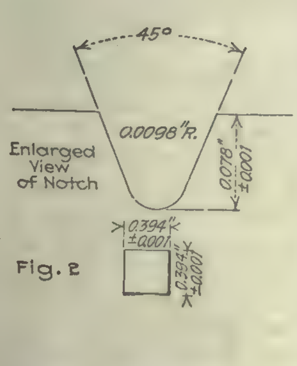
FREE-CUTTING openhearth steel is widely used for such parts as bolts, nuts, studs and other members where strength is not such an important consideration as ease of machining and the ability to produce smooth threads. It is often called screw-machine stock from its adaptability for this line of work. The usual composition, according to the standard of the American Society for Testing Materials, is as follows: Carbon, 0.15 to 0.25 per cent.; manganese, 0.60 to 0.90 per cent.; phosphorus, not over 0.06 per cent.; sulphur, 0.075 to 0.15 per cent.

A portion of the sulphur is added during the manufacture of the steel and to its presence is due the free-cutting qualities.

The tests were performed upon specimens 4¾ in. long, cut from 1-in. diameter and 4-in. diameter bars, all the specimens for each size being cut from the same bar. The composition of the bars was as follows: For the 1-in. diameter bar: carbon, 0.22 per cent.; manganese, 0.65 per cent.; phosphorus, under 0.04 per cent.; sulphur, 0.106 per cent. For the 4-in. diameter bar: carbon, 0.23 per cent.; manganese, 0.71 per cent.; phosphorus, under 0.04 per cent.; sulphur, 0.087 per cent.

Two sizes of bars were used in order to determine the increase in strength of a small bar over a large one, due to the greater reduction in rolling of the former; and, in addition, to ascertain the effect of a variation of mass upon the speed of quenching and depth of penetration of quench, and the corresponding physical properties.





FIGS. 1 AND 2. LOCATION OF TEST PIECES IN 4-IN. BAR AND IZOD IMPACT TEST PIECE

The following tests were made:

1. Two 1-in. diameter specimens were tested as received, one being used for tension and the other for impact test.
2. Two 1-in. diameter specimens were quenched in water from a temperature of 1550 deg. F., one being used for tension and the other for impact test.
3. Two 4-in. diameter specimens were tested as received, an impact and tension test piece being taken from both the center and from a point near the surface so as to obtain the effect of rolling upon the interior as compared with the surface.
4. Two 4-in. diameter specimens were quenched in water from 1550 deg. F., an impact and a tension test piece being taken from both the center and from a point near the surface so as to show the effect of penetration.

The location of the test pieces for the 4-in. diameter specimens is shown in Fig. 1.

The tension test pieces were turned to a diameter of 0.505 in. along the gage length and the ends were threaded to fit the grips of the testing machine. The impact test pieces were made according to the standard Izod form shown in Fig. 2. These test pieces were

TABLE SHOWING RESULTS OF THE TESTS

1-In. Diameter

	Untreated	Water-Quenched
Tensile strength	67,500 lb. per sq.in.	85,400 lb. per sq.in
Yield point	42,900 lb. per sq.in.	54,800 lb. per sq.in.
Elongation in 2 in	32.0 per cent	25.0 per cent.
Reduction of area	54.6 per cent	59.0 per cent.
Impact strength	53-61 ft.-lb.	73-81 ft.-lb.
Brinnell hardness	124	159
Shore hardness	24	29

4-In. Diameter. Untreated

	Center
Tensile strength	56,110–56,000 lb per sq.in
Yield point	26,750–28,350 lb. per sq.in.
Elongation in 2 in	36.0 per cent–36.5 per cent.
Reduction of area	59.8-57.2 per cent.
Impact strength	28-31–28-30 ft.-lb.
Brinell hardness	107–107
Shore hardness	25–25

4-In. Diameter. Untreated.

	Surface
Tensile strength	57,900-57,500 lb. per sq.in.
Yield point	30,500-29,350 lb. per sq.in.
Elongation in 2 in	36.0 per cent.-35.0 per cent.
Reduction of area	59.8 per cent.-59.8 per cent.
Impact strength	21-10–19-27 ft.-lb.
Brinell hardness	107-112
Shore hardness	25-25

4-In. Diameter. Water-Quenched

	Center
Tensile strength	68,700-68,500 lb. per sq.in.
Yield point	48,200-47,900 lb. per sq.in.
Elongation in 2 in	32.0 per cent.-33.0 per cent.
Reduction of area	64.7 per cent.-67.0 per cent.
Impact strength	76-83–74-79 ft.-lb.
Brinell hardness	149-149
Shore hardness	28-28

4-In. Diameter. Water-Quenched

	Surface
Tensile strength	69,800-70,800 lb. per sq.in.
Yield point	52,800-51,60 lb. per sq.in.
Elongation in 2 in	32.0 per cent.-29.0 per cent.
Reduction of area	69.2 per cent.-71.3 per cent.
Impact strength	80-80–84-85 ft.-lb.
Brinell hardness	149-156
Shore hardness	28-27

broken as cantilever beams by the action of a knife-edge fastened to a pendulum bob.

After each tension test piece was broken, a flat was milled on the threaded portion of one end and Brinell and Shore hardness tests were carefully made. Ex-

perience has shown that at this point of the test piece, the material is unaffected by the stretching along the gage length and a true hardness record can be obtained. The complete results of the tests are given in the accompanying table.

In addition to the tests, photo-micrographs, Fig. 3, were taken of the untreated and water-quenched 1-in. diameter bars, and the greatly improved structure of the quenched bar is obvious.

What the Results Show

A summary of the results shows that water quenching raises the tensile strength of the 1-in. diameter steel 27 per cent., the yield point 28 per cent., the reduction of area 8 per cent., while the elongation is decreased 22 per cent. The hardness has, of course, been increased, but not to a sufficient degree to affect the cost of machining.

The results are shown even more strikingly in the case of the 4-in. diameter bars. Here the water-quenched bars average 23 per cent. higher in tensile strength, 76 per cent. in yield point, 15 per cent. in reduction of area, and 230 per cent. in impact strength, while the elongation is decreased 8 per cent. As in

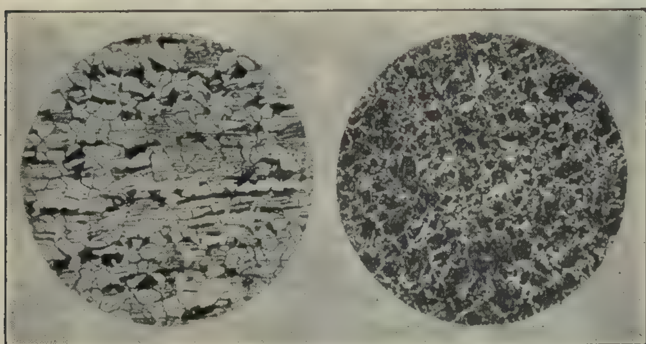


FIG. 3. PHOTO-MICROGRAPHS OF 1-IN. BARS (100 DIAMETERS)

the case of the 1-in. diameter bars, the increase in hardness is negligible. The tests also show that there is very little difference between the properties at the surface and those at center of the 4-in. diameter bars, either in the untreated or water-quenched condition; a slight increase in strength in the surface test pieces being the only characteristic noticeable.

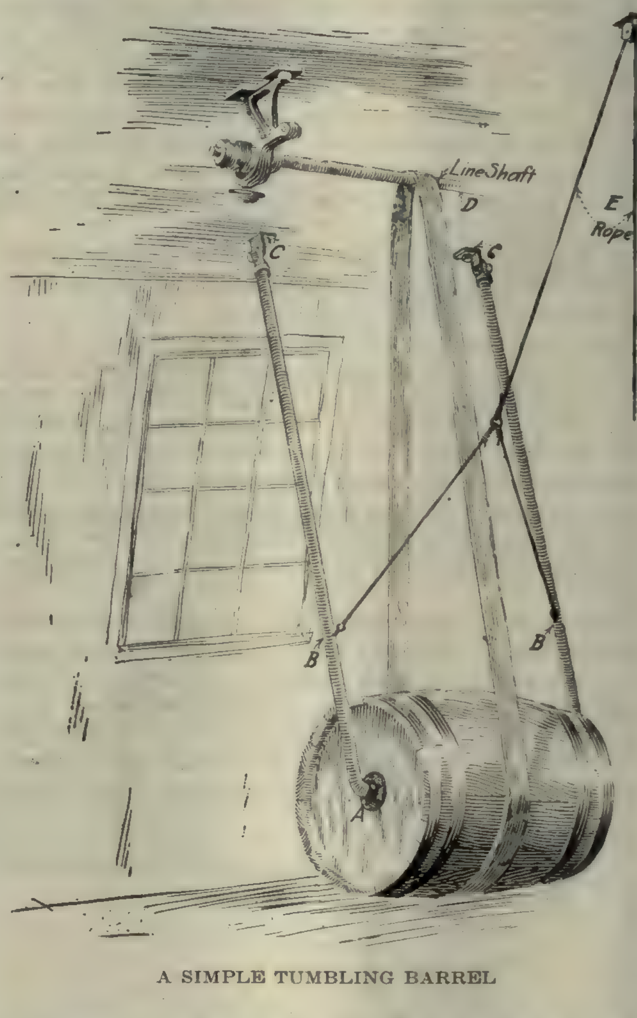
The effect of the difference in size betwen the 1-in. diameter and 4-in. diameter bars upon the strength is very evident, especially for the untreated steel. In this case, the tensile strength of the 1-in. diameter bar is 19 per cent. greater, the yield point 50 per cent. greater, and the impact strength 140 per cent. greater. With the water-quenched steel, the tensile strength of the 1-in. diameter bar is 23 per cent. greater, the yield point 9 per cent. greater, and the impact strength practically identical.

The conclusions drawn from these tests are: (1) The tensile and impact strength of free-cutting steel is greatly increased by water quenching (in this connection it should be stated that the decrease in ductility is of no significance for the toughness and resistance to shock are shown by the impact test); (2) that the increased hardness due to water quenching is not great enough to cause difficulty in machining; (3) that the larger bars are much lower in tensile strength than the smaller ones and that in designing, figures should be used which are based upon tests of bars of approximately the same size as those contemplated in the design; (4) that the impact strength of the larger bars in an untreated condition is very low, but can be greatly increased by quenching, and (5) that the tests show greatly improved general qualities for the quenched steel, a fact which can be readily deduced from a comparison of the structure shown in the photo-micrographs.

A Simple Tumbling Barrel

By Frank C. Hudson

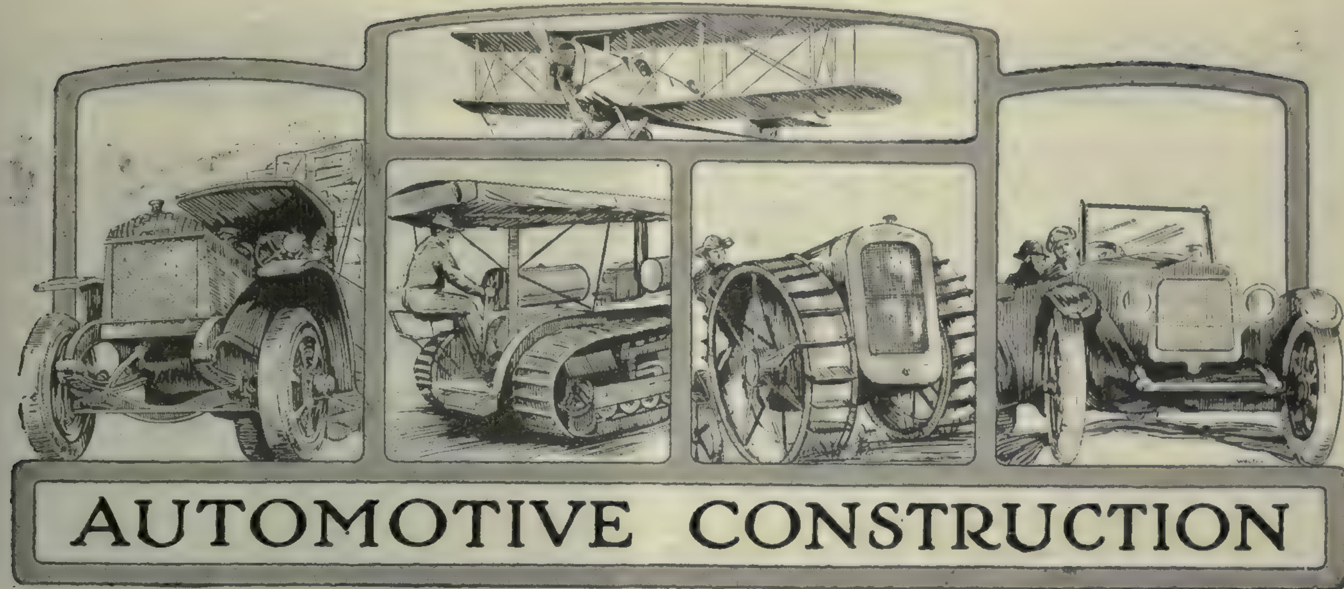
In some classes of work, tumbling is extensively used and there are probably many more shops where it could be used to advantage on small work. The illustration shows a simple tumbling barrel made from a substantial wooden keg *A*, suspended from the ceiling by



A SIMPLE TUMBLING BARREL

the framework of pipe *B*. It will be noticed that the upper end of the frame *B* hangs in a bracket at *C* behind the lineshaft *D*.

The tumbling barrel is driven by a belt which runs on the lineshaft and around the center of the keg. The angle of the framework *B* provides the necessary tension to insure positive driving, while the rope *E*, running over a pulley in the ceiling, allows this to be varied or to be raised out of contact when it is desired to load or unload the tumbling barrel. This makes a very simple tumbling barrel for the small shop and one which will be found extremely useful in many cases.



Connecting-Rod Forgings for the Liberty Motor

By H. A. CARHART, M. E.
Lincoln Motor Co., Detroit, Mich.

The forging problems of the Liberty motor connecting-rods were solved in various ways by different makers, the different methods being briefly described. The following article also points out the numerous difficulties of handling chrome-nickel steel and shows how the rods were heat-treated and tested.

THE connecting-rods for the Liberty motor were made from chromium-vanadium steel, containing carbon, 0.30 per cent. to 0.40 per cent.; manganese, 0.50 per cent. to 0.80 per cent.; phosphorus, not over 0.40 per cent.; sulphur, not over 0.04 per cent.; chromium, 0.80 per cent. to 1.10 per cent.; vanadium, not less than 0.15 per cent. This steel is ordinarily known in the trade as 0.35 carbon steel, S. A. E. specification 6135, which provides a first-rate quality steel for structural parts that are to be heat-treated. The fatigue resisting or endurance qualities of this material are excellent. It has a tensile strength of 150,000 lb. minimum per sq.in.; elastic limit, 115,000 lb. minimum per sq.in.; elongation, 45 per cent. minimum in 2 in.; and minimum reduction in area, 45 per cent.

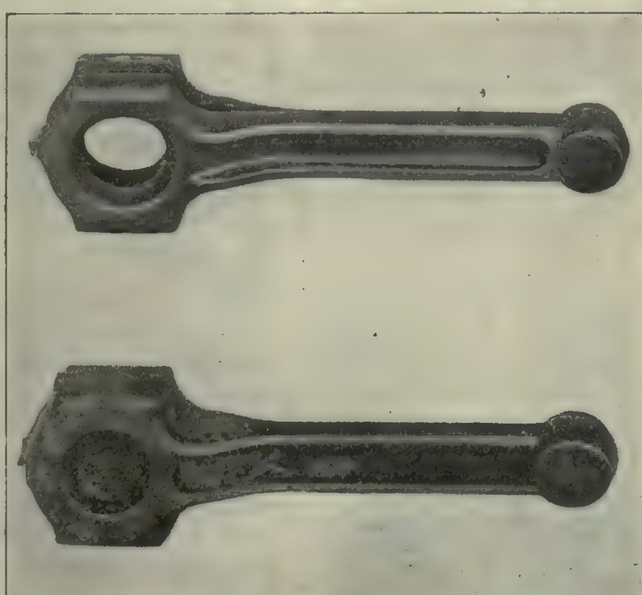


FIG. 1. FORKED-ROD FORGINGS BY PACKARD

The plain-end rod is forged from a flat bar with rounded corner, which is approximately the size of the large end of the rough forging, or about $1\frac{1}{2}$ x $3\frac{1}{2}$ in. The blank is cut from the bar by power shears, to a length which will forge out into a finished rod, with a small tong hold or gate, and as little flash as is practicable. This blank is heated in an oil-fired forge furnace, and swaged down along the center to draw the shank out to the proper length to match the die impression. The piece is then broken down to the approximate shape of the rod. It is then placed in the finishing impression and struck again to straighten and size it, and is allowed to cool slowly so as to somewhat reduce the forging strains. The center hole in the large end of the rod is then punched out, and it is snag-ground and cleaned up.

The forked rod is forged from larger stock than the plain-end, in approximately the same way, up to the trimming operation. It is forged with the heavy end solid, and several different methods are employed to form the fork.

The method of the Western Drop Forge Co., Marion, Ind., is to part the fork end of the forging by two distinct operations. First, a $\frac{1}{4}$-in. plate is forced half way through the forging from one side. The plate is knocked out, the flash removed, the rod reheated, and the plate is forced in from the opposite side to complete the slot. This is done in an Ajax 4-in. upsetting machine. The rod is again heated, and in the same machine as above, clamped in dies and a formed punch, forced in from the end. This spreads the fork and squares up the sides to shape. Just above this die in the upsetting machine is a finishing die with formed ram, which does the final straightening and forming.

A method used at the Buick works is to forge the forked end solid and of full width. Then the fork

section is punched about three-quarters of the way through, leaving a tie strip between the outer points of the fork. The rod is reversed and the punched portion pushed back and out, leaving the fork formed complete, except the tie piece, which held the rod in shape during the heat-treatment. This is machined out later.

Still another method employed a hot saw to do the slitting. The operations of spreading and straightening were practically the same as described in the preceding method. This method was originally used by the Canton Drop Forge and Machine Co., but was discontinued in favor of the following: After the forging had been trimmed, it was heated for the operation of parting. A 4-in. Ajax upsetting machine was arranged with three sets of suitable dies one above the other. The ram carried a parting blade, about $\frac{5}{16}$ in. thick at the bottom. Opposite the middle die was a formed punch of about the general shape of the inside of the fork. The finished punch for the upper die was a block of correct shape, mounted on the end of a bar which served as a handle.

The heated rod was inserted in the bottom die and the first operation of the upsetting machine forced the slitting blade into the end of the rod to the proper depth. The rod was then moved to the next die above and the second operation on the upsetting machine brought the formed punch into the end of the rod, thus spreading and forming the forked end. The rod was then placed in the finishing die at the top. An assistant held the finishing punch in front of the ram as it came forward and the rod was finish-formed and straightened. All of this was done at one heating.

The Packard Motor Car Co. uses another method, in which the forked end of the rod is forged to the full thickness of the finished rod. Then the stock between the two forks is punched out from one side of the rod, leaving the forked end in nearly finished shape and without setting up stresses in the metal. The end is then shaped up in finishing dies. Fig. 1 shows the rod before and after punching out the forked end.

Another Method

The original material specifications, which included specifications for the heat-treating of the parts, were taken in hand by the inspection department of the Lincoln Motor Co. and the treatment started on the first batches of parts under the supervision of the metallurgical inspection department. The first forgings were

FIG. 3. QUENCHING RODS

hand machined and parts were treated at a number of commercial heat-treating establishments of Detroit.

The connecting-rods, both plain and forked, caused a great deal of trouble and loss right along. As matters were growing worse, the Lincoln Motor Co. undertook an investigation of the difficulty, with a view of eliminating the cause. The connecting-rod forgings were developing cracks before, during, and after heat-treatment. The steel-mill representatives and the drop-forge men making the rod forgings, were called in consultation. The Lincoln Co. insisted that although part of the trouble might be due to heat-treating, and part of it to poor stock, the principal difficulty lay with the fact that the chromium-nickel steel used required extremely careful handling, due to its inherent quality of resisting physical changes.

The Signal Corps was asked to change the specification from chromium nickel to chromium vanadium, which would benefit all concerned, owing to the fact that chromium vanadium, although capable of being treated to just as high physical property, is very much easier to handle.

The Signal Corps, after the matter was carefully gone over, concurred in this suggestion, and at the instance of the Lincoln executive, called a meeting of the representatives of the steel mills engaged in the manufacture of material for Liberty motors, and the drop-forge men making the principal forgings. After considerable debate, it was decided that owing to the difficulty of handling, in the manufacture of the steel, and in the production of the forgings, it would be best to substitute chromium vanadium for chromium nickel.

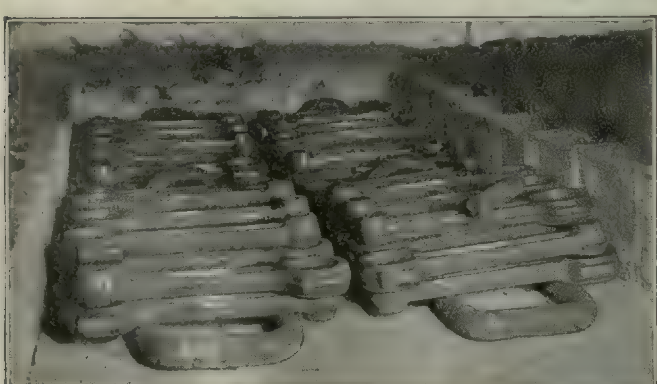


FIG. 2. RODS IN FURNACE

The original production system as outlined for the

AUTOMOTIVE CONSTRUCTION

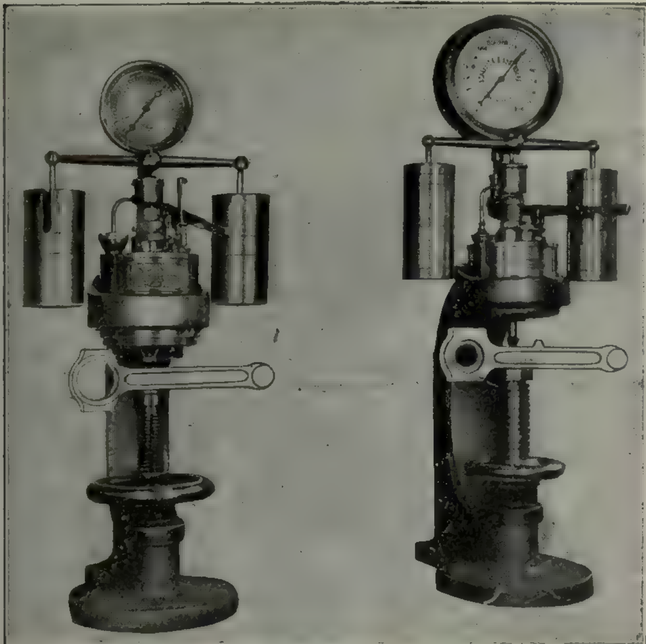


FIG. 4. BRINELL TESTING

manufacturers had called for a heat-treatment in the rough-forged state for the connecting-rods, and then semi-machining the rod forgings before giving them the final treatment. The Lincoln Motor Co. insisted from the first that the proper method would be a complete heat-treatment of the forging in the rough state, and machining the rod after the heat-treatment. After a number of trial lots, the Signal Corps acceded to the request and production was immediately increased and quality benefited, by the change. This method was later included in a revised specification issued to all producers.

The original system was one that required a great deal of labor per unit output. The Lincoln organization developed a method of handling connecting-rods whereby five workmen accomplished the same result that would have required about 30 or 32 by the original method. Even after revising the specification so as to allow complete heat-treatments in the rough-forged state, the ordinary methods employed in heat-treating would have required 12 to 15 men. With the fixtures now in use, five men handle 1300 connecting-rods, half of which are plain and half, forked, in a working period of little over seven hours.

The increase in production was gained by devising fixtures which enabled fewer men to handle a greater quantity of parts with less effort and in less time.

Change in Design Suggested

A change in design of the forked connecting-rod and its cap, and a little later of the plain connecting-rod and its cap, was suggested by the metallurgical force of the Lincoln plant early in production. This was that the cross-section of the metal at the lock notches in the rod by the bolt head, and also the cross-section of the metal in the cap by the nut seat, should be increased so as to obviate the danger of breakage through these notches. A practical demonstration of the principles involved in this change was arranged to convince all concerned that the change would be beneficial. This was done by shaping a number of rods as they should be, with increased cross-section, and as heavy a radius as possible for a fillet instead of a sharp-notched corner, as in the original design, and then alternately stressing the parts until they failed. The fact that the advocated design with heavy cross-section and rounded notches withstood over 20 times the stress that the original design withstood, clinched the argument.

Preliminary Inspection

The rods are received from the Western Drop Forge and Canton Drop Forge companies. Each rod is inspected by use of templet and calipers. Particular attention is paid to length of all bolt bosses and piston-pin bosses, and to the position of fork in relation to channel in forked rod. A visual inspection is also given to detect any cracks or cold shuts. The capacity is 400 rods in 9 hr., with one man for either single or double rods.

Both the single and forked rods are subjected to practically the same form of treatment and we shall treat the preliminary inspection and operations of both rods jointly until the major machine operations began.

In heat-treating, the forgings are laid on a rack or loop *A*, Fig. 2, made of 1¼-in. double extra-heavy pipe, bent up with parallel sides about 9 in. apart, one end being bent straight across and the other end being bent upward so as to afford an easy grasp for the hook. Fifteen rods are laid on each loop, there being four loops of rods charged into a furnace with a hearth area of 36 x 66 in. The rods are charged at a temperature of approximately 900 deg. F. They are heated for refining over a period of 3 hr. to 1625 deg. F., soaked 15 min. at this degree of heat and quenched in soluble quenching oil.

In pulling the heat to quench the rods, the furnace door is raised and the operator pulls one of the loops *A*, Fig. 3, forward to the shelf of the furnace, supporting the straight end of the loop by means of the porter bar *B*. They swing the loop of rods around from the furnace shelf and set the straight end of the loop on the edge of the quenching tank, then raise the curved end *C*, by means of their hook *D* so that all the rods on the loop slide into the oil bath.

Before the rods have cooled entirely, the baskets in the quenching tank are raised and the oil allowed to partly drain off the forgings, and they are stacked on curved-end loops or racks and charged into the furnace for the second or hardening heat. The temperature of the furnace is raised in 1½ hr. to 1550 deg. F., the rods soaked for 15 min. at this degree of heat and quenched in the same manner as above.

They are again drained while yet warm, and placed on loops and charged into the furnace for the third or tempering heat. The temperature of the furnace is brought to 1100 deg. F. in one hour, and the rods soaked at this degree of heat for one hour. They are then removed from the furnace the same as for quenching, but are dumped onto steel platforms instead of into the the quenching oil, and are allowed to cool on these steel platforms down to the room temperature.

The forgings are pickled in a hot solution of either niter cake or sulphuric acid and water at a temperature of 170 deg. F., and using a solution of about 25 per cent. The solution is maintained at a constant point by taking hydrometer readings two or three times a day maintain-

ing a reading of about 1175. Sixty forked or one hundred single rods are placed in wooden racks and immersed in a lead-lined vat 30 x 30 x 5 ft. long. The rack is lowered or lifted by means of an air hoist and the rods are allowed to stay in solution from one-half to one hour depending on the amount of scale. The rods are then swung and lowered in the rack into rinsing vat of running hot water until all trace of the acid is removed.

The snagging operation, including grinding a spot for the Brinell test, is performed on a No. 30 Ransom grinding machine with 18 x $1\frac{3}{4}$ x 2-in. Norton wheel, grain 20, grade 0. This spot is then polished on a felt wheel.

The rod is next subjected to Brinell test, this being performed on hydraulic testing machines, shown in Fig. 4, manufactured by the Pittsburgh Instrument and Machine Co. and a Swedish firm. These machines show whether or not the rod has been heat-treated to the proper hardness. If the rods do not read between 241 and 277, they are re-treated until the proper hardness is obtained.

The test lugs on the side and end of rod are first notched on a Whitney No. 6 hand milling machine, using a 60-deg. angular left-hand $2\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{1}{2}$-in. cutter. Notching side lugs, one man can handle 125 rods an hour and 75 rods for the end notching. The lug is then broken off on a Bliss No. 18 punch press with a V-shaped hammer, one man handling 125 rods per hour.

The grain is then inspected to determine if the rod has been treated properly, and is here subjected to the Government Inspection Metallurgical Department. After the test lug is removed, the surface is ground smooth by use of the wheel previously used for snagging.

Before beginning the machining operations the rod is tested in a fixture to determine straightness and centrality of fork with channel. This fixture consists of a cast-iron plate 12 x 24 x $1\frac{1}{4}$ in. that has two steel angle blocks fastened so that the rod channel rests on same, and one small angle block used to test the amount of stock on the piston-pin boss. The rod is laid on these blocks and held by hand while using templet that determines amount of material on inside as well as outside of fork. It is often found that the forgings require straightening and the forks either opened or closed. The channel is straightened by a screw press and the forks are either opened or closed by a wedge or by striking with a sledge on an anvil.

Grinding a Rear-Axle Housing

By I. B. Rich

The rear-axle housing used by the Chandler Motor Co. is made of pressed steel in two parts which are afterward welded by the oxy-acetylene process. The surfaces which make the joints for both the differential case and the back cover are machined on a large grinding machine of the type built by the Diamond Machine Co., as shown in Fig. 1. The outer ends of the housing are previously ground in a large plain cylinder-grinding machine and these form the locating points for this facing operation. The ends are held in clamps *A* and *B*, while the angle plate *C* supports the center of the housing against the thrust of the grinding wheel.

A few passages of the housing past the cutting surface of the large cup wheel make a perfectly satisfactory joint on each side. A long bar gage placed across the ground surface and touching the cylindrical ends of the axle housing, shows when the work is within the desired limits.

The jig shown in Fig. 2 is used in drilling the holes for the clamping bolts on both sides of the housing.

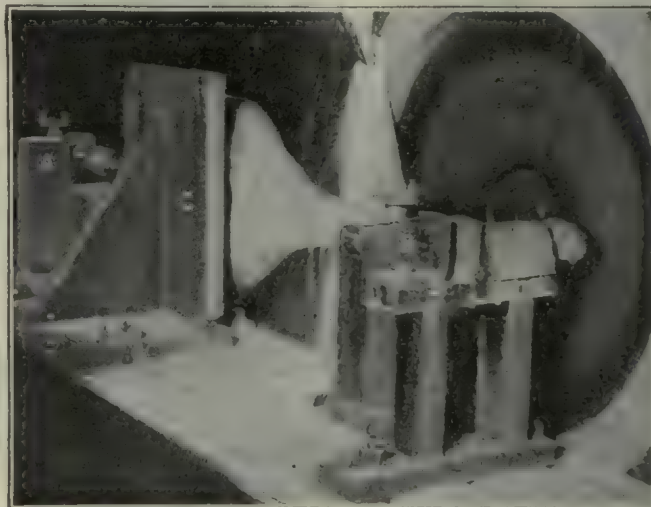


FIG. 1. GRINDING THE FACE OF THE HOUSING

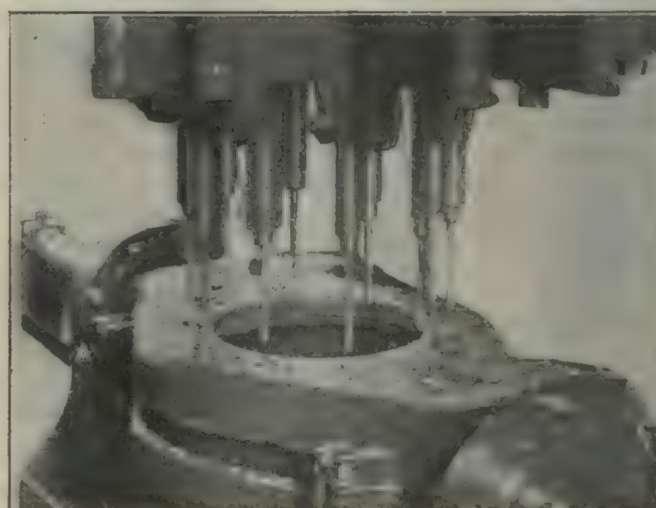


FIG. 2. DRILLING THE BOLT HOLES

This is a revolving jig, the axle being carried in the trunnion shown. The upper half of the jig is hinged at *A* and *B*, the cover lifting out of the way so as to give free access for handling the work. The two halves are held together by the pin *C*.

Second Annual Aëronautical Exposition

The Manufacturers' Aircraft Association will hold its second annual Aëronautical Exposition at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, in March, 1920. Planes for private use, for sporting or touring purposes, or long-distance transportation of freight and mail will be on exhibition. Larger planes, carrying from 3,000 to 6,000 lb. and driven by three or four motors, will cover half the distance across the United States in a single flight.

Making Difficult Duplicate Gages

By Adolph Moses

On page 461, Vol. 51, under the above heading, E. A. Dixie expresses a strong desire for light upon several matters. He wants to be shown just how the accuracy of his gage, described on page 162, Vol. 50, was dependent upon a sharp edge.

This is most easily shown by supposing the plug to have been properly made and inserted in the ring. Examination under a microscope would have shown that the edge was never really sharp and that contact with the surface plate had still further reduced its keenness. The result is that the base diameter of the cone is not the same as that of the cylinder, but is smaller by an amount equal to double the thickness of the "edge." This is shown in the line drawing, Fig. 1, in which the dullness of the edge is exaggerated for clearness.

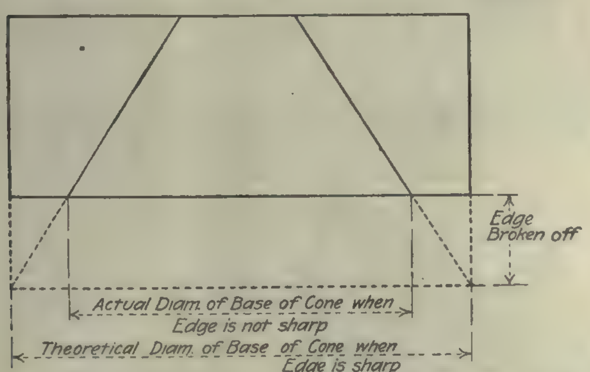


FIG. 1. EFFECT OF DULLNESS OF EDGE UPON ACCURATE MEASUREMENT

On page 1245, Vol. 50, under the pen name of B. A. Munson I have shown two other ways of making this gage. Mr. Dixie says that it seems to him that these measurements are also dependent upon sharp edges for their accuracy. If the line of contact between a cylinder or a cone and a plane surface is an edge, it certainly is news to me. As to the means of resetting the plug in the grinding machine, anyone who knows all about Hindoo mythology ought to know enough to grind the plug on centers—almost any ordinary two-handed man could then replace it so that it would run true.

Referring to the plug method of measuring, he questions the possibility of getting an accurate reading. If I am not mistaken I suggested the use of a size block in my original manuscript. However, if one holds the plugs down lightly with a finger on each, allowing the parallel surfaces of the micrometer spindle and anvil to line up the plugs, he will have no trouble in getting the measurement. By inverting the gage upon a surface plate as shown in the line drawing, Fig. 2, the conditions will be similar to those when measuring the pitch diameter of a screw thread with the aid of wires.

Again, he states that the making of a master gage to which a working gage is fitted is less accurate than the more direct method of making a working gage only. Most toolmakers know that if a plug is to go into a ring gage, it must be somewhat under the gage size, unless it is to be subjected to greater pressure than ought to be applied to a gage. By making a master gage, the necessary allowance for fit is automatically taken care of and does not introduce an error. It is a practical application of the ancient axiom that things equal to the same thing are equal to each other. When the scientist desires to obtain accurate weights, he uses the method of substitution, which is exactly what we are doing in the case of the master gage. Thus, strange as it may seem, it is possible to get more accurate results by making two weighings or two measurements than one.

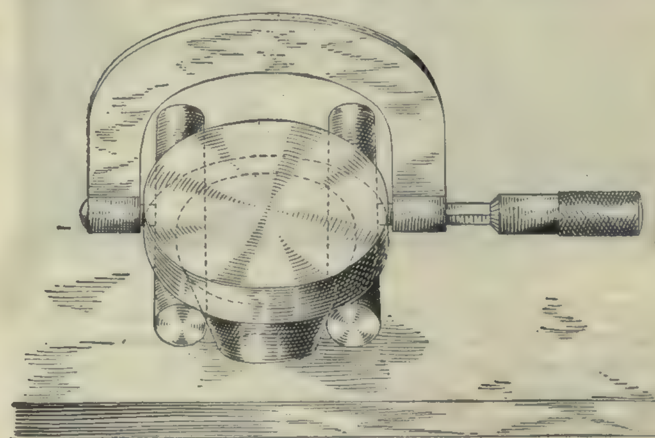


FIG. 2. MEASURING THE CONE BY MEANS OF PLUGS

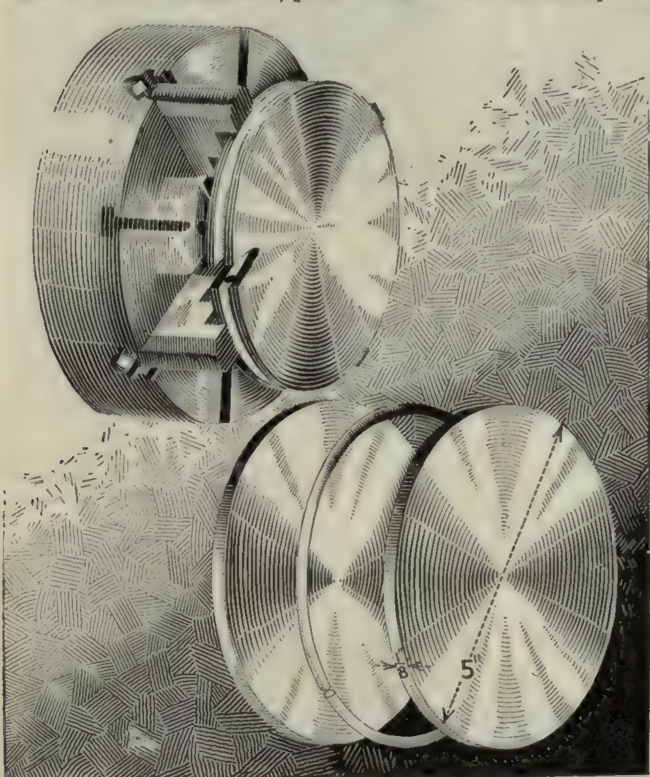
The ball method is probably the easiest and most direct way of measuring this gage. I have described it and given the necessary formula on page 706, Vol. 50.

Mr. Dixie thinks the gage must have been right or the work would not have been accepted. I would like to know how the inspection was made. Did he lend his gage to the inspector?

Quick Way to Make a Thin Disk

By Gustave Remacle

I recently had the job of turning two disks, 5 in. in diameter, from ⅛-in. cold-rolled flat stock. To hold the work I bent a piece of ⅛-in. round stock into a circle of about 4¾ in. in diameter, placed it between the two pieces of flat stock which had been cut off, and sweated them all together as shown in the sketch. This permitted me to grip one piece in the chuck while the other was being turned; then reversing them, in the chuck, to turn the other.



HOLDING A THIN DISK IN THE CHUCK

Second-Hand Supplies That Cost the Foreman Nothing

By Peter F. O'Shea

In each supply stockroom of the Greenfield Tap and Die Corp., there is a separate part set aside for supplies which have been partly used and returned. Leather belts are sometimes taken off machines because they have been found too narrow or otherwise unsuitable, or because the machine has been moved to a new location and rigged in a different way. Such belts are still usable. They are therefore returned to the supply stockroom and put in the second-hand department. Pulleys, hangers, brackets and other shop supplies are likewise gathered.

When a foreman wants new supplies for his department he gets them only on requisition made in duplicate which goes to the office and has the price charged up against the monthly account of his department. But he can get the second-hand supplies by merely giving the clerk an informal memorandum, and then going in, looking over the available articles, and picking out what will serve his immediate purpose. Such goods have been paid for once and charged against the department which first ordered and partly used them.

In the bookkeeping of the shops, no attempt is made to set a value on the partly used goods. They are therefore not charged up against the foreman who is able to find a further use for them. Naturally, the foreman wants his comparative sheet at the end of the month to show up well, with as little charge for expense as possible. So he visits the second-hand shop first, before ordering anything new. This cuts down consumption, and uses up all the old supplies.

Every foreman is welcome to the articles in this stock, no matter what department returned them. No condition is made, except that each foreman and the maintenance department shall return to the supply stockroom all his own partly used material. Thus, the departments and the foremen's cupboards are not cluttered up with reserved supplies, for this material is all collected into a common pool, where the man who has the earliest use for it takes it. This multiplies, according to the number of foremen, the chance of its being used.

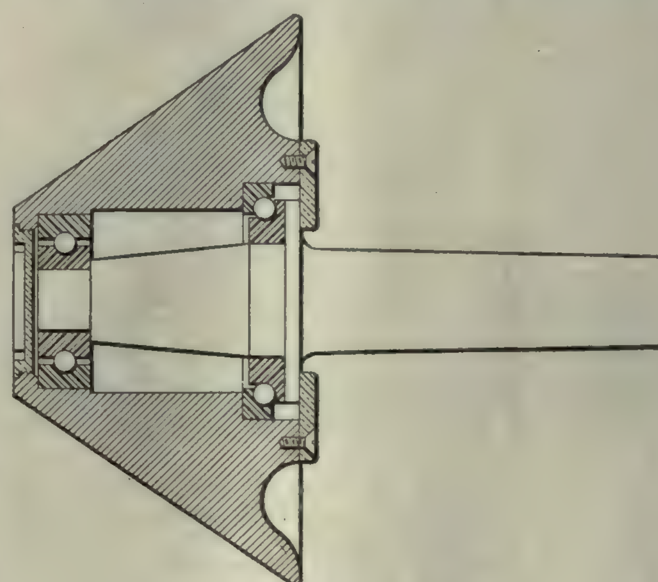
Another Way to Make a Pipe Center

By T. W. Harrison
Balboa, Canal Zone

I notice on page 182, Vol. 51, *American Machinist*, a "better way to make a pipe center," and if I am not too late I have another. Herewith is a full-size drawing of one we made in 1915.

Although it cost more than the kind you find in most machine shops, this center has paid for itself several times over.

We have considerable heavy work requiring the use of a pipe center and I have found that the repairs were so great on the ordinary kind (several kinds), that I was forced to design something heavier not only for pipe work but for heavy, long bushings, etc.



BALL-BEARING PIPE CENTER

At the same time we made two 16 in. in diameter of the same design and neither have had any repairs, though there is hardly a day passes that they are not in use.

The ball bearings and brass cap at the small end of the center are taken from our stock of pneumatic-tool spare parts.

US ARMY ORDNANCE NEWS

Modern Artillery Ammunition—II

BY CAPT. H. M. BRAYTON, ORD. R. C.

This article comprises a study of some of the more important calculations involved in the design of modern artillery ammunition and a description of some of the more important developments during the war at the Frankford Arsenal.

IN a previous article the writer discussed powder pressures within the gun and the effects of this pressure in producing the force known as "set back" within the shell. Calculations were carried out showing how to determine this force under various conditions. While set back is one of the more important forces to be considered in the design of ammunition, it is by no means the only force produced or set up within the shell by the pressure of the propelling gases.

All guns, howitzers and nearly all mortars are rifled; that is, the interior of the bore is spirally grooved. A cross-section of a modern gun is shown in Fig. 4. The raised portions are called lands while the cut away parts are known as grooves. The grooves are much wider than the lands. This grooving of the interior of the bore is for the purpose of making the projectile rotate during flight. Rotation is necessary in order for the shell to carry properly in its trajectory. The rear of the shell is fitted with a copper rotating band which is cut into by the harder steel lands within the gun and forced to rotate on its way out of the bore. Of course, these grooves must be cut into the interior of the bore in the form of a spiral, otherwise the shell would not rotate. In American practice, guns are rifled in a clockwise direction as viewed from the rear; that is, the shell will be forced to rotate in a right-handed direction when forced from the bore by the pressure of the burning powder. Foreign practice is in most cases directly opposite from this as most of their guns are rifled in a counter-clockwise direction when viewed from the rear. No particular arguments can be advanced for either of these two systems as both are equally good and it really makes no difference in which direction the gun is rifled.

To the technical man it will be evident that the forces set up within a shell by this sudden rotation are enormous. A heavy shell at rest within the bore of the gun is in an extremely short interval of time ejected from the muzzle and brought up to its full rotation which may amount to from a few thousand up to over 20,000 revolutions per minute, depending upon the type of gun or howitzer. Let us take a concrete illustration, using the standard American 3-in. field piece. The projectile will weigh 15 lb. and the interior length of the bore or travel of the projectile is approximately 28 calibers or 84 in. The muzzle rotation is 17,000 per minute and the muzzle linear velocity about 1700 ft. per second. This linear velocity varies, of course, from zero at the start to its maximum value at the muzzle but if we assume the average value of the velocity to be around 800 ft. per second, which is very close to what it actually is, we can determine that the shell is in the bore of the gun only about 0.008 second. Yet, in this extremely short interval, the shell must be accelerated and brought up to both its linear and rotational speeds. This can mean nothing less than very great resulting inertia forces.

It would naturally be our first thought that the rifling should be cut along some curve that would be easy to reproduce and also one that would reduce the angular inertia forces to a minimum. Much thought has been put into this phase of gun design. The end to be attained, namely, higher pressures and lower stresses in the shell, warranted the spending of much time and money in the finding of a suitable solution.

The simplest of all rifling is one in which the spiral is uniform and it was but natural that men turned to that form when they first began to rifle guns. It was simple, easy to machine, and it served the purpose when powder pressures were low and ammunition consisted of less complicated mechanisms than is true at the present day. A diagram of uniform spiral rifling is shown in Fig. 5. This means that if one of the lands could be taken out and straightened it would form a straight line as shown in the sketch. This line would at all times be inclined to the axis of the gun the same as shown on the plot. This inclination is known as the slope of the rifling and upon its value depends the final value of the rotation of the shell. When drawn through, the origin as shown its equation becomes simply $Y = mX$; where m denotes the slope of the line or $m = \frac{dY}{dX}$. The slope is then constant and the second derivative or the rate of change of the slope is zero. This means that the shell is given just as much of an angular twist when it first starts on its outward path as it gets at the muzzle. It will be recalled from the previous article

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that the pressure curve reaches its maximum near the breech. The linear acceleration was shown to be a direct function of the pressure, hence also reaching its maximum value at the same point. It will be shown later that a definite relation exists between the slope of the rifling curve, the linear acceleration and the angular acceleration. This angular acceleration will reach its maximum value at the point of maximum pressure and maximum linear acceleration when the slope of the rifling is constant as in the case cited. It will readily be appreciated that it is not good design to have all of these forces reach a maximum value at the same point. The linear relation existing between the pressure and the linear acceleration makes it impossible to separate these two but in the case of the angular acceleration the slope of the curve enters.

As time went on and knowledge of machine-shop methods increased, a more complicated form of curve was introduced for the rifling. This was the parabola shown in Fig. 6, the equation of which is given by

$$Y = mX^2 \qquad (8)$$

the first derivative or slope by

$$\frac{dY}{dX} = 2\,mX = \text{slope} \qquad (9)$$

and the second derivative or rate of change of slope by

$$\frac{d^2y}{dX^2} = 2m \qquad (10)$$

It can be seen from the slope equation that the greater the value of X, that is, the farther out toward the muzzle, the greater is the value of the slope. With small values of X or up near the breech where the pressure and linear acceleration are a maximum we have a low value for the slope. This is exactly the result desired and results in a much lower angular acceleration and correspondingly lower angular inertia forces.

But men were not contented with the results given by this form of curve and so the ordnance experts set about finding something a little better. After much experimentation and study a curve known as the semicubical parabola was adopted. This curve is given by the equation

$$X^{\frac{3}{2}} = 2\;PY \qquad (11)$$

and is plotted in Fig. 7. The first derivative or slope is given by

$$\frac{dY}{dX} = \frac{3\sqrt{X}}{4P} \qquad (12)$$

and the second derivative or rate of change of slope by

$$\frac{d^2Y}{dX^2} = \frac{3}{8\,P\sqrt{X}} \qquad (13)$$

This curve is used almost exclusively in the rifling of modern guns and howitzers and for this reason further discussing will be warranted in order to make clear to the designer of ammunition just how to use it in determining the forces resulting from rotation and angular acceleration.

The Ordnance Department of the Army publishes a "Cannon Data Book" which contains all sorts of data of value to the designer. Among this data is given the rifling used on the various guns, showing the slope of the rifling curve at the muzzle and at the breech in case these two values are different. Take for an illustration the standard 3-in. field gun. The data book states that the slope of the curve is 1 in 25 at the muzzle and 1 in 50 at the breech. This means that the slope of the curve at the muzzle is 1 in 25 calibers, or, in other words, that the shell will make one complete turn in traveling a linear distance of 75 in. This would be true if the ratio of 25 to 1 held throughout the bore which it does not because at the breech the slope is only 1 in 50. With this information it is possible to determine the equation of the curve as follows:

$$\text{Slope} = \frac{dY}{dX} = \frac{3\sqrt{X}}{4\,P} \qquad (12)$$

Let X_1 = the point on the curve at the breech of the gun;

X_2 = the point on the curve at the muzzle.

Then $X_2 = X_1$ + length of gun in inches $= X_1 + 84$.

$$\text{Slope of curve at muzzle} = \frac{3\,\pi}{3 \times 25} = \frac{\pi}{25} \qquad (14)$$

$$\text{Slope at breech} = \frac{\pi}{50} \qquad (15)$$

We may then write

$$\frac{3\sqrt{X_1}}{4P} = \frac{\pi}{50} \qquad (16)$$

$$\frac{3\sqrt{X_2}}{4P} = \frac{\pi}{25} = \frac{3\sqrt{(X_1 + 84)}}{4P} \qquad (17)$$

Solving these two equations for the value of P, we find it equal to 63. We then have $X_1 = 28$, $X_2 = 112$. The equation then becomes

$$X^{\frac{3}{2}} = 126\;Y \qquad (18)$$

and the rifling at the breech starts on this curve at X = 28 in. and ends at X = 112 in. From the equation in this form we may find both the slope at any point and the angular acceleration.

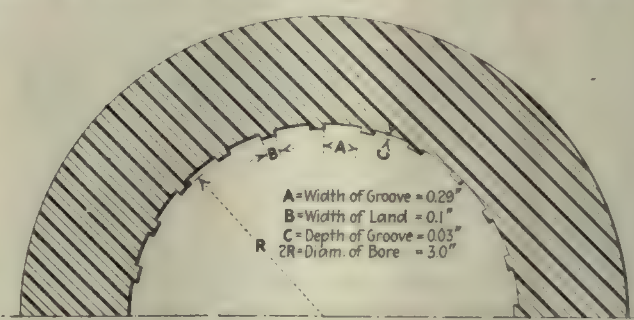

FIG. 4. CROSS-SECTION OF 3-IN. GUN NEAR THE MUZZLE

This form of rifling offers somewhat more resistance to the passage of the shell through the gun due to the fact that the rifling is compelled to cut a new path for itself in the rotating band throughout the entire bore. This is shown in the second derivative where the rate of change varies inversely as the square root of the distance. This increase in passive resistance, as it is called, is not of sufficient importance to be worthy of further discussion.

It was shown in a previous article that the pressure in the gun acting on the projectile caused the linear acceleration. In the same way a combination of this lin-

ear acceleration and the rifling causes the angular acceleration. The forces set up in the shell due to this sudden twist seem to be very vague to most men and it is common practice for designers to ignore these stresses due not to their insignificance, for they are very real and often large, but rather to a lack of knowledge of the simple mathematics involved. Rather than master this technical side of the problem, many designers and manufacturers have preferred to build their fuse or their shell along the cut-and-try method, trusting to luck that their devices would in some mysterious way work as it was desired to have them. The inevitable result under these conditions is complete failure and it will indeed be fortunate if no accident happens during the experimental tests.

The angular acceleration is obtained from the linear by simply multiplying the linear by the slope of the curve, all expressed in proper units. An illustration will make this clear. Let us suppose the linear acceleration equals 500,000 ft. per second, per second, and that the slope of the rifling curve equals 1 in 50 calibers or $\frac{\pi}{50}$. We may then write for the 3-in. gun

$$\alpha' = \text{angular acceleration} = \frac{500{,}000\,\frac{\pi}{50}}{\frac{3\pi}{12}} =$$

$$\frac{500{,}000 \times 12}{3 \times 50} = 40{,}000 \qquad (19)$$

This α' is expressed in revolutions per second, per second. If we desire it in radians per second, per second, we must, of course, multiply by 2π.

In the same manner, the value of this acceleration may be found at any point from the breech to the muzzle when the linear acceleration curve is known.

Whenever we have acceleration we must have inertia forces. This holds true in angular as well as in linear acceleration. In the case of the latter we have the force of set back produced, while with the former we get a torque or twisting action. This torque must be expressed as a moment and may be obtained from the following formula:

$$\text{Torque} = \frac{\alpha I}{12\,g} \qquad (20)$$

Where torque is expressed in inch-pounds, $g = 32.2$; I = the polar moment of inertia of the shell, and α = the angular acceleration at the point in the gun that is under discussion or, which is more usual, the maximum value expressed in radians per second, per second. If the maximum value of the torque is known, it is usually sufficient for most practical purposes in the determination of the results of this moment on the parts of the design. It must be remembered, however, that this maximum value of the torque does not necessarily occur at the point of maximum pressure. It only occurs at this point in guns having the uniform rifling curve. The actual point of greatest angular stress comes slightly ahead of the point of greatest pressure; but for all practical uses it is sufficient to calculate it at the latter place as the difference is slight and the pressure curve is not always known for every gun when using the various grades of powder. It is a simple matter, as shown in equation 19, to get the value of α at this point if one has the standard data of the gun being considered.

Coming back to equation 20, we have as a factor the polar moment of inertia I. This quantity would be difficult to obtain exactly due to the peculiar shape of the shell. For most practical work we may, without appreciable error, consider the projectile as a hollow cylinder. The value of I is then found from the well-known formula

$$I = \frac{W\,(r^2 + r^2{}_1)}{2} \qquad (21)$$

where

W = weight of the shell in pounds;
r = outside radius of shell, inches;
r_1 = inside radius of shell, inches;
I = polar moment of inertia in inch units.

Formula 20 may be combined with 21 and we then have

$$T = \frac{\alpha\, W\,(r^2 + r^2{}_1)}{24 g} \qquad (22)$$

Application of Formulas

Thus far nothing has been said in regard to the use of these formulas in the determination of the forces set up in the shell due to angular acceleration. Let us suppose we have designed a fuse to be used in a high-powered gun. We have already calculated the force of

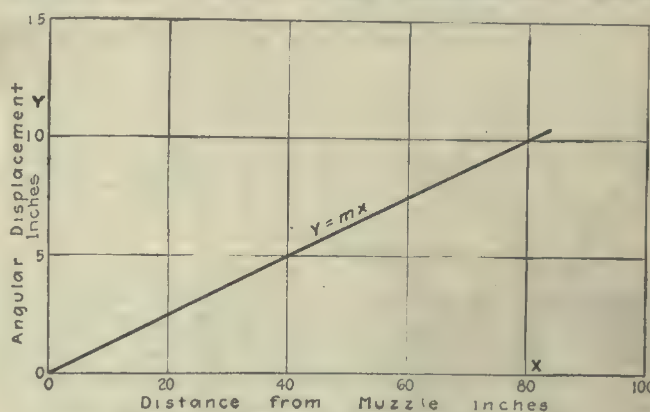

FIG. 5. LINE OF UNIFORM RIFLING

set back on all of the parts and designed them to withstand this tremendous force. It might well happen, however, that the fuse was well protected from the set back force but wholly unprotected from the angular. As is well known all parts have inertia due to their weight. When the shell is rapidly accelerated and the angular torque occurs, the part upon which we desire to know the stresses will set back just as it did in the case of the linear acceleration except that this time it tends to move in a plane perpendicular to the axis of the shell and in a direction opposite to the direction of rotation. Of course, as a rule the part does not actually move or rotate backward as it may be held by other metal parts but in this case the metal must take up the stress as it did in the case of the longitudinal force.

Probably the most direct way of obtaining the angular set back is to transfer the angular acceleration into terms of linear acceleration for the point off-center

which represents the center of gravity of the mass we are considering. An example will perhaps be best to make all this clear. Let us assume that the fuse contains a part one inch off-center and that this part weighs half an ounce. We have found from equation 19 the value of α for the whole shell. This value will be expressed in revolutions per second, per second. What then is the linear acceleration of the center of the mass which is one inch off center? Simply

$$a = \frac{2\pi R\alpha'}{12} \tag{23}$$

Where a = linear acceleration of the point in feet per second, per second;
R = distance off-center in inches;
α' = angular acceleration of the shell in revolution, per second, per second and found from formula 19.

With the value of the linear acceleration known, it is simply a matter of applying the linear inertia law to get the set back. This was given in equation 3 in a previous article as follows:

$$F' = \frac{W'a}{g}$$

Where F' = total set back in pounds;
W' = weight of part in pounds.

In our example we have
R = 1 inch;
α' = 40,000 revolutions per second, per second;
$W' = \frac{1}{32}$ pounds.

With these specific values we obtain

$$a = \frac{2\pi 1 \times 40{,}000}{12} = 21{,}000 \text{ feet per second, per second.}$$

$$F' = \frac{21{,}000}{32 \times g} = 20.4 \text{ pounds.}$$

This simply means that our part which weighs only half an ounce and is but one inch off-center sets back against its supports with a force of over 20 pounds. If calculated further in terms of unit area and pounds per square inch compression, it would undoubtedly exceed the elastic limit of the metal. This is a very vital point to consider in all design work in this field and its neglect will account for a large number of the failures. The metal may deform under this force in such a way that it can not properly perform its function later on when called upon to do so.

This twisting moment is often the cause of time-rings turning relative to the body of the fuse, thus causing short or long burnings. The friction caused by the linear set back, however, tends to keep the ring from turning and is usually sufficient to do so. It is a factor of sufficient importance, nevertheless, to have caused some fuse designers to incorporate a locking device on the fuse. This first appeared in foreign designs and has not yet been universally adopted on American fuses.

Generally speaking, inertia forces due to angular acceleration are a detriment and their results must be guarded against by scientific designing and calculation of all the forces. Such procedure will save much time and money and a more satisfactory product will be produced. The safety factor also enters in here because it may well happen that the fuse is made unsafe by the failure of some part to withstand the stresses brought to bear upon it. Failure of the detonator carrier, for example, might explode the detonator and thereby the shell, prematurely wrecking the gun and perhaps doing serious injury to the gun crew.

Centrifugal force probably causes the designer more trouble and interferes more with his plans than all of the other forces with which he has to deal put together. Practically everyone who is at all technically inclined knows what this force is, how it acts and what produces it; yet it was noted that a large number of technical men presented new designs to the Government for consideration in which the effects of centrifugal force had been entirely neglected. In many cases, the designer was wholly ignorant that such a force was present and in others it was known but not considered of sufficient importance to calculate. This lack of the fundamental principles of shell and fuse design caused the failure of many men's dreams in the quest for new things to revolutionize warfare.

The principle is simple. Everyone knows that if we fasten a weight on a string and revolve it while re-

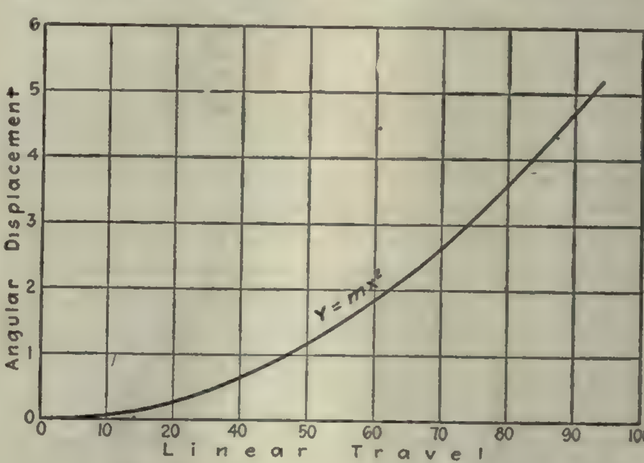

FIG. 6. PARABOLIC CURVE OF RIFLING

taining hold of the other end that the weight will continue around in a circular path and will create a very noticeable tug on the string. If the string is released the weight flies off at a tangent showing that a force was actually present. We have the same condition within a shell. As previously stated the shell is brought up to a very high rotational speed within the gun due to the rifling. This rotation sets up centrifugal force and this force exists everywhere within the projectile. All parts tend to move toward the outside and if prevented from so doing by adjacent parts a very great stress is created just the same as the force created in the string when the weight is forced to travel in the circle.

Fortunately for the science of gunnery, this centrifugal force is easily calculated. It is also possible to obtain its value with mathematical exactness. The fundamental formula is as follows:

$$C.F. = \frac{MV^2}{R} \tag{24}$$

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Where $C.F.$ = centrifugal force in pounds;
M = mass of part under consideration in pounds;
V = linear velocity in feet per second;
R = distance of part from center of rotation in feet.

In this form the formula is not always convenient for use in fuse designing. We usually know the radius of the part in inches, the weight of the part in pounds, ounces or grains and the rotation of the shell at the muzzle of the gun in revolutions per minute. We may readily transform this equation to meet the needs of these units. The following calculations will be self-evident:

$$M = \frac{W}{g}$$
$$V = 2\,\pi\,RN$$
$$R' = 12\,R$$

Where W = weight of part in pounds;
R' = distance of part off-center in inches;
N = speed of shell in revolutions per second.

We may then write

$$C.F. = \frac{MV^2}{R} = \frac{W\,(2\pi RN)^2}{gR} = 1.23\;WRN^2 \qquad (25)$$

Here N = rotation in revolutions per second.

Generally, however, it is not convenient to express N in second terms, R in feet and W in pounds. The parts under consideration generally are smaller and we find it best to express W in grains, R in inches and N in revolutions per minute. This last unit is preferable because it is customary to give the rotation of shell in this way. With these units we may write equation 25 as follows:

$$C.F. = \frac{1.23\;W'R'(N')^2}{7000 \times 12 \times (60)^2} \qquad (26)$$

In which W' = weight of part in grains (7000 grains = 1 pound);
R' = radius in inches;
N' = rotation of shell in r.p.m.

This may, of course, be reduced to one constant when we have

$$C.F. = 0.000,000,004,070\;W'\,R'\,N'^2 \qquad (27)$$

Equation 27 is a practical formula which may be easily applied in determining this force. As an illustration, let us assume that in the fuse we are designing there is a metal part half an inch off the center of rotation or axis of the shell. This part weighs 200 grains which is slightly less than half an ounce. We are designing our fuse for the American 3-in. field gun or the French 75-mm. field piece. The muzzle rotation of the shell in these guns is practically 17,000 r.p.m. By applying the formula given in equation 27 we have $C.F. = 0.000,000,004,070 \times 200 \times 0.5 \times (17,000)^2 =$ 117.5 lb. This illustration will give an idea of how large this force really is and how vital a factor it really becomes in the design of modern ammunition.

Some men are not accustomed to dealing in grains as a unit of weight and for those we will write the formula in terms of the ounce as the unit as follows:

$$W = \frac{W''}{16} \text{ Where } W'' = \text{Weight in ounces}$$

Then $$C.F. = 0.000,001,785\;W''\,R'\,N'^2 \qquad (28)$$

This force is different from the forces due to inertia described in the previous sections. While they last only as long as the shell remains in the bore, a very short interval, the centrifugal force is present during the whole flight of the projectile. It varies in the gun from zero at the breech to its maximum at the muzzle and remains fairly constant during flight, as the rotation decreases but slightly while the shell is traveling to its target. The air friction, which is small, is the only force tending to slow down the rotation. Centrifugal force is then always present during the flight of the shell. Fuses designed to function upon impact are affected by it because it is almost certain to be present during the whole time that the shell is penetrating its target and functioning.

The effects of this force are by no means confined to the stresses which it produces in the various parts.

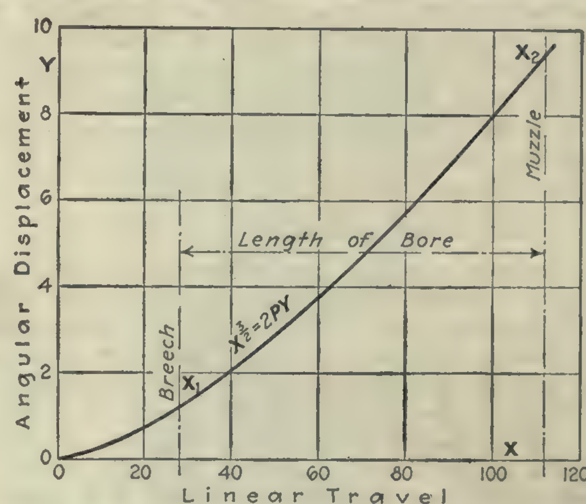

FIG. 7. CURVE OF RIFLING—SEMI-CUBICAL PARABOLA

Force properly applied always produces friction in moving parts. We have here an excellent illustration of this principle. If we attempt to move a part within the fuse while it is rotating by means of a spring, for example, we find that considerable force is necessary. If sufficient force is not applied we find that the part will not move. This is according to the simple law of friction; yet many designers, even of the higher type, failed utterly to apply this law to their designs. These statements apply with special emphasis to the attempt which has been and is still being made to develop a mechanical time fuse to take the place of the powder train method of obtaining the time of explosion. In the mechanical time fuse we have a complicated arrangement of gears, wheels, springs, etc., arranged much the same as in an ordinary watch. The mechanism must, of course, run and function during the flight of the shell and thus during the time that the centrifugal force is at its maximum. A large amount of friction is created in the bearings and those parts upon which other parts move and is often more than sufficient to prevent the clock from running. This was one of the great difficulties encountered in the early development work in this line and delayed the progress a great deal. Most of this development work was

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carried out by the watch and clock companies because they were better equipped to carry it through to a successful conclusion. Continual failure was encountered mostly because the watch companies neglected to analyze the forces existing within a shell in flight. Centrifugal force was the most troublesome of all but when properly considered its disastrous affects *per se* were found to be more imaginary than real. As an illustration, one watch concern that had been blessed with continual failures for over a year decided that something radical must be done at once if it were ever to get results. It consequently sent some of its fuses to an Army arsenal where a ballistic engineer analyzed the problem. After careful study it was found that a certain wheel which was carried on a shaft parallel to the axis of the shell and placed about ¼ in. off-center would stop rotating under the action of the mainspring when a weight of two ounces was hung on the shaft. The wheel and shaft were carefully weighed and the centrifugal force calculated for the gun from which the fuse was to be fired. Much to the surprise of the designers, and perhaps to the engineer as well, it was found that this shaft had a force of over two pounds acting on it in a radial direction during flight. This was more than 16 times the force actually required to stop the whole mechanism.

Centrifugal Force Helps the Designer

Heretofore, we have mentioned only the undesirable aspects of centrifugal force. It fortunately has its good qualities. It is the one force next in importance to set back in the designer's field. Without it we could not have the superhuman devices which we have today in modern ammunition. By its absence in bodies at rest, shells are made safe in handling and in storage. This is accomplished by making it necessary for the shell to receive a high rotation before it is armed or in position to fire. This arming is accomplished by utilizing centrifugal force in many different ways, usually by causing weights to fly out and thereby exposing the firing pin so that it can come in contact with the primer when the shell meets resistance.

To calculate the force necessary to overcome friction created by centrifugal force it is only necessary to multiply the force by the coefficient of friction. A value for this coefficient for the surfaces under consideration may be found in any engineering handbook. Where the two surfaces are steel a good value to use and one which has been found to work out well in practice is 0.2. If the surfaces are smooth it may be advisable to reduce this value to 0.15 although the former value will be found more nearly correct in most cases. What does this mean then? Simply this—if you have a part off-center in a shell and desire to move it during the flight of the projectile, you must apply a force to it equal to the product of the centrifugal force and the coefficient of friction. This is only one of the laws of friction and holds good within a shell just as well as it does anywhere else. One fact must be well fixed in mind and that is that the friction is absolutely independent of the area. More people go astray on this than any other one thing connected with the determination of the friction forces. It is not at all uncommon to find a designer attempting to reduce his friction and friction moments by reducing the area of contact. As a matter of fact this neither reduces nor increases the force. It varies the intensity of stress to be sure but not the friction. The only way to reduce this effect is to reduce the centrifugal force and this is done by making all parts as light as possible and placing them as near the center of rotation as is practicable.

At this point the centrifugal force in the shell while the latter is within the gun may be noted. It was shown previously that the rotation starting at zero at the breech gradually reached its maximum at the muzzle. As the centrifugal force varies as the square of the rotation it will readily be appreciated that this force gradually increases as the shell travels outward, reaching its greatest value at the muzzle but practically retaining it throughout flight. This has a bearing in the design of fuses, for example, and is often utilized. This means that when the two inertia forces are a maximum the centrifugal force is a minimum and vice versa. Great care must be exercised in designing a device that will arm the shell on rotation to safeguard it from arming before it has left the gun and before the effects of the set back have disappeared. If the device does arm before it should, it is almost certain that the shell will explode either just as it leaves the gun or just before. In the latter case the end of the gun will be blown away if the shell happens to be a high-explosive one. These facts coupled with others have led to the development of "bore safety" features on fuses.

The principal forces acting on a shell while in the bore of a gun are first the linear set back, a force which is great in magnitude, always present and which varies from zero at the breech to a maximum in a distance of a very few inches and then gradually drops off to zero about 10 ft. outside the muzzle. This force may be used as the designer sees fit in releasing catches that control the firing of primers by forcing them down on to the firing pin, as is done in the ordinary powder time fuse, or in any one of many different ways in which this force is now used. On the other hand every part must be calculated to withstand this force; otherwise it will be crushed in the gun and unable to perform its function. Then we have the angular acceleration as a result of the linear acceleration and the rifling. It was shown that this force acted in a plane perpendicular to the axis of rotation of the shell which makes its line of action 90 deg. from the linear set back. It was pointed out that this force reached its maximum at about the same point as the linear but that it became zero exactly at the muzzle instead of outside. This was due to the ending of the rifling. Then lastly it has been shown how to calculate centrifugal force and how to overcome it when it is excessive. It was further shown that this force, while it acted in a plane perpendicular to the axis of rotation just as the angular acceleration was, nevertheless, quite different in that it started from zero at the breech and reached a maximum at the muzzle. Centrifugal force always acts, of course, in a strictly radial direction, while the angular inertia force always acts perpendicular to this direction of the tangent to the plane of rotation. This

makes the angular force at right angles to the centrifugal force but in the same plane.

It will be apparent then that we have these three forces acting on the parts within a shell all at once in varying degrees. For any one point within the gun it is possible to calculate each one separately and combine them vectorially and get their resultant. This is the only true way to determine the stress on the parts and it should be carried out for several points along the bore in order to determine the maximum value. It is a simple matter to combine them as the three really act in three planes at right angles to each other. The position of the resultant will depend on the relative values of the three forces. If calculation is carried out in this way on every part of the device and each part is designed to perform its proper function under those conditions, the designer need have no fear of the results in practical firing tests.

The question of the determination of the pressure curve in any given gun has not been taken up here. This subject will be found fully treated in any of the many books on the subject of ordnance and gunnery. The determination of this curve is, of course, fundamental because without the information which it gives, none of the calculation carried out above could be accomplished. This curve may be determined in two ways: by experimental firings or by calculation. The former method is costly but apt to be the more accurate. The method of calculations will suffice for most purposes. This determination involves such factors as the character and weight of the powder, the size and shape of the grain, the volume of the powder chamber, the caliber of the gun, the temperature of the powder at time of firing and above all on the weight of the shell. The greater the weight of the projectile the higher the pressure curve will go—all other factors remaining the same. The density of loading is the ratio between the weight of powder used in the charge to the weight of water which will just fill the powder chamber. This value naturally varies greatly in the different guns and howitzers and will range all the way from 0.7 to 0.3. In a few exceptional cases it reaches 0.8 but this is not usual. The higher the value of this ratio the greater will be the pressure in the gun.

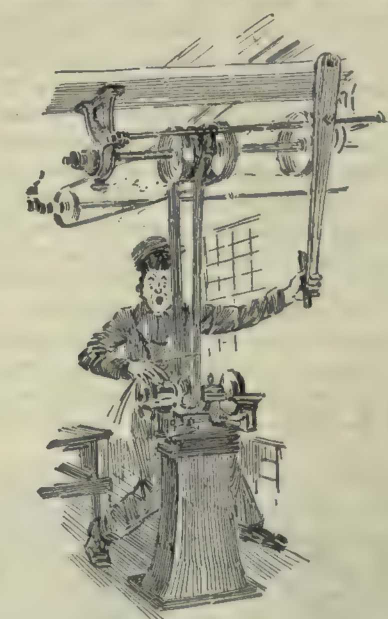
It is not unusual in practice to use an excess charge of powder. This results, of course, in excess pressure and greater muzzle velocity of shell. The objects to be attained in the use of excess pressure are twofold: first to test the strength of a gun or the durability of ammunition and, second, to increase the muzzle velocity and thereby the range of the shell. This excess pressure is seldom carried beyond 12½ per cent. of the normal pressure. In old guns no excess pressure is allowed. Fuses and other parts of ammunition are often calculated upon the basis of the excess-pressure curve rather than on the normal so as to insure perfect operation under all tests to which the proving-ground officers will subject them when presented for trial. Some nice problems arise when it becomes necessary to use shells which are not standard weight or when it is desirable to change the powder charge from the normal. These questions need not bother the average designer as they need to be considered only when conditions are abnormal.

If the civilian engineer who wishes to submit a design to the Ordnance Department of the Army for consideration will first calculate the stresses within his mechanism according to the above outline his serious difficulties will disappear.

Braking a Grinding Wheel by Hand

By Harry Senior

During the war we, like all other employers of skilled labor in any way relating to the machine business, were afflicted with all sorts and conditions of machinists who came from "road and river—countryside and town," and ranged from fellows who modestly admitted that they had "fixed dad's mowing machine," to those



who "could do any job in the shop," and wanted all the money there was in sight.

One day one young fellow, whose entire previous mechanical experience had been acquired behind the ribbon counter of the local dry-goods store, came to me with a very bad looking hand. Diagonally across the palm was an ugly bleeding wound that was part blister, part cut, and part tear.

"For the love of Mike!" I ejaculated, "what have you been trying to do; get your hand in by grinding it?"

"Just stopping the emery wheel quick, like Bill does," was the reply.

"Bill" was an old and tried jour, who, I was perfectly certain, had never attempted to stop a grinding wheel by braking it with his hand—at least not in a good many years; so after dressing the boy's hand we went over to interview Bill.

"What do you think I am! Nutty?" casually inquired Bill upon hearing the boy's story.

"Saw you do it only a few minutes ago," said the boy, "right over here"; and he led us over to the speed lathe and showed us how Bill had stopped that machine quickly, after shipping the belt off, by pressing his hand on the large step of the smooth iron cone.

EDITORIALS

The President's Industrial Conference

WE ARE all interested in the object of the conference which is to avert or postpone industrial conflicts. And as it is the desire of the conference to have the careful consideration of all interested individuals or organizations, we give an outline of the points so far brought out.

The conference is not seeking the causes of industrial unrest, but rather the best methods of preventing or adjusting disputes. It emphasizes the importance of considering the human element in the belief that the successful industrial organization must yield a large satisfaction in the life of the individual. It contends that the industrial world has failed to adjust human relations to the facts of our economic interdependence.

The conference points out that the relationships in modern business must be organized on a sound basis, with a sincere effort for mutual understanding and with the employers as leaders rather than as masters.

It is proposed to establish a national tribunal and regional boards for inquiry and adjustment of disputes, the country being divided into twelve or more industrial districts. The national tribunal is to have headquarters in Washington and is to be composed of nine men, three representing employers, three representing employees and three representing the public. The Secretary of Labor will nominate the employee representatives, the Secretary of Commerce those for the employers and the President will choose the members representing the public.

The regional boards consist of a chairman who is to represent the public interest and to be appointed by the President, two employees and two employers. The board must publish its report within five days of the close of the hearing and within thirty days from the date of original request. If the reports are not unanimous both majority and minority reports must be published. The regional boards have the right to subpoena witnesses, examine them under oath, require production of pertinent books and papers and to insure protection to witnesses. Whenever agreement is reached or decision made it shall have the force of a trade agreement.

The conference is undertaking a gigantic task in the hope of securing national co-ordination and stimulating the formation of bodies for local adjustments. It will not and cannot formulate plans which will suit everyone nor which will work perfectly at all times; they are bound to be too conservative for some and too radical for others.

It is the part of wisdom to support the conference as far as possible to show our good faith in desiring an end to industrial disputes. Both sides must concede something in nearly all settlements and we should be willing to go halfway in meeting changes which are in the line of evolution and progress. If means are provided to prevent strikes or lockouts until the dispute has been passed on by the regional board we shall have made a long step forward.

The Foreman and His Job

THE foreman's job has changed greatly since the days of the old shop. Then, he was the instructor, guide, counselor—almost the father confessor—of the whole shop. When the shop began to grow larger, the foreman's job changed according to the size of the shop and the kind of management. The management which prided itself on cold-blooded efficiency and proclaimed the motto that there must be no sentiment in business, developed the bull-dog type of foreman. In other shops the foreman became simply a timekeeping clerk, handing out various jobs as they came from the planning department. The shops which have suceeded best from every point of view, however, are those which retained the human side and realized that the personal element played a large part in manufacturing.

The job of foreman should not be that of a buffer, standing as a wall between the management and the men, and taking blows from both sides. Such a position is most unhappy from every point of view. A foreman of this kind is under suspicion from both sides and is often ostracized in the social life of the community.

The modern foreman should rather be a representative or interpreter of both sides. He should thoroughly understand the policies of the management and be able to explain their workings to the men. On the other hand, he should be able to interpret to the management the attitude of the men on all questions, and his opinion and friendly criticism should not be suppressed, but should be sought by both the management and the men.

Perhaps the first requisite of a good foreman who is to retain his self-respect is loyalty—loyalty to his *job*.

If the men insist on acting unfairly to the management or make unreasonable demands, he must notify them that loyalty to his job compels him to side with the management. If the management refuses to act fairly toward the men, loyalty to the job of foreman demands that he look for employment elsewhere. He should not feel obliged to uphold unfair tactics, but when he finds he cannot be loyal to the management he should lose no time in severing his connection with that company.

The foreman who is to be really successful, who is to grow out of the job into one of larger opportunities, must be above petty jealousies of any kind. He should encourage suggestions from his men, as this is one of the many ways of increasing production. The foreman who frowns on such suggestions, will never get very far up the ladder.

Some of the most successful foremen and higher executives have won their success by gathering around them the most capable men possible. They have encouraged suggestions and have given credit freely in all cases. The foreman who attempts to appropriate the ideas of his men for his own advancement rarely gains anything by so doing. The foreman must learn that it is team work of the whole department which counts, and that unless he can secure the hearty co-operation of his men he cannot hope to make a very creditable showing.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Toledo Drawing and Stamping Press

The Toledo Machine and Tool Co., Toledo, Ohio, has added to its line a series of double-crank, toggle, drawing- and deep-stamping presses, the smallest one being illustrated herewith.

It is claimed by the maker that the presses in this series embody all the most modern ideas in presses particularly adapted for the manufacture of automobile bodies, fenders, hoods and other deep work of a like character.

Provision can be made for disconnecting the toggle mechanism from the blank holders and connecting the outer and inner slides together, thus converting the presses into single-action machines. Spring-pressure attachments can be fitted to the beds of these presses, converting them into triple-action machines.

Several sizes are contained in the series, ranging in opening between the uprights from 84 to 120 in. and in weight from 85,000 to 240,000 lb.

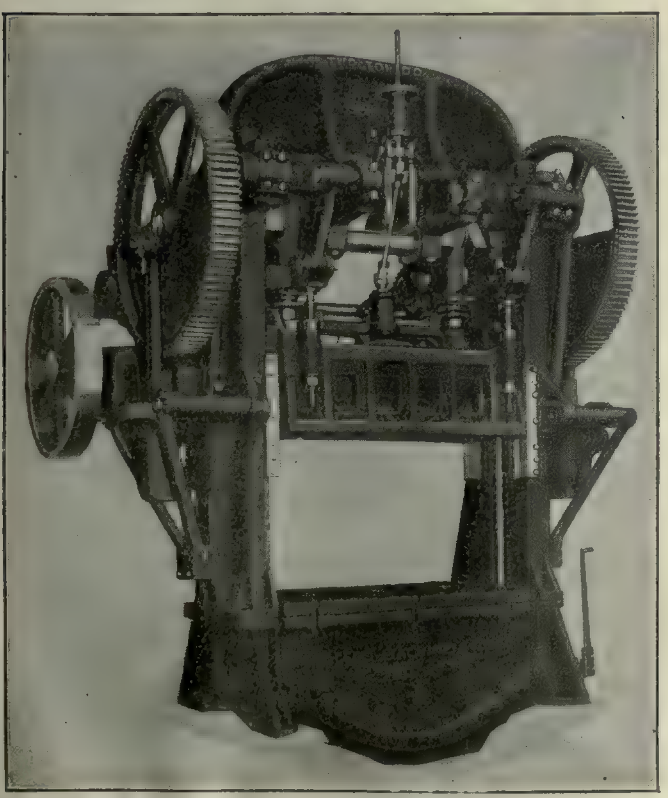
The specifications of the machine here illustrated are: Width between uprights, 84 in.; opening in bed, 28 x 76 in.; distance from bed to blank holder with stroke down and adjustment up, 52 in.; distance bed to plunger, with stroke down and adjustment up, 55 in.; adjustment of blank holder and plunger, 5 in.; stroke of blank holder, 11½ in.; stroke of plunger, 16 in.; weight of balance wheel, 1,800 lb.; speed, 250 r.p.m.; ratio of gearing, 27½ to 1; distance from floor to center of shaft, 153 in.; floor space, 110 x 195 in.; weight, 85,000 pounds.

Duff High-Speed Ball-Bearing Jack

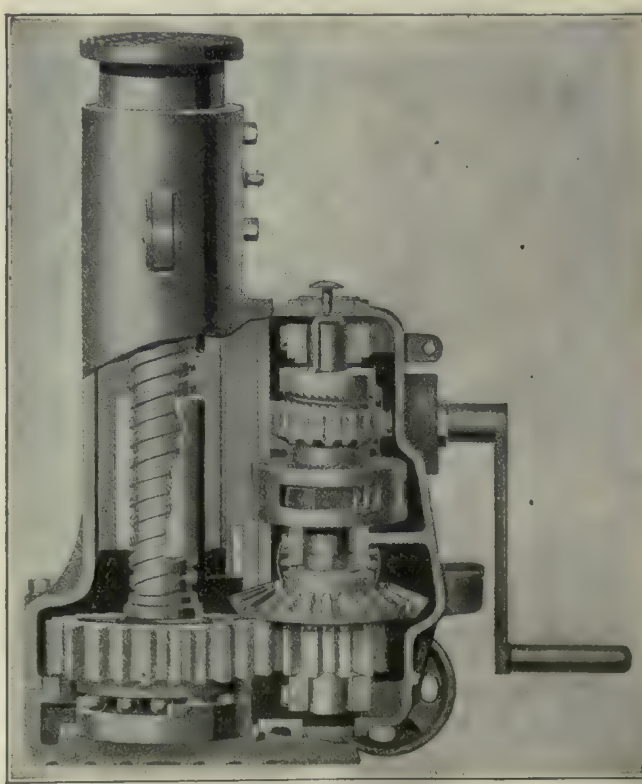
The Duff Manufacturing Co., Pittsburgh, Pa., has placed on the market a line of ball-bearing jacks, one size of which is shown in the illustration herewith. The operating mechanism of this jack is in the base so that the greater weight is at the bottom. By inserting the operating lever in a special socket, the jack can be tipped over on to the wheels with which it is provided and rolled to wherever needed.

The load is raised by means of a 6-ft. lever which operates a double-threaded screw through a ratchet and gearing. The screw has a steep pitch, turns in a bronze nut, and the thrust is taken by a ball bearing. For lowering the load, a crank handle is used.

It is claimed that safety in operation is assured by



TOLEDO DRAWING AND STAMPING PRESS



DUFF BALL-BEARING JACK

a positive clutch which holds the load at all times and that, regardless of the speed used in lowering, the load may be stopped at any desired point. The line comprises three sizes of jacks with heights of 20, 24 and 26 in. and capable of maximum raises of 6, 10 and 12 in. respectively. Each has a lifting capacity of 75 tons.

Jacques "Never Wear" Gages

The Production Equipment Co., 1 Madison Ave., New York, has placed on the market a line of end-measuring gages, one of which is shown in the illustration. The contact points are hardened-steel balls which are retained by screw caps as shown. As wear occurs the caps can be loosened and the balls turned to present new surfaces, thus compensating for wear.

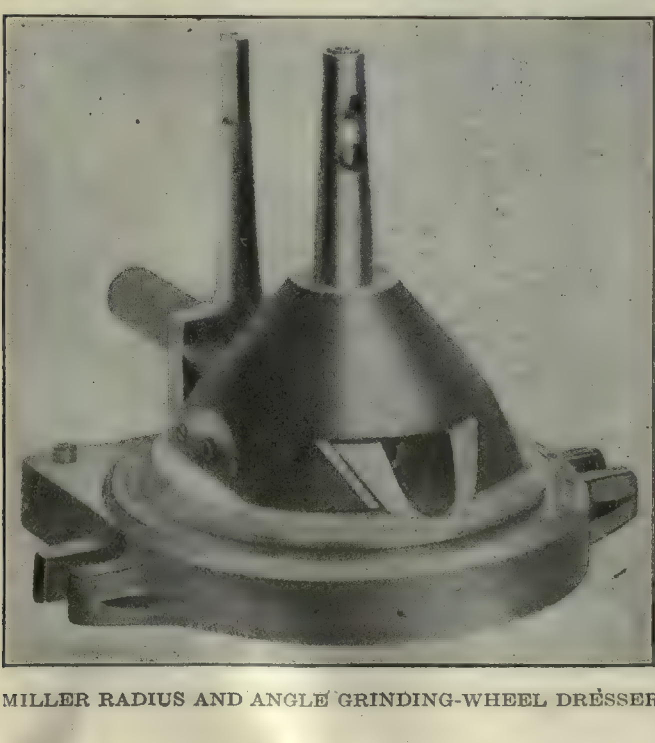
JACQUES "NEVER WEAR" GAGE

Every gage is provided with rubber insulation to prevent expansion from the heat of the hand. The gages are made in sizes from 1 to 12 in., varying by inches, though any intermediate sizes can be furnished. It is claimed that the gages are accurate, though the degree of accuracy is not stated.

Miller Radius and Angle Grinding-Wheel Dresser

The S. L. & M. Sales Co., 408 Moffat Building, Detroit, Mich., has placed on the market a tool for dressing abrasive wheels with radius or angular faces as shown in the accompanying illustration.

It is claimed that this tool will dress a 12-in. wheel to a radius of from 0 to 1¼ in. either convex or concave, and also to any desired angle. The toolpost has a height adjustment of 2 inches.



MILLER RADIUS AND ANGLE GRINDING-WHEEL DRESSER

Corrected List of Boring Mills for Société le Construction Metallique

Here is the revised list of horizontal and vertical boring mills required for the War Department's contract with the Société le Construction Metallique of Belgium. We published the first list in our issue of Dec. 18, 1919, with the statement that revisions would be made in it as soon as we received them from the Director of Sales. The attention of manufacturers and dealers is called to this list and to the letter and editorial which appeared in our Dec. 18 issue.

Lists of bolt cutters, steam hammers, punches, shears, bending rolls, gap lathes, special lathes and grinding and milling machines will be published as the information is collected and released by the War Department.

VERTICAL BORING MILLS

Quantity	Size In.	Description	Customers' Identification Number
1	20	With one turret and one swivel head	801 V 8
3	24	With one turret head	509 F 43-44, 660 L 9
8	30	With one turret head	509 F 41-42, 217 B 10, 281 B 6, 370 C 23-24, 370-C 25-26
1	30	Regular	848 V 5
1	30	Regular (S. P. D.)	304 C 23
2	30	With plain boring bar	366 C 3-4
2	30	Regular, arranged for motor drive, but without motor	715 M 18-19
1	36	Regular	215 B 7
12	36	With one turret head	[illegible]1 L 38-39, 406 D 5, 502 F 25, 501 F 5, 715 M 13-14-15-16-17, 840 V 4-5
1	36	With one turret head—cone drive	207 B 7
1	36	With one turret and one side head	320 C 5
1	36	Bullard "New Era" with one side head, arranged for motor drive but without motor	659 L 8
2	38	With one plain and one turret head	366 C 7-8
7	42	With two swivel heads	509 F 36-37-38, 366 C 6, 217 B 11, 616 L 2
2	42	With one turret and one swivel head	509 F 95, 801 V 7
1	42	With one turret and one swivel head S.P.D.	659 L 1
1	42	Niles car-wheel boring machine	715 M 5
1	48	With two swivel heads	406 D 4
2	48	With two swivel heads arranged for motor drive, but without motor	715 M 20-21
1	60	With two swivel heads	509 F 39
1	84	With two swivel heads	320 C 6
2		Niles or Universal vertical boring mills with 4-ft. table	208 B 83-84
1		"Hole Hog" cylinder boring machine with four spindles for boring 4-in. hole	208 B 82

HORIZONTAL BORING, MILLING AND DRILLING MACHINES

Quantity	Size In.	Description	Customers' No.
12		No. 31 Lucas	223 B 27, 211 B 28-29, 502 F 31, 509 F 126-127, 801 V 3, 403 D 4, 208 [illegible] 113-114-115, 617 L 7
1		No. 31 Lucas, arranged for motor drive but without motor	715 M 50
2		No. 31 Lucas, with 7-ft. bed and 34 x 48-in. platen	659 L 9, 219 B 11
3		No. 32 Lucas	684 L 9, 221 B 20, 429 D 12
1		No. 32 Lucas, with all accessories	717 M 2
1		No. 32 Lucas, with plain circular swiveling table	851 V 4
1		No. 2 Beaman & Smith (Catalog E-1900) Cone drive, one boring head and two facing heads	639 L 1
1		No. 1 Cleveland with 2½-in. spindle	617 L 6
1		No. 3 Detrick & Harvey with 20-ft. runway transportable table (1918 catalog)	304 C 88
1		No. 3 Detrick & Harvey with 10-ft. runway and 66-in. feed	319 C 22
1		No. 35 Landis (1917 catalog)	319 C 23
1		No. 3 Detrick & Harvey 10- to 12-ft. runway (outer support without base plate—(1918 catalog)	616 L 5
1		No. 3-A Universal	707 M 3
2		No. 2 Detrick & Harvey (1918 catalog), arranged for motor drive but without motor	715 M 49, 654 L 4

American Belting Needed

Although there are few factories in the Ciudad Juarez district of Mexico, says commerce reports, there is considerable demand for rubber, leather and canvas belting, and purchasing agents of local shops and mills would welcome quotations from American manufacturers. Quotations and descriptive literature may be in Spanish or English. As a rule, sales made to establishments in the district are consigned to their brokers at El Paso for passage across the border into Mexico.

Gages and the Ordnance Department

By E. C. PECK
General Superintendent, Cleveland Twist Drill Co.

The Army had to learn many things by bitter experience. Probably one of the hardest things to swallow was the lack of efficiency in the very field where we felt we led the world—quantity production. Colonel Peck tells something of the gage troubles of the Ordnance Department and gives the results of its experience.

THE object of this article is to place before the readers of the *American Machinist* a brief description of the gage troubles encountered in the manufacture of ordnance material during the World War.

It is believed and confidently hoped that the experience in interchangeable manufacture gained by the manufacturers and the Ordnance Department will result in future economy. It is predicted that manufacturing in the future, by the use of gages, will be carried on much more extensively than in the past.

A certain well-known and highly specialized shop was building two hundred machines per day with three hundred men. This shop was also making in large quantities one of the accurate fuses for the Government, and it was necessary to double the output on these fuses. Man power was unobtainable, so a large part of the force from the special machine department was transferred to the fuses. The superintendent then decided to fully gage the special machine job just as the munition job was. When this was finished and under way, two hundred machines per day were being turned out with one hundred and fifty men, and the product was strictly interchangeable with no fitting required. The cost of the change and gages was probably wiped out in three months. This is only one of many examples with which the writer constantly came in contact.

Importance of the Gaging System

The necessary transfer of the required skill to produce first-class uniform work in quantity is very materially aided by the application of a correct and suitable gaging system. This means that a correct and suitable system of gaging enables a manufacturer to obtain and spread over his organization the special ability of one good man, because correct gaging takes into consideration each step in production and hence each machining operation forms a part of the gaging analysis, and each receives its share of the ability of the good man.

It is a perfectly safe statement that a competent gage man who understands quantity production will save several times his salary every year, and produce a more uniform product.

Through the press and investigations by Congress, the War Department has been severely criticized, but the gigantic tasks imposed on some of the officers have received small consideration. It is well known to those on the inside that all of the failures were not army men—some of the loudest kickers against the regular army failed to make good on the jobs given them.

Roughly, the War Department expanded about one hundred to one. To get an idea of what this meant to the Engineering Division, let any manufacturer of special product increase his engineering and drafting force suddenly to one hundred times its normal force, and he will get a fair idea of the difficulties to be encountered. Let him consider further, that, besides building his regular product, he must take on a hundred foreign-made specialties which must be made interchangeable with the product already made in Europe. Consider also that the drawings are inaccurate and to an unfamiliar system, which requires the translation of voluminous documents forming a part of the drawings before they can be used. Consider still further that many of the dimensions, especially threads, had no tolerances given and in many cases the particular thread system was unknown and not recognizable from the samples submitted.

If a manufacturer can imagine these conditions and realize that many of the best men he can get for his greatly increased force never had experience in interchangeable manufacture, are unfamiliar with the product and never heard of manufacturing tolerances, he must realize the size of the problem he has to solve.

Picking the Personnel

One man alone, in helping to find the required engineers and draftsmen for this force, personally examined over five thousand applicants. It must be understood that he did not have the pick of the country to choose from, as many firms would not let their good men go. However, this country owes a lasting debt of gratitude to those manufacturers who were patriotic enough to sacrifice the services of their best men to help solve the problems.

It would be the realization of a tale of the Arabian Nights to expect such a force to come together without a percentage of incompetents; in fact, it was a wonderful opportunity for friends and relatives to fix up letters of reference which were bound to land some pet slacker in a bombproof job. Even this would not have been so bad, if these slackers had settled down to work and made good, but for the most part they would not learn the work they were to do, and many of them deliberately loafed and even boasted that civil service rules would not permit their dismissal. It should be said, however, that in the force collected, there were many excellent men who proved to be very capable and of the utmost assistance, and it is to this class that the credit is due for what was accomplished.

Early Errors Unavoidable

It is easily seen that at the outset there were bound to be ridiculous errors in judgment and design, but these were rapidly reduced as competent checkers were selected and developed who caught the mistakes before they got out.

One of the sources of trouble was the lack of standardized practice, and this is not to be wondered at when we consider that with all the standardizing which has been done very little of it actually applies to the making of drawings, so that there is a uniform interpretation of the exact requirements.

Eight sections of the Engineering Division designed ordnance material, and each section was responsible for the allowance between parts which fit together and the manufacturing tolerances to maintain proper functioning of these parts. An engineer's previous training

largely determined the refinement he called for in allowances and tolerances. If his experience had been in a first-class shop on high-grade work, his fits were close and tolerances small. If it had been on rough work, in a shop doing poor work, he would have liberal allowances and tolerances, or, as likely as not, no conception at all of tolerances, and in the latter case 0.0005 in. (one-half of one-thousandth) would look larger on paper than 0.005 in. (five thousandths), but very different in accomplishment.

The general lack of knowledge in the proper allowance to make a desired fit, even among otherwise competent engineers, was remarkable and the cause of much annoyance. It would almost approach the ridiculous, if the writer were to quote figures showing the difference in the opinions of some of the best engineers in the country, outside the Ordnance, when asked to set down the prescribed limits for a certain kind of fit made every day in almost any shop.

Setting Tolerances

This brings out one of the responsibilities of the engineer in this Ordnance work. He was expected to set down on paper a set of tolerances that would enable an untrained manufacturer to produce a million storage parts that would function properly without time to prove the dimensions. He could not be governed entirely by the manufacturers' opinions, as one would say the tolerance was too close and another would say he did not use all of the tolerance because the work was too "sloppy."

It is not hard to understand that, in the early days of the war, with a new, untried force at work on strange material, there would be improper allowances and tolerances prescribed. It is much harder for the writer to understand the attitude of some manufacturers who, instead of helping in time of war, sat back and criticized everything the Government did, at the same time refusing to help themselves, simply because they had an excuse to lay down. It was extremely fortunate for the Ordnance Department that this class was greatly in the minority, or there would have been nothing for our boys to fight with.

A noticeable feature in the relations between the Ordnance Department and some contractors was the harmony that prevailed, and their entire willingness to coöperate in every way. Very often ordnance matériel would function perfectly at the proving ground, and be condemned when it reached Europe where radical changes would be ordered. This required suspension of work and changes in the parts, which the contractor could not understand. Many of them turned in and helped; others "cussed" the War Department generally, and wrote their Congressman about it.

Effect of Gage Changes

The greatest single item which was closely related to all of the above trouble was that of gages. Every change in a dimension or tolerance affected the gages and many times called for entirely new ones, a procedure which was costly in both time and money.

The gage-making facilities before the war were so limited that, compared with the condition at the signing of the Armistice, they were practically unknown. Before the World War very few shops were making a strictly interchangeable product of first-class quality by the use of gages. Many thought and claimed they were, but investigation showed that the assembly was largely made by the selective process. Much of the work was done with "go" gages only, and the limits of acceptance were determined by a skilled workman judging the amount of shake between the piece and the gage. With a skilled workman trained to do this work a fair degree of interchangeability can be maintained in a single shop, as in the assembly parts can be fitted or selected to save scrapping those that were accepted by the poor judgment of the inspector. This method usually assures that the work will go together without interference, but there is no control on the quality of the fit, and the pieces may go together so loosely as to be useless for the purpose intended.

What Is Interchangeability?

Strict interchangeability consists in making, on a quantity-production basis, various component parts in different shops, so that they can be brought together and assembled properly according to the drawings. This means, first, that the standard unit of measure is comparable in each shop with some fixed standard; second, that all dimensions of the components are within the prescribed limits shown on a correct drawing. This is readily done by the use of "go" and "no-go" gages which represent the boundary lines fixed by the component dimensions.

The boundary lines should always be as far apart as the proper functioning will allow. In other words, the prescribed tolerances should be as great as the designer will risk for proper functioning. This is fundamental from a technical, as well as an economical standpoint. The allowances for proper fits, in quantity production, must prevent interference and allow the parts to go together after tolerances have been applied. This carries with it the assumption that a predetermined minimum allowance which must never be enroached upon admits of the proper assembly when the condition of extreme tight fits allowed by tolerance is present. If these allowances are too small there may be functioning trouble due to the parts working too tight, and if too great the fits may be so loose as to prevent proper working. The improper application of tolerance can produce either of the above conditions.

Cost of Too-Small Tolerances

If the tolerances are too small the work will be more costly as to labor, tools and gages. There will be more rejections and friction between inspectors and producers. This will bring about a condition in which the natural tendency will be to salvage the rejected parts. Salvaging by granting increased tolerances is generally bad practice, and it lowers the standard of work and discredits the designer's ability, especially if he has allowed all he is willing to risk. If tolerances are enlarged, the producer has a right to say, "If part of the product can be accepted with increased tolerances and will function properly, why not all of it?" It is therefore better to set them as large as can be risked in the beginning, and then live up to them. With this fundamental established the extreme component dimensions should be the master-gage dimensions, and any master-gage tolerance that is required must come out of the component tolerance in order that the extreme component boundary line is never exceeded, and in order to provide a means of making a number of master gages which shall be identical within a very small measurement. This really means that, if the master gages have any error, it is treated as an allowance for wear.

These master gages represent the exact physical measurements of the original component, and are for reference only. They are primarily for the checking of working, or inspection gages, and not supposed to be used on component parts. They may be duplicates of the component parts, or counter parts, or merely a check with one or two dimensions.

Inspection gages, as the name implies, are for accepting work in quantities which shall be within the dimensions shown on the component drawing, and as they are required from an economical standpoint to gage a large number of pieces during their life, they must be provided with an allowance for wear. The amount of this allowance is an economical question for each manufacturer to determine, keeping in mind that too small an amount increases gage cost, and too large an amount increases, to some extent, production cost. Where actual experience is lacking it is well to allow 10 per cent. of the component tolerance for the wear on inspection gages, and this amount is inside the component tolerances.

Working Gages

The working gages, as the name implies, are for the use of the workman producing the work, and may be duplicates of the inspection gages in design and size, but it is better practice to still further rob the component tolerance by making the working gages slightly nearer the mean of the component tolerance. This will insure that everything accepted by the working gages will pass the inspection gages. It requires less superintendence and helps to train good workmen.

Many manufacturers think that all of the tolerances allowed should be taken, and in attempting to do so have rejections by the inspectors. A No. 1 product is, of course, that which is the mean of the limits given, and one usually expects a large part of the product to be first class. Therefore, the mean dimension is the one a manufacturer should aim at; the successful ones do.

Most of the trouble during the recent war was caused by manufacturers trying to take all the tolerance and sacrifice the supervision necessary to produce work nearer the mean dimension. The result of working too near the boundary line was that large quantities of work exceeded the boundary line and were rejected. A great source of trouble was the failure of the manufacturers to grasp the idea that the boundary line established by the limits on the component drawing must not be exceeded. A typical example is illustrated by the following: The dimension on a component was 1.000 in. + 0.005 or — 0.005, which means that all pieces with dimensions between 1.005 in. and 0.995 in. would be accepted. If gages were submitted to the Bureau of Standards for verification, which would accept work one-ten-thousandth larger or smaller than the above limits, they would be rejected, and rightly, because they already exceeded the limits. But these gages could vary more than this amount and be accepted, if the variation was so that work accepted by them would be within the prescribed limits. One of the favorite criticisms was, "I have a component tolerance of 0.010 in. and they throw out my gage, when it is only out one-ten-thousandth, which is absurd." The trouble was that it was out in the wrong direction. If the error in the gage had been in the opposite direction, or so as to have it within component tolerance, it would have been accepted for either working or inspection gage, even if it had been out a whole thousandth of an inch.

If additional argument is needed, this subject of applied tolerances might be compared to target shooting. The outside of the target is the boundary line and is identical with the boundary line of the component dimensions. Any shot within the outside ring scores, but the marksman tries to hit the bull's-eye, and the oftener he does the better is his score. So it is with the manufacturer. Any of his pieces within the boundary will be accepted, but his final score, or worth as a desirable manufacturer, is based on how many times he hits the bull's-eye; that is, how much of his product is near the center or mean of the tolerances.

Any manufacturer who habitually produces work so near the rejection line that the inspector is in doubt as to whether or not he ought to reject it, certainly ought not to receive the same consideration as one who always produces work of a good uniform quality. This applies also to workmen and the majority of manufacturers are already familiar with this, but do not realize that it applies to the whole product as well.

The material out of which gages are made needs a thorough investigation, and this was started by the Gage Section, Engineering Division, of the Ordnance Department, but the signing of the Armistice practically stopped this section's activities in this direction.

The general practice was to make gages out of machinery steel pack-hardened; that is, a deep case-hardening process. This was especially true of thread gages, and as these were usually lapped to size before the present war, this means of finishing probably largely accounted for the choice of machinery steel pack-hardened, because it did not change as much in hardening as tool steel, and hence required less lapping. This method did not, however, produce gages of the required uniform accuracy, and grinding with abrasive wheels came rapidly into practice without, however, generally changing the material.

An investigation was made of the various conditions under which gages were used, their life, first cost and upkeep. This investigation included a summary of the records of the British Imperial Munitions Board and those of the United States Ordnance Department. A steel was selected for experiment and thread gages made for artillery ammunition and sent into the field for use with the usual instructions. At the signing of the Armistice and stopping of the work, the performance of the gages was collected and the records show an average life of eight times that of the combined average of the records above mentioned. Some of the gages had done ten times the average, and were still going with 25 per cent of their wear limit left for use. It was found that on a five-million contract for one thread only of a 75-mm. shell, gages of a similar quality would have saved $30,000 in the cost of the gages required on this contract.

Immigration and Emigration

Statistics for the twelve months ended June 30 have recently been made public, regarding immigration and emigration. In June, 17,987 immigrants arrived, or 3,740 in excess of the corresponding month in 1918. For the fiscal year 141,132 arrived, or about one-fourth more than in 1917-18, when low mark was reached with a total of 110,618.

Arrivals from Australia and Africa were few, while South America sent 3,271 and Asia 12,674. The greatest number of immigrants came from Canada, Mexico and Japan.

Sparks from the World's

By E. C. Porter,

Bonus Distributed by Fellows Gear Shaper Company

Following a custom inaugurated in 1916, the Fellows Gear Shaper Co., on Dec. 24, distributed an annual cash bonus to its employees. Approximately 665 employees received this bonus, which amounted to a total of $25,000, $20,000 of this amount being paid in gold.

The rating of this bonus is governed by the length of continuous employment, and is based on the total wages earned during the year. For the first and second years it is two per cent of the total wages earned, and increases by one per cent each succeeding calendar year up to ten per cent.

The bonus distribution this year was of special interest to those who were in the "Service" during the World War. To all of those who returned to the employ of this company, the bonus was calculated from the time of their original employment. That is to say, when they returned, they were not considered as new employees, and the time spent in the service of "Uncle Sam" was not deducted.

Of the 665 employees, approximately fifteen per cent received over five per cent bonus, which means that they had been in the employ of this company for over five years.

Three Associations to Hold a Triple Convention in Atlantic City

The National Supply and Machinery Dealers' Association, the Eastern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will hold a triple convention in Atlantic City, N. J., May 17, 18, and 19, 1920. The headquarters for all three associations will be at the Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

Copper Production for the Past Year

The production of copper in the United States in 1919 was markedly smaller than in 1918, according to preliminary figures and estimates collected by B. S. Butler of the United States Geological Survey from all plants that make blister copper from domestic ores or that produce refined copper. At an average price of about 19c. a pound the output for 1919 had a value of $243,000,000, as against $471,000,000 for 1918.

The figures showing the smelter production from domestic ores represent the actual output of most of the companies for the first eleven months of the year and the estimated output for December. A few companies gave no figures for November but furnished estimates of the combined output of November and December. The production of blister and Lake copper from domestic ores was 1,278,000,000 lb. in 1919, against 1,908,000,000 lb. in 1918 and 1,224,000,000 lb. in 1913.

The supply of refined copper (electrolytic, Lake, casting and pig) from primary sources, domestic and foreign, for 1919 is estimated at 1,800,000,000 lb., compared with 2,432,000,000 lb. for 1918 and 1,615,000,000 lb. for 1913.

Ships Delivered Passes Mark Set by E. N. Hurley

Ship deliveries during the year 1919 totaled 6,229,323 deadweight tons, thus passing the 6,000,000 mark which was the annual figure set by former chairman E. N. Hurley as the goal to be worked toward.

This total included 741 steel ships, twelve composite, 403 wood and three concrete, a total of 1,159. The tonnage of the steel ships was 4,838,673, that of the composite ships, 42,000, that of the wood ships, 1,338,650, and that of the concrete, 10,000.

Up to date since the commencement of construction keels have been laid for 2,261 ships of a deadweight tonnage of 13,055,161. Those launched total 1,975, with a tonnage of 10,892,440, while those delivered total 1,740, with a tonnage of 9,557,444.

Foreign Commerce Corporation Formed by J. P. Morgan Company

J. P. Morgan & Co. announced on Jan. 1 the formation of the Foreign Commerce Corporation of America to engage in international trade. The incorporators are J. P. Morgan, H. P. Davison, T. W. Lamont, E. T. Stettinius, and Grayson M. P. Murphy who will resign from the Guaranty Trust Co. to accept the presidency of the corporation. The principal concern of the corporation will be to effect an improvement in the demoralized foreign exchange; it also promises to become a vehicle for the development of American trade in all parts of the world.

The Curtis Airplane and Motor Corporation Sold

The motor factories of the Curtis Airplane and Motor Corporation at Hammondsport, N. Y., were sold recently to L. J. Seely of that place. The plant has now been turned over to a new organization known as Keuka Industries, Inc., of which the officers are: L. J. Seely, president; John H. McNamara, vice president; K. B. MacDonald, secretary and treasurer. The directors are Glenn H. Curtis, Hammondsport; K. B. MacDonald, Buffalo; J. H. McNamara, Hammondsport; Hugh Satterlee, New York; L. J. Seely, Hammondsport.

Labor Disputes Decreasing, Says Federal Conciliation Director

The United States entered the new year with fewer pending industrial disputes than at any other time during the last three years, said Hugh L. Kerwin, Director of Conciliation of the Department of Labor, after receiving reports from the department's conciliators in the thirty-five great industrial centers of the country.

With the exception of the steel strike, the actual strikes throughout the country are few in number and of minor importance, Mr. Kerwin declared. There now are, he said, 101 industrial disputes before the department for adjustment, only twenty-one of which have reached the strike stage.

The industrial outlook for the year is excellent, Kerwin said, as all indications point to a cessation of the industrial unrest under which the country has suffered since the end of the war. The general tendency, he said, is for the employer and the worker to attempt adjustment of their differences without stopping work.

Will Investigate South American Markets

An investigation of the South American markets for industrial supplies will be conducted by P. S. Smith, trade commissioner of the Bureau of Foreign and Domestic Commerce, who will sail for Buenos Aires the latter part of January.

Mr. Smith will confer with manufacturers of machinery accessories before leaving for South America. He has arranged to meet interested manufacturers in Boston, Jan. 8, 9, 10; in Philadelphia, Jan. 15 and 16; and in New York, from Jan. 19 to the date of sailing.

Industrial Forge

News Editor

German Engineering Industries Preparing To Distribute Trade Papers in Foreign Countries

The German engineering industries are preparing a scheme to distribute their technical and trade papers in foreign countries on a large scale. Under the leadership of the National Association of German Manufacturers (Reichsverb and Deutcher Industrieller) and the Society of German Engineers (Verein Deutscher Ingenieure), a combine or trust of the German industrial press is to be formed for concerted efforts in the above-mentioned direction. Besides, a large monthly paper devoted solely to the export of engineering manufacture will shortly be issued in four languages: namely, English, French, German and Spanish. German works are subscribing freely to this enterprise in the shape of large display advertisements. The paper will have a large free circulation abroad, which is paid by the German works, each taking up the fees for a number of copies for a period of five years. Krupp's alone is said to have contracted to pay for a mailing list of 3,000 during that period. This part of the scheme is under the management of the "Ala" (Allgemeine Anzeigen Gesellschaft m.b.H.), a concern closely connected with the Rhenish industrial magnates. The "Ala" contemplates establishing offices in all foreign capitals to act as distributing centers, advertising agencies and news gatherers.

Minimum Export Prices of German Machine Tools

From Our German Correspondent

The German machine-tool export has lately taken such vast dimensions that it has received close attention from the Government, resulting in a strict regulation of prices. The idea is to prevent price cutting below a certain minimum and to urge the works and dealers to get the best possible prices for their goods.

English and American export prices are not known here very well, but information on that point is being vigorously collected, to serve as a schedule for maximum prices. Export licenses are necessary for each single shipment and are subject to a strict control of sale prices. The administration of this business is in the hands of the "Association of Germany Machine-Tool Builders." The minimum export prices have been keyed to the pre-war standard. Up to now the formula "eight times pre-war price" has been in force. The ratio was increased since Dec. 1, to ten times pre-war price and has further been increased to eleven times pre-war price on Jan. 1.

A small lathe which used to be sold at 500 marks before the war cannot be sold for export at less than 5,500 marks after Jan. 1. As four to five times pre-war price is sufficient for the manufacturer to sell for home consumption at a reasonable profit, there is a wide margin between home and export prices, which makes export sales an exceedingly profitable business. It is not surprising therefore that there is a great rush to the export field and it is difficult to get tools quoted for domestic use. Dealers found themselves in some difficulty to get delivery and in consequence have made themselves liable to pay the manufacturers 75 per cent of the surplus price realized by export.

The strong tendency of the market has not failed to have effects on delivery times, especially as the manufacturing facilities are rather limited and far below the normal, mainly on account of the insufficient coal supply. The well-known works are sold out up to a year and more ahead, but there are enough stragglers whose chances are coming in the same degree as the works ranking higher get saturated with orders. The time, however, is coming when even the last straggler will be seized by the extraordinary wave of demand now going over the whole industry and it seems a safe prophecy that in a not far future a reaction will set in, owing to the impossibility to get delivery within a reasonable time.

Gun Stock Blanks to Be Sold By War Department

Informal proposals are invited by the War Department for the purchase of 1,215,000 walnut gun stock blanks, or any part thereof. These blanks are located at various points in the East, and are available for immediate delivery, f.o.b. point of shipment nearest the purchaser's plant.

The blanks come in two sizes, the model 1917 being 51½ in. long by 2½ in. thick, tapering rifle shape from 6 in. at the butt to 1¾ in. at the tip; weight, 11 lb. 2 oz. The model 1903 is 45½ in. long by 2⅝ in. in thickness, tapering rifle shape from 6½ in. at the butt to 2 in. at the tip; weight, 8 lb. 5 ounces.

Detailed information may be obtained from the Ordnance Salvage Board, Ordnance Building, Washington, D. C.

Business Conditions in England

By Our English Correspondent

London, Dec. 1, 1919.

The demand for manufactured goods of all kinds cannot be met despite high prices and exchange difficulties, and the interest of the money market in industrial concerns is shown by the large and successful appeals for capital that have been made of late. The tendency to consolidation on the electrical side of engineering continues, the latest firm to join the English Electrical Co., Ltd., or rather to be associated with the company, being the Siemens Works at Stafford. In the immediate past, by reason both of want of technical experience and of want of capital and other resources, the British electrical concerns have been heavily handicapped in world competition; that is, as regards machinery of the heavier order. The English Electrical Co., one of several combinations, now has a group of associated works at Bradford, Coventry, Preston, Scotstoun, Rugby and at Stafford. Vickers, Ltd., probably the largest commercial organization in Great Britain, recently acquired the patent rights of the well-known Swiss engineers, Brown, Boveri & Co., for Great Britain and the British colonies and, again, have undertaken to finance and co-operate generally with the Swiss concern in western Europe.

To further co-operative effort, the Agricultural and General Engineers, Ltd., has been formed by old established firms, including Aveling & Porter, Rochester; E. H. Bentall & Co., Heybridge; Blackstone & Co., Stamford; R. Garrett & Sons, Leiston; and J. & F. Howard, Bedford. The managements remain unchanged, and, as in the case of the somewhat similar machine-tool combination, the firms do not lose their identities, but specialize in their own particular lines according to agreements.

In the motor industry, too, about which as regards production there has of late been much cry but little wool, amalgamation of interests will be effected in a new company (capital £6,000,000) now being formed. It includes Harper Sons & Bean, Dudley, with interests in Hadfields, Ltd., Sheffield; Harvey Frost & Co., Ltd., London, W.; Swift, Ltd., Coventry; British Motor Trading Corporation, Ltd., London, S. W.; the Vulcan Engineering Co., Ltd., Southport, and the whole share capital of Rushmores, Ltd., London, S. W.; Mosses Radiator Co., Ltd., London, W. C.; Regent Carriage Co.,

Ltd., London, S. W.; Gallay Radiator Co., Ltd., London, N. W.; and Jigs, Ltd., London, W. It is to be known as Harper Bean, Ltd. The first object at any rate is to produce motor cars at lower prices than prevail at present. It will also produce castings, stampings, etc., for other branches of the hardware trades.

It is not thought that full production will be reached in less than two years. The program starts with fifty cars a week at the beginning of 1920, rising to 600 by the end of the year and then to 2,000 a week. Apparently, too, the commercial vehicle is to receive attention, for the yearly output aimed at includes 50,000 small cars, 25,000 medium cars and 25,000 commercial vehicles.

In order to insure the interest of labor, some half a million ordinary fully paid £1 shares, to be held by trustees, will form a benevolent fund for work people and their dependents, the fund being controlled as regards disbursements by a committee formed by six of the directors and six of the employees.

Consolidation of interest is not confined to capital, for amalgamation of a number of the engineering trade unions has become almost certain. Such a proposal has been made many a time within the last thirty or forty years, usually only to be thwarted by the interests of the officials, some of whom necessarily would be displaced. A ballot has however recently been taken and eight trade unions voted in sufficient numbers to secure the proposed action, while seven societies failed. The figures so far given were 239,645 votes in favor of fusion and 42,665 against, 527,640 ballot papers being distributed. The statement has been made that the object is to gather together in one organization about half a million work people, with funds averaging about £7 per member. The leading union, the Amalgamated Society of Engineers, voted 56⅔ per cent of full numbers, less than eight per cent of the votes being against the fusion.

In technical circles two matters have lately been discussed, one, limit systems; the other, standard spindle noses for milling machines. While the Herbert firm has put forward their standard system with hardened conical exterior and hardened box clutch (not dissimilar from the pattern understood to be recently adopted by the Brown & Sharpe Co.), on the other hand the British Machine Tool Makers, Ltd., the other organization endeavoring to spread the sale and use of British machine tools in other parts of the world than those under British government, has adopted what is really the standard of the Cincinnati Milling Machine Company.

On the question of limits there may be much more difficulty in reaching a satisfactory conclusion. The old engineering standards committee published a system on a shaft basis, and it is hardly an exaggeration to say that nobody in Great Britain worked to it. On the other hand, the British Engineering Standards Association, its successor, has for the better part of a year been considering the whole subject as regards plain cylindrical work, the system to be applicable to engineering generally. There seems to be no difficulty in accepting the hole as a basis, but whether the tolerance shall be uni-lateral or bi-lateral has been the subject of much discussion in the columns of the European edition of this journal. The former system would, of course, have the nominal size of hole as the minimum, all the tolerance being positive; several leading machine-tool firms support this. With the bilateral system, the nominal size would be of about the mean dimension, with tolerances on each side, positive and negative, and the Alfred Herbert firm, basing themselves on its own practice, advocates it. As a detail, it is supported with a view to adapting to the Coventry firm's standard holes parts—tool shanks being instanced—made abroad. To avoid mistakes and reduce numbers, in using gages, etc., only one set of tolerances for holes are employed, the firm working to limits for finest work only. Preliminary recommendations are expected shortly. The Standards Association has been making inquiries throughout the engineering industry, but a decision has not yet been reached. The association works generally for standardization at the instance of the particular branch of industry concerned, and all questions of detail are delegated to committees, the endeavor being to get these committees representative both of makers and of users, representatives of the latter often being in the larger proportion.

To turn to another direction, it has been obvious that the supply of electric generating plants during the war did not keep step with the demand, and more than one large town has experienced the effects of a breakdown in service. A quite unusual method of easing the load on the power station has been adopted by the committee responsible for the running of the Birmingham municipal electric supply. Connected to the supply mains with the possibility clearly before them, some of the factories have been warned that they must not take current between 3:30 and 5:30 in the afternoon, the object being to reduce the supply by 10,000 hp.-hr. Various ways out of the trouble have been suggested, and in certain instances overtime in the evening is being worked; but not always, for the British workman has set himself very definitely against anything of this character.

Perhaps the most absurd instance occurred not long since at the foundry of J. Lang & Sons, Ltd., Johnstone, the well-known lathe makers. Here a visit had been arranged for a section of the British Foundrymen's Association, a body of men interested in technical affairs. The visit was for a Saturday afternoon and the firm, thinking that everything should be in order, applied to the local branch of the prevailing ironfounders' union, for the use of the foremen and two or three men for demonstration purposes. But this was refused, the refusal being subsequently confirmed when the question was brought before the Glasgow headquarters of the trade union.

Signs of Foundry Strike Ending

The strike in the foundries continues but the signs that it will come to an end before long multiply steadily. Meanwhile, branches of industry dependent on castings close down or work at slower pace in increasing numbers. and even building extensions are stopped in some instances owing to the lack of guttering and so on. At Crewe, to take an example of engineering works, the locomotive fitting and erecting shops of the railway company have been placed on short time and other departments are working three or four days a week; the boiler shops, however, remain on full time. Thus, while about 300 molders are on strike at Crewe, their inaction has caused short time for about 6,000 men. British machine-tool shops of course feel the effects as well as other branches of engineering, and a leading English firm has been practically closed down as regards production for nine or ten weeks.

The exhibition to be held toward the end of next year at Olympia, London, W., under the control of the Machine Tool Traders' Association, shows every promise of success. As the result of a ballot a week or so ago almost the whole of the space has now been allotted to members. Any space available for outsiders will be notified shortly. The Athens exhibition organized by the federation of British industries, was so successful that it was extended a week beyond the original period. The exhibits, to the value of more than £500,000, have been practically all sold, while in many cases orders simply had to be refused for want of ability to undertake. The success of the Alfred Herbert exhibit of lathes, die heads, etc., at Philadelphia has been a matter of congratulation over here.

Trade Currents From Cleveland, Chicago and Philadelphia

Cleveland Letter

Difference in opinion as to what the immediate future holds out for the machinery industry of the Middle West is noted with the turn of the year among Cleveland and northern Ohio interests. While some manufacturers and distributors of standard equipment hold the view that the same high-class business will be seen as soon as the inventory-taking period is over, there are others who believe that a radical change must come in economic conditions before there will be a stabilized market.

The claim is advanced that manufacturing costs have gone too high to com-

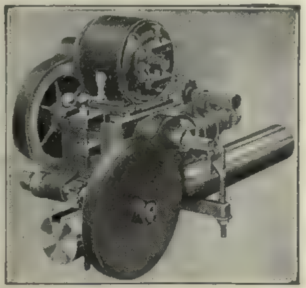
(*Continued on Page 110b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

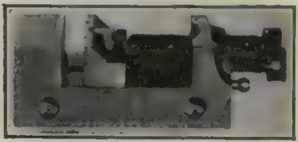
Keyseating Machine, Portable
The Bucher-Smith Co., East Liverpool, Ohio,
"American Machinist," Sept. 25, 1919

Size style A-2 has power feed; depth of cut is regulated by vertical screw. The main shaft is squared for hand-power operation. The motor is either alternating- or direct-current. The machine will cut keyways from ¼ to 1¼ in. wide by 12 in. long, and is suitable for shafts from 1¼ to 5 in. in diameter.



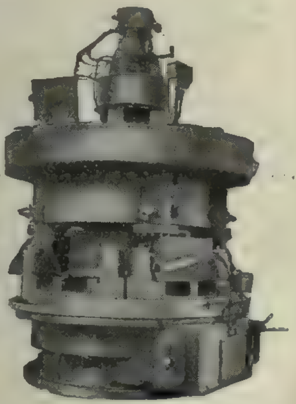
Vise, Toolmaker's
The Austin Tool and Machine Co., Inc., Pittsburgh, Penn.
"American Machinist," Sept. 25, 1919

This vise is finished square on five sides, and fitted with a hardened and ground detachable jaw face, which is held by two screws. The movable swivel jaw is held down by a screw in the center, and has three V-grooves in the face for gripping round pieces either in the vertical or horizontal position. The jaws are 2 in. long and ⅝ in. deep and will hold round stock up to 1 in. in diameter.



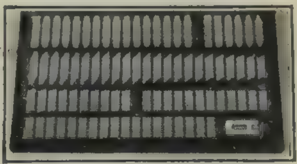
Milling Machine, Continuous, Circular.
Ingersoll Milling Machine Co.,
Rockford, Ill.
"American Machinist,"
Oct. 2, 1919

This machine has great production capacity on large pieces and needs small floor space. Cutter head carries from four to seven cutters and revolves in same direction as table, but at different speed. Continuous cutting, except at loading station. Two revolutions of table for roughing and finishing cut; each machine planned for single purpose. Approximate floor space required for 80-in. machine, 8 ft. 2 in. x 8 ft. 2 in. Approximate net weights, 60-in. machine, 35,000 lb., 80-in. machine, 45,000 lb.



Gages, Angle Block, Johansson.
C. E. Johansson, Inc., 245 West 55th St., New York, N. Y.
"American Machinist," Oct. 2, 1919

This set is about the same size as the standard set of size blocks but each block instead of having parallel edges has each of the four corners beveled off at a different angle. The angles have been so worked out that combinations from 1 min. of arc to 270 deg., varying by minutes, are possible. These blocks can be combined with the regular size blocks for making gages for angular formed cutters, checking sine bars, etc.

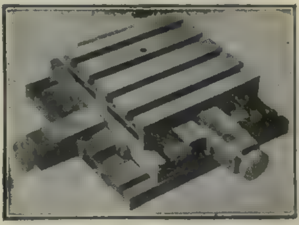


Gage Blocks, Johansson.
C. E. Johansson, Inc., 245 West 55th St., New York, N. Y.
"American Machinist," Oct. 2, 1919

This set of blocks is of more interest to the scientist than to the manufacturer or toolroom foreman. The set consists of 11 flat size blocks claimed to vary by equal amounts from 0.100000 in. to 0.100010 in.

Laying-out Fixture for Gaging
C. E. Johansson, Inc., 245 West 55th St., New York, N. Y.
"American Machinist," Oct. 2, 1919

This is a laying-out and locating fixture for use in combination with Johansson size blocks. The two movable beds are shifted by accurately cut screws ending in the large knurled nuts shown. The size blocks are inserted between carefully finished contact surfaces for each table. This fixture lends itself to a variety of uses in the shop and toolroom where quick and accurate work involving close measurements is to be done.

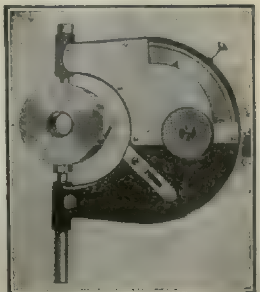


Caliper, Combination Micrometer
C. E. Johansson, Inc., 245 West 55th St., New York, N. Y.
"American Machinist," Oct. 2, 1919

This tool is flexible in each of the four sizes. The 200-mm. or 8-in. size has four standard blocks, 25, 50, 50 and 75 mm. in width, making it possible to get 25, 50, 75, 100, 125, 150, 175 and 200 mm. as zero settings for the micrometer screw or practically the range of eight micrometers. For measuring large diameters or deep holes, the jaws can be extended to full capacity; where rigidity of the caliper is important they may be drawn in until the screw of the measuring arm is close to the frame. The sizes are 100-, 200-, 300- and 400-mm.

Caliper, Registering Micrometer
C. E. Johansson, Inc., 245 West 55th St., New York, N. Y.
"American Machinist," Oct. 2, 1919

The friction retained pointer is released by the knob so that rapid readings can be taken while the work is revolving in the machine. If the light is poor the caliper may be carried to the light to be read, the setting being obtained without looking at the instrument. The caliper can be set at zero on a size block or on a master sample piece and the progress of the cutting determined by the distance on the scale from the pointer reading to the zero point.



Clip, paste on 3 x 5-in. cards and file as desired

pete with foreign production, and that the big export demand expected with the ending of the war not only does not exist, but is diminished by the fact that the American dollar is too high when competing with the currency of foreign countries. This view, when taken by firms catering largely to export trade, naturally seems well founded.

On the other hand, domestic business has kept up better through the last weeks of the year, according to leaders in the trade concentrating on business in the Cleveland and Ohio territories. They point to the fact that consumption is still somewhat ahead of production generally, and that the machinery industry feels this, in part at least. Certain kinds of equipment stand out in demand at the present. Punches and shears are particularly good. The sensational is totally lacking, it must be admitted, when large contracts are considered. The fill-in business is therefore much better than usual for the time of year.

About the most promising feature, in the opinion of some interests, is the fact that the railroads are promised to be returned to private ownership March 1. It is claimed by authorities in the machinery industry in this section that some of the biggest contracts in recent years are likely to be placed for manufacturing equipment, for all roads will require improvements in all directions. Big revival in machinery purchases is looked for in consequence.

Increase in Buying Looked For

Natural increase in buying is looked for by some firms as early as the middle of January, and in at least one instance inquiries and some orders have been coming in over the telephone, seemingly indicating that some manufacturing interests have foresworn the waiting attitude and are preparing to go ahead with their production.

The vote of 5,000 steel workers to continue striking in the Cleveland steel district was taken this week. The move, while of interest to industries depending upon steel production, means little, according to officials of the American Steel and Wire Co. The ranks of workers have been gradually filled so that there is not much in the way of work for those who would make application at this time, it is claimed.

In contrast to such discussions was the announcement of the Brown Hoisting Machinery Co. to give as Christmas presents turkeys to all employees. About a thousand employees were thus remembered. At 60 cents a pound, this made one of the biggest purchases of the month for purchasing agent R. G. Clapp. The turkeys were free and above the regular bonus this company awards to its employees each year.

The meaning of industrial research was discussed by R. E. Carpenter, manager of lynite laboratories of the Aluminum Castings Co., at the joint meeting of the American Society of Mechanical Engineers and the Cleveland Engineering Society at Hotel Statler.

E. A. Bartunek has been appointed welfare director and employment manager of the Vlchek Tool Co. He formerly was naturalization clerk for Cuyahoga County.

Chicago Letter

Continued good business marks the final week in the year and marked optimism is displayed on all sides in this district. While it is too early, yet, for figures on the entire year's business, it is assured that on the books of most dealers 1919 will show the greatest business, both gross and net, of any year in the history of the machine-tool industry, excepting only 1918. Had January and February been up to the mark set by the last ten months of the year, the record of 1918 would have been surpassed.

The volume of orders on book to be carried over into next year is enormous. Deliveries are even slower now than in the recent past, some heavy items requiring as much as six months. Inquiries and actual orders show no holiday laxness. Stocks are away down in quantity of tool on hand, but inventories will be relatively high owing to the increased value of the individual items.

Recent business continues to consist largely of scattered orders, but has been marked to a certain extent by the re-entry of the great corporations into the buying field. International Harvester has bought some tools and is considering others, and various railroads are making inquiries. The C. B. & I. has bought several items and more are now being ordered for its shops at Aurora. It is well known that the machine equipment of all the roads is in need of renewal so that the return of the roads to private ownership in March will undoubtedly mark the beginning of heavy purchases by these interests.

The year closes with prices about level with, or a little higher than, the peak reached in 1918. A readjustment upward is expected in the near future, based on constantly increasing costs, both of labor and raw materials. Such an advance will not affect the quantity of business, for the reason that all purchasers are being compelled to increase capacity, owing to the quantity of orders still on hand. Manufacturers are looking for increased efficiency, too, in an effort to beat rising costs, and this can only be attained by buying machinery of the most modern type.

Industrial building has fallen off materially in Chicago in December, the total being about half that of each of the preceding three months. This is occasioned by weather conditions, partly, and by recent increases in brick, sand and lumber. The Packard Auto Open Body Co. announces the start of a new million-dollar plant. The Stromberg Motor Devices Co. is starting a $300,000 plant, and the E. H. Wachs Co., manufacturing engines, is doubling the capacity of its plant at an ultimate cost of $100,000. It is probable that at the close of the holiday season many more announcements of industrial development will be made.

Philadelphia Letter

Many Philadelphia manufacturers are in the market for machine tools, but they are buying in small lots, and no large orders are reported from this part of the country. Comparatively few large new plants using machine tools are being erected. The railroads, which at this season are usually engaged in making up long lists of requirements, appear to be holding back until something definite is known as to the amount of assistance they are to receive from the Government.

Philadelphia differs from many of the Western cities. New manufacturing plants are springing up all through the Middle West and are sending out long lists of requirements. One large order is reported from Elizabeth, N. J., where a large purchase of machine tools has been made by the Willys corporation; but, in the main, business throughout the East appears to be pretty much the same as in Philadelphia.

Ordering in small lots is an indication that conditions for quick delivery are very bad. This branch of the industry is as bad if not worse than it was four months ago. Manufacturers of cheaper tools have benefited to a great extent from this inability on the part of older houses to fill orders promptly, inasmuch as there is usually a larger supply of the cheaper tools on hand, thus making it possible for the dealer in that class of material to make immediate delivery.

There has been a good demand lately for lathes and milling machines. Business in gear-cutting machines is usually brisk, owing to the comparatively few houses handling these tools, but at present it may be said to be even better than usual.

Foreign inquiries are for the most part referred back to the agency resident in the country from which the inquiry was received, and very few foreign orders have been filled here.

Commission Appointed to Appraise Arsenal Surplus Machinery

In order to reduce the machinery and equipment in Government arsenals and manufacturing plants, which had been working during the war under Government-aid contracts, to a peace-time basis, an appraisal commission has been appointed to determine what machinery and equipment in such plants and arsenals might be declared surplus.

The commission is composed as follows: Captain Lane Scofield, of the Ordnance Salvage Board; A. A. Fuller, chief of the machine-tool section, representing the Director of Sales; and J. F. Snyder, of the manufacturing section of the Ordnance Department.

(*Continued on Page 110d*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Lathe, Urban, Bench

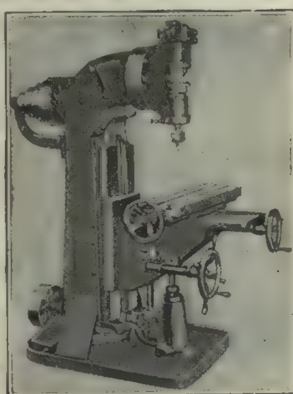
Ohio Tool and Machine Co., 2300 St. Clair St., Cleveland, Ohio.
"American Machinist," Oct. 2, 1919

Five selected speeds and one reverse are furnished. The motor is built into headstock and direct-connected to the spindle with worm gearing inclosed and submerged in nonfluid oil. Lathe can be set up anywhere and power taken from a lamp socket. Attachable grinding wheel is furnished for grinding the tools. Lathe is built in three sizes, the one illustrated being the middle size.

Specifications: Swing over bed, 8 in.; swing over carriage, 6 in.; hole through spindle, ½ in.; size of tools, ⅜ x ⅜ in.; ball-bearing spindle; tailstock spindle diameter, 1 1/16 in.; travel, 2½ in.; centers, Morse taper No. 2.

Die Sinking Machine, Daly

Riverside Machinery Depot, Detroit, Mich.
"American Machinist," Oct. 2, 1919



Headstock is 15¾ in. in diameter and graduated. Main table moved by hand power only. Cherrying device incorporated into revolving head. Largest cone step, 14 in. in diameter; belt, 3 in.; hp., 5. Specifications: Height over all, 7 ft. 2 in.; base dimensions, 3 ft. 9 in. x 2 ft. 10 in.; vertical travel of knee, 22 in.; cross movement of table, 16 in.; longitudinal movement of table, 32 in.; size of table over all, 39¼ x 13 in.; net weight, 4700 lb.

Expanders, Boiler-Tube.

J. Faessler Manufacturing Co., Moberly, Mo.
"American Machinist," Oct. 2, 1919

Fig. 1 shows an expander with the mandrel stop collar omitted, intended for use where tube must be expanded through a water space. The expander in Fig. 2 is to be used where there is no water space. The operation is identical in both cases. The expander is placed in tube with flaring roller just clearing tube end. Expander is self-feeding; the mandrel must be turned to right until tube is rolled tight in sheet. To flare tube, mandrel stop collar shown in Fig. 2 is placed against roller cage.

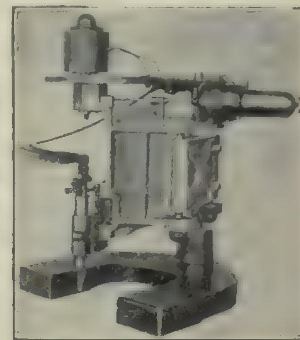
Guards, Safety, for Power Hammers

United Hammer Co., Oliver Bldg., Boston, Mass.
"American Machinist," Oct. 2, 1919

For all sizes of Fairbanks power hammers up to and including 500-lb. weight of ram, the 400- and 500-lb. sizes being recent additions to its line that were brought out for the heavier classes of work, such as found in locomotive shops, shipbuilding plants, etc. The guard, as shown, covers all working parts of the machine, the door permitting easy access. The guard can be easily attached to hammers now in operation as well as to new ones.

Cutting Machine, Camograph

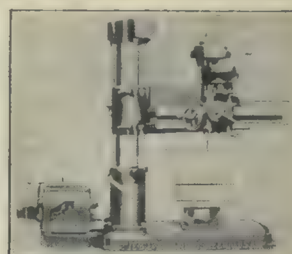
Davis-Bournonville Co., Jersey City, N. J.
"American Machinist," Oct. 2, 1919



Is automatic in action, used for cutting openings in steel plates. Oxy-acetylene torch moves over path determined by master cam. Feed roller is magnetised to hold it to cam face and also acts as traction driver, being driven by motor. Direct current, 110 volt, required. Specifications: width, 17 in.; depth, 15 in.; height, 25 in.; net weight, 125 lb.

Drilling Machine, Radial

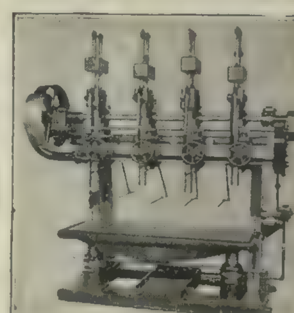
Silver Manufacturing Co., Salem, Ohio.
"American Machinist," Oct. 2, 1919



Manufacturered in three sizes to the following specifications: Sizes, 2½ ft., 3 ft., 3½ ft.; working surface of base, 31 x 33 in., 31 x 39 in., 31 x 45 in.; drills to center of 5 ft. 6 in., 6 ft. 6 in., 7 ft. 6 in.; traverse of head on arm, 23 in., 29 in., 35 in.; height of base, 6½ in.; traverse of arm on column, 29 in.; maximum distance spindle to base, 50 in.; column diameter of outer sleeve, 9 in.; spindle traverse, 12 in.; Morse taper No. 4; maximum distance spindle to floor, 9 ft.; working surface of table, 16 x 22 in.; height of table, 19 in.; drive pulleys, 14 x 3½ in.; net weights, 4250 lb., 4400 lb., 4560 lb.

Drilling Machine, Multiple-Spindle

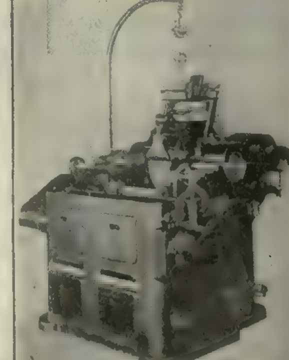
Edwin Harrington, Son & Co., Philadelphia, Penn.
"American Machinist," Oct. 2, 1919



Working surface of table, 5 ft. 1 in. x 18½ in.; shortest distance between spindles, 5½ in.; greatest distance between end spindles, 4 ft. 10 in.; vertical traverse of spindles, 10 in.; vertical movement of table, 13 in.; clear opening between uprights, 4 ft. 9 in.; Morse taper, No. 4; countershaft pulleys, T. & L., 20 in. x 5 in.; size of motor, 10 hp.; floor space, 8 ft. 4 in. x 4 ft. 1 in.; height over all, 7 ft. 11 in.; net weight, including countershaft, 6150 lb.

Grinding Machine, Plain

Woods Engineering Co., Alliance, Ohio
"American Machinist" Oct. 2, 1919



Maximum size of grinding wheel is 8-in. face by 20-in. diameter; centers take work 15 in. long by 10 in. in diameter. The machine occupies a floor space of 6 x 6 ft. and weighs 6000 lb. Crossfeed is accomplished by a rocking motion instead of the usual dovetail or V-slide arrangement. Headstocks and tailstocks are movably mounted on a square shaft having journals at the ends which operate in bronze-bushed, pedestal-type, dust- and grit-proof bearings.

Clip, paste on 3 x 5-in. cards and file as desired

The members of the commission will visit arsenals located at Watertown, Mass.; Watervliet, N. Y.; Rariton, N. J.; Frankfort, Pa., and Rock Island, Ill. In addition, they will visit approximately twenty manufacturing plants located in the East and the Middle West, which had been given Government aid during the war.

The amount of machinery and equipment that will be declared surplus by the commission and that will be offered for sale will depend upon the need of such material for the manufacturing program of the War Department. The commission will fix a price on all the equipment that is declared surplus for Army needs.

Personals

J. R. Richards, formerly with the Fairbanks Co., New York City, has been transferred to its Philadelphia office.

Dan C. Swander, vice president of sales of the Standard Parts Co., Cleveland, Ohio, has been appointed general manager.

E. D. Clarage, for fourteen years manager of the Cleveland branch of the Columbia Tool Steel Co., has resigned, effective Jan. 1.

Theodore C. Greene, for a good many years employment manager of the Graton and Knight Manufacturing Co., Worcester, Mass., has resigned.

Hugo L. Siegel, formerly general sales manager for the Ford Roofing Products Co., is now with Walter A. Zelnicker Supply Co. as assistant to the president.

Hugo Frankel is now in charge of the tool and die departments of the Steckert Electric Machine Co., manufacturer of Eureka Vacuum Cleaners, Detroit, Mich.

D. J. Rice, who has for a number of years been identified with the small tool trade, has become associated with the Michigan Tool Co., Detroit, Mich., as sales manager.

Roy Brakeman, formerly chief engineer of the Fairchild Works, American Steel and Wire Co., Fairfield, Ala., has been made chief engineer of the Otis Steel Co., Cleveland, Ohio.

William C. Smith, at one time the assistant manager of the Russell Motor Axle Co., Detroit, Mich., has been appointed president and general manager of the Detroit Hexagon Drill Co., Detroit, Mich.

Enlen S. Hare, of Detroit, Mich., who recently became president of the Mercer Motors Co., Trenton, N. J., has also been made president of the Locomobile Co., Bridgeport, Conn. Both plants will be operated under the same directing heads. Mr. Hare will be in charge of the New York offices at 245 West 55th St.

W. E. Lewis, who has been connected continuously with the United States Cast Iron Pipe and Foundry Company for the last 15 years, has been appointed resident manager of its plant at Anniston, Ala.

Harry W. Cobb, employment manager at the Heald Machine Co.'s plant, has resigned, and his position has been filled by Arthur E. Barr, who has been connected with the Heald concern for a number of years.

Wm. H. Chappell, formerly superintendent of the Page-Storms Drop Forge Co., Springfield, Mass., has become connected with the General Railway Signal Co., Rochester, N. Y., as superintendent of its forge department.

A. L. Mercer, assistant director of sales of the War Department, has resigned from that position to become president of the Needham Tire Co., Needham, Mass. Mr. Mercer, whose resignation became effective Jan. 1, will be succeeded by Major H. S. Johnson, who is now special assistant to the director of sales.

Russell W. Stovel, who recently returned from France, where, as lieutenant-colonel of Engineers, he served as chief of the terminal facilities division of the Army Transport Service, has been appointed a consulting engineer of Westinghouse, Church, Kerr and Co., Inc., and, as a member of that organization, will devote his entire time to the company's electrical and mechanical work.

Business Items

The Ross Manufacturing Co., of Cleveland, Ohio, has moved into its new plant at 3160 West 106th St.

The Tool and Auto Parts Co., East and St. Claire Ave., Cleveland, Ohio, is a new concern, recently incorporated for the purpose of manufacturing tools, and automobile parts.

The Massachusetts Blower Co., Boston, Mass., has re-opened its Boston office which is located in the Kimball Building, 18 Tremont St. This office is in charge of A. C. Barlett.

The corporate name of the Ladewig & Stock Co., Waukesha, Wis., has been changed to the Ladewig Co. The new company assumed all the assets and liabilities of the old company. There will be no change of officers and the policies of the company will remain the same as formerly.

L. Best & Co., has moved its business to 28-30 West Broadway, N. Y., where it has secured larger quarters. The increase in floor space is nearly a hundred per cent and will permit the company to display its products, such as grinding wheels, machinery and polishing supplies to a much greater advantage.

The Hendricks Manufacturing Co., and Rothweiler & Co., both of Seattle, Wash., have been consolidated under the name of H. R. L. Motor Co. The officers of the company are: J. J. Hendricks, president; H. N. Rothweiler, vice president; J. A. Lagoe, general manager, and H. G. Mead, purchasing agent. The company will manufacture three-quarter-ton, one-half-ton and two-ton motor trucks.

Obituary

Charles Keith Blackwood, vice president, assistant treasurer and a director of the Sullivan Machinery Co., Chicago, Ill., died on Dec. 14, 1919.

Charles E. Smith, superintendent of the Smith-Egge Manufacturing Co., Bridgeport, Conn., and connected with this firm for more than forty years, died Dec. 16, 1919, at his home 732 Lafayette St. Mr. Smith was sixty-two years old.

Thomas J. McGonnell died recently at his home, 110 Neville St., Pittsburgh, Pa. He was born and resided all of his life in Pittsburgh and was connected with the United Engineering and Foundry Company for more than twenty years.

William H. Hart, of New Britain, Conn., died Dec. 13, 1919, at his home on Lexington St. Mr. Hart was one of the founders of the Stanley Works, manufacturers of butts and hinges, etc., and had been with the company for over fifty years prior to his retirement from active affairs in January, 1918.

Forthcoming Meetings

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The motor-truck sections of the 20th Annual Automobile Shows of 1920 will hold an exhibition in the 8th Coast Artillery Armory, New York, Jan. 3 to 10, 1920, and in the International Amphitheatre, Chicago, Ill., Jan. 24 to 31, 1920.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Society of Automotive Engineers will hold its annual meeting in New York on Jan. 6 to 8, inclusive. For further information of program, address the meeting committee, 239 West 39th St.

January 15, 1920 American Machinist Vol. 52, No. 3

Rolling Threads on Container Caps

By S. A. HAND
Associate Editor *American Machinist*

Probably no industry has been less influenced by standardization than that engaged in the manufacture of screw caps for bottles, jars and other like containers. The existing variations in the shapes and pitches of the threads in use are the result of the manufacturers having no well-defined standards; and as far as any attempt at standardization is concerned, the whole business appears to be in a state of utter chaos.

THE threads on container caps are formed by rolling in a machine, the principles of which may be easily understood. The machines themselves may vary from very simple hand machines to those which are entirely automatic and quite intricate. Fig. 1 illustrates a simple machine for either hand or power built by the Ferrachute Machine Co., Bridgeton, N. J., many years ago at a time when containers requiring screw caps were limited (as far as glassware is concerned) practically to fruit jars. The roll upon which the cap is mounted for threading is attached to the fixed spindle at *A* while the outer roll is attached at *B* to the spindle carried by the swinging yoke *C*, the yoke being mounted on the shaft *D* on which it is free to swing. Motion to bring the axes of the spindles toward each other is derived from pressure on the treadle *E*, and the return to the normal position is by the counterweight *F* when the treadle is relieved from pressure. A sketch of a set of threading rolls for this machine is shown in Fig. 2. *A* is the roll on which the cap is placed for threading and on it the thread is cut right hand though it revolves in a left-hand direction as shown by the arrow. In this machine the rolls are provided with threaded shanks for screwing into the spindles and the shank of the roll *A* is cut with a left-hand thread to prevent it from unscrewing while in operation. The outer roll *B* has a left-hand thread cut on it and runs in a right-hand direction, but as its shank faces the opposite way to that on the roll *A* the thread on that part is also left hand.

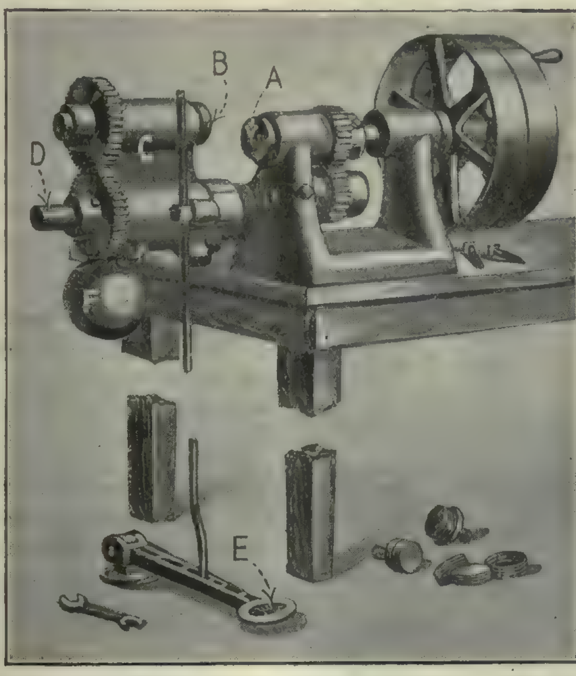


FIG. 1. A THREAD-ROLLING MACHINE OF THIRTY YEARS AGO

Usually, both rolls are made with equal diameters. However, if the caps are very small and the construction of the threading machine is such that the spindles cannot be brought close enough together, the outside roll may be made any number of times larger than the inner roll. In that case the lead of the thread on the outer roll must be increased and the speed decreased so that the helix angles and peripheral speeds will be the same on both rolls.

Referring to Fig. 2 it will be seen that roll *B* is larger than roll *A* and that both rolls are provided with flanges. In the earlier design of threading rolls it was thought advisable to make the outer roll the larger and to run both rolls at the same number of revolutions per minute. This of course caused considerable slippage between the outer roll and the cap, which not only prevented the cap from unscrewing while being threaded but was thought to make a more perfect thread by the ironing action imparted. Both rolls were provided with flanges to insure the cap being held in the proper location during the operation of threading. Later practice has shown that it is necessary to provide only the outer roll with a flange.

In operation, the cap is placed on roll *A* and roll *B* brought to bear upon it with sufficient pressure to force the metal of the cap into the threads of the rolls. One revolution plus a slight overtravel is all that is necessary to produce a full thread on soft or thin metal, while for hard or thick metals two or more revolutions may be required.

After the cap is threaded the rolls are separated, when a slight pressure of the hand on the cap will cause it to unscrew from the inner roll. As before stated, this roll runs in a left-hand direction and it will be understood that it is not necessary either to stop the machine

FIG. 3. CAM-OPERATED THREAD-ROLLING MACHINE

or to reverse its direction of motion in order to remove the cap. Caps are also placed in position while the machine is running.

Caps may be either beaded or knurled while the threads are being rolled, though the rolls must of course be properly made for the purpose.

Fig. 3 illustrates a thread-rolling machine made by the E. W. Bliss Co., Brooklyn, N. Y., in which the rolls are automatically advanced and retired by a cam, sufficient dwell being given in both the closed and open positions to allow for threading and feeding. In the operation of this machine the only attendance required is to put on and take off the caps.

A close-up view of a set of rolls in a machine of the type just described is shown in Fig. 4, while Fig. 5 illustrates three sets of such rolls together with samples of the work produced by them. The rolls with flanges on them are the outer rolls.

Several types of automatic machines are used for rolling threads. In these the caps are fed from a magazine to the rolls, where they are threaded and ejected, one operator looking after a battery of machines.

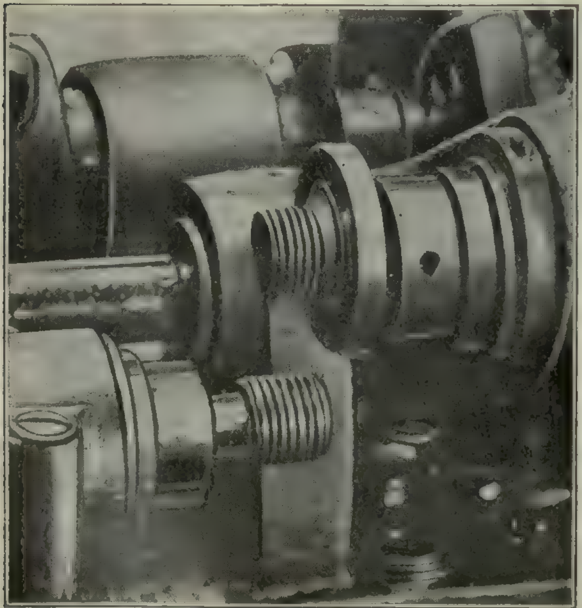


FIG. 4. CLOSE-UP VIEW OF THREADING ROLLS IN A MACHINE OF THE TYPE SHOWN IN FIG. 3

The best grades of caps are made on the hand machines where the caps and the inner rolls are made to fit each other and where both rolls are of the same diameter. In such cases the rolling action is somewhat like that of spinning and brings the metal of the cap in close contact with the inner roll, the product being uniform in size.

In automatic machines the rolls on which the caps are placed must be enough smaller than are the caps, after the thread has been rolled, to permit their ejection from

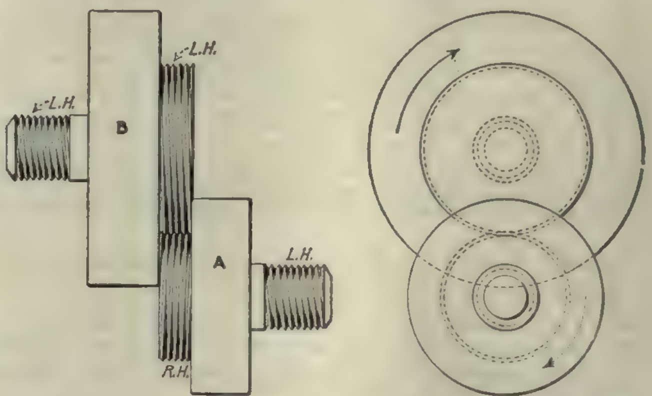


FIG. 2. SKETCH OF ROLLS USED IN MACHINE SHOWN IN FIG. 1

the roll without reversing the machine. The outer roll is of the normal size and it will be readily understood that there will be some slippage and that the helix angles of the threads on both rolls will not be the same. This results in stretching the metal in the caps and any difference in either the temper or thickness will result in wide variations of size in the product.

In the case of very soft metal, such as the zinc used in fruit-jar caps, having both rolls the same diameter may result in the spinning action closing in the cap on the inner roll so as to make it difficult to remove. To obviate this, the outer roll may be made larger than the inner one so that the metal will be slightly stretched and the cap easily removed. However, this actual difference in roll sizes will have to be found by experiment.

In regard to the threads used there appears to be an absence of any standard as to pitch in relation to diameter or as to shape and clearance. Fig. 6 illustrates sections of the various shapes of threads commonly used on glass bottles, jars, etc.

When a new container is to be made the procedure is about as follows: The size of the opening is decided upon and a cap (of which glass manufacturers carry a full line of samples) picked out. The model maker makes a wooden model or pattern of the container to be made. This may be made from a sketch or from some stock container with certain changes as per verbal instructions—most likely the latter.

When the model is approved the job is sent to the mold maker who proceeds to make the mold. When he comes to getting out the threaded ring, which is the part of the mold that forms the thread on the container neck, he cuts the thread with a tool that is ground, not to a gage but to the shape and width he judges to be about right. When he thinks the thread has been cut deep enough he makes a lead cast from the ring on which he tries the cap. If the fit is not right he takes

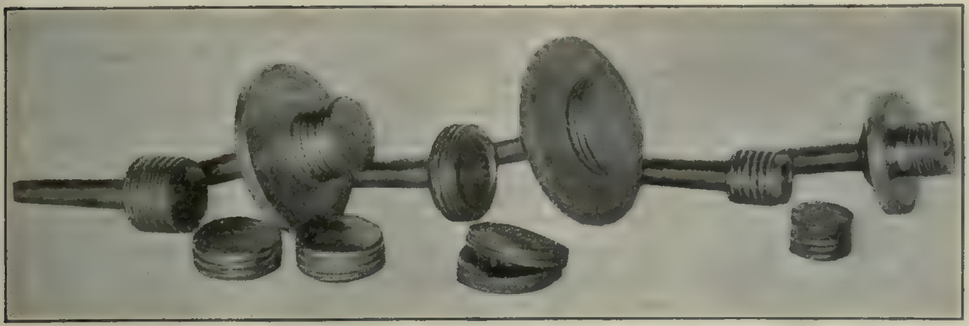


FIG. 5. THREADING ROLLS AND SAMPLES OF WORK

another cut, makes another lead cast and again tries the cap. At last the ring is finished by the cut-and-try method and all is lovely until production starts when the fun begins.

The screws on the container necks do not all come out of the mold alike. If the mold is too cold the threads will not fill the ring and the diameter over their tops may be so small that the cap will slide on and off without engaging the threads. A container with this defect is known as a minimum. If the container is taken from the mold when too hot and before the glass has set, the neck containing the threads may be out of round so that the cap will not screw on. Such a container is known as a maximum.

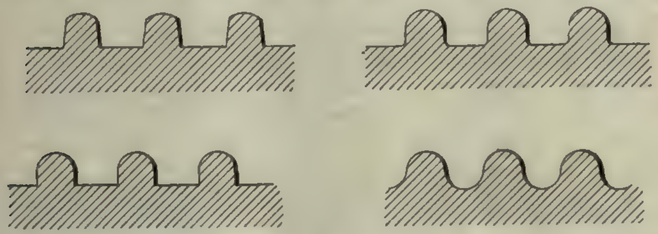


FIG. 6. VARIOUS SHAPES OF THREADS ON GLASSWARE

In such cases the glass manufacturer sends sample maximum and minimum containers to the cap maker with instructions to make a cap to fit both.

If the cap is prevented from going on the maximum container by interference at the top of the threads, increasing the diameter over the threads on the cap will permit it to be screwed on and if there is any clearance between the cap and the container at the root of the thread, the threads on the cap may be deepened enough so that they will engage with those on the minimum container. This of course will necessitate the making of a new set of threading rolls and a new lot of caps. In cases where the trouble cannot be remedied in the above manner, two sizes of caps will have to be made.

From the foregoing it will be seen that this industry is at present entirely dependent on cut-and-try methods and that there is an excellent chance for some one to take hold and standardize it.

A New Aluminous Abrasive

By Otis Hutchins

Present-day grinding has become so highly specialized that abrasive manufacturers have found it necessary to carry on experimental and development work, with the idea of perfecting abrasive materials and making grinding wheels that will definitely meet the exacting needs of the grinding industry.

The Carborundum Co. has perfected a new abrasive material known as Aloxite AA, having characteristics which appear to be ideal for the grinding of reamers, cutters and small tools; also for certain kinds of cylindrical grinding. Still another field in which this new abrasive is expected to show marked efficiency is in the surface grinding of broad surfaces on vertical grinding machines, particularly where a large amount of stock is to be removed in a short time.

The bulk of the aluminous abrasive now used in grinding operations contains from 92 to 96 per cent. alumina, 2½ to 4 per cent. titanium oxide, ½ to 1 per cent. each of iron oxide and silica, and lesser amounts of lime and magnesia. Most of the alumina is present in the crystallized state, while the other impurities combined with a small portion of the alumina form a glass which functions as a matrix or cement holding together the crystals of alumina. These crystals are composed of practically pure alumina and have all the characteristic hardness of our natural jewels, the ruby and sapphire.

The shape and size of the alumina crystals and the amount of matrix present have an important bearing upon the characteristics of the abrasive, and a study of the internal structure of the abrasive is of great importance. The method now generally used for this investigation is by means of thin sections cut from a massive lump of the abrasive. A microscopic study of these thin sections shows the size and shape of the alumina crystals and their arrangement.

Fig. 1 is a microphotograph of an aluminous abrasive of the ordinary type containing about 94 per cent. of alumina. The white areas represent crystals of alumina, while the black patches surrounding the white areas represent the matrix holding together the crystals. Fig. 2 is a microphotograph of an aluminous abrasive of the ordinary type containing about 96 per cent. alumina.

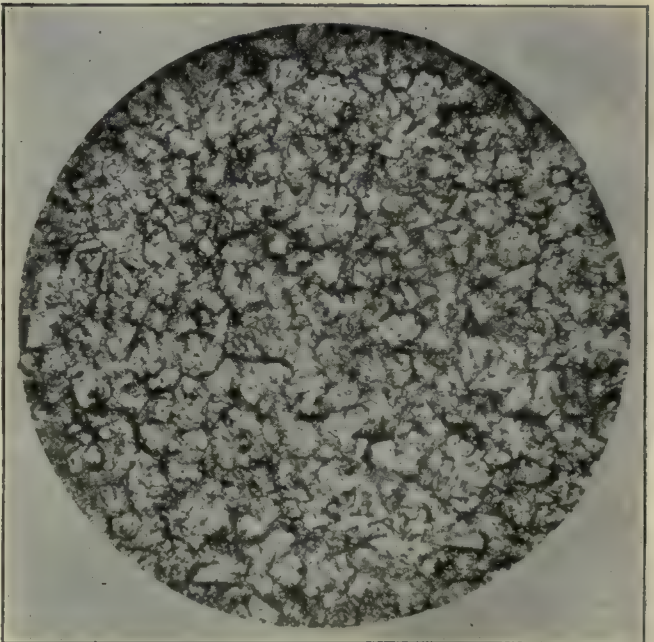


FIG. 1. ORDINARY ALUMINOUS ABRASIVE (94 PER CENT. ALUMINA)

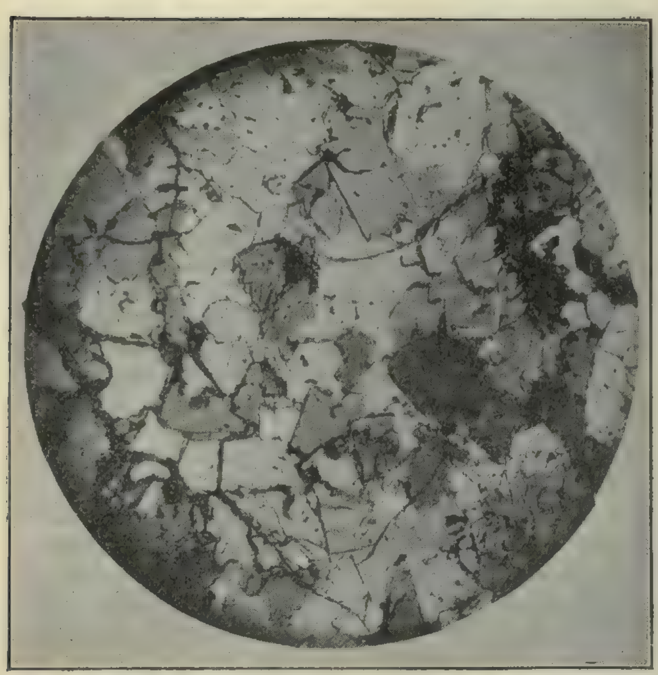


FIG. 2. ORDINARY ALUMINOUS ABRASIVE (96 PER CENT. ALUMINA); TAKEN BY POLARIZED LIGHT

This photograph was taken by means of polarized light to better bring out the size and shape of the crystals. The average size of the alumina crystals is about 0.7 mm. The types of abrasive represented by Figs. 1 and 2 are admirably suited for general grinding and are used in large quantities. The illustration, Fig. 3, is a microphotograph taken with polarized light of a thin section of Aloxite AA.

The areas of the same color in the photograph represent the same crystal growth and show the alumina crystals to be of very large size. In some cases these crystals are 12 mm. or more in size. The amount of impurity present is about 1½ per cent. or very much less than is found in the ordinary type of aluminous abrasive. This decreased amount of impurity has an important bearing on the characteristics both of the abrasive grain and of the wheel made from it. The cutting power is increased due to the greater amount of crystallized alumina present. There is less fluxing between the bond and the grain which results in a brittle wheel so necessary for rapid cutting. It also makes possible, due to the high purity of the grain, the production of wheels of very soft grade. The small amount of impurities allowed to remain in the abrasive is not objectionable, but on the other hand is extremely beneficial, as it prevents both the formation of skeletal crystals and the more or less open and porous structure which obtains when molten pure alumina is allowed to solidify. The resulting abrasive consequently exhibits a greater toughness and imparts a longer life to the wheel.

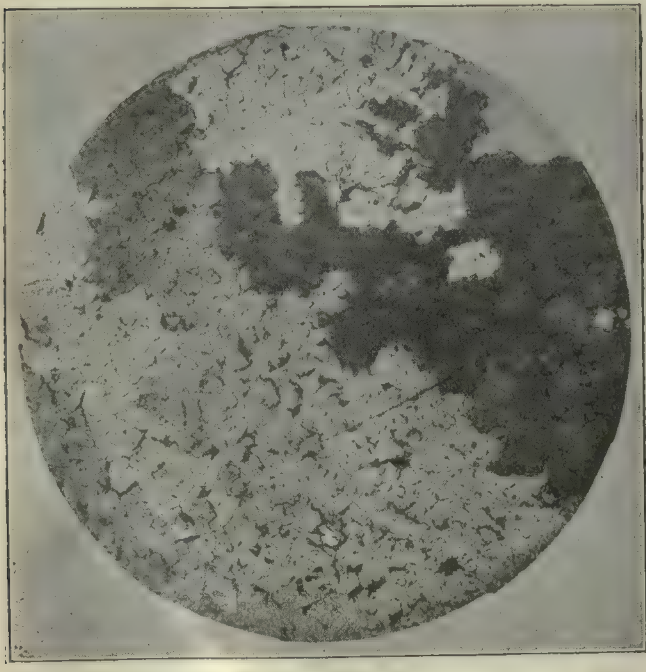


FIG. 3. THIN SECTION OF ALOXITE AA; TAKEN BY POLARIZED LIGHT

Large Alumina Crystals Important in Cutting

The large size of the alumina crystals in Aloxite AA has an important bearing on the cutting power of the abrasive. As the grits commonly used are 20 and finer, almost every individual grit will consist of a fragment broken from a larger crystal of alumina, and due to this fact possesses exceptional sharpness. During the process of grinding, there is a breaking down of the abrasive grains in a wheel and the character of the new cutting edges exposed depends largely upon the size of the alumina crystals in the original abrasive. When the alumina crystals in the abrasive are small, a rupture of the grain may mean a tearing away of a few small crystals without fracture. However, when the crystals are large and a rupture occurs in an abrasive grain, it means that a crystal of alumina has been fractured and that new sharp cutting points have been produced.

In summing up briefly it may be said that Aloxite AA is composed of nearly pure alumina with just enough impurity present to produce a desirable toughness and furnish an abrasive which will have a long life when used in a grinding wheel. It is possible to manufacture from this high-purity grain a bonded wheel of brittle nature, soft and uniform in grade, of open structure, yet which will be fast and cool cutting.

Rotary Bushings

By Wm. C. Betz

I have read with interest the articles on rotary, or floating bushings as we call them, and would add our experience with this type of bushing and method of making them.

Some years ago we were experiencing considerable trouble with the bearings and bushings of countershafts on our automatic screw machines; a bushing wouldn't last three months on the loose pulley, so we decided to do a little experimenting. We used the floating type of bronze bushing, allowing only 0.002 to 0.003 in. between the shaft and the bushing and 0.001 to 0.002 in. between the bushing and the pulley bore.

We drilled the oil holes and plugged all but two rows at opposite sides of the bushing with hard graphite grease, filling the unplugged holes with heavy engine oil to float the graphite. We have had very little trouble from this source since.

Some of these counters have been running two years since the last repairs were made and show no appreciable wear to date. I believe in the floating bushing on small-diameter, high-speed shafts where the load is not excessive.

The Evolution of the Workshop—II

By H. H. Manchester

Prior to 875 B. C., construction work of all kinds was done, on the whole, by manual labor. With the advent of a combined use of the wheel and the lever and their applications in various forms, methods and tools for such tasks developed rapidly. (Part I appeared Oct. 30, 1919.)

WHILE the earliest records of workshops come from Egypt, as has been seen in our previous article, it is of course true that, during much of the Egyptian era, metal work was almost as common in southwestern Asia as it was in Egypt. Unfortunately, however, there are no Asiatic pictures of shop interiors at that period extant to enlighten us as to the methods employed, though it is advisable to note the entry into civilization of several great inventions in Asia which have since had a marked influence on the machine shop.

Bronze probably originated in Asia, where copper and tin were both native. Tools of this metal are found in the Chaldean graves of perhaps 2500 B. C. The Phœnicians were great traffickers in tin at a very early date, and skilled workers in bronze before the time of Solomon. Iron itself may have first been used among the Hindoos, who appear to have known of it at the time of the Rig Vedas as early as 2500 B. C.

Although the wheel and the lever had been known for some time, the first evidences of both the lever and pulley date from about 875 B. C., when they were depicted in a bas-relief, at Nineveh. Among the remains of Nineveh, hammers were found. The handles were fitted into sockets in the heads, which was a vast improvement over the Egyptian form. These relics also include files of bronze, iron, and steel, which were essentially a new tool devised to be an improvement over the prehistoric flint scrapers and sandstone smoothers. The discoveries at Nineveh also included screws, nuts, heavy chains and grappling irons.

FIG. 7. A BLACKSMITH'S SHOP, FROM AN ANTIQUE GREEK VASE

Perhaps the earliest Greek picture of a metal workshop is found on an archaic vase, Fig. 7. In this the furnace is in the shape of a bee-hive, and appears at the left of the picture. This interpretation of it is made certain by a comparison with pictures showing potters' furnaces of the same general date. The anvil is still only an ordinary block, and in fact is cruder than the anvils of the Egyptian period. The hammers show the improvement of handles running through the head; the tongs are jointed instead of being merely of the spring type, as were the Egyptian; and the saw has a curved back for a handle.

Probably the most important improvement which can be traced to early Greek times was made in the design of the furnace. This seems to have preceded the discovery by Theodorus of Samos in 532 B. C., according to Pausanias, of the method of melting and casting iron. This improved furnace, shown in Fig. 8, consists of a round stack about six feet high. It has a semicircular opening at the bottom, and is blown by a bellows of goat skin which appears at the back of the stack. On top of the stack is what seems to be a ladle which was presumably used to hold metals like copper and tin. An improvement in the bellows was said to have been made about 250 B. C., by Ctesibius, to whom is ascribed the invention of the bellows constructed of wooden leaves equipped with handles. This

FIG. 8. THE STACK FURNACE IN A SMITH'S SHOP

furnace was of course much more powerful than the previous types, and facilitated the working of iron to no small extent. The tools shown are sledge hammers and jointed tongs.

Invention of the Hoist

The hoist or derrick made its appearance at this time and was used largely in architectural work. Other tools of the Greek period were jointed shears and planes formed by setting a chisel in a frame, but whether they were first invented in Greece or elsewhere is uncertain.

A fair idea of the bronze statuary shop of the classic period is illustrated on a Greek bowl, Fig. 9. This depicts the stack furnace with a helper working a hand bellows behind it. The statues were evidently made in parts, and the head and feet especially were joined on afterward. The only novel tool shown is a straight saw with a handle which could be worked with both hands. Its illustration here indicates that it was employed for sawing metal.

In both the Greek and Roman periods the greater part of the work was done entirely by either slaves or freed slaves, and it is significant that the early machines were designed to make use of power furnished by the

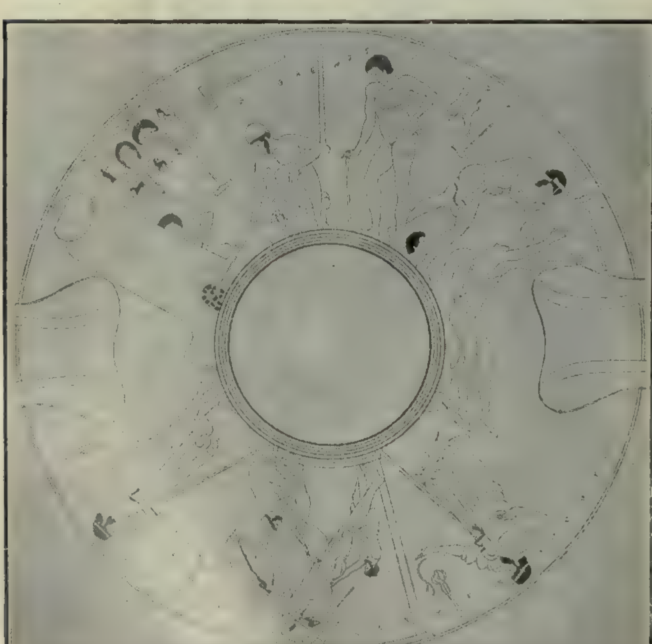


FIG. 9. MAKING BRONZE STATUES

slaves. Perhaps the most interesting machine of this sort was the tread-wheel derrick, Fig. 10, in which slaves trod the inside rim of the wheel and furnished sufficient power through a system of ropes and pulleys to raise heavy weights.

Some of the most interesting occupational pictures of the Roman period are found on grave monuments, plaques, and even in catacombs. One plaque of this sort, Fig. 11, represents a woodworker's shop. It portrays the various tools then used in woodworking, including perhaps the first illustration of planing with

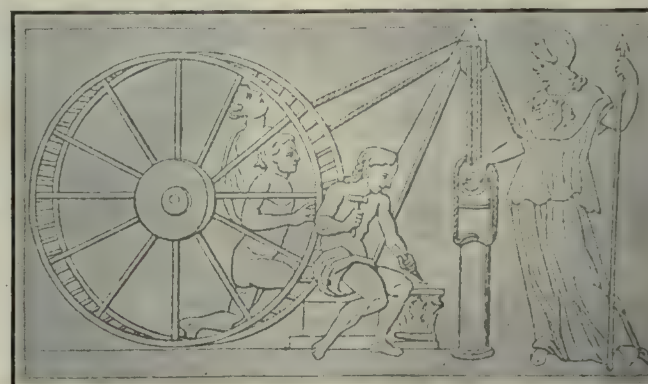


FIG. 10. AN ANCIENT ROMAN TREADMILL

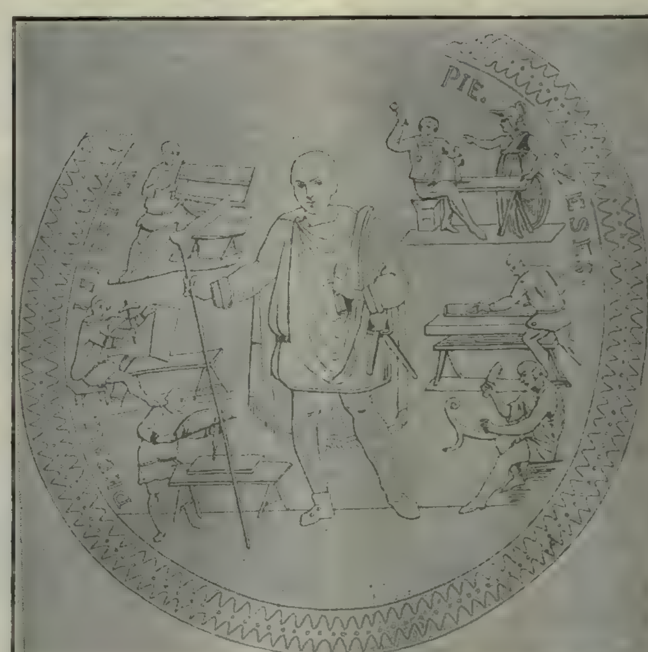


FIG. 11. A ROMAN WOODWORKER'S SHOP

a set plane. It will be observed that the bow drill was still employed, and that the bucksaw had come into use.

Among the pictures of the Roman period, illustrating metalworkers' shops, are several paintings depicting the forge of Vulcan. Most of these are more artistic than enlightening from a technical standpoint. The same may be said of several sarcophagi illustrating cupids forging, and other work. Two pictures illustrating especially toolmaking and a toolmaker's display are interesting in the types of instruments they picture, even more than in any special processes which they disclose. There is also one picture which delineates a portable furnace and forge in which the furnace in particular seems to be of a new type.

Just before the time of Augustus there were introduced into Rome and set up on the banks of the Tiber a few small waterwheels. The waterwheel is said to have been invented in Cappodacia during the reign of Mithridates and used for grinding grain. It was very crude and hardly able to compete with the slave labor of the period.

However, in the time of Ausonius in the fourth century A. D., we hear of it being employed to saw stone with the aid of toothless saws and sand. It was at all events of great importance as the first practical use of natural power to do work, and as a machine it was destined to revolutionize the labor of the later Middle Ages and early Modern Period.

Geometrical Progression of Speeds in Machine Tools

BY C. C. STUTZ

The method of proportioning the speeds of machine tools given here is presented as a logical and readily understandable system which may be applied to almost any problem of this type.

IN DESIGNING machine tools of any type it is now an accepted practice to so proportion the speeds that they will form among themselves a geometrical progression, so that each speed is increased from the preceding speed by the same multiplier.

We shall not concern ourselves here with the problem of arriving at the proper minimum and maximum speeds best adapted for any particular design in hand, but shall consider these two speeds as having been determined. The total number of speeds desired shall also be a known quantity.

Let there be:

a = slowest speed;

b = fastest speed;

n = total number of speeds;

n–1 = total steps or intervals between total number of speeds;

f = ratio of one step, or factor wherewith to multiply any speed to obtain the next higher speed;

d = number of steps in cone pulley.

Algebraically expressed, the various speeds, therefore, form the following series:

$$a, af, af^2, af^3, af^4 \dots\dots\dots\dots af^{n-2}, af^{n-1}$$

The last or fastest speed, is expressed by both af^{n-1} and b; therefore:

$$af^{n-1} = b, \text{ or } f^{n-1} = \frac{b}{a}, \text{ from which}$$

$$f = \sqrt[n-1]{\frac{b}{a}} \qquad (1)$$

By multiplying the slowest speed a by the factor f, we obtain the second speed and so on through the whole series.

As a rule the number of speeds n is such that it can not be obtained by a cone pulley alone, and the machine is therefore either back geared or triple geared, or perhaps even quadruple geared. In such a case it is a simple matter to obtain these gear ratios as will be shown.

Assuming as an example a lathe with a four-step cone, (d = 4), triple geared. This would give us: Four speeds with cone, four speeds with cone and back gears, four speeds with cone and triple gears; or 12 speeds in all, and the series (from the fastest to the slowest speed) would be: $af^{11}, af^{10}, af^9, af^8, af^7, af^6, af^5, af^4, af^3, af^2, af, a$.

It will be noticed that these three sections of the full series (each forming a series) bear the following relation to each other:

1. The second series can be obtained by dividing each member of the first series by f^4. In this case f to the fourth power is the ratio of the back gears.

2. The third series can be obtained by dividing each member of the first series by $f^4 \times f^4 = f^8$. In this case f to the eighth power is the ratio of the triple gears.

As the actual calculations are best carried out by logarithms we can summarize the above by writing

the log of ratio of back gears $= d \log f$ (2)

the log of ratio of triple gears $= 2d \log f$ (3)

and the log of ratio of quadruple gears $= 3d \log f$ (4)

Example 1. A triple-geared lathe.

Proportion the speeds and find the gear ratio of a six-step cone, triple geared. $6 \times 3 = 18$ speeds in all.

Slowest speed = 0.75 r.p.m.

Fastest speed = 117.00 r.p.m.

We have: a = 0.75

b = 117.00

n = 18.00

n–1 = 17.00

d = 6.00

$$f = \sqrt[17]{\frac{117}{0.75}} = \sqrt[17]{156}$$

As mentioned above, the calculation is very readily carried out by the use of logarithms. We have

log 156 = 2.1931246

log f = log 156 = 0.1290073

f = 1.3456

The series of speeds is as follows:

log 0.75 = 0.8750613 — 1	= log	0.75
log f = 0.1290073		
0.0040686	= log	1.009
0.1290073		
0.1330759	= log	1.358
0.1290073		
0.2620832	= log	1.828
0.1290073		
0.3910905	= log	2.461
0.1290073		
0.5200978	= log	3.312
0.1290073		
0.6491051	= log	4.458
0.1290073		

0.7781124	= log 5.999
0.1290073	
0.9071197	= log 8.075
0.1290073	
1.0361270	= log 10.867
0.1290073	
1.1651343	= log 14.626
0.1290073	
1.2941416	= log 19.685
0.1290073	
1.5521562	= log 35.658
0.1290073	
1.6811635	= log 47.990
0.1290073	
1.8101708	= log 64.590
0.1290073	
1.9391781	= log 86.930
0.1290073	
2.0681854	= log 117.0

Gear Ratios:

$d = 6$; therefore, according to formula 2, we have:

$$\log f = 0.1290073$$
$$d = \quad \times 6$$
$$d \log f = 0.7740438$$

Ratio of back gears = 5.9435.

According to formula 3, we have

$$\log f = 0.1290073$$
$$2d = \quad \times 12$$
$$2580146$$
$$1290073$$
$$2d \log f = 1.5480876$$

Ratio of triple gears = 35.325.

Machine with Two Countershaft Speeds

A complication of the problem which is sometimes met with is due to the countershaft driving the machine having two speeds. In this case we obtain double the number of otherwise obtainable speeds and this number of speeds may be expressed by $2n$. The problem is treated in the same manner as above, the factor f in this case being

$$f = \sqrt[2n-1]{\frac{b}{a}}$$

We now consider that one-half of the total obtainable speeds are due to the first overhead speed, the other half to the second.

In writing the odd number of speeds on one line, and the even number on a second line we obtain the following two series:

$$a, af^2, af^4, \ldots\ldots\ldots\ldots af^{2n-4}, \quad af^{2n-2}.$$
$$af, af^3, af^5, \ldots\ldots\ldots\ldots af^{2n-3}, \quad af^{2n-1}.$$

An examination will show that both series are geometrical progressions and that each series has the same factor, namely, f to the second power. The second series can be obtained by multiplying the first with the factor f. This means that the ratio of the two countershaft speeds must be f.

As far as obtaining the gear ratios of the machine itself, we need concern ourselves with only one, and either one, of the two series.

By following the deductions given earlier in this article we find for this "two countershaft speed" problem

log of ratio of back gears $= df^2$
log of ratio of triple gears $= 2df^2$
log of ratio of quadruple gears $= 3df^2$

Example 2. Lathe with two countershaft speeds.

Proportion the speeds and find the gear ratios of a four-step cone, back geared, two speeds to countershaft.

Slowest spindle speed = 25 r.p.m.
Fastest spindle speed = 500 r.p.m.

We have:
$$a = 25$$
$$b = 500$$
$$2n = 2(4 \times 2) = 16$$
$$2n\text{-}1 = 15$$
$$d = 4$$
$$f = \sqrt[15]{\frac{500}{25}} = \sqrt[15]{20}$$
$$\log 20 = 1.3010300$$
$$\log f = \tfrac{1}{15} \log 20 = 0.08673533$$
$$f = 1.2210$$

In following out the calculation as shown in example 1 we obtain the series of 16 speeds given below:

1. 25.	5. 55.58	9. 123.54	13. 274.64
2. 30.53	6. 67.86	10. 150.85	14. 335.35
3. 37.28	7. 82.86	11. 184.20	15. 409.48
4. 45.51	8. 101.18	12. 224.92	16. 500.

Dividing the Speeds Between the Two Countershaft Ratios

Of these 16 speeds, eight are due to one countershaft speed, the other eight to the second countershaft speed. We write the odd and even speeds in two series, as below:

First series	Second series
1. 25.	2. 30.53
3. 37.28	4. 45.51
5. 55.58	6. 67.86
7. 82.86	8. 101.18
9. 123.54	10. 150.85
11. 184.20	12. 224.92
13. 274.64	14. 335.35
15. 409.48	16. 500.

The log of ratio of back gears as explained above is df^2

$$\log f = 0.08673533$$
$$\times 2$$
$$\log f^2 = 0.17347066$$
$$d = \quad \times 4$$
$$\log df^2 = 0.69388264$$

Ratio of back gears = 4.9418
Ratio of countershaft speeds $= f = 1.2210$.

This method of proportioning speeds in machine drives will be found, after one or two applications, a rather simple one. Its usefulness, however, is not limited to the proportioning of speeds in machine drives, as it can also be applied to the proportioning of feeds.

Some designers hold that the factor f should be held between the values of 1.18 and 1.3 for best all-round results.

Shop Paper as a Means Toward Co-operation

By PETER F. O'SHEA

What do the other men in the shop know about the difficulties of your work? Isn't it true that the things they ought to know are the things they don't know? There are certain men in the shop who could make things easier for you if they could see your side of the game. Perhaps you never even saw these men. Wouldn't you like to point out to them the particular ways in which they might use a little more care in doing the work they send on to you? The author of this article, who has had wide experience with shop papers, answers these and other questions from his point of view.

I SUPPOSE every shop man has at some time wanted to have the rest of the men in the shop looking over his shoulder some day when all the difficulties incident to his work come pouring in upon him. How many times have you said, "Huh! If you don't believe I earn my pay, I'd like to have you follow me through a day's work. You'd drop dead just from looking at it, boy!"?

Well, why don't you? Did it ever occur to you that you might easily tell all this in your shop paper, if your shop has one?

What you do for the plant. Just where you fit in with the rest of the men. Why you and your job are necessary to the rest of the shop. Tell the value of the work you do, the details, and the funny side of it all.

On the other hand, make a mental list of the men in the shop or the office. You would like to be shown why these other men are necessary, how they are of service to you, how they fit in with you, and how they go at their work, which is different from yours.

If your shop paper has not a live, interesting, and worth while "coöperation" column, why don't you give it a start by contributing an article about your work?

If you haven't a shop paper, why hasn't one been started? I venture to predict that the management will be willing to pay the expenses of a live, interesting shop monthly appealing to men with brains and a sense of humor. They will find it valuable.

There are plenty of papers about parts of your work—the *American Machinist,* the trade papers, the management magazines, etc. and there should be a paper about the work and the people of your shop.

What a Shop Paper Should Be

The shop paper should be full of items about the people in the plant, of news, of information, and of all the thousand things that a man would like to see in print about his plant and his work.

The employees—and employees includes the president—of a modern shop will find a good paper so interesting that they will read it thoroughly—which after all is the best compliment to any paper. Why shouldn't they read it? It is their own particular paper, about themselves and their activities.

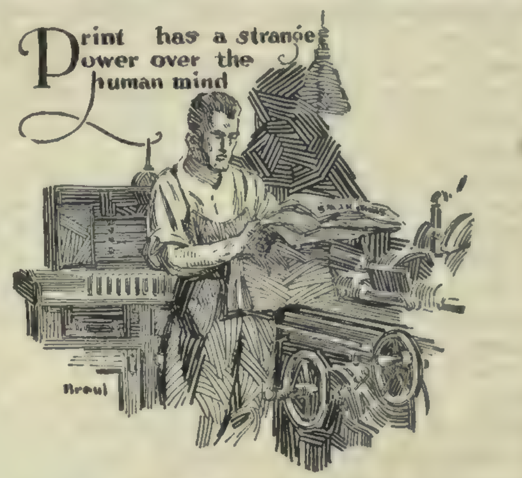
In the modern factory, cut up by walls into isolated departments, the manager and the workman often feel the need of closer union. Nowadays each man is only a piece of a workman. The other pieces are the men who do the rest of the processes, and who may be out of sight and out of mind.

To get the best results we must bring back at least a mental reunion. We should have a spirit of unity, a personal acquaintance of each man with the rest of the shop.

The shop magazine is put into the hands of all on the same day. It overcomes distance, impersonality, and walls.

The most obvious coöperation "story" for printing in the shop paper is a description of the chain of processes in the manufacture of a product. But it should not be treated in a dry way. We should apply the principle of making everything personal. Instead of detailing the mechanical processes only, treat the subject as a chain of people, each preparing or completing the work of the other men in the chain.

Suppose the individual workman finds his name and job in the shop paper in an article on the making of a



certain product. He sees in the article all the preceding and succeeding processes on the same product, as done by workmen who are designated by name just like himself. These other fellows do not even differ from him by the product they are working on, but simply by the particular process each one does on that product.

The Workman's Impulse Toward Coöperation

The average workman's first real impulse toward coöperation comes from the realization that other work as well as his own involves not simply the company's interest but the human interest of another workman. It is brought home to him that such and such a man has an interest in receiving his work in shape so that he can do the next process quickly and correctly. Possibly he has never before been told the chain of processes in making his product. Certainly he has never seen it in print in human terms. Print has a strange power over the human mind.

In each article, put in a little conversation or dialogue. Refer to amusing "Kinks" in the work. Some of the men in the chain should be mentioned by name—not all of them: pick out those who have been longest on that particular job so that the others on the same process may regard the man mentioned as only typical of themselves.

We should have plenty of pictures in the shop paper

and the subjects of these pictures should be scattered at salient points along the chain of processes, all the way from the raw material to the finished product.

The story should be told interestingly in the text, where there is a chance for humor, but the photographs should give visual proof of the story. Names of all men in the pictures should be given below them.

Occasionally a product should be selected for description, which during the course of manufacture passes through not one but two or three plants of the company, if there are more than one. This brings home the essential unity of the whole company.

The Story of a Plant

How would you go to work to describe your plant?

Starting in the office, the story should note the classification and distribution of orders, then dividing with the work, follow through its main parallel channels in the shop to meet again at the shipping room door. The photographs follow the same procedure.

In writing about the work of strictly service departments—that is, departments making tools or accessories or doing repairs, etc., for other departments of the company—the story should include a description of the use of such products by the other plants. This shows that the department is of service and brings out once more the fact that the production plant is of service to it by being its customer and finishing its final production work.

At least one photograph should show the product of the service department in use in another department or plant. In demonstrating the value and the work of the toolroom, for instance, a photograph of one of the fixtures attached to a production machine in another department, with a workman turning out quantity product on it, is indispensable.

Always it is men that the shop reader is interested in—men with two hands and a vocabulary of cuss words and a family at home, men who at work are interested in their work, and will use the cuss words about it if it goes wrong. When you get a shop reader thinking in human terms you have him on the point of offering to coöperate in any way he fits in.

Any man can write about his own work. Writing is a matter of knowing your subject, and has very little to do with a pencil or a typewriter or with grammar. So why not pick out the instructive and most interesting part of your view of your work and make it an interesting subject in the shop organ where it belongs?

What to Tell

Nothing said here means to have a man tell all his troubles. Let him tell a few, provided he laughs at them. As a matter of fact, no man will want to "whine" in a publication that is going to be read by the men around him. But turn him loose on his professional pride. Let the writer show of what value his product is, why he has to be careful with his work, and why he desires other people to be careful with the work that is coming up to him.

Some shop magazines proceed on the policy that they must make people forget their work. That is pitiful. What they ought to do, and most of them try to do it to a limited extent, is to show the shop readers their own work and how it is done.

Brevity of descriptions is a great help to getting an article read. So is simplicity. Avoid so-called technical terms understood only by the men in one room. The articles are to be read by foremen and by office people, and men in other departments. It is quite easy to select terms of description or comparison which will readily be understood by a wide circle.

We cannot insist too strongly on humor, human nature, and personal interest in these articles. Wherever there is a chance to avoid making a dry statement, bring out the same idea humorously. It doesn't take a humorist to do this. Any man knows the humor of his job as well as he knows the work of it.

A Trip Through the Shop

It is impossible to take the whole shop for a trip through its various departments in fact, but it is quite convenient to do this on paper. I have had men say to me that a fellow working in one room always thought the fellow in another room had a better job than he had. "I suppose the other chap must work," one young fellow told me, "but I don't know he works—I never saw him work. If I could go in and see him working, then I'd know that he worked. Another thing, I'd probably find by looking at him that he could do his job better and faster than I could. I'd be interested in his work, and I'd wish him luck at it. So I'd be satisfied to go back to my own job that I can do pretty well myself."

When a man has thus come into contact with a great many men in the shop paper he gets a notion of the inter-working of the factory team. He realizes definitely the need of a captain for the team. He asks himself, "Where would I be if we didn't have a manager to tie us all together at the right time?" In other words, you have sold him management. And you have sold it to him in the best possible way, by creating a demand from him for it.

For he has arrived at the understanding of management, not as a "cinch" position, but as a job of work that has to be done by a man who has his hands full and his head level. When he comprehends management as a necessary day's work, full of human worry and effort, and sees its important relation to what all the other men in the plant are trying to do, he will disclaim any intention of putting obstacles in its way and will be ready to help. From that moment you have an increase in voluntary intelligent obedience to the management.

Appealing to the Workers

Every man would rather have his work intelligent, straightforward, efficient, and civilized, with a certain pleasure in the decency and the efficacy of it.

Can the workers in a plant actually be reached by the appeal of such ideas?

Every workman has a professional pride, even if it is only a germ, which can be aroused. There is also a pride of team work. It is exemplified most strongly in the members of a big league base ball-team, each working not for himself, but to fit into the swift clock work which ends at a base.

All that is necessary is to give the man an opportunity to show himself and others what he does and where he is of interest and importance to others.

The idea of team work can certainly be built up through the house organ.

The shop magazine should show to the people in the shop that the people in the office are of value to them. The men in the shop will be glad to find out that they aren't having something put over on them, that the white-collared chaps in the office really do have

to work for their pay envelopes as well as themselves.

Furthermore, an explanation of the fundamental value of costs, accounting, routing, etc., to the shop, expressed in simplified terms will make the shop less impatient with the red tape of blank forms and other tools of office functions. If you put it up to any foreman whether he would rather do his own book-keeping complete, or do it only in skeleton on a few blank forms for somebody else to work up, he will see the matter in a new light.

The office departments which have no routine intercourse with the shop departments are in most danger of appearing to the shop to be useless appendages. It is of course easy to prove that they are service depart-

ments for the plant. It is for the interests of the whole company that such proof of the purpose and the work of such departments be presented.

Why should the manager of the company be willing to pay the expenses of a shop paper?

Because it helps him in running the shop. It makes his men more intelligent, more educated in the processes, purposes, and problems of the shop. It is easier to deal with intelligent men who know something beyond their own machines.

The shop magazine has nothing to do with labor troubles. It is not affected by either closed shop or an open shop. It is appropriate under any management system, staff, line, or committee, with shop committees or without them. It is simply and always a means to make work in the plant easier, more intelligent and more pleasant.

Helpful to the Management

The manager may do his work well from the top, but he finds it difficult to stir up a force from the bottom. His function is not only to control the force that comes up to him from the organization, but it is also to reach down into the organization and there set free and arouse more of the potential force of the factory so that additional energy will come up to him and be available for control. Modern management demands more and more attention to the personal element of the factory and the best way for the manager to reach every man in the shop is through a shop publication.

Our magazine must be the employees'. The manager pays for it. That is all he does. He should desire, both as a gentlemen and as a wise manager, that the employees forget the matter of payment as soon as possible. In other words, the manager buys the ticket then he gets off the train. He does just the same thing for a salesman. No manager, just because he pays the fare of one of his salesmen, would think it necessary to do the traveling also. The shop paper is a salesman which the manager sends traveling in his factory.

We have seen that the most efficient way to get at things is from the bottom, from the employee's point of view. Then build upward. The manager knows all the parts of his plant. He is not trying to instruct himself. He is only giving the employees the means to become interested in each other and in the plant in which they spend their lives. So the assistant editors should be employees, the news gatherers and contributors and illustrators should be employees, who are working at their own daily jobs. If the company is a large one it will require an editor who has no other job but editing the paper. But he must have the employee's point of view. He must consider himself the composite employee. He must also of course have ultimately, in the back of his head, the manager's point of view. But the two are not inconsistent. For the composite employee includes particularly the manager, who is the leader of the team. As a matter of fact the manager is a composite employee. It must be constantly remembered that things which are good for the whole team are good for the individual employees as well as the manager.

Make everything constructive. This accords with our purpose of coöperation and unity. Make everything readable in subject, style and length. There is no use in printing what won't be read. You can't follow the employee into his home and stand over him with a club until he wades through a long, dry article. The paper must carry inside itself the attraction which will draw him through it. Your magazine must be a self-starter.

Make everything personal to some men, group of men, or class of men in the plant. Shop people are interested in people.

There are a great many highly valuable and interesting things that the employees' magazine could not use, though they might be good for *Snappy Stories*, or the *Review of Reviews*, or *Harper's Magazine*. If Rudyard Kipling offered you a new story like "The Light That Failed," you would have to catch your breath in pleasant surprise and at the same time look around for some way to refuse. You might get a happy inspiration and put to him the test question. "Is it about our shop?" "No, of course not, I never heard of your shop." "Then I am sorry, Rudyard; it pains me more than it does you to reject your manuscript. For the company hasn't got the money, the editor hasn't the space, and the employees haven't interest for anything that isn't about the greatest topic on earth—themselves."

Special Machinery in the Future

By Entropy

If the old saying that necessity is the mother of invention is still true there appears to be a flood of invention directly ahead of us. Labor costs are so high that a very ineffective automatic machine is cheaper than man power. If the work done by a man who draws a couple of thousand dollars a year, can be anywhere nearly duplicated by a machine, we can afford to spend anywhere from two to ten thousand dollars for it depending on how long it will remain in use, and this in turn depends on not only its wearing qualities, but

on how long its product can be kept on the market profitably without changes which will throw the machine out of commission. It may be that this rush of high wages will prove to be a great blessing instead of the curse that it now seems to be. We have always been an inventive nation, but we seem to need an economic pressure to make us invent. We do not invent for the fun of it. It may seem so from a perusal of the Patent Office Gazette, but almost everything there, is there because of a real or fancied economic pressure on the investor's pocketbook or his stomach.

Just what evolutions in the machinist's business is this going to bring about? One thing seems likely, and that is that more special-purpose machines will be built; another is that we will settle into more stabilized lines. The economy which results from manufacturing any given thing in a few sets, and large lots, and for a long time without change, is something almost too stupendous to believe. The fact that a given machine can be manufactured safely for ten years without the change of a line of its design, enables the manufacturer to buy stock to advantage, build special machines to dispense with help, and to put parts through in large lots, enabling him to hire low-priced help to break in on the job.

Will this affect methods in the shops building machine tools with which to build machines for production? Probably not in the same way. The product of machine-tool shops will probably be more varied; they will not be able to take advantage of the specializing which their customers' customers will do; they will likely build in even smaller lots, and vary designs a great deal more. It is almost safe to predict that a great many machines which are built now in quantities, such as lathes, milling machines, etc., will be built with more variations and attachments. The big point is going to be the necessity for making the product of the machine that is made by means of machine tools cheap. That is, the point of greatest economy is needed in the second remove from the machine-tool shop. Machine tools can cost much money, and the machines which are built, such as looms, steel mills, farm machinery and so on, by the use of machine tools can cost a great deal so long as they are efficient in making fewer men necessary in the shops and factories in which they are used.

Evolution Is Too Slow

It is in the design of these last machines that scientific investigation must have its place. Evolution is too slow. We have built lathes for the past 50 years by adding a sixteenth of an inch to the size of the spindle every few years. We do not know how many more sixteenths should be added to make the best lathes. We do know that every particle of increased weight and size costs money, and we wonder if the market will stand it. There is danger in getting ahead of the times, but the danger is not very great if there is a good sales department. The public can be educated. It costs money to do it but the rewards are correspondingly large.

There will still be the need of all-roundness in machine tools because of the very fact that they will be so much more used to build special machinery, and that that special machinery will be made in such small lots. Machine-tool shops will need not only all-round equipment but all-round men. Before the war machine-tool shops were not famous for liberal wage rates. Their men were rapidly absorbed by the automobile manufacturers and they were running with a few good men who were reluctant to leave old jobs for new, and a large mixture of men who were anything but machinists. Machine-tool manufacturers will have to maintain their prices high enough to enable them to hold a good organization, even if that means paying the highest rates of any machine shops. Maintenance of prices is only a matter of education, both of competitors and of customers. Prices would have to go several times as high as they are now before it would pay manufacturers to run small shops of their own, building their own tools with which to build their own machinery. Charging all the traffic will bear for machine tools is not politic but there is a large margin between that price and the present, enough at least to justify the retention of sufficient capable mechanics to do the work well and efficiently.

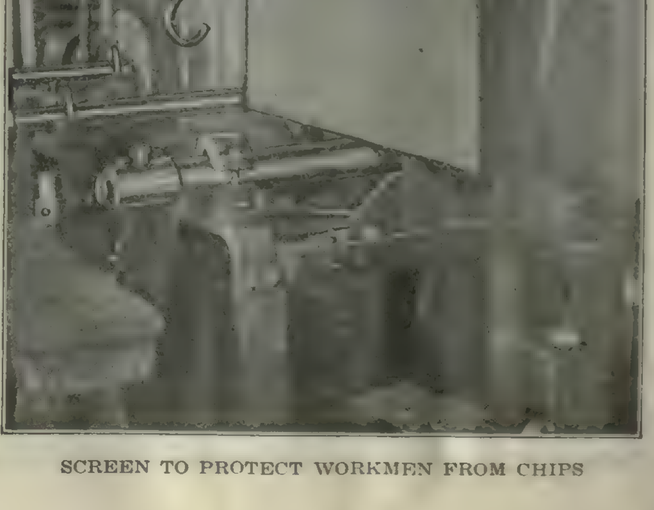
It is almost safe to predict that machine-tool shops will have to come more nearly to being engineering establishments, which instead of building machinery by the mile, and telling their customers to take them or leave them, will prescribe for their clients and design the machinery best adapted to the purpose for which it is to be used.

Safety First

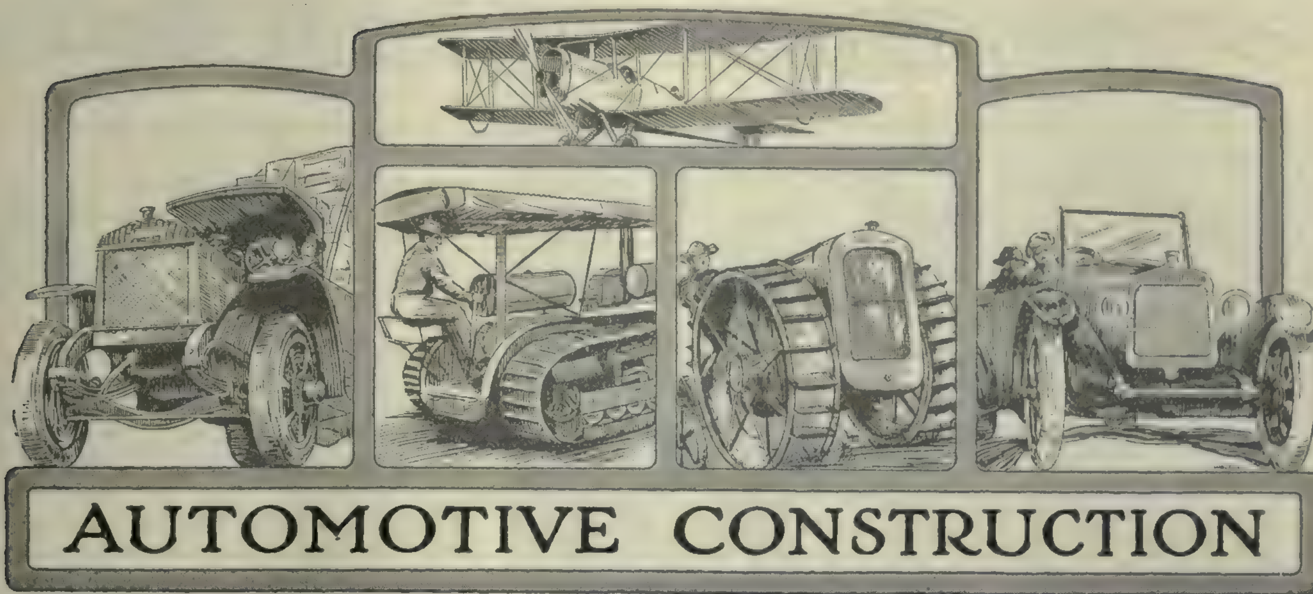
By Charles Maxwell

The illustration shows a screen used in the Chicago shops of the Chicago & Northwestern R.R., to protect workmen against injury from flying chips. The screen consists of a wooden frame covered with light sheet iron and on top of that a covering of burlap, or other soft material, to prevent the chips from bounding into the workman's face. It is portable and can be placed anywhere it is needed. Besides being used to protect workmen, it can be placed in front of a window to prevent chips from breaking the glass.

As illustrated, the screen is shown placed on top of a piston rod clamped in a movable stand, ready for chipping out the slot for the cross-head key.



SCREEN TO PROTECT WORKMEN FROM CHIPS



How We Make Automobile Cylinders

By FRED H. COLVIN
Principal Associate Editor, American Machinist

What is the best method of machining cylinders and other parts for automobile and similar motors? The answer depends upon such conditions as design, quantity required and the equipment available. This is the beginning of a series which will show the methods of some of the best-known builders in the United States. It begins with cylinders and will show how the different shops handle this problem.

THE manufacture of automobile cylinders in the various plants throughout the country seems to have developed certain methods, which comprise basic principles as to the operations employed and the sequence followed — particularly during the first few operations. The problem is to face the cylinder flange as squarely as possible with relation to the cored holes in the cylinder castings. Unless this is done, it becomes more difficult to bore the cylinders straight and true, owing to the difference in the amount of metal to be removed on the sides, and it also leaves a varying thickness of cylinder wall which affects the cooling as well as the strength of the cylinder block.

In the early days of automobile-motor building, a number of manufacturers, notably the Thomas Co., of Buffalo, bored the cylinders as the first operation and used the bore as a working point. The cylinders were cast in pairs and located with relation to the bore by means of targets set on the boring fixture. There was a cored hole at the top through which the targets could be sighted, and all future operations were located from the cylinder bore.

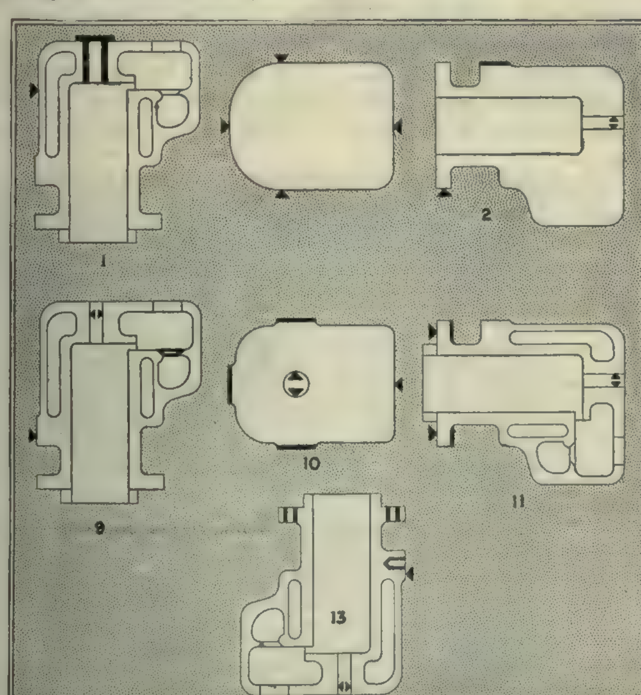


FIG. 1. THE TRANSFORMATION DIAGRAM SIMPLY GIVES A GENERAL IDEA OF THE OPERATIONS AND HOW THE WORK IS LOCATED. THE HEAVY LINES SHOW THE SURFACES MACHINED AND THE BLACK TRIANGLES THE POINTS USED FOR LOCATING OR POSITIONING

The present tendency, however, is to break away entirely from this practice, as the uniformity of the castings now obtained allow the cylinder blocks to be located quite accurately from the outside of the casting.

The exact procedure in the machining methods used in the manufacture of cylinders for automobiles varies with the design of the cylinder itself and with the quantity manufactured. This, however, does not affect the actual methods of the machining operation as much as the arrangement of the machines and the method of handling the work.

In almost every case, whether it is an individual cylinder, or cylinders cast in blocks, the first operation is to machine the lower face or flange surface on a planer type milling machine. The next operation is to drill and ream the bolt holes, using this surface and two or more of the bolt holes as locating points for all future operations. In one or two instances

AUTOMOTIVE CONSTRUCTION

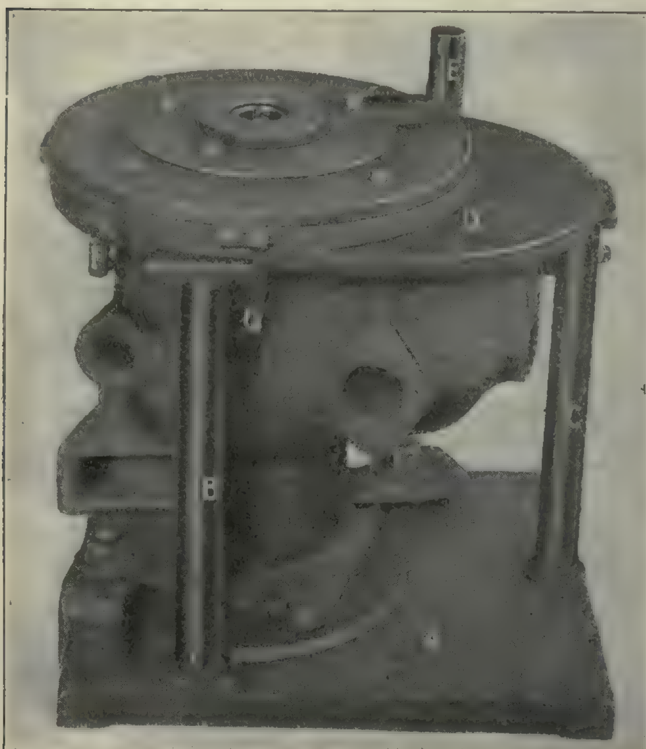


FIG. 2. FIXTURE FOR DRILLING HOLE IN TOP

this is varied by first machining the top of the cylinder and using this as a surface from which to machine the bottom flange, this applying, of course, only to cylinders having removable heads.

The main consideration is to so bore and face the cylinders that the bore will be at right angles to the base flange. This is usually done by utilizing the outside of the cylinder wall below the water jacket, and with the state of perfection now obtainable in automobile-cylinder castings, there is comparatively little difficulty with the concentricity of the cylinder bore.

In cylinders having removable heads, it is, of course, comparatively easy to so locate the cylinder that the bore will be at right angles to the flange, and by so doing, aid materially in the boring of the cylinders.

In the examples which are to follow, it will be noted that while the exact sequence of operations may vary to some extent, they have become fairly well standardized and only occasional variations are noticeable. One of the later developments is the finishing of the top of removable-head cylinders by grinding so as to insure a better joint with the cylinder head and in some few cases this is also done on the base flange of the cylinder. Grinding of the cylinder bore is almost universal although a few adhere to reaming and there is one notable example of finishing by rolling to compress the metal of the wearing surface.

The motor built by the Autocar Co. of Ardmore, Penn., has the unique distinction of being the only two-cylinder-opposed motor which has survived the test of time. The cylinders are cast singly and bolted to an offset crank case so as to connect with the two-throw crankshaft.

The first operation is to drill a $1\frac{5}{32}$-in. hole in the head, using the fixture shown in Fig. 2. This fixture consists of the baseplate *A* and three posts, two of these being shown at *B* and *C*. The cylinder is clamped in position as indicated, its exact position on the base not being especially important. Then the plate *D* is put over the cylinder so as to rest on the posts and the handle *E* closes centering fingers, two being shown at *F* and *G*, around the cylinder casting, which locates the drill bushing central with the bore. The hole thus drilled forms one of the working points for future operations.

Operation 2 mills the foot on the side of the cylinder and as can be seen, a series of fixtures are used for this purpose. The cylinder rests in a cradle and the hole just drilled fits over the plug *A*, Fig. 3. The cylinder is positioned by the level *B* so that the finished surface of the foot may be parallel with the cored opening across the side of the cylinder. The target is used for locating the open ends of the cylinder, the stop *D* being controlled by the screws *E*, while the supporting posts *FF* are controlled in a similar manner by the screws *GG*. The actual fastening of the cylinder is done by the clamp *H* and screws *I*.

The cylinder is next rough-bored and after drilling an $\frac{1}{16}$-in. hole, goes to an air test as shown in Fig. 4. This apparatus handles both the air and water testing, but as the water test is a later operation, we will again refer to this illustration later.

The device for air testing is both ingenious and

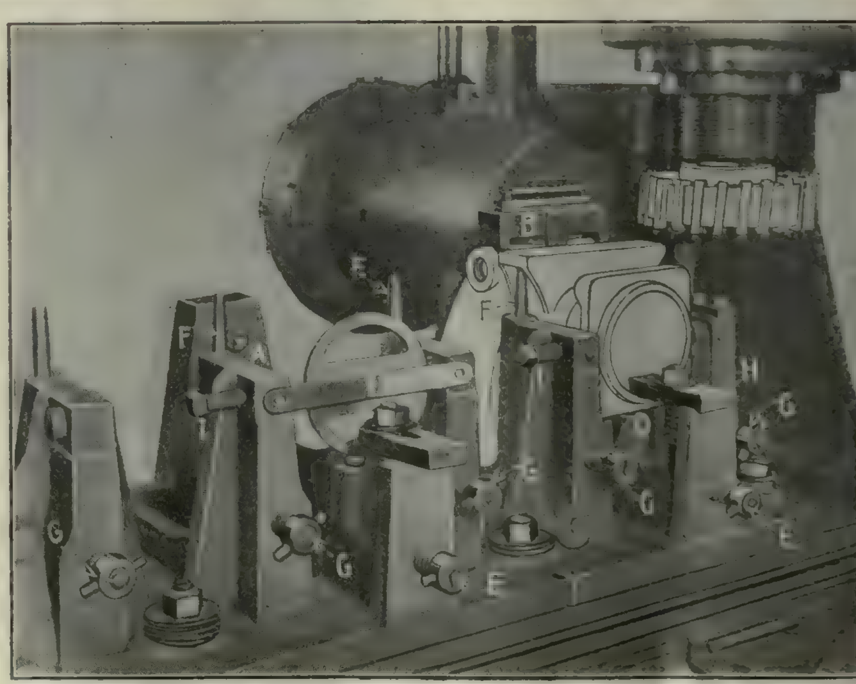


FIG. 3. MILLING FOOT ON SIDE OF CYLINDER

AUTOMOTIVE CONSTRUCTION

convenient, the work being done in the tank shown in the foreground. The cylinder to be tested, with the various openings properly capped, is placed on the rack as shown and the air hose connected. This rack is counter-balanced so as to be easily handled and the cylinder is readily submerged in the tank. At the side of the tank is a carefully hooded incandescent light which shines through a glass plate in the side and illuminates the water so that the smallest bubbles can be easily detected.

After testing, the cylinder is readily raised owing to the counter-balance and is ready to go on its way after disconnecting the air hose and removing the caps.

The cylinder is next annealed for 90 min. at about 900 deg. F. after which it is finished-bored, allowing 0.010 in. for grinding. The next important operation is the boring and facing of the valve seats, this being done in the fixture shown in Fig. 5. The tools used are shown on the stand beside the fixture which is shown empty in order to give a better idea of its construction. The shoulder on the crank-case end or pilot of the cylinder slips into the hole *A*, the plug *B* fits the hole at the top, while the foot on the side of the cylinder is positioned by the camshaft *C*.

The valve-seating tools are guided by the bushings in the sliding plate *D*, the plug *E* locating this slide with reference to the main fixture so that when the cylinder is moved, the bushing *F* locates the guide for the second hole. By the use of quick-changing chucks and the simple fixture shown, a very satisfactory production is secured.

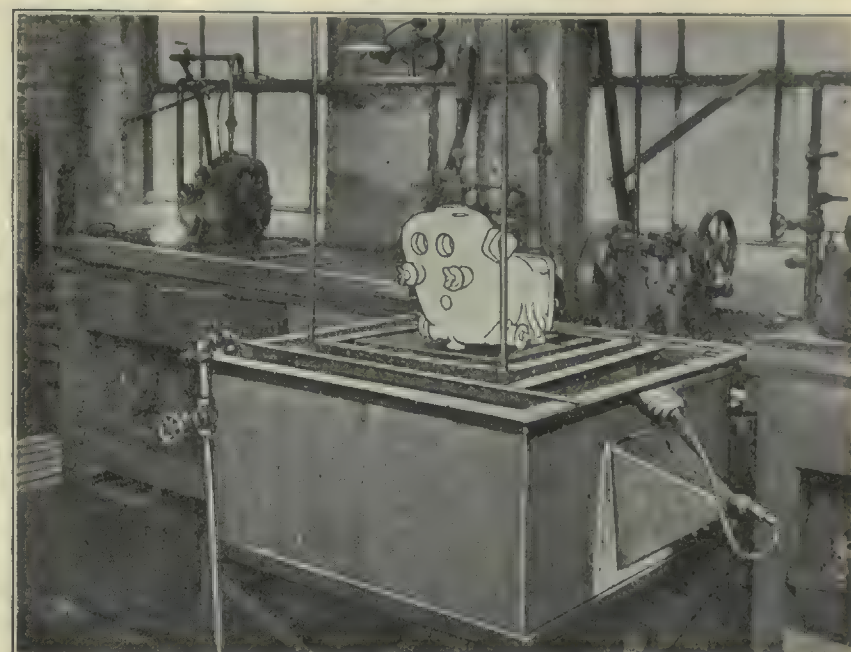


FIG. 4. AIR AND WATER TESTING

The top and exhaust flanges are milled in the three-spindle machine shown in Fig. 6. This also shows the method of supporting the cylinder and of setting the cutters. The hole at the top and the foot on the side of the cylinder both center and position it, the screw *A* which fits the hole forcing the flange against the upright *B*. The wedge *C* then locates the foot of the cylinder and the supports *D* are then adjusted to support the cylinder against the cut and prevent vibration.

The cutters are set by means of the gage *E* which has three setting points; two of these are shown by *F* and *G*. The gage fits a slot in an upright of the fixture and is used in setting the cutters from the three spindles.

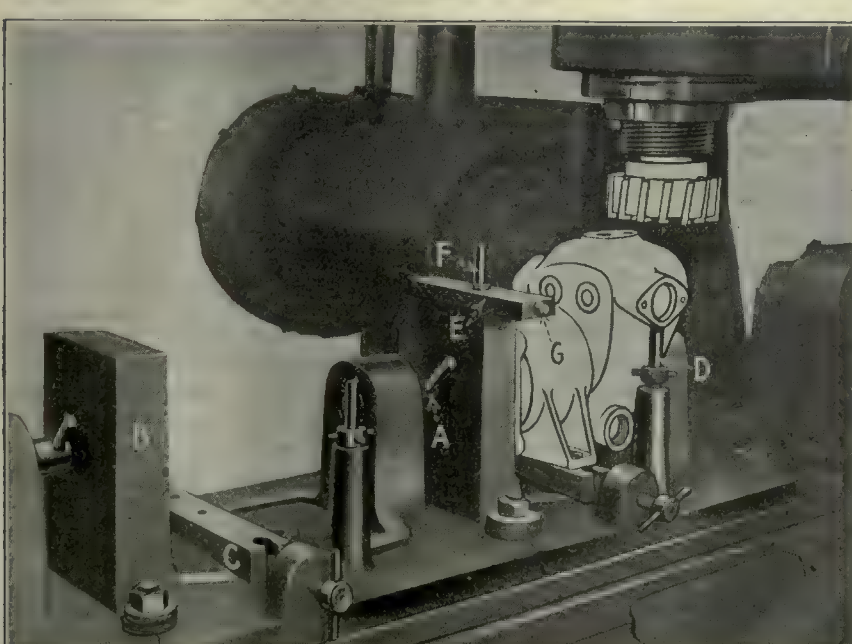
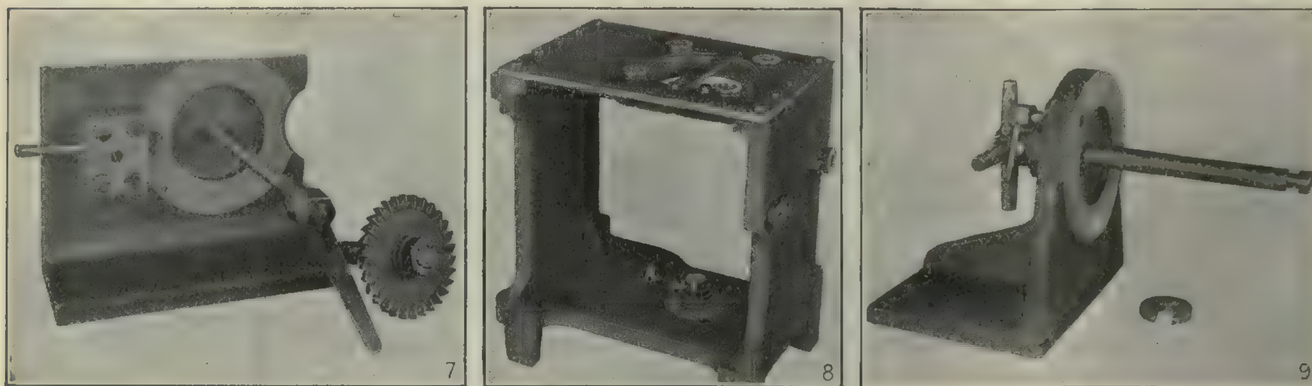


FIG. 6. MILLING OUTLET FLANGES

The bolt or washer seats on the back of the cylinder flange are finished by the fixture and milling cutter shown in Fig. 7. The pilot of the cylinder fits the central recess and the cylinder is held in place by the bolt shown. The V-block at the left simply locates the flange so as to bring the bolt corner in the proper position and the milling cutter back-faces the flange on a plain milling machine.

The fixture for drilling the four bolt holes in the flange and the two holes in the foot is shown in Fig. 8. Here again the pilot and the hole at the top of the cylinder are used, the plug *A* screwing into the small hole and holding the cylinder in place. The foot comes into position against the side and the six holes are then used, the drilling fixture being turned into two positions for this operation.

AUTOMOTIVE CONSTRUCTION



FIGS. 7, 8 AND 9. FIXTURES FOR DRILLING AND INDEXING

A very simple fixture for drilling other small holes in the side is shown in Fig. 9. The cylinder is simply slipped over the mandrel shown, the C-washer dropped into position and the cylinder pulled into place by means of the cross-handle *A*. The cylinder can be located in four positions by means of the pin *B* which fits into any of the four bolt holes in the flange, holding the cylinder square for any of its four faces.

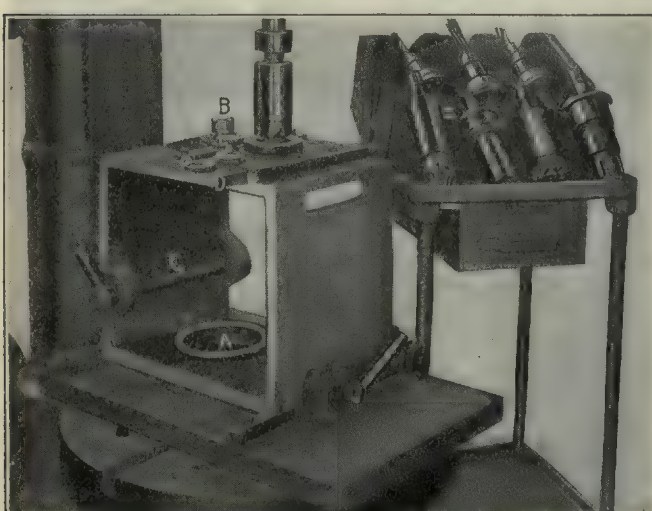


FIG. 5. FIXTURE FOR VALVE SEATS

Then comes the water test which refers us back to Fig. 4; a cylinder being shown on the bench at the left connected for this test. An electric hand lamp is used to allow close inspection all around the cylinder to see that there is no ooze of water at any point. Grinding to finished size and inspection completes the operations on the cylinder.

In connection with the single opposed cylinder, it is interesting to see the type of crank case which differs so radically from that of the usual truck motor of today. This is shown in Fig. 10, the crank case being complete except for the driving of the last stud which is shown in the stud driver at the right. The crank case shows how the cylinders are offset to bring each connecting-rod in line with the two-throw crankshaft.

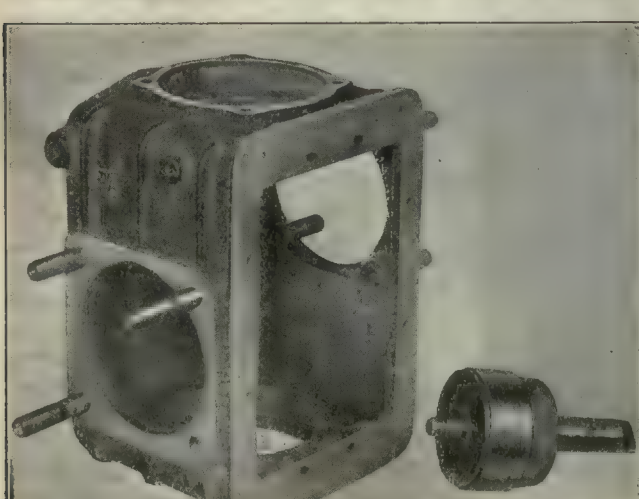


FIG. 10. CRANK CASE AND STUD DRIVER

Canadian Substitute for a Lathe Chuck

By W. D. Forbes

The description of "Les Poupées" by Charles Canec, on page 741, Vol. 51, of the *American Machinist* is interesting. I have seen and used these "dolls," as the words would be translated, and have found them very convenient—in some cases even more handy than a chuck.

While on a bicycle trip years ago I saw in a blacksmith's shop a modification of the idea that was most satisfactory and allowed the regular faceplate to be used by filing out the slots.

The body, or main part, was made about as Mr. Canec described the poupée, except that the turned tail was threaded on its end, and this tail was considerably larger in diameter than the width of the slots in the faceplate. These slots were filed out parallel for their entire lengths and the tail of the poupée was filed flat on both sides in line with the greater length of the body, making a nice sliding fit in the slots.

When passed through the slots the bodies could be adjusted to any position, just as the sliding jaws are now fitted to the platen of vertical boring mills. The plungers were made just as were those described by Mr. Canec, except that the square ends were solid on the plungers and were hardened. The nuts on the tails of the bodies allowed them to be firmly secured.

The man who made these poupées told me it was lack of funds that caused him to think up the design but he thought that if in making them he had counted his time in at his regular charge rates he could have bought a chuck for the amount and had he possessed the cash would have done so. Here, certainly, necessity was the mother of invention.

The Organization, System and Routine in a Phonograph-Motor Shop

By W. E. Thompson

There are systems of all sorts in shop organizations—systems where one man keeps every thing in his mind and from that, running the gamut up to the Taylor system. A system should be built to fit the particular shop in which it is to be used and the one requiring the least amount of clerical work, that will keep the bearings oiled and the machine running smoothly, is undoubtedly the best. In this article the author tells of a system that in many ways is semi-automatic and works well in the shop for which it was designed. Some notes of the manufacturing processes in this shop are also given together with descriptions of a few of the special tools.

THE system and methods in use at the plant of the Tiffany Motor Co., West New York, New Jersey, are worthy of description as representing efficient management of great simplicity as applied to a comparatively small plant.

The start of shop system is an organization so arranged as to divide responsibility as evenly as possible, to prevent interference between different heads of departments, and to avoid overloading any one executive. A chart representing such an organization is shown at Fig. 1. All correspondence, purchasing, sales and accounting is naturally handled by the general office and is in direct charge of the chief executive. All shipping orders are issued by the general office but stock orders and all business pertaining to production are directly under the jurisdiction of the superintendent. The timekeeper's office is located in the finished-stock room, a standard clock time-card system being used

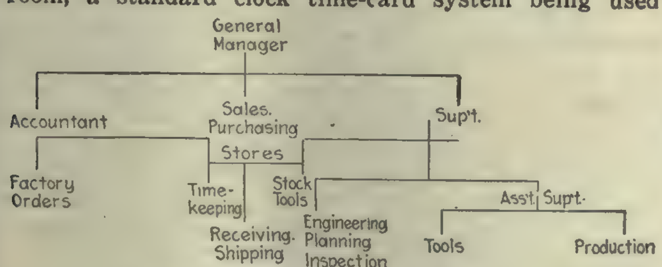
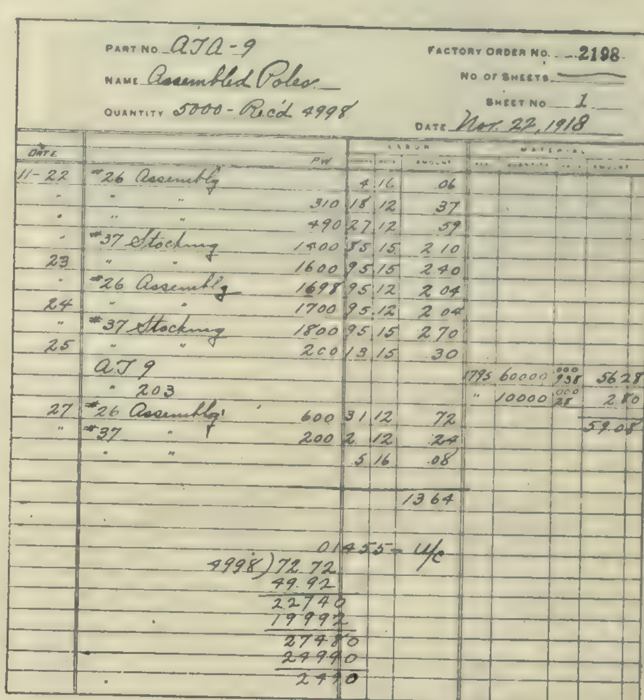


FIG. 1. ORGANIZATION CHART

to keep the elapsed time on all tasks; also all shop-production orders are issued by the stock clerk from this point.

A simple cost sheet on which is posted all labor and material charged to the job is shown in Fig. 2. These order sheets are kept in a loose-leaf file, arranged in numerical order by part number, and all time cards and material requisitions are posted each day for the day previous. Upon completion of an order the sheet is removed and turned over to the accountant to be posted and filed by part number. All material is issued on a requisition from the stockrooms to the department in which it is to be used together with a tag, a sample of which is shown at Fig. 3. This tag has the production order number, and name of part, quantity to be made, and part number on it, and remains with the



Part No. ATA-9 Factory Order No. 2198
Name Assembled Poles No. of Sheets
Quantity 5000 - Rec'd 4998 Sheet No. 1
Date Nov. 22, 1918

Date		PW	Labor		Amount	Material			Amount
11-22	#26 Assembly		4	16	.06				
"	" "	310	18	12	37				
"	" "	490	27	12	59				
"	#37 Stocking	1400	55	15	2 10				
23	" "	1600	95	15	2 40				
"	#26 Assembly	1698	95	12	2 04				
24	" "	1700	95	12	2 04				
"	#37 Stocking	1800	95	15	2 70				
25	" "	200	13	15	30				
	AT 9					1795	60000	938	56 28
	" 203					"	10000	28	2 80
27	#26 Assembly	600	31	12	72				
"	#37 "	200	2	12	24				59 08
	" "		5	16	.08				
					13 64				

01455 - u/c
4998)72 72
49 92
22740
19992
27480
24990
2490

FIG. 2. THE COST SHEET

work until it reaches the finished-stock room when it is signed by an inspector, and turned over to the time clerk. A white tag is used on all regular stock orders and a red for orders that are to have precedence and these tags are referred to by all connected with the production of the parts called for by the order.

All parts are listed by symbols and numbers, and part books, a sample sheet of which is shown at Fig. 4, are distributed throughout the shop. These sheets are kept in loose holders and contain complete information regarding the part to be made, stock per 1000 pieces, specifications and operations in the proper order of procedure.

The tool crib is so arranged that all tools are convenient to the window, each tool having a listed space,

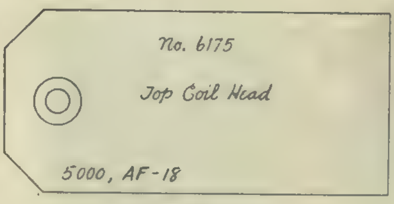


FIG. 3

FIG. 3. REQUISITION FOR MATERIAL

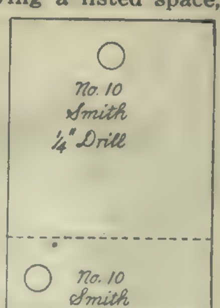


FIG. 5

FIG. 5. TOOL-CHECK TAG

small tools being kept in cabinets and large tools on shelves or on a rack in the center of the room. The tag check system is used, and a tag, Fig. 5, having a perforated stub is furnished the workman who fills it out at the window or bench. The stub is torn off by

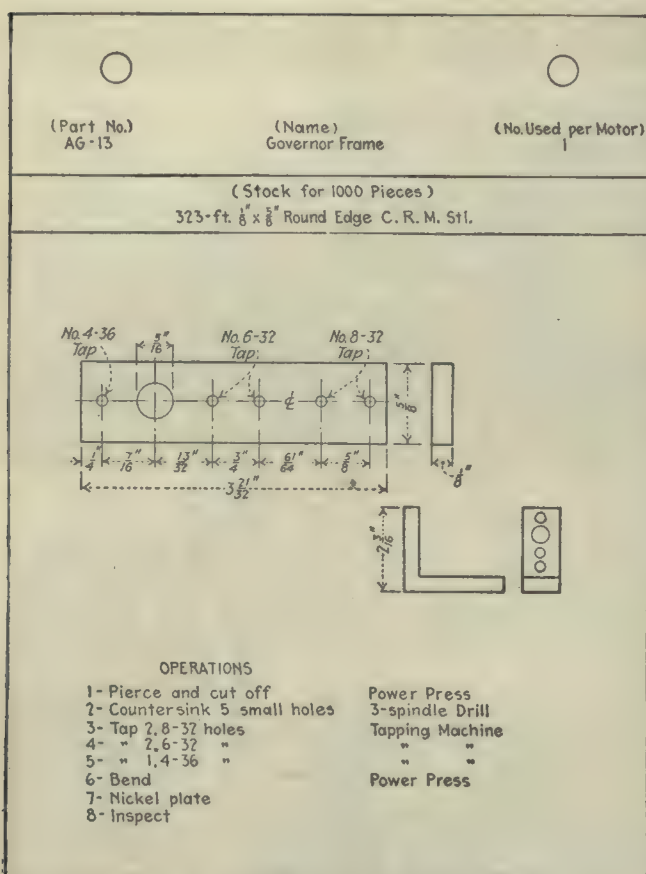


FIG. 4. SHEET FROM PARTS BOOK

the tool attendant and placed in the tool space, the large check being hung on the corresponding number on the check board. This system furnishes a cross index of all tools in use and is the most satisfactory that has come under the observation of the writer.

Storage of Finished Parts

Finished parts are stored on shelves in boxes consecutively by part numbers, the symbol and part number on the front of each box being in plain sight, and a perpetual inventory kept of each single part, sub-assembled part, or group. In some cases one part must be assembled with one or more other parts before it can be finished for stock and in this case it is listed as a sub-assembled part. Group parts are issued from finished stores as single and sub-assembled parts on an order calling for group assembly, and upon their return are stored as groups to be issued by requisition on an order for complete assembled motors; this order covers all time and material for a complete lot of motors up to shipment. Each type of motor has a letter symbol designating the general type and a letter designating parts common to one type only. In practice, on an order for AC type motors, all parts found in the A list and all parts found in the C list are requisitioned and assembled. If the order calls for AV type

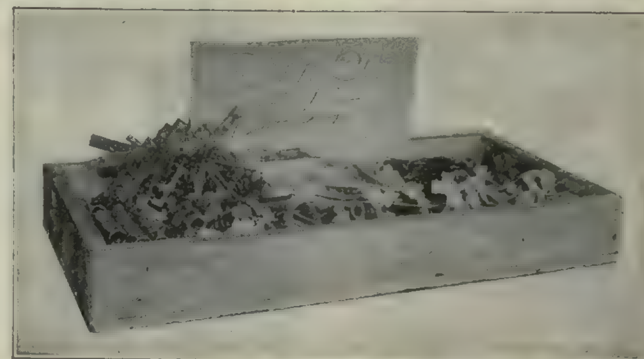


FIG. 7. TRAY OF MAGNET PARTS

motors, all parts in the A and V lists are used. The motor parts are also subdivided into groups and symbolized as G-governor, F-field, etc., each group consisting of a certain number of parts that form the unit for which they are named when assembled together. Each part thus bears two symbols and a number as well as a name; for example, AF 18 part belongs in all motors having A symbol, and in the field group.

The rough-stock room is located in the basement and is in charge of the general storekeeper. All stock is issued on requisition and a perpetual inventory kept. The card used is shown at Fig. 6 and this card is equally applicable to finished or unfinished stores.

Machines and Special Tools

The machines are all grouped together by kind and all special tools for each class of machine are stored on shelves in locked cupboards convenient to each battery of machines. All tools are stamped with symbol and part number and are arranged consecutively by number. Complete sets of small tools for each part, such as foot press, or screw-machine tools, are kept in boxes of uniform size, about 6 in. x 12 in. x 6 in., with the number stamped on the end and are arranged consecutively by number. Duplicate sets of tools are made for all troublesome operations where the quantities used are large.

Part Nos.	Lbs. Per M.	Ft. Per M.	Dimensions	Material.	Name of Part.	Max.	Min.

Ordered.		Received.					Issued.					On hand.		
Date.	Order No.	Date.	Inv. No.	Quantity	Price	Amount.	Date.	Req. No.	Quantity	Price	Amount.	Quantity	Price	Amount.

FIG. 6. STOCK REQUISITION

Transportation of work from one operation to the next is done by hand tray or truck. Shallow trays, one of which is shown in Fig. 7 containing all the parts comprising the magnet group of an AU-type motor ready for assembling of various sizes, are at hand and boxes mounted on heavy castors or wheels handle the heavy parts. Parts susceptible to damage are handled in special trucks and racks, some of which are here illustrated.

The frame of the motor to which all of the parts are assembled, after preliminary inspection for defects, is tagged with a special tag shown at Fig. 8, and placed in wooden-truck racks in lots of 60 for convenient handling. Each tag has the number of the lot marked when starting and remains with the frame until the motor is ready for shipment, when the tag is removed, checked as finished on the order sheet and filed by the motor number. One of the special trucks with a lot of motors partly assembled is shown at Fig. 9.

The assembly benches are so arranged in sections that the different operations follow each other logically, each group assembly being complete before passing to the next. Each operator is held responsible for his work and is required to initial the tag of every motor assembled by him. Each assembly operation is divided into a series of moves, a typewritten list of which is placed before each group of operators as a means of securing uniformity and eliminating lost motion so that when the rack of frames reaches the adjusting benches all parts are complete.

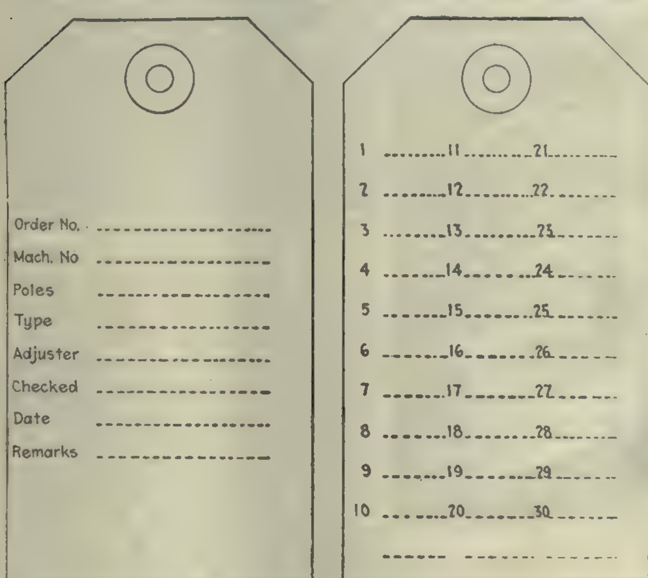


FIG. 8. MOTOR-ASSEMBLY TAG

The testing benches are so designed that operators work on both sides without confliction. The motors fit into racks which leave a clear open view of both bottom and top of motor at a height convenient to work. A voltmeter and ammeter are mounted on a stand, free to move about a pivot in the base, and may be moved by an operator on either side to obtain a full face view of the dials. Four insulated rods under the motor rack, having snaps for holding cable-terminals attached to them, are so connected that the motor may be instantly placed in series with a storage battery, voltmeter or ammeter by changing one terminal. For testing motors of 110 volts a.c. or 120 volts d.c., a series of receptacles are mounted on the edge of the bench with a double-throw switch to change from one current to the other. At the top center of each bench is mounted a board on both sides of which are adjustment and inspection instructions divided into a series of consecutively numbered moves, each of which must be performed and checked against the corresponding number on the motor tag. After the motor has been finished by the adjuster, the most important points are rechecked by the head inspector who finally initials the tag.

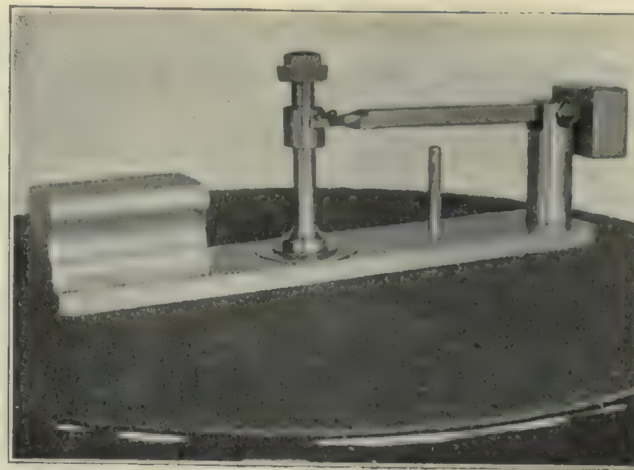
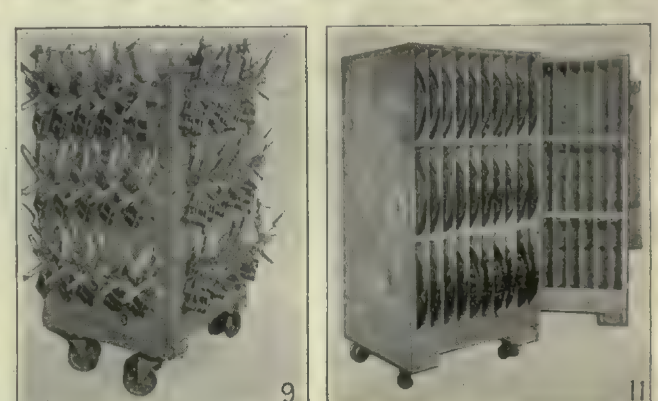


FIG. 10. SPEED INDICATOR

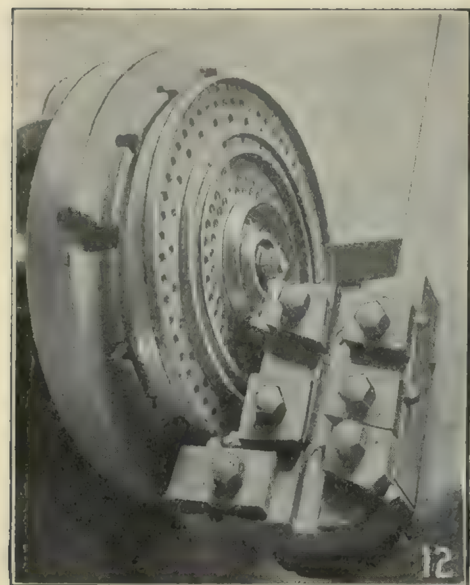
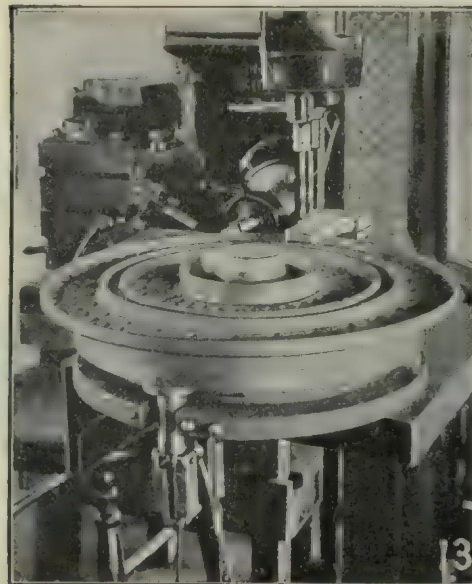
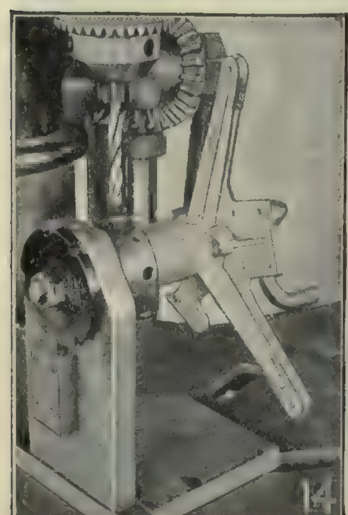
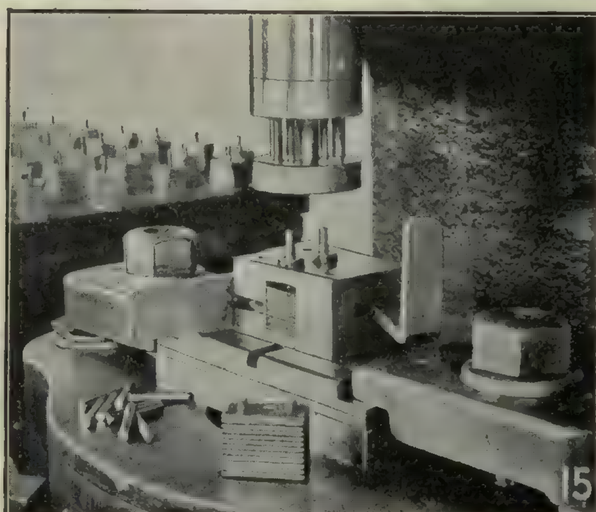
Speed regulation is checked by using the special speed indicator shown at Fig. 10. This consists of a base fitting over the turntable center nut of the phonograph; a pivoted lever at one end of which is a ring encircling the center post but not in contact with it, and at the other end, a weight. A weight for obtaining running balance and which also serves as a handle for lifting the indicator, may be seen to the left of the center post. The center post has three equally spaced lines near the top, and the lever weight is adjusted to balance the top of the ring at the center line when the motor is revolving at the desired speed.

The turntables in the rough are inspected for defects and started from the rough-stock room in the special racks shown in Fig. 11. After the center holes are drilled and reamed they are clamped on a lathe face-plate, and driven by a pin through one of the cored holes and all necessary surfaces finished in four cuts by means of the tools in the reversible multi-tool holder shown in Fig. 12.

The indexing jig shown in Fig. 13 is used in drilling 20 holes in the pole rims for locating the poles. This



FIGS. 9 AND 11. A TRUCK AND A RACK FOR PARTS
Fig. 9—Truck with partly assembled motors. Fig. 11—Rack for turntables.

FIGS. 12 TO 15. SOME OF THE TOOLS AND AN OPERATION
Fig. 12—A reversible multi-tool holder. Fig. 13—Jig for drilling pole rims. Fig. 14—An indexing jig. Fig. 15—Assembling turntable poles.

jig consists of a table having 10 hardened bushings equally spaced fitting a tapered locking pin, a foot-actuated treadle for operating the locking pin, and a two-spindle drillhead. One hand operates the indexing of the table and the other the drill spindle and a production of 50 turntables or 1000 holes per hour has been obtained with this arrangement. After the poles are assembled and all machine work finished the table is cleaned, enameled, and the felt put on.

The felt, previously cut to a specified diameter and with the center hole punched, is stretched and held in a heavy metal form, which has a depression the diameter of the finished felt and a series of phonograph needles set inside of the rim at an angle that will hold the felt in position. The turntable top is cleaned with benzine, a coat of shellac brushed on and allowed to dry just beyond the "sticky" stage, a coat of warm glue brushed over this, and the form containing the felt placed on it.

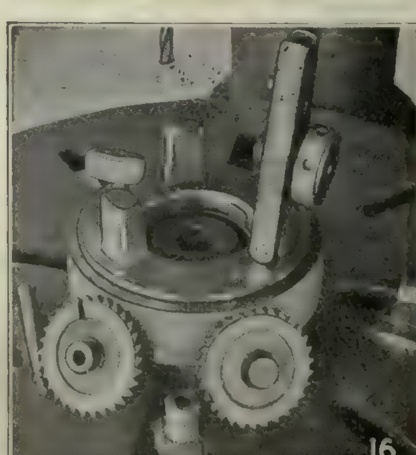
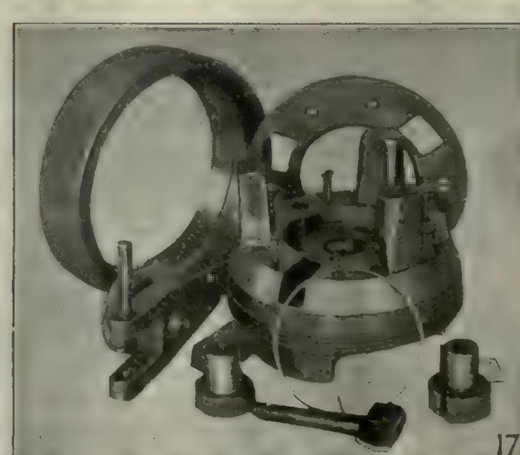
An indexing jig used in drilling screw holes in the frame is shown at Fig. 14. The frame is locked by a hand nut and can be rotated in one direction only.

The turntable poles are pierced and blanked at a rate of 3000 per hour, and assembled with pins in a foot press, as shown in Fig. 15.

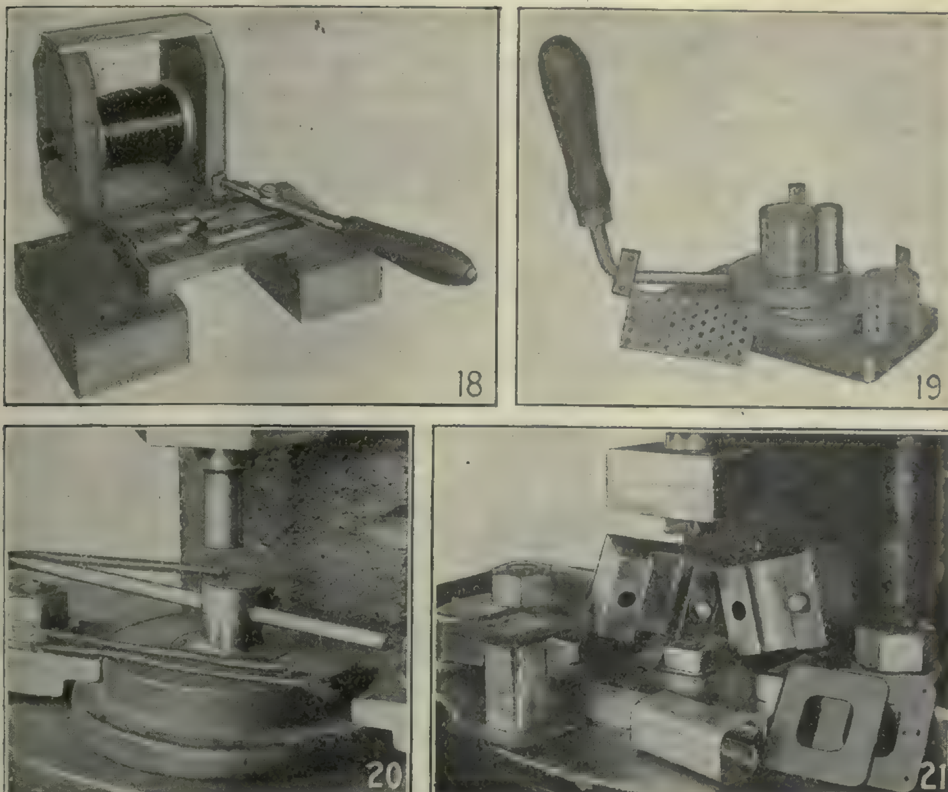
The shaft is made of drill rod and assembled with the ratchet wheel. As the teeth of the ratchet wheel are not machine-finished, and as it is necessary that the outer points of the teeth should rotate approximately true, the jig shown in Figs. 16 and 17 is used for machining the center hole. It consists of a casting having three sliding jaws, held against a tapered ring by a spring and other parts as shown. The ratchet wheel is placed in the jig and centralized by a part turn of the knurled ring; the leaf is closed and the hole drilled and reamed.

A bench tool for making wire magnet-coil connecting loops is shown at Fig. 18. The wire is fed in with one hand, cut off and bent with one movement of the hand lever and thrown out by the return movement. In Fig. 19 is shown a bench tool for roll-bending lead-condenser plates.

A number of wires are used in making the electrical connections of the motor and these have the insulation removed from a small portion for soldering. It was found that if the wire was marked or nicked with a

FIGS. 16 AND 17. A JIG FOR DRILLING AND REAMING RACHET WHEELS



FIGS. 18 TO 21. BENDING AND ASSEMBLING TOOLS
Fig. 18—Tool for bending magnet connecting loops. Fig. 19—Tool for bending condenser plates. Fig. 20—Tools for stripping insulation. Fig. 21—Tools for assembling magnet spools.

knife or sharp tool it was liable to break so a foot-press tool, Fig. 20, was made for this operation. The wire is held between two flat faces and struck just hard enough to break the insulation. The wire is slightly flattened and the insulation is easily removed by the fingers after this operation.

The magnet spools are assembled in a foot-press tool, Fig. 21. The shell, previously formed into a rectangular shape, is assembled with the core ends, inclosed in the spacing blocks and brought over the lower rolling punch. Four spring-backed pins regulate the depth of the lower flange and the press rolls and flattens both ends in one operation.

Pipe Dreams of a Tramp Machinist—The Practice of a Mystic Art

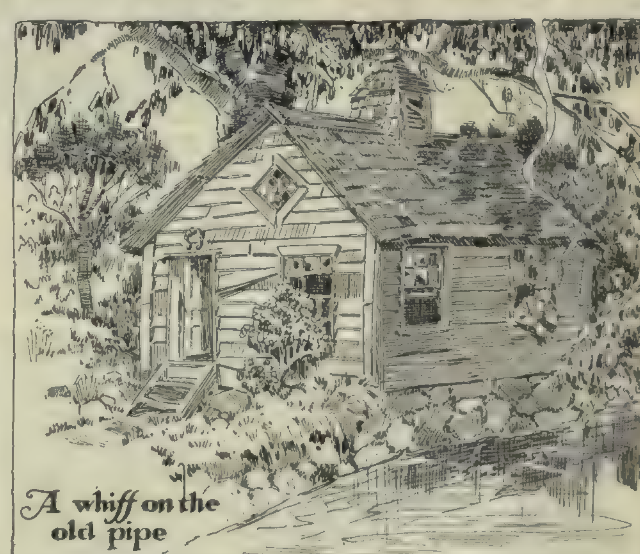
By Glenn Quharity

Under a spreading tree—not a chestnut—at the foot of the yard, with one side almost overhanging the brook, stood the little old wooden building that 30 years ago served the Brookdell Co. as a blacksmith shop; or, as we would call it in the modern language of mechanics, the heat-treating department.

There was no moving machinery in the building; the side toward the brook had two windows from which one could look out into the cool green woods or down into the equally cool, limpid water of the brook. These windows were not within range of vision from any inhabited part of the factory buildings, and therefore made an ideal spot on a hot summer morning from which to hang out and steal a few surreptitious puffs on the old pipe.

A huge stone and brick forge with a double hearth, after the manner of the old-fashioned country blacksmith shop, formed the central feature of the shop's equipment. These hearths had been, and still were, provided with bellows of wood and leather, operated by a long handle over which the "blacksmith's helper" was wont to lovingly hook his arm in the old days of strenuous toil, but at the time of which I write the regular blacksmith had passed into more or less innocuous desuetude. Each machinist forged his own tools and performed all the hardening and tempering operations required by the particular job to which he was assigned; and the wind—for the fire—was supplied through an underground conduit by a Sturtevant fan located in the machine shop. Other equipment of the shop consisted of a couple of anvils with sledges, hammers, flatters, fullers, and such, with which all blacksmiths are familiar; a foot drop for hobbing dies; and various and sundry hunks of old iron, broken pulleys, etc., not to mention numerous boxes and barrels that had once contained Heaven knows what—the 40 years' accumulation of useless oddments that will pile up in out-of-the-way corners of even the most up-to-date of factories.

Another feature of the equipment was a tub, made by sawing a barrel in half, in which cool clear spring



water was constantly running summer and winter alike, while over in the corner stood a barrel of brine that when stirred up gave off the odors of the sea—a very, very Dead Sea.

Altogether this cool, quiet spot presented an agreeable contrast to the hot and noisy machine-shop in the good old summer time and, as every machinist who has worked under these conditions is well aware, one cannot be too careful of an expensive tool during heat-

treating operations at this period of the year. The charcoal fire must be carefully built up (to avoid waste, one should light one's pipe with the same match) and allowed to simmer along with the blast almost shut off while one leans one's elbows on the window-sill and communes with nature.

When the fire has at last reached exactly the right stage—a condition sometimes hastened by the boss coming out to see how things are coming—the piece is bedded in it, the blast shut entirely off and contemplation of the scenery resumed with one ear cocked toward the door in anticipation of approaching footsteps.

All too soon—dangerously soon it sometimes seems—the piece reaches hardening temperature and is fished out of the fire with poker or tongs according to its shape, and then comes the breath-catching plunge into the water. Suppose it should crack? It usually

doesn't, and with growing confidence one sits on the edge of the tub and swashes the piece gently to and fro until it is thoroughly cold.

I will not dwell upon the tempering or "drawing" as everyone who has been there knows all about heating the "draw-plate"—not too hot or the temper could not be controlled; watching with one eye the faint dawning of the irridescent colors on the polished steel while the other eye is engrossed with the equally beautiful and changeful colors in the forest, or following the fish as they dart in and out of the shadows at the rocky bottom of the stream; and the regretful sigh with which one, realizing that there is no further possible excuse for tarrying longer among such delightful surroundings, takes his way leisurely back to the machine shop and is met by the scornful query from some jealous fellow-workman: "How many ye makin'?"

In the winter it was different. There was a large open-sided "cupalo" in the roof to carry off smoke and gas, and the company had long since discontinued the practice of reglazing the windows while the time-honored custom of throwing things through them regardless of the position of the sash was still rigidly observed.

I will skip briefly over this period: There was no heat in the building except that provided by the forge fires and the language of the men. There were sometimes orgies of tool forging on mild days which required the presence of three or four men and two very large fires, but hardening and tempering were brief operations indeed, and the luckless apprentices usually had to get the fires ready. The old blacksmith shop always floats dreamily back to my memory through a golden haze of summer sunshine, bathed in the sweet odors of luxuriously garbed nature—except when I remember the brine barrel.

On one lazy, hazy autumn afternoon yours truly was busily engaged as above described in tempering a forming cutter, when out stormed George accompanied by a burst of profanity and an 8-in. drawing die. "S'matter George?" I inquired solicitously. "Gotta shrink this dam die again," said George, "this is the 'leventh time,"—George was prone to exaggeration.

Now shrinking a ring die is performed, as not everybody knows, by heating it almost to the danger point, sticking a short piece of large-sized pipe through it and rolling the pipe back and forth on the edges of

the hardening tub. The height of the water in the tub must be carefully adjusted beforehand so that as the red-hot die hangs edgewise in the tub its periphery will be submerged to a depth of a half-inch or so, thus the ring as it is rolled about by rolling the pipe is quickly surrounded by a cold band of steel, forcing the still heated interior toward the center as it cools. It is possible in this way to close an 8-in. die as much as $\frac{1}{4}$ in. by repeated shrinkings, but the limit is usually set by the breaking of the die either in hardening or in service.

George, for reasons for which he was not wholly blameless, was shrinking this die for about the third time instead of the "'leventh." He built up a roaring fire on the hearth opposite the one I was using, bedded down the die, and almost recovered his good humor while waiting for it to heat. Trouble in the shrinking and subsequent hardening however "got his goat" again, and when he finally laid the now glass-hard ring on the corner of the hearth he was fit to eat wire nails. He raised his hands above his head and waving them about after the manner of a conjuror he said solemnly, "I hope to ——, that the —— —— —— thing *busts!*"

Simultaneously with the word "busts," there was a report like the crack of a rifle and the corner of the hearth where the ring had rested was vacant. No one saw the ring leave and no one has since seen the pieces. It was the neatest, completest, most successful piece of legerdemain I ever saw.

US

ARMY ORDNANCE NEWS

Machining Problems Solved in Gun Making—III

BY J. V. HUNTER, Western Editor *American Machinist*

The art of gun making has never required extensive machine-tool development until the last few years; consequently, machine tools adapted to all its requirements have not been made as standard lines. The lack of these has led to the design of special tools for this purpose, some of which are described in this article.

FOR slotting out the threaded sector of the breech a special swing shaping machine, Fig. 36, has been devised at the Northwestern Ordnance Co.'s plant, using a standard 16-in. Cincinnati shaping machine fitted to the heavy cast-iron bed *A* with the necessary pedestals for carrying the gun body. The toolhead of the ram was removed and fitted with a special pivoted swinging arm *A*, Fig. 37, carrying the cast-iron toolhead *B*, which is hinged on the hinge-pin hole of the breech. As thus arranged the tool will swing from the exact center of the breech block and the cut made by it will have the correct radius for clearance. In order to reach the four clearance sectors of the breech the tool *C* is revolved by a center spindle carried in the casting *B*, which is rotated by a worm-gear feed driven by the handle *D*.

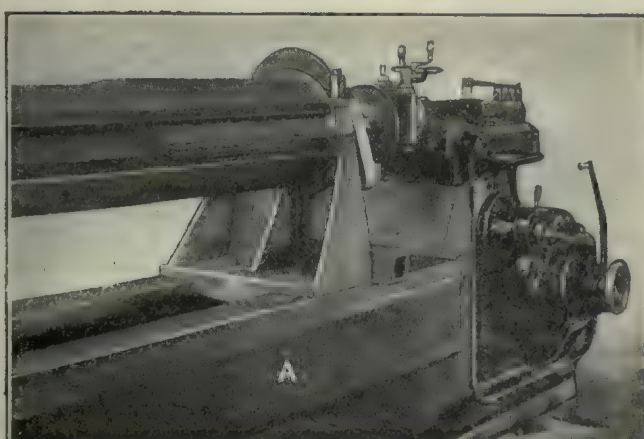


FIG. 36. SPECIAL GUN-HOLDING FIXTURE FOR SWING SHAPING MACHINE

For finishing the extractor hole the vertical slotting device *A*, Fig. 38, was purchased and fitted on the table *B* and vertical column *C* in the Gisholt shops. The base of this column is attached to the heavy cast-iron bed *D* which supports the gun body. An electric motor mounted on the device furnishes power through a chain drive to the crankshaft. All feed is by hand, the wheel *E* advancing the carriage across the table and the wheel *F* feeding the saddle.

A Dill vertical slotting machine, Fig. 39, has been fitted with a special carriage *A* and trunnion *B* for holding the gun body at the required angle during some finishing operations on the extractor hole. The trunnion moves right and left with the exact movement of the table and is controlled by chain drive from the sprocket wheel *C* mounted directly on the hand-feed shaft of the cross-movement of the table.

A method of using a planing machine for obtaining

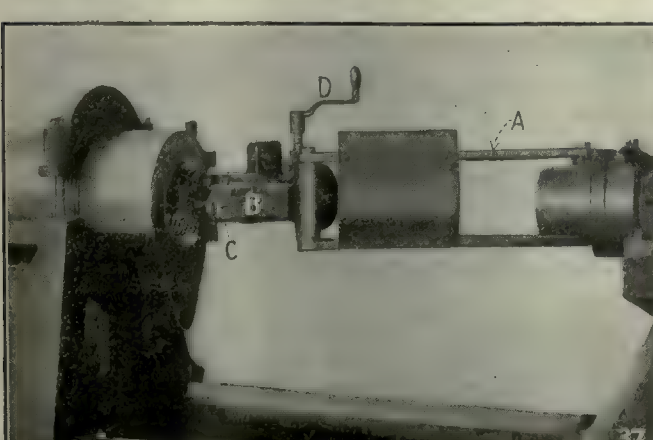


FIG. 37. TOOL AND SWING ARM FITTED ON SHAPING MACHINE

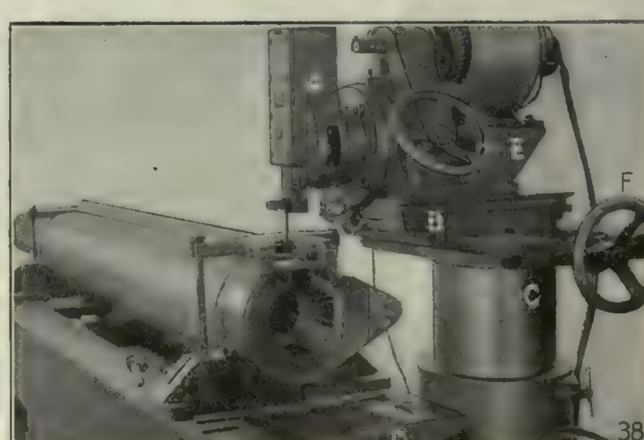


FIG. 38. SPECIAL SLOTTING MACHINE FOR FINISHING EXTRACTOR HOLE

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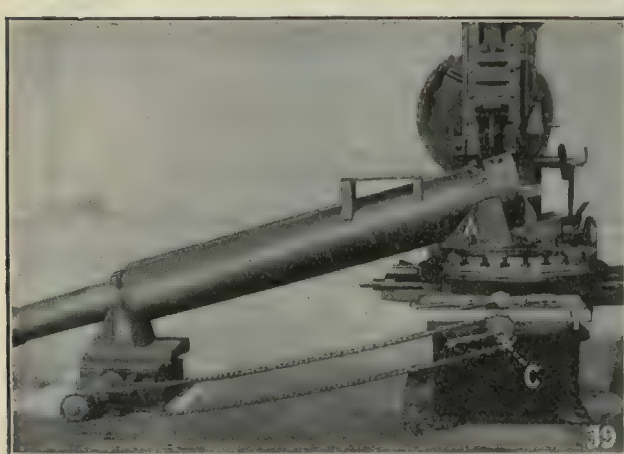


FIG. 39. INCLINED CARRIAGE FOR ANGLE WORK ON VERTICAL SLOTTING MACHINE

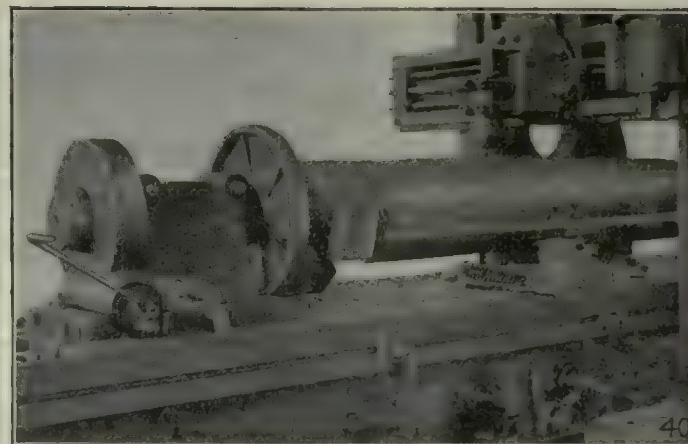


FIG. 40. ROTATING GUN TO PLANE A CYLINDRICAL CONTOUR

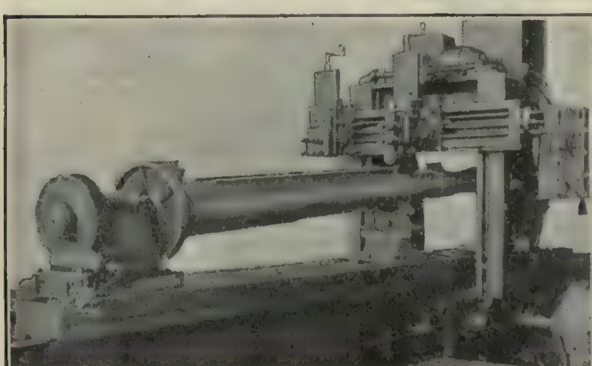


FIG. 41. PLANING A CONICAL SECTION ON LOCKING HOOP

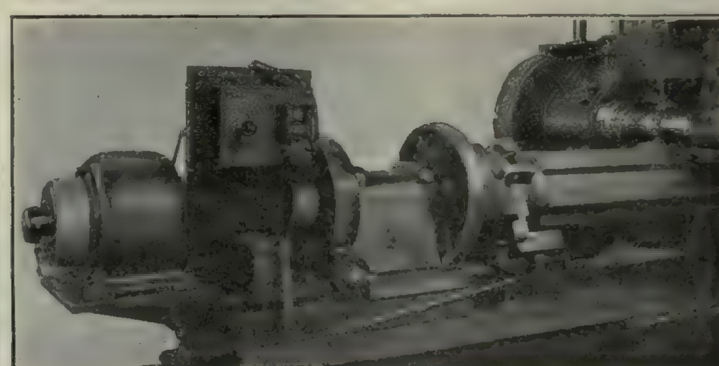


FIG. 42. MOTOR-DRIVEN INDEXING HEAD FOR MILLING OPERATION

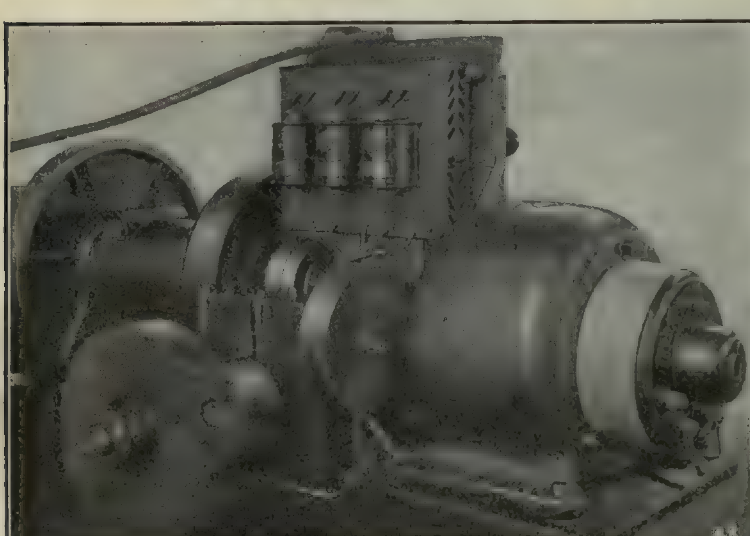
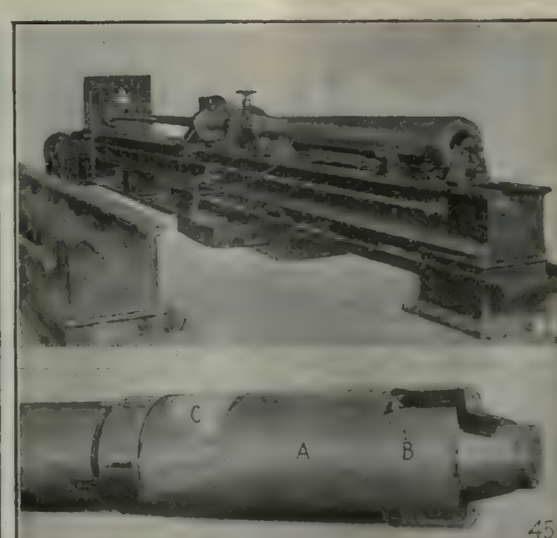


FIG. 43. GEAR-DRIVE ARRANGEMENT FROM MOTOR TO INDEXING HEAD



FIGS. 44 AND 45. RIFLING MACHINE AND RIFLING HEAD WITH GROOVE CUTTERS

a part-cylindrical contour of the gun body, Fig. 40, is accomplished by supporting one end of the gun by an indexing center and the other by a plain center. The toolhead remains stationary, and between each stroke of the table the work is given a small amount of rotary feed by the indexing center which is handled by the machinist's helper.

The same method of rotating the work is used in the formation of a conical section on the locking hoop, but it will be noticed, Fig. 41, that the gun must be inclined at an angle with reference to the horizontal bed of the planing machine.

The breech section of the body is larger than the forward end, and a space is milled around the body for relief when planing the forward section. This milling was conducted in a manner somewhat similar to the

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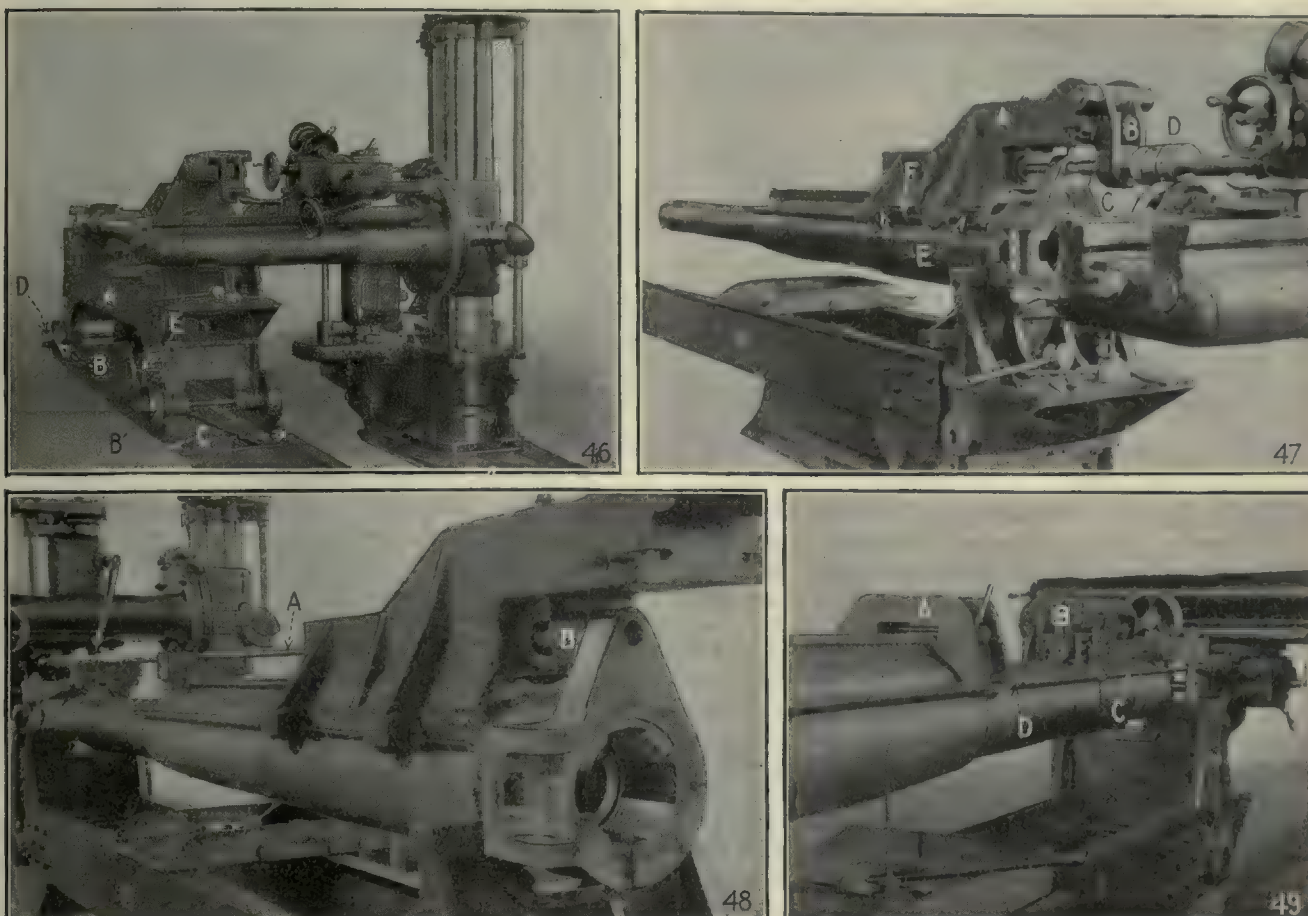

FIGS. 46 TO 49. DRILLING, BORING AND KEYWAY CUTTING
Fig. 46—Radial drilling machine with wheeled work carriage. Fig. 47—Heavy jig used for boring apron hole. Fig. 48—Keyway-cutting operation in apron hole. Fig. 49—Drilling holes in muzzle end of locking hoop

planing method just described of holding the gun between centers and rotary indexing by hand. Hand feed made this a lengthy task, so a motor-driven indexing unit was constructed, Fig. 42, which shows the work in process. The details of the motor drive are further shown in Fig. 43, which gives a general idea of the design which employs two spur-gear and two worm-gear reductions.

The Le Blond rifling machine and the rifling head, Fig. 44, are similar to the types used for this work in other parts of the country, the machine being driven by a reversing motor which is actuated by an automatic control panel *A*. The rifling head, Fig. 45, consists essentially of a heavy bronze, body shell *A*, an interior steel core which carries the three single groove-rifling cutters *B* and the necessary cone with trip movement to relieve the cutters at the end of each cutting stroke. The adjustment for setting up the cutters is available through the opening *C* in the body.

One of the interesting machine tools provided with special equipment is the Cincinnati Bickford radial drilling machine, which has a work carriage mounted on wheels, Fig. 46, so that the gun body may be passed back and forth for a variety of operations of drilling, keyseating, etc. The heavy cast-iron and structural-steel carriage *A* is mounted on the wheels *B* that run on the steel rails *C* laid parallel to the bed of the drilling machine. Since the carriage is too heavy to move easily by hand the rear axle is provided with a capstan *D*, in which the operator may insert a long bar and more readily turn over the wheels. A clamping device *E* is provided, which acts as a positive brake on one of the wheels to prevent the carriage from being moved by the thrust of the boring bars or drills.

Description of the Heavy Drilling Jig

A more detailed view of the heavy drilling jig *A*, Fig. 47, shows it mounted directly on the gun body for use in a series of the operations. It has an overhanging bolted-on arm *B* which acts as an outboard bearing for the long boring bar *C* used for boring and reaming the large hole through the breech apron. A semi-flexible coupling *D* is provided between the spindle shaft of the boring machine and the main boring bar to take care of any lack of alignment. The main body of this drilling jig is clamped by the bars *E* to the sides of the slide guides which extend lengthwise of the gun body. The flange *F* carries hardened drill bushings for small holes which pierce the slide guides.

After the apron hole is drilled and reamed a keyway is cut from the muzzle end for about half its length, and to handle this the work carriage is propelled along the track to the further side of the radial arm which has been temporarily raised for clearance, Fig. 48. The arm is then reversed and drives the keyway cutting tool through the long spindle extension shaft *A*. The out-

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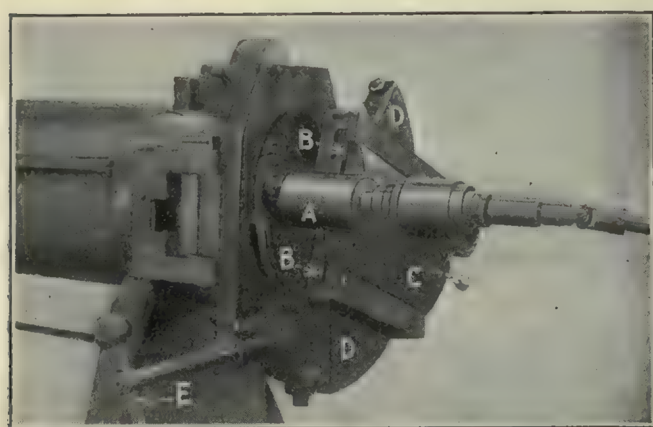


FIG. 50. ATTACHMENT FOR MILLING RECESSES IN BREECH END

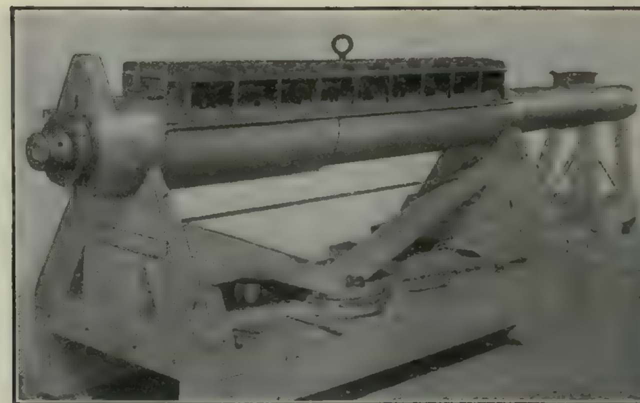


FIG. 52. SLEIGH GAGE FOR CHECKING SURFACES OF THE SLIDE GUIDES

board bearing arm previously mentioned is removed and a small fixture casting *B* is bolted under the inside of the overhanging portion of the fixture to carry and guide the small milling-cutter type of keyway-cutting tool.

After the apron hole is completed the large jig is removed and several smaller ones, Fig. 49, are placed on the muzzle end of the gun for drilling the forward end of the locking hoop and the front clip. One of these drill jigs *A* is supported and clamped to the flanges of the slide guides and the other *B* is made fast in the grooves of the front clip, thus assuring their perfect alignment. The long extension of the drill spindle shaft *C* is supported by the lower portion of the drill jig *B* and carries at its forward end the drill *D* which, guided by hardened bushings in the jig *A*, drills three holes in the front end of the locking hoop.

Milling Small Recesses

The milling of certain small recesses in the breech of the gun is done by the use of an attachment, Fig. 50, that fits on the face of the breech and carries a sliding and adjustable spindle arm, which is power-driven through a flexible shaft and several universal joints from a small motor. It will be noticed that the spindle arm *A* may be set forward and back, sliding in suitable ways *B* by the feed-screw handle *C* at its rear. This sliding arm may also be rotated through a limited angular distance, for which purposes it is supported by the segment *D*. Rotation is obtained by the hand drive through the feed-screw handle *E*.

FIG. 51. FINAL STAR-GAGING OF THE GUN BORE

Throughout all boring and rifling operations the bore of the gun must be carefully inspected and star-gaged. Inspectors handling a star gage in the bore of the gun after one of the operations are shown, Fig. 51, together with the woman clerk, who is recording their observations and thus saving the services of one man. A sleigh gage, Fig. 52, is used for the inspection and check on the scraping of the finished bearing surfaces of the slide guides.

Efficient Pattern Storage

By E. A. Dixie

In many shops little attention is given to pattern storage. It does not require much argument or intelligence to see that this is poor policy. Today, with the high cost of labor and materials, pattern costs are several hundred per cent. higher than they were ten years ago. Wooden patterns are fragile affairs at best, and the longer they are dried out in storage the more fragile they become. Each time a pattern goes to the foundry it acquires a new coating of foundry sand which is carried back on it to the storage room, and

FIG. 1. VIEW OF PATTERN STORAGE RACKS

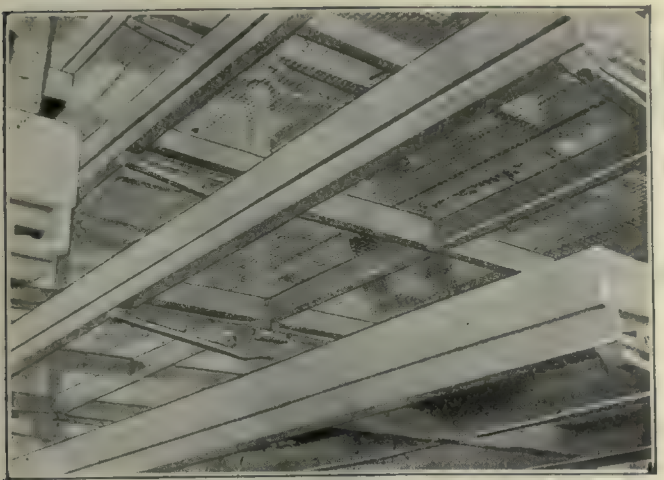


FIG. 2. LOOKING UP FROM BELOW THE RACKS

tends to make this place one of dust and discomfort for those who have to take care of the patterns.

In Fig. 1 is shown a part of the pattern storage room of the Taylor & Fenn Co., Hartford, Conn. The castings used for supporting the shelves are from the well-known patterns of the Brown & Sharpe Co., Providence, R. I., but the construction of the shelves differs materially from the B. & S. practice.

The room in which the patterns are stored is lighted from both sides by windows which reach from the ceiling to about 3 ft. from the floor, so that there is plenty of light.

The pattern racks run down one side of the room and are disposed at right angles to the center line of the room. The racks are 39 in. wide and 16 ft. long with a 30-in. alleyway in between them. At the right-hand end, considering Fig. 1, there is a 4-ft. passage between the ends of the racks and the windows.

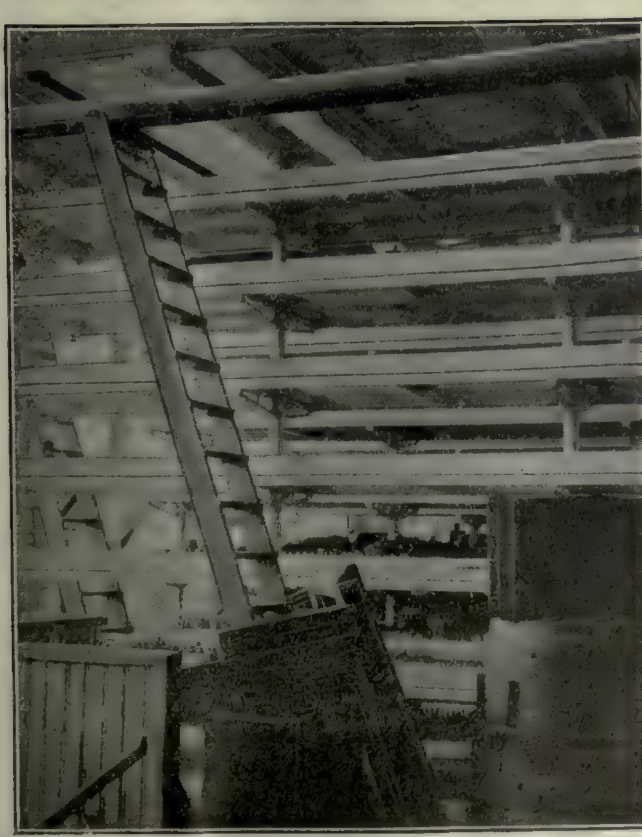


FIG. 3. THE LADDERS

The posts for the racks are made of 3-in. wrought-iron pipe, and four of them are equidistantly disposed throughout the 16-ft. length of each of the shelves. The length of the posts is about 11 ft. 6 in. and they extend from the floor to the beam overhead, to which they are connected. The distance between the bottom shelf and the one immediately over it is 23 in.; the rest of the shelves are spaced vertically about 19 in. apart.

As in the B. & S. construction, a 1½-in. angle iron (shown in Fig. 2) runs along the edge of the shelves and is secured to the cast-iron brackets. In the B. & S. construction this angle iron supports the boards which form the bottoms of the shelves. Board bottoms for pattern-storage shelves are not good as the molding sand and dust accumulate on them and they are difficult to clean. In these shelves the board bottoms are eliminated and rectangular frames of 2 x 3-in. spruce are fitted to the angle irons, and 2 x 3-in. spruce is also fitted between the posts lengthwise of the shelves. Over this framework, galvanized-iron-wire netting, ¾-in. mesh, is stretched. At the outside it is cut to overlap the 2 x 3's about 1 in. and the edge is hammered over so that there are no sharp wires to scratch the patterns. The netting is fastened to the 2 x 3's with ¾-in. staples. To cover the edges and to make a margin for the shelves, ¾ x 4-in. boards are nailed to the 2 x 3's. The disposition of the angle irons, the cross and lengthwise 2 x 3's and the wire netting are clearly shown in Fig. 2, which is a view taken at an angle looking upward under the racks. The ¾ x 4-in. boards provide a margin or edge, 2 in. high above the netting, which is quite high enough to prevent patterns from falling off the shelves.

For fire protection, sprinkler heads are disposed at intervals over the racks. In the alleyways between the racks are ladders which are hung on overhead tracks. These can be seen in all the illustrations, but the method of hanging them is shown in Fig. 3.

Every other rack is wired and a socket is provided for an electric-lamp extension which is long enough to cover that entire zone.

The other side of this pattern storage room is used for the patterns which are too large for storage on the shelves.

With this system of racks and the method of tabulating the stock of patterns, the pattern-storage man can locate any pattern almost instantly. The patterns are comparatively clean, as practically all the sand that sticks to the patterns as they come from the foundry becomes dislodged and falls through the wire netting to the floor, whence it is easily brushed away.

It is worthy of mention that the racks and walls of the room are painted with glossy white paint which does not absorb the light transmitted through the windows as dark paint is so prone to do.

Which Side Do You Stand On?

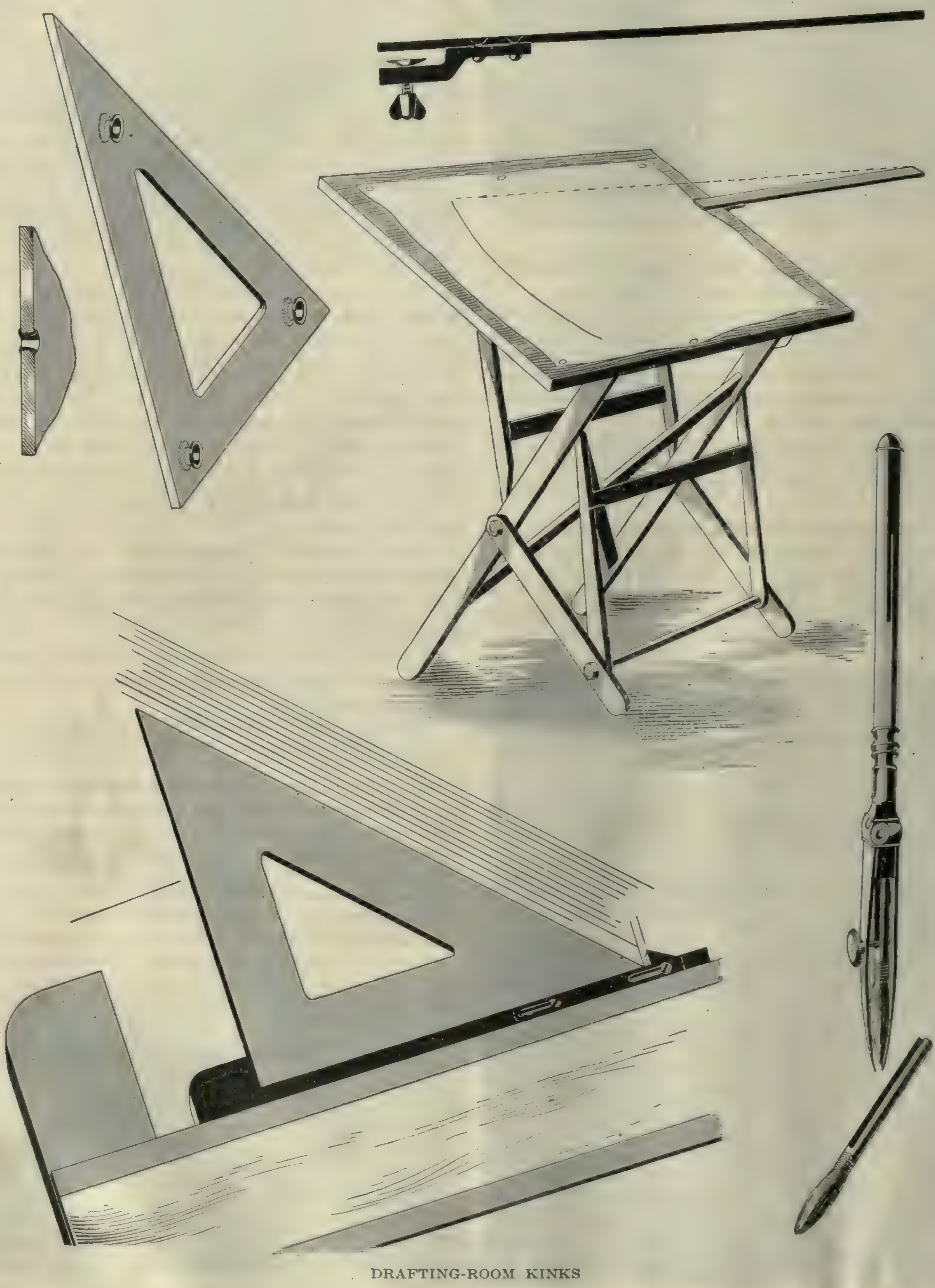
By J. A. Raught

On page 1064, Vol. 51, Sandy Copeland asks the above question.

Speaking of a planing machine, I will say most emphatically that the operator stands on the left side. Speaking of a crank shaping machine (I assume he means a shaper), the cone and feed works on most such machines are on the left side, though on some of the older types the cone is on the right side and the feed works on the left or operating side.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS

Testing Abrasive Wheels for Efficiency

BY RAYMOND FRANCIS YATES

Little has been done in the way of testing the efficiency of abrasive wheels, most users being willing to accept without question the one which turned out the most work. A device for testing the relative merits of different wheels should open a field of research with great possibilities.

THE modern artificial abrasive wheel has become an indispensable article in the industrial world, and many mechanical operations are being performed today by its use that could not be done by other methods. A quarter of a century ago the emery wheel reigned supreme, but with the advent of artificial abrasive substances such as carborundum, aloxite, crystalon and alundum the use of the emery wheel has become very limited.

The finding of the true cutting efficiency of abrasive wheels for different substances constituted a problem that has been somewhat difficult to solve. The testing of abrasive wheels in the past has been carried out by rule-of-thumb methods and no actual formula has been devised that would express the efficiency of a wheel on a given substance in cold figures. A manufacturer may find that a workman can grind 400 small castings per day with one wheel of a certain grade and grit, while 350 can be ground in a day with another wheel. As far as practice is concerned, the manufacturer is satisfied to use the wheel that produces the most work. While such testing methods may suffice for the consumer of abrasive wheels it must be confessed that it is not a scientific method and that the manufacturer of abrasive wheels should rely upon a more carefully conducted test which will show in accurate figures the efficiency of one wheel over another.

FIG. 1. ABRASIVE-WHEEL TESTING APPARATUS

Having in mind the importance of a machine which would give the various factors entering into a formula for the calculation of abrasive efficiency, the author designed and constructed the simple machine herein described. The tests with the machine were conducted in the laboratories of the American Society of Experimental Engineers and the data set forth in this article is taken from the author's laboratory notebook. The tests which were conducted were by no means exhaustive but it is hoped that they will introduce the subject to the reader and carry some hint of their importance to those who are concerned with the work.

Before entering into the subject of the abrasive testing machine and its operation, a few general facts concerning the manufacture and nature of abrasive wheels will be given to afford the uninformed reader a better understanding of the machine than he would gather otherwise.

Wheels are made in various grits, grades and bonds. By grit is meant the size of the abrasive particles that constitute the wheel. For instance, if a wheel is 30 grit it is known that the particles composing the wheel are able to pass through a screen having 30 meshes to the square inch. Thus 10 would represent a very coarse wheel, while 200 would indicate a wheel composed of very fine particles. Grade refers more or less to the nature of the abrasive substance, that is as regards its temper or hardness. The electrothermic production of the artificial abrasives of today is under such perfect control that it is possible to produce abrasive substances of varying hardness. The bond of a wheel is the substance that holds the abrasive particles together in a solid form. Different bonds are recognized as vitrified, silicate, shellac and rubber. The particles in a vitrified wheel are held together by a clay that has undergone vitrification in a vitrifying kiln. The silicate wheel is held together by silicate of soda which is merely baked to a solid form. Shellac wheels are bonded by ordinary shellac and they are, of course, used for special purposes. Like rubber wheels, their use is so limited that nothing more will be said of them in this treatment. The bonding process in the manufacture of an abrasive wheel is very carefully regulated, and a wheel can be made of practically any degree of hardness. The bond of a wheel is extremely important and is a large factor in the de-

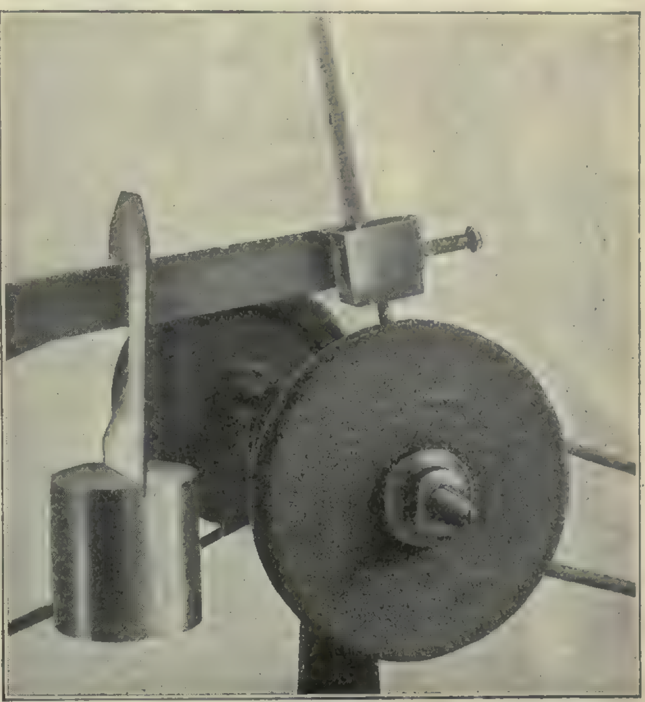


FIG. 2. THERMOMETER AND TEST PIECE IN BLOCK

termination of its efficiency when cutting certain substances. If a wheel is cutting cast iron, for instance, and its bond is not of the proper nature, the particles may

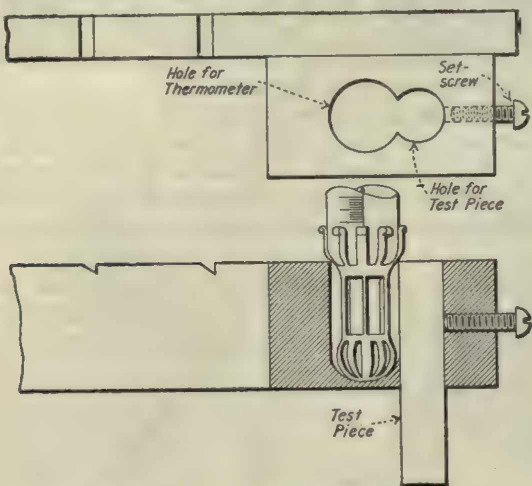


FIG. 3. DETAIL OF END BLOCK

lose their sharpness and yet remain in place, or the bond may not be able to hold until they become sufficiently dull to break away from the rest of the wheel. In the first case, very low cutting efficiency will result as the dull abrasive particles hang to the wheel and cause undue friction in rubbing over the surface of the iron. In the second case, the wheel may cut freely and quickly but it will wear down very rapidly.

The machine used by the author to conduct efficiency tests on abrasive wheels is shown in Fig. 1. It is a very simple device and it must be confessed that it was put together somewhat hurriedly. A small grinding head was used and a pulley was placed upon the free end of the spindle. This pulley was belted to a tachometer with a ratio of 1:1. The grinding head was driven by a small power motor. A lever of the third class is mounted upon a standard and the opposite end of the lever rests upon the periphery of the wheel under test. The top of the lever is provided with notches every half inch and these notches are cut to accommodate a weight so that the

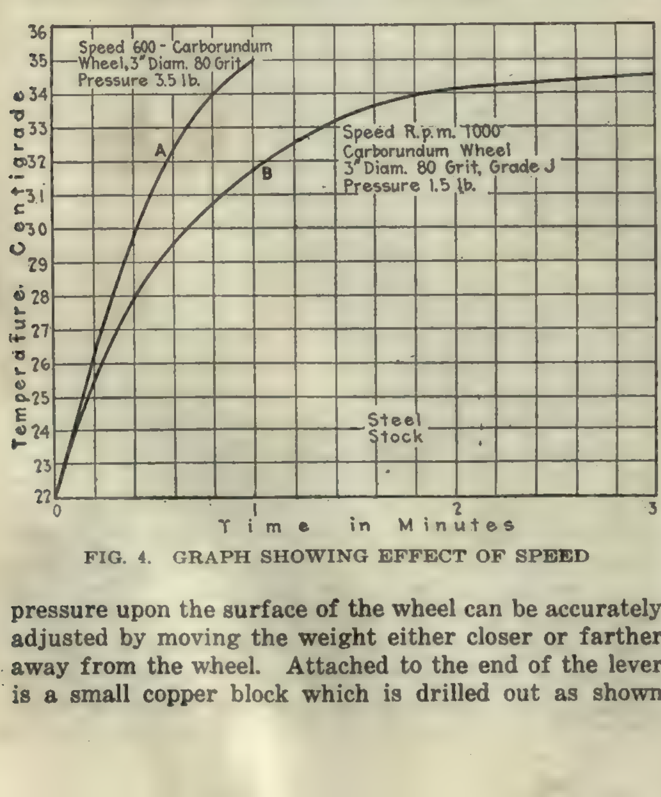


FIG. 4. GRAPH SHOWING EFFECT OF SPEED

pressure upon the surface of the wheel can be accurately adjusted by moving the weight either closer or farther away from the wheel. Attached to the end of the lever is a small copper block which is drilled out as shown in Fig. 2. First a hole 1/8 in. in diameter is drilled through the piece. Another hole is drilled into this at right angles and tapped for an 8/32 setscrew. A third hole is drilled with a No. 14 drill so that it will just break into the first hole drilled through the piece. This hole, however, does not extend through the piece, as will be noticed. The first hole accommodates the test piece of material which is 1/8 in. in diameter and 1 in. long. It should be a very close fit in the hole, and it is held in place by the setscrew. The other hole is used to accommodate the tip of the thermometer so that any heat developed in the test piece will be conducted to the thermometer. To obviate any possible loss in thermal conduction, the tip of the thermometer rests in a bath of mercury thereby connecting the test piece with the thermometer by a metallic path. In order to prevent the mercury from finding its way out the test piece must fit very closely into its hole as stated before. Fig. 3 gives an enlarged view of the block.

Some very interesting curves were plotted by the use of this machine, showing the relation between temperature and time with steel stock at given pressures on different grades of wheels. The curve *A* shown in Fig.

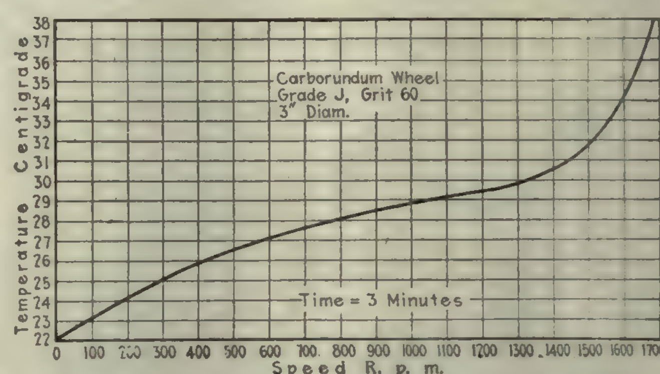


FIG. 5. GRAPH ILLUSTRATING BEST CUTTING SPEED

4 is an interesting one and it gives results that tell just how the wheel is performing. The speed was 600 r.p.m. (surface velocity 471 ft. per min.) with a carborundum wheel 3 in. in diameter, 80 grit. The test piece rested upon the wheel under a pressure of 3.5 lb. It will be seen that the temperature rise was fairly rapid until 31 deg. was reached and at that point the curve rounded out. The time element was 1 min. A surprising result was obtained with the same wheel by increasing the speed to 1000 r.p.m. and running the test for 3 min., curve *B*. The temperature rose rather abruptly until it reached 34 deg. at which point the curve flattened out. Although the temperature rose more quickly in this test than it did in the previous one, over four times as much stock was removed from the test piece of steel in 3 min. than was removed in the previous test in 1 min. The result of these two tests shows that although the temperature mounted more rapidly in the second case the cutting efficiency was also made greater by the increase in speed. It is well to mention here that the temperature is a factor that is generally controlled by the friction. If a wheel is too hard for a certain metal and the abrasive particles do not break away from their setting after becoming dull, considerable friction will be produced and the temperature will rise correspondingly. The abrasive particles will rub over the surface of the metal without cutting and of course this friction will give rise to heat and this heat can be taken as an indication of the fric-

tion produced. In the average case the temperature rise in a given time can be taken as some indication of the cutting efficiency of a wheel. The two tests previously cited are interesting to note in this respect. Although the temperature rose more abruptly when the vheel was travelling at a speed of 1000 r.p.m. it was found that the abrasive efficiency was greater than when the wheel was travelling at 600 r.p.m.

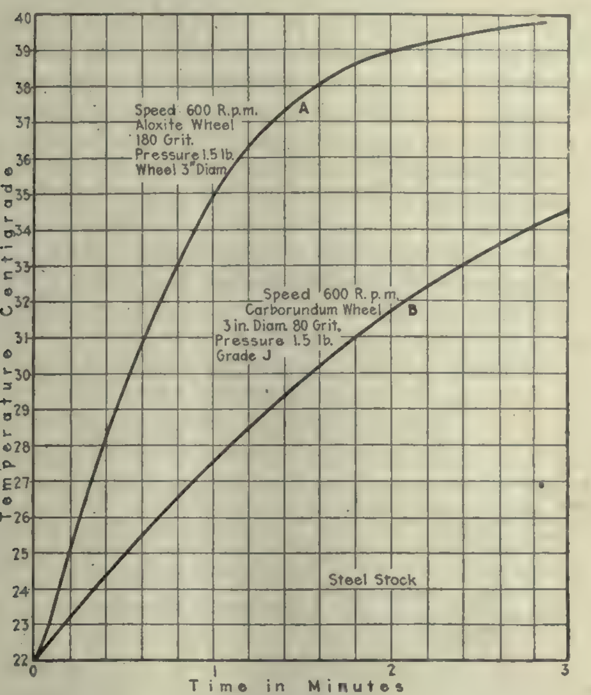


FIG. 6. GRAPH SHOWING EFFECTS OF DIFFERENT ABRASIVES

The curve shown in Fig. 5 is a notable one and it shows how excessive speed on a wheel will reduce its cutting power. The wheel used was carborundum, grade J, grit 60, 3 in. in diameter. Starting at 100 r.p.m. the speed was gradually increased to 1700. Up to 1300 r.p.m., the rise in temperature was very gradual, but beyond this speed the temperature suddenly mounted to 38 deg., showing that the most efficient cutting speed for this wheel was in the neighborhood of 1300 r.p.m. A test conducted afterward showed that this was true. During a 3-min. run more metal was removed from the test piece at 1300 r.p.m. than at 700 r.p.m. and the temperature in the first case was lower.

Curve *A*, Fig. 6, gives the results obtained by an aloxite wheel of 180 grit with a pressure of 1.5 lb. at 600 r.p.m. The temperature in this case mounted rapidly to 40 deg. and the time was 3 min. The high temperature developed in this wheel was attributed to its very fine grit.

A test with a 3-in. carborundum wheel, 80 grit, grade J, with a pressure of 1.5 lb. at 600 r.p.m. is shown in Fig. 6, curve *B*. Steel stock was used for the test piece and the temperature took a very normal rise to 35 deg. in the 3 operating minutes.

The tests conducted by the author were by no means exhaustive but with the data set forth in this article those who are interested will be able to construct a machine and conduct experiments with it. The author hopes that he has at least made clear the importance of the device and the possibility of developing it into a reliable testing machine to determine the abrasive efficiency of various wheels of various substances. One large manufacturer of abrasive wheels emphasizes the fact that the "right wheel should be used in the right place" and this little machine, if properly developed, will certainly aid in bringing this about.

Other interesting charts could be plotted showing the relationship of temperature and pressure as well as speed and temperature at given pressures, and alsc between the amount of metal removed and the rise in temperature.

Inventors' Troubles and How to Prevent Them

BY E. H. MICHAELIS
Consulting Mechanical Engineer

MY BUSINESS brings me in contact with quite a number of inventors and I have occasion to hear their tales of woe and their troubles. I will let one of my clients tell you his experiences and then I will try to show how most of these troubles can be avoided. It is impossible to do away with all of them, for such troubles as interference proceedings and infringement cases cannot be entirely eliminated.

"I am a machinist," said my client, "and had been working on my invention for more than 18 months before I was satisfied that it was worth while to spend money on having it protected by patents. I had seen lots of advertisements of different patent attorneys in magazines and Sunday papers and so I wrote to some of them to give me information as to how to apply for a patent, the cost of it, etc. In due time I received my answers. There were all kinds of booklets and leaflets stating the terms and prices of the sender. Nearly all of them were alike in stating that the patent attorney sending them had had years and years of experience in his work and could refer to thousands of satisfied clients. They all said they would examine my invention if I would send them sketches and a description or model and that they would pass on the patentability of it and send me a report for the price of five dollars. In some cases this amount was to be deducted from the fees, provided I would let them apply for my patent; in others, it was in addition to the patent fees. One of them offered to file my case if I would pay the first Government fee, the attorney's fee and price of drawings not to be paid until my patent was allowed. In case the application was rejected, I would not have to pay anything. This last offer looked too good to me, because I could not understand how anybody, even a patent attorney, could work for nothing or guarantee me a patent.

"I decided to send my model and five dollars to one of the others and in about two weeks I received a letter containing the report on the search, stating that there was nothing in the way, that they would advise me to go ahead with my application and that their fee would be 75 dollars distributed as follows: attorney, 35 dollars; one sheet of drawings, five dollars; first Government fee, 15 dollars; final Government fee, 20 dollars.

This last amount was to be payable only after my patent had been granted. If I intended to authorize them to prepare my case I should send them 25 dollars cash. This I did and by return mail I received the blank form for a patent application. On this form was printed the petition, power of attorney made out to the patent attorney, the preamble for the specification and the oath. Three spaces were marked where I was to sign the papers. Together with these papers I was to send the balance of the fee amounting to 35 dollars. I followed their instructions promptly and in a short time the acknowledgment that they had received my remittance came to hand. Then I did not hear from them for quite a while and finally I wrote, inquiring what they were doing in my case. After about a week I got a letter inclosing the filing notice of my application and a letter stating that they would keep me informed as the case progressed.

"I have not heard from them for about three months now and cannot get any satisfaction. In the meantime I have talked to a few friends about my patent and they tell me that I am protected and can sell my patent right or put my invention on the market. To do that I need a set of drawings and I am here to have you make them for me."

Invention Is Not Protected Until Patent Is Issued

The first thing I did was to call the attention of the inventor to the fact that his invention was not protected; at least not legally, because his monopoly on the right of manufacture and sale of his invention would not begin until his patent had been issued to him. He could, however, mark his article "Patent applied for" or "Patent pending" and add the serial number of his filing notice. That would scare off other manufacturers; but if one should start to make and sell the same article, he, the inventor, would not have any legal remedy. I asked him if he had a copy of the patent drawing and his application. He said that he had not seen anything beside the papers he signed. He had not seen, let alone read, the specification and claims as set forth by his attorney.

Now Rule 31 of the "Rules of Practice in the U. S. Patent Office" reads as follows: "Every application signed or sworn to in blank, or without actual inspection by the applicant of the petition and specification, and every application altered or partly filled up after being signed or sworn to, will be stricken from the files." This means that the application of my client was void at the time it was being filed.

I told him to ask his attorney to furnish him with a copy of the drawings, specification and claims. He followed my advice and after corresponding back and forth, received copies and brought them to me. Together we started to examine the application. Everything was all right until we came to the claims. There we found that the attorney had not grasped the idea or the spirit of the invention at all. The claims set forth everything but the essential part of the invention; they covered nothing but incidental parts and if the patent had been granted as applied for, it would have been absolutely worthless, because anybody could evade what was covered by those claims.

The inventor grew angry and was for taking the case out of the hands of this attorney, if it could be done. "This can be done," I told him, "by the simple act of revoking the power of attorney filed in the Patent Office. However, it is better to try another way first. Let us write to your attorney, call his attention to the things he overlooked and suggest some claims which will cover the invention thoroughly." This we did and as answer received a letter from the attorney saying that he was taking care of the case as well as anybody could do it, that there was one claim allowed and that he was ready to accept this and have the patent issued. If we had let him do this, the resulting patent would have been simply a scrap of paper limited to one narrow claim. Therefore, the inventor revoked the power of attorney given the patent attorney and turned the case over to our local patent attorney. After going over all the papers, the local attorney started the case all over again. He told the inventor that the search he would make would be an exhaustive one, that it would include all patents issued in the United States along the lines of his invention, but would not include foreign patents and patents pending in the U. S. Patent Office.

After the search was made the local attorney worked out a new application, gave the inventor a chance to examine and approve the specification and claims, and then asked him to sign the papers.

This case shows, exactly, what the source of most of the troubles is and why there are so many worthless patents which cost the patentee a lot of money and do not bring any returns.

It is a very hard proposition for most people to describe in a letter any object, especially a mechanical invention, so that somebody else will understand it thoroughly; therefore, it is to the advantage of an inventor to go to the nearest patent attorney in person. He can then talk to him face to face and the attorney can ask questions until he really understands the invention. The applicant has a chance to inspect the drawings, specification and claims of the original application and later on the amendments and arguments put in by his attorney after the Patent Office has taken action. A patent attorney who will accept the first decision of the Patent Office without trying to get all he can for his client, does not give the right service and does not do his duty.

If you are living in Iowa and your attorney is located in New York or Washington, you do not know what he is doing. His practice comes to him mostly through advertising in magazines and Sunday papers and if you are not satisfied with his services you cannot hurt him. But if you employ your local patent attorney, or one that you can reach by making short trips, you have the opportunity to talk to him personally and he has to satisfy you, because you can either help him or hurt him very much; and you can depend on it, there is no business man, be he patent attorney or shoemaker, who does not want to be helped along.

My advice to inventors, therefore, is:

1. Employ wherever possible a patent attorney who does local business only and whom you can see personally as often as necessary.

2. Where it is not possible to do this, insist on seeing and inspecting all the papers and drawings before signing your application.

3. Have your attorney forward to you all communications from the Patent Office and the answers he intends to send in before he does so.

Large Work at the Poole Engineering and Machine Co.'s Shop

By E. A. SUVERKROP

A few heavy machine tools built by some of the older engineers, while perhaps not of such pleasing design as those built in later years, have done and are continuing to do work that cannot be excelled by more modern tools. The shop in which the tools described in this article are to be found has been noted both in this country and abroad for its good work for several generations. Many years ago, before the advent of the cylindrical grinding machine, the late J. Morton Poole built such a machine for grinding calender rolls, the accuracy and finish of which were wonders of the mechanical world.

THE Poole Engineering and Machine Co., Baltimore, Md., which is one of the oldest of the American machine shops turning out really large work, was established about 60 years ago. The writer has never met Mr. Poole but has talked with a number of men who worked with him, and the general impression gathered is that he was an exceptional engineer with remarkable insight into the future and anticipation of the big things in engineering. Large work and accurate work seem to have been his hobbies. Many of the large tools used in the shops were built there, and although many of them have been superceded by more modern and efficient tools built by specialists, two notable ones still remain and are likely to remain for years to come; that is, the big measuring machine and the big pit lathe. While considering these two tools the reader must remember that they both date back nearly half a century.

The bed of the measuring machine, Fig. 1, is 22 ft. long and is a single piece. At the front a T-slot is planed in the top for the reception of the measuring heads. When preparing to measure, the head A is first set to approximate position and clamped by the knurled nut. The head BC is similar to the sliding head of a vernier caliper. The adjusting screw D is fixed in the head B and projects through the member C. Between B and C is a helical spring which forces B away from C to the limit permitted by the adjusting nut E.

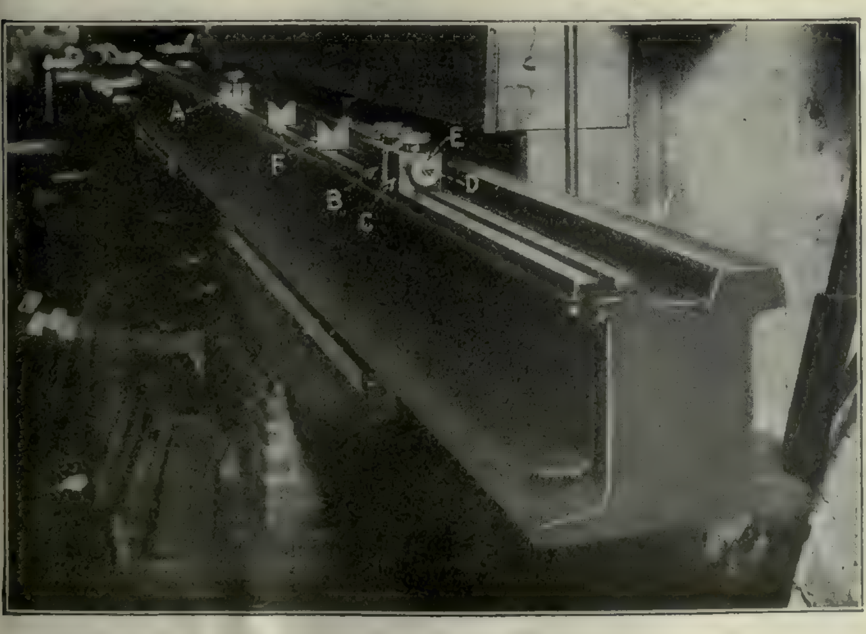


FIG. 1. 22-FT. MEASURING MACHINE

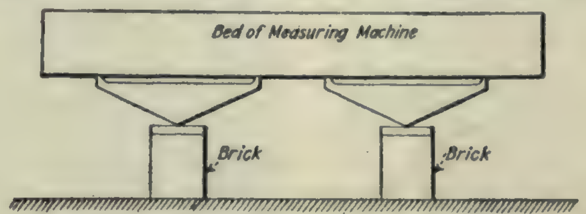


FIG. 2. METHOD OF SUPPORTING THE BED

When making long pin or bar gages they are supported on V-blocks F, of which there are a number. A set of jaws is provided for measuring snap gages for external measuring. These clamp direct to the measuring members of the heads A and B, and by their use snap gages up to nearly 22 ft. can be checked.

A 12-ft. Brown & Sharpe vernier is used for setting all sizes within its capacity. For greater lengths, two bars of known length are made up and laid end to end in the V-blocks.

The method of supporting the bed is about as near correct as it can be. There are two brick columns with metal caps. These support the two rockers which in turn support the bed at two points each. This is shown diagrammatically in Fig. 2.

The pit lathe shown in Fig. 3 was built about 40 years ago by Mr. Poole. The pit was designed to accommodate work up to 100 ft. in diameter. However, the largest job so far, was a sand wheel for the Calumet and Hecla mine which was turned out about 25 years ago. It is still in use at the mine disposing of the "tailings." The wheel is 65 ft. in diameter, provided with buckets at the rim. It is driven by a ring of spur teeth near its perimeter. The teeth were cut while the job was in the lathe, using a gear-cutting attachment and an end mill. The pitch of the teeth is approximately 5 in. One of the men who worked on the sand wheel told me that when it was tested up after completion: "The rim ran true within 0.002 inch."

Normally the pit lathe will swing 66 ft., but the head can be blocked up if necessary to swing 100 ft.

The spindle A, Fig. 3, is cast iron about 24 in. in diameter at the rear bearing and about 30 in. in diameter at the front. A belt from the countershaft drives a large seven-step cone, between which and the faceplate drive there are several reductions. There is provision for driving either through

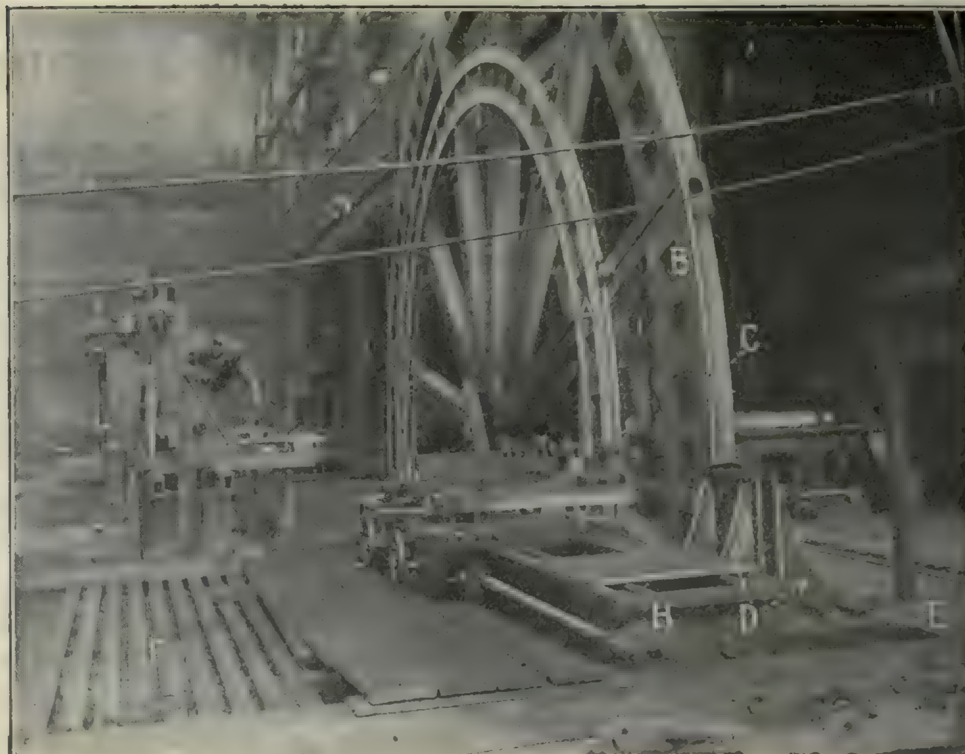


FIG. 4. THE BIG PIT LATHE

the faceplate gear or through the gear mounted direct on the spindle. In this way a wide range of speeds is obtainable, suitable for a variety of sizes and materials. In this connection it may be mentioned that at the time this lathe was designed many mortise gears were used in mill drives. The cogs of these gears were usually made of hard maple or other wood, the turning speed for which is much greater than that of metal.

The ring *A*, Fig. 4, is built up from a number of steel castings and is about 28 ft. in diameter. The large faceplate *B* is built up in sections, and at the edge has a turned flange *C* about 2 in. thick by about 3 in. wide. This flange takes a bearing between the two large angle plates *D*, at an elevation almost in line with the tool pressure on the work. Anyone who has run an old-fashioned pit lathe on work such as segments of circles will at once appreciate that this double support of the rim of the faceplate will almost entirely eliminate end movement of the spindle, faceplate and work.

There are a number of attachments for this machine. These have accumulated in the years since it was built. One is a large Gleason gear cutter used principally for mortise gears. The dividing head of the machine is stored in the pit where it could not be photographed but the ways for the shaping slide and its drive are shown in Fig. 5.

This is the same outfit that was used for milling the teeth in the big sand wheel previously referred to. In order that those who are not familiar with this work may know how it is done I refer them to Fig. 6. Here is a much smaller machine built by Gleason of Rochester, N. Y. and capable of shaping the teeth of gears up to only 10 ft. in diameter. Similiar reference letters will wherever possible be used in Figs. 5 and 6, so that there will be no chance of confusion. The slide *A* has a carriage *B* which is reciprocated by a crank *C* and connecting-rod *D*. The length of stroke can be readily adjusted. Mounted on top of the carriage *B* is a cutter head *E* which carries a rotary cutter *F* driven from the overhead drum by the belt *GG*. The reciprocating mechanism *C* is driven by the belt *HH*.

Both spur and bevel gears can be cut in this. In order to cut bevel gears the slide *A* must be capable of being adjusted to the angle of the tooth flank. As there seems to be no such provision in the old Poole attachment shown in Fig. 5 I assume that it was for spur gears only. There is also apparently no place to which the former *I*, Fig. 6, can be attached. A further reason might also be found in the fact that the teeth of the big sand wheel were cut with an end mill.

Another one of these big lathe accessories, perhaps

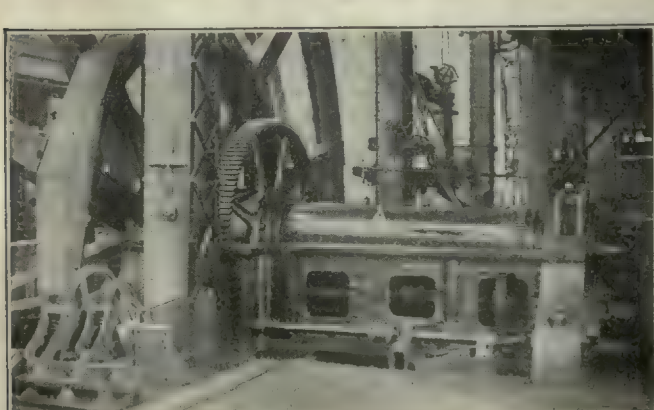


FIG. 3. THE BIG PIT LATHE HEAD

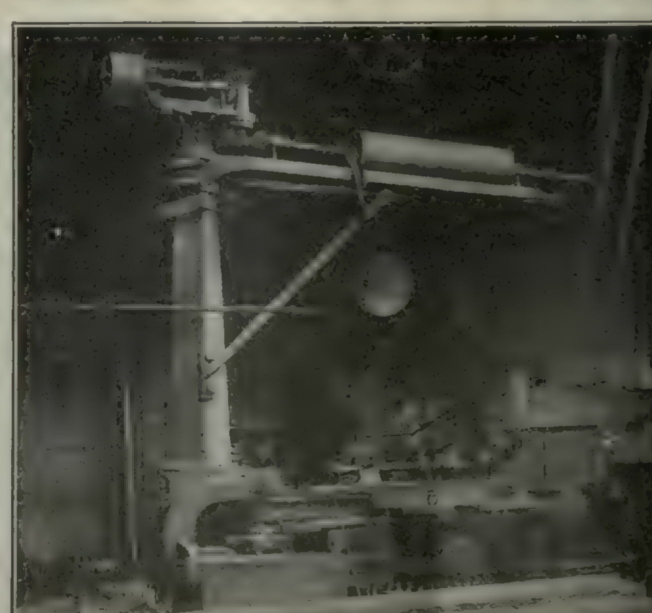


FIG. 5. POOLE MORTISE GEAR-CUTTING MACHINE

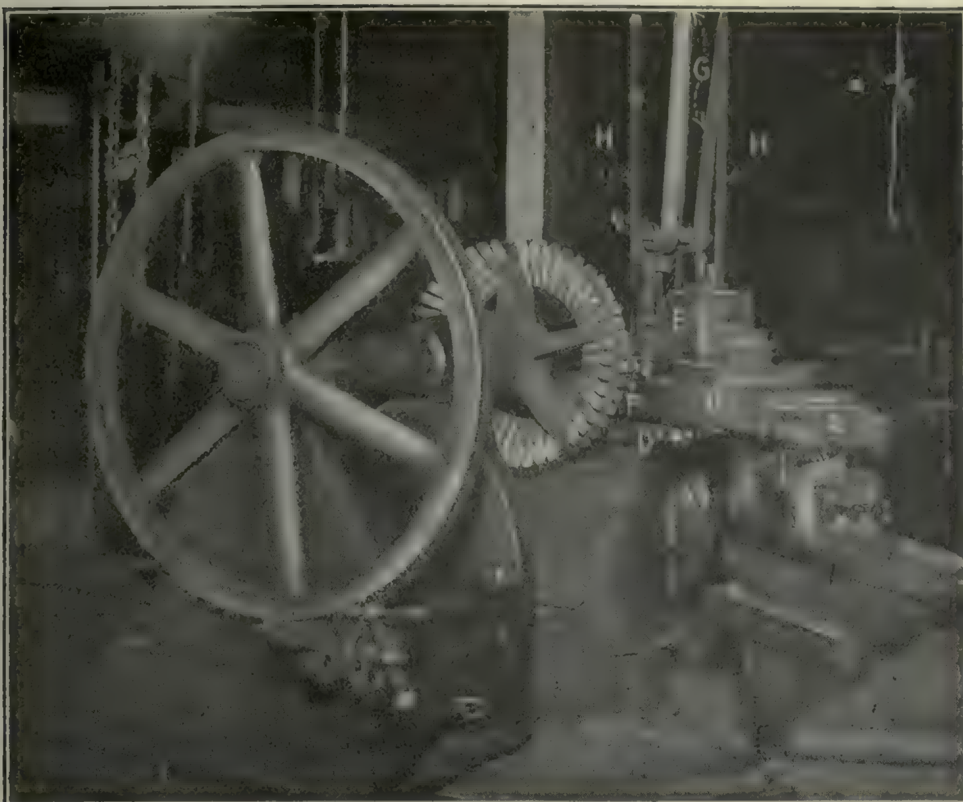


FIG. 6. CUTTING BEVEL MORTISE GEAR

it had better be called a *shop* accessory, is the portable milling machine shown in Fig. 7 where it has been used for milling the locking keyseats on the tracks for the 16-in. gun turrets for the battleship "Maryland." These tracks are 28 ft. outside diameter and each of them weighs 38 tons. They are built up from four castings which are bolted together with fitted bolts.

The first operation is to plane the bottom after which the joints are planed on a big Detrick & Harvey openside planing machine. When finished and bolted together the planed joint must not admit a 0.002-in. feeler; the planing job therefore calls for exceptionally close work. The method of obtaining such close joints is shown in Fig. 8.

The individual castings are chalked and roughly laid off. The length of the chord *C* is either taken from the blueprint or calculated and laid out roughly on the job. The faces *AA* and *BB* are also approximately laid out so that the excess metal for finishing is equal at both ends. The work is now placed in approximate position on the planing machine, with the point *F* in *AA* a certain distance from the edge of the planing-machine table. The point *D* is now located the same distance from the edge of the planing-machine table as *F*, the line *DF* being the radius of the circle of which *FF′* is a part. With the trammel set to this radius the casting is swung (about *F* as a center) till the trammel (with one point at *D*) touched both *F* and *F′*. The work is now bolted down and the joint *AA* planed, and after it is finished the work is turned around as shown at the right. The joint *BB* is set the same distance from the edge of the planing-machine table as the center punch mark *D*. The trammels are now used to test the location of the arc *F′F*, relative to the center punch mark *D*. If care be used the point *F* in *AA* can be easily brought to within say 0.005 in. of its proper position which would bring the face *BB* well within the prescribed limit of 0.002 in.

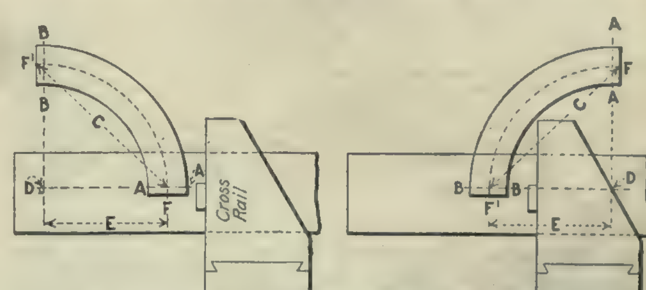


FIG. 8. HOW THE CLOSE JOINTS WERE PLANED

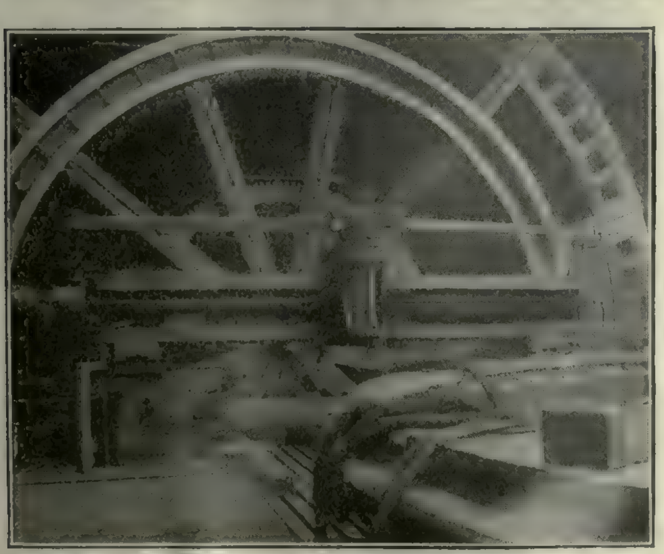


FIG. 7. LARGE PORTABLE MILLING MACHINE

Design of Steam-Hammer Swagers

By A. S. Hesse

Swages are commonly made in two types—the open, shown at *A*, and the closed, shown at *B*, Fig. 1. I consider the latter to be superior for a great deal of work. This type incloses the entire circumference of the forging and insures an accuracy of size which is not so certainly obtained with the open swage that incloses only the upper and lower thirds of the circumference.

Closed swages should have a full bearing on each side of the pass, to aid them to hold their shape when they come together. They must also be provided with relief on each side to accommodate the metal that does not draw or exude through the pass when the hammer blow is struck. Unless this relief is provided a certain

amount will spread outward at each blow of the hammer, causing the swage to pinch the forging. This effect is more pronounced on pieces that are too large for properly starting the swaging operation.

The relief generally considered good practice is one-twelfth of the circumference relieved on each half of the swage on each side of the parting line, as indicated in Fig. 2. This relief tapers away at a tangent from the circumference of the pass. At the parting the corners are rounded off in proportion to the size of the pass to prevent the corners from digging in.

Allowance should be made for the shrinkage of the forging when it cools, as shown in Fig. 3, which shows some of the essential details for a 6-in. swage.

FIG. 1

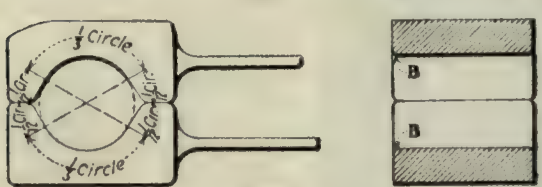


FIG. 2

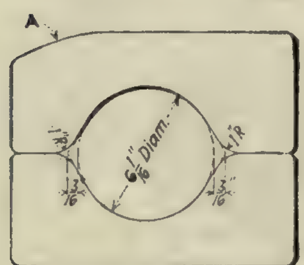


FIG. 3

FIGS. 1 TO 3. EXAMPLES OF SWAGES

Fig. 1—Swages for round stock, open and closed. Fig. 2—Showing relief at corners of swage. Fig. 3—Correct design for a 6-in. swage.

The pass must not be less than 6$\frac{1}{16}$-in. diameter for the upper and lower thirds of the two swage halves. Forged swages are made complete in the smith shop. The smith should fit this swage hot on a 6$\frac{1}{8}$-in. mandrel, or one slightly larger to allow for the double shrinkage from the making of the swage to the completion of the work in the swage.

When swages are fitted hot around a mandrel there is little need to pay much attention to the side relief, as the spreading action during fitting will afford relief. The corners must be rounded off to not less than the 1-in. radius for this size, and most of this rounding should be done before fitting to the mandrel.

It is not practical to swage stock of more than $\frac{1}{4}$ in. to $\frac{3}{8}$ in. over the size of the pass of this 6-in. swage. When forging stock that is only roughly rounded up from the square before putting it into the swage, more side clearance must be allowed to provide for the corners.

When swaging tubing, very little side clearance need be allowed, as this work must be handled differently, for the reason that part of the pass must be tapered from the largest diameter of the tubing at the start of the swaging operation to the diameter to which it is to be reduced at the finish. Into this tapered portion of the swage the tubing must be fed gradually, as the blows of the hammer reduce its size; otherwise it would be crushed and distorted. The outside-face edges on swages (see *B*, Fig. 2) must be rounded off with a medium degree of radius to prevent nicking and marking the bars.

An experienced smith when swaging will not take too big a bite and will use judgment as to the amount of stock to be left for rounding up. The more stock that has been left the shorter should be the bite which he takes as the work advances into the swage.

The upper half of the swage should be rounded on its front end *A*, so that the force of the blow will come nearer to the center of the pass. Leaving this corner straight in line with the top surface is the most common cause of swage handles breaking when too much stock is allowed for rounding up in the pass.

Another prolific cause for breakage of swages is hollow or uneven dies on the hammer.

A Triple-Purpose Rack

By I. B. Rich

The illustration shows a convenient and yet inexpensive form of storage rack, designed by J. P. Rombach, factory manager of the Glen L. Martin Co., Cleveland, Ohio. The racks themselves consist simply of the uprights *A* and the horizontal cleats *B*. Tote boxes of suitable size are held by the cleats as shown at *C*.

THREE WAYS OF USING A SIMPLE RACK

By substituting boards or platforms as at *D*, horizontal storage for short tubes or other material is easily secured. These boards are easily removable, so that boxes can be used at any time when it is found more convenient to do so.

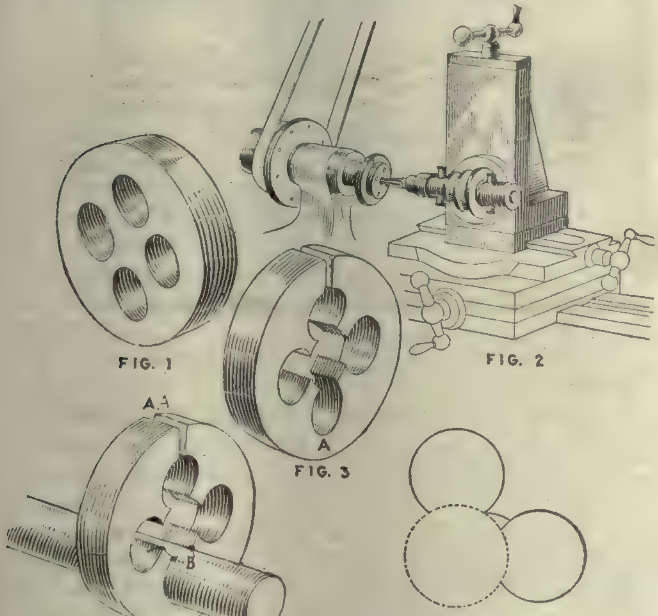
By removing the boards and leaving only the uprights and cleats, long tubing and other material can be easily stored as shown at *E*. There are doubtless many places where racks of this kind will be found extremely useful on account of the elasticity of the whole arrangement and the ease with which the storage space can be varied. It will be noted that the boards and platforms are braced by strips along the underside and also that the cross-strip in front provides a convenient handle for removing or otherwise handling them.

Small Round Threading Dies

By Atol Maker

On page 385, Vol. 51, *American Machinist*, M. H. Potter has written a short article partly describing the making of small round threading dies. A few additional comments on such dies should be of interest.

When the dies are to be made in small quantities, the following process may be followed if excellent dies are desirable: The four holes shown in Fig. 1 may be drilled and reamed in a simple jig and then plugged up with a steel similar to the steel in the die blank. The die should then be set up in a bench lathe, preferably



FIGS. 1 TO 4. EVOLUTION OF THE DIE

one equipped with a push spindle tailstock, and drilled and tapped to size. A set of four or five taps should be used, each tap removing its share of stock from the blank. The final tap should be to size, sharp, and should only remove a few thousandths of stock from the blank. After this operation, the plugs should be removed.

This method of plugging the holes to permit tapping is superior to another method often employed (tapping first, then counterboring the four holes), because in the former operation the edges are sharp and clean cut, while in the latter they are blunt and burred.

The die can be backed off while set up in the spring collet of the bench lathe, a milling attachment equipped with a tapered mill being used as shown at Fig. 2.

After being hardened and drawn in any convenient manner, the die should be dipped in a lead bath so as to draw it to a blue at point *A*, Fig. 3, which will minimize the danger of breaking at this, the weakest point.

The die may be given a fine cutting edge by grinding. This may be accomplished with the same set-up used for backing off the die. An oil stone tapered to correspond to the mill used in backing off is used for the grinding.

When the dies become dull they may be reclaimed by grinding before they are too far gone. Of course they are reground in the same manner as the first grinding, also they should be lapped as shown at Fig. 4, pressure being applied at *A*. The lap will remove metal at points *B*, thus giving a clean cutting edge to the die.

Hobbing Wormwheels on a Hand Milling Machine

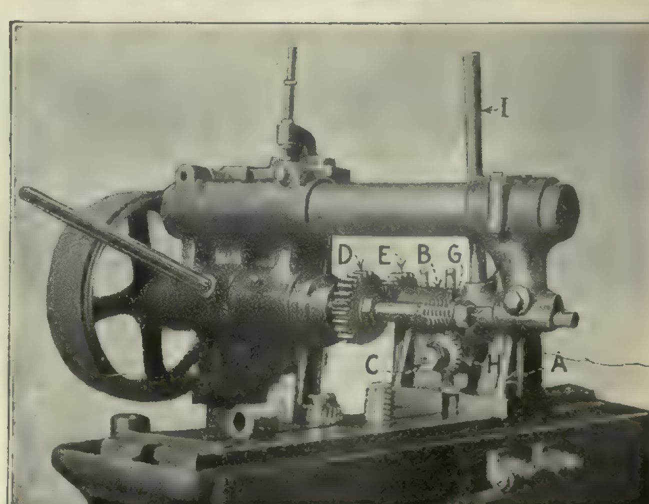
By J. B. Dunton

Where wormwheels of one kind are to be made in limited quantities, an attachment to a milling machine such as is shown in the illustration will be found very efficient.

The attachment consists of the base *A*, the swinging wormwheel housing *B*, work spindle *C*, and the gears *D* and *E*. The hob is shown at *G* and the wormwheel to be cut at *H*.

The work arbor is rotated by a worm and wormwheel, contained in the swinging housing *B*, through the gears *D* and *E*, all of which must be so proportioned as to drive the wormwheel blank in the proper ratio to the hob.

In the position shown a blank may be put on the work



HOBBING THE WORMWHEEL

spindle without interfering with the hob. When the machine has been started all that is necessary is to depress the lever *I* attached to the swinging housing. This brings the blank into cutting contact with the hob and is continued until a stop set for the proper depth of cut arrests further motion. Raising the lever *I* brings the finished wormwheel out of mesh with the hob, when it can be removed and a blank put in its place.

The arrangement as shown is used for hobbing small bronze wormwheels in the shops of the Acme Machine Tool Co., Cincinnati, Ohio.

Cost Factors on a Large Welding Job

By D. C. Cook

The Reid-Avery Co., Philadelphia, Penn., recently completed a large job of electric welding, on which careful observations were made on the electric current consumption, time and electrodes required, as well as the preparation time such as grinding and chipping

FIG. 1. A FEW OF THE WELDED SHIP ANGLES

and the activity of the welders. The job consisted of 4800 miscellaneous ship angles, of which those shown in Fig. 1 are typical.

In view of the great variety of welds involved, it was decided to base the observations on the factors of 116 representative welds, from which averages were obtained for the entire lot. On the 116 welds the current consumed was 450 kw.-hr.; the time required, 72.8 hr.; electrodes, 58 lb. The preparation time amounted

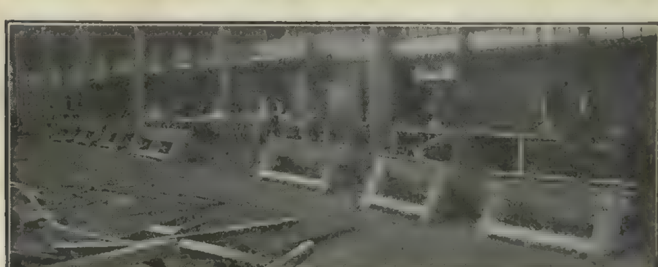


FIG. 2. WHERE THE JOB WAS DONE

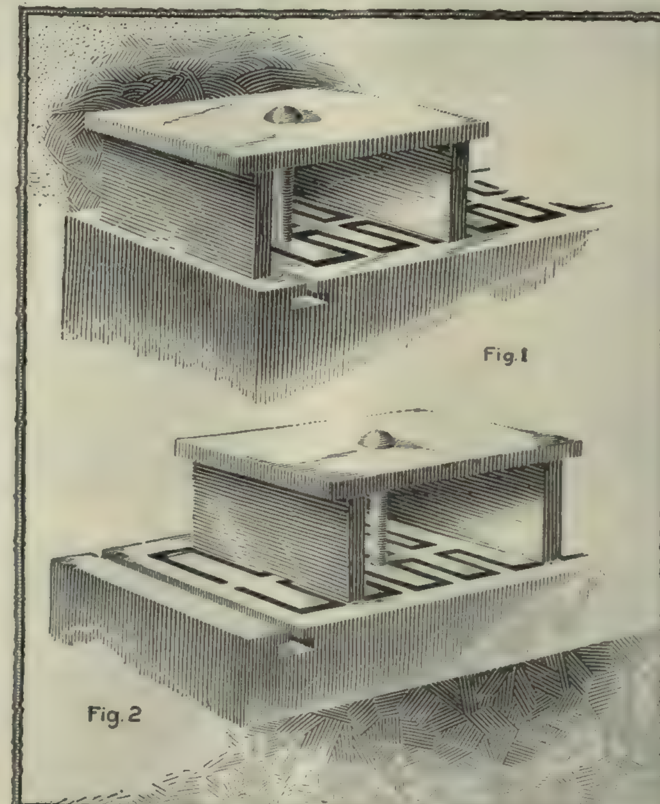
to 52 hr. The above figures are based on an actual welding activity of 33 per cent.

Fig. 2 shows the equipment used on the job, each welder being fully equipped with current regulation devices, mask and gloves for personal comfort and protection, as well as screens to protect the neighboring welders from side flashes.

Holding a Piece on Parallels on the Magnetic Chuck

By Joseph C. Fisher

When it is necessary to grind the bottom of a punch retainer or other piece, the under side of which is of such shape as to make it necessary to rest it on parallels, the magnetic chuck will not hold it unless one of the parallels is made to rest on the frame of the chuck



FIGS. 1 AND 2. RIGHT AND WRONG WAY TO HOLD A PIECE ON PARALLELS

as in Fig. 1, which provides a positive and a negative pole for the magnet. With the parallels in the position shown in Fig. 2 there will be little or no tendency to hold the piece.

I have asked several of the men in our toolroom if they could hold a piece like this on the magnetic chuck and the answer was that they could not. They evidenced considerable surprise when they discovered how easily it was done.

Figuring Diameter of Three-Surface Tangent Plug

By Wm. F. L. Dobbins.

I was greatly interested in the problems of the flush-pin gage by Cleveland C. Soper on page 1098, Vol. 50 of the *American Machinist.* While his formulas for Figs. 1 and 2 are correct, I think the following is much more simple and will be more readily understood by the majority of your readers.

In solving Fig. 2, I follow the rule that when two dividends each have divisors which are of the same ratio to their respective dividends their quotients are equal, and are also equal to the quotient of the sum of

the two dividends divided by the sum of the two divisors.

Example:

$$\frac{60}{5} = 12,\ \frac{72}{6} = 12;$$

therefore

$$\frac{60 + 72}{5 + 6} = \frac{132}{12} = 12.$$

As the tangent of an angle is the ratio of the side opposite to the side adjacent, it follows that where two adjoining angles have a side adjacent common to both, their side adjacent equals the sum of their sides opposite divided by the sum of their tangents. Therefore referring to Fig. 2 of Mr. Soper's problem, all the formula necessary is the following:

$$C = \frac{A}{\sin\theta} = D + F$$

$$R = \frac{C}{\tan\frac{\theta}{2} + \tan\frac{90^\circ - \theta}{2}}$$

For example, let A in Fig. 1 = 0.625 in.; angle θ = 30 deg.; angle $Y = \frac{\ }{2} = 15$ deg., and angle $Z = \frac{90^\circ - \theta}{2}$ = 30 deg.

Therefore:

$$G = \frac{A}{\sin 30^\circ} = \frac{0.625}{0.5} = 1.25 = D + F$$

and

$$R = \frac{D + F}{\tan 15^\circ + \tan 30^\circ} = \frac{1.25}{0.26795 + 0.57735} =$$

$$\frac{1.25}{0.8452} = 1.47876 + \text{in.}$$

Proof:

$$F = R \times \tan 15^\circ = 1.47876 \times 0.26795 = 0.39623+$$
$$D = R \times \tan 30^\circ = 1.47876 \times 0.57735 = 0.85376+$$
$$C = D + F = 0.39623 + 0.85376 = 1.24999+$$
$$= 1.25000-$$

We may take advantage of the same principle to find the side (A and B, Fig. 2) of a rectangle when the sum of A and B, and the angles Y and Z are known

Formula:

$$C = \frac{A + B}{\sin Y + \sin Z}$$
$$A = C \times \sin Y$$
$$B = C \times \sin Z$$

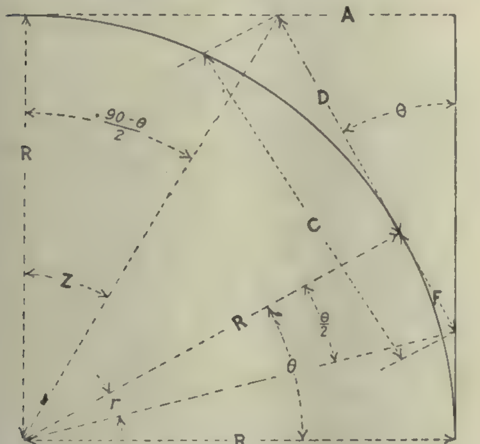


FIG. 1

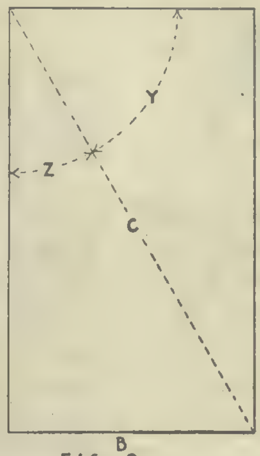


FIG. 2

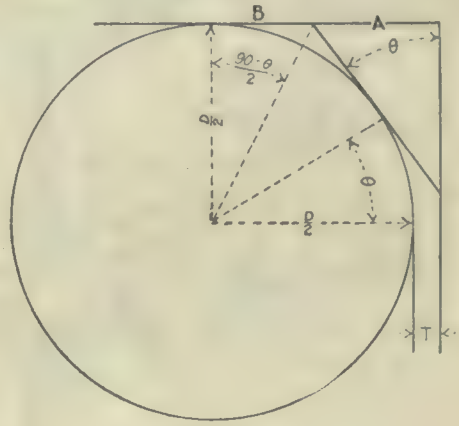


FIG. 3

FIGS. 1 TO 3. DIAGRAMS FOR FIGURING THE DIAMETER OF A THREE-SURFACE TANGENT PLUG

In Mr. Soper's solution of his diagram Fig. 4, he is correct so far as:

D = Diameter of standard plug,

$$T = A + B - \frac{D}{2};$$

$$B = \frac{D}{2}\tan\left(\frac{90^\circ - \theta}{2}\right).$$

which is all that is necessary, so why go farther?

His next equation,

$$T = A + \frac{D}{2}\left[\frac{\sin 90^\circ - \theta}{1 + \cos 90^\circ - \theta}\right]$$

is incorrect; the correct formula would be

$$T = A + \left[\frac{D}{2}\left(\frac{\sin(90^\circ - \theta)}{1 + \cos(90^\circ - \theta)}\right)\right] - \frac{D}{2}$$

For example, in Fig. 3 let us assume that angle θ is 30 deg., dimension A to be 0.4 in. and diameter of plug to be 1.4 in.

Then

$$B = \frac{1.4}{2}\tan\left(\frac{90^\circ - 30^\circ}{2}\right) = 0.7 \times \tan 30^\circ = 0.7 \times 0.57735$$
$$= 0.404145 \text{ in.}$$

$$T = A + B - \frac{D}{2} = 0.4 + 0.404145 = 0.7 = 0.104145$$

and

$$T = A + \left[\frac{D}{2}\left(\frac{\sin(90^\circ - \theta)}{1 + \cos(90^\circ - \theta)}\right)\right] - \frac{D}{2} = 0.4 +$$
$$\left[0.7\left(\frac{\sin 60^\circ}{1 + \cos 60^\circ}\right)\right] - 0.7 = 0.4 + 0.7 \times \frac{0.86603}{1.5} - 0.7 =$$
$$0.4 + 0.7 \times 0.57735 - 0.7 = 0.4 + 0.404145 - 0.7 =$$
$$0.104145.$$

Another correct formula would be

$$T = A + \left[\frac{D}{2}\tan\left(\frac{90^\circ - \theta}{2}\right)\right] - \frac{D}{2}.$$

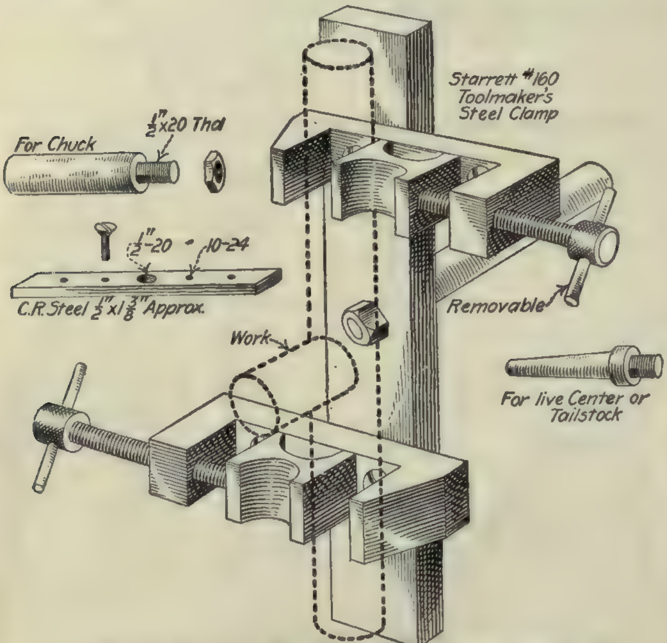
[The omission of the term $-\frac{D}{2}$ from the last two equations of Mr. Soper's article was a typographical error for which he is not responsible.—Editor]

Fixtures for Holding Work in Lathe

By H. H. Parker

The fixture shown in the illustration was originally used on a special milling attachment made for the lathe, but subsequently was found useful for special operations when held in the lathe chuck.

It consists merely of a steel plate with a cylindrical steel stub screwed to it and held by a locknut. The center line of the plate has a series of holes drilled and tapped for No. 10 machine screws, by which a pair of Starrett No. 160 toolmaker's clamps may be screwed to the plate at different distances from the center. These clamps hold the work and if they face in opposite directions, the center of the work will coincide with the lathe center.



FIXTURE FOR HOLDING WORK IN LATHE

Instead of being held in the chuck, or for holding the work in the tailstock for drilling, the stub could be tapered to fit the lathe centers.

The clamps will hold round or square work.

Broaches for a Keyed Bushing

By Frank A. Stanley

The halftones, Figs. 1 and 2, illustrate a set of broaches for finishing the interior of a bronze bushing used in the front head of the coal plugger made by the Pneumelectric Machine Co., Syracuse, New York.

The bushing is $4\frac{1}{2}$ in. long and $3\frac{7}{16}$ in. outside diameter as indicated in Fig. 3. It has two solid keys, $\frac{5}{8}$ in.

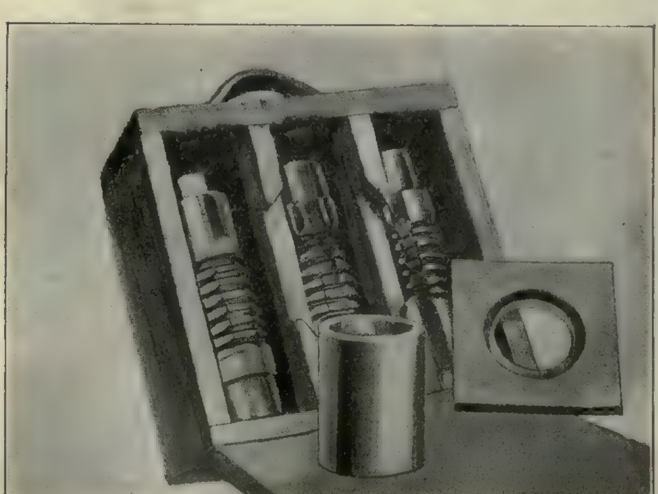


FIG. 1. THE THREE BROACHES IN THE CASE

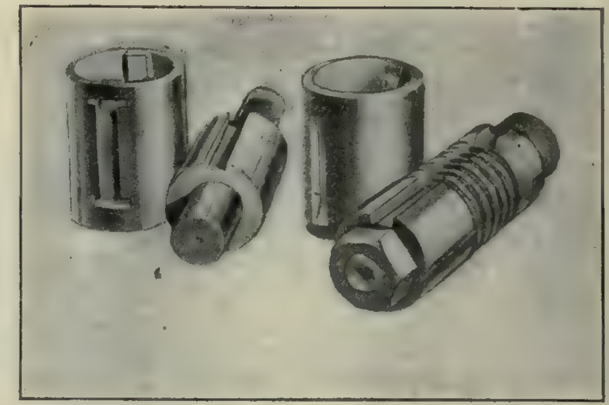
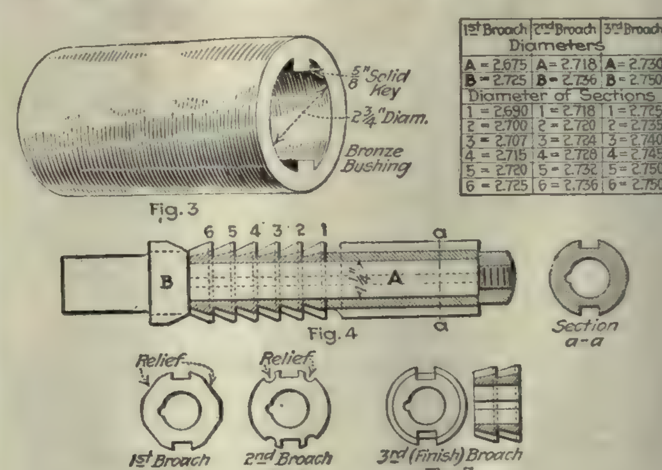


FIG. 2. THE FINISHING BROACH AND THE LATHE MANDREL

wide, formed in the bore and the only method at all practical for machining the inside is therefore by means of broaches. The set of three broaches is shown in its case in Fig. 1 with a guide plate and finished bushing in the foreground, while Fig. 2 shows the finishing broach and the lathe mandrel used in turning the exterior of the bushing concentric with the broached bore. The broaches are made up in sections as represented by the longitudinal section in Fig. 4. The broaches proper are disks made up in pairs, two cutting edges to a section, and the bores are ground out to fit snugly over the central body which is threaded at the leading end to receive a tightening nut for securing all parts in place. The faces of the broaching disks are ground square with the bore to avoid springing the central body when clamped in position.

The pilot on the first broach is small enough to enter the bushing and once in place the broach starts cutting at certain portions only of the circumference. Fig. 5 shows the relieved portions of the edge, only about one-fourth of the circumference being left for cutting on this first pass through the work.

The second broach, Fig. 6, is relieved with narrow half-round grooves on both sides of the rectangular keyway portions, but otherwise the edge is unbroken, thus covering the sections of the bore not rounded out by the first broach. The third, or finishing broach, cuts all the way around as indicated by Fig. 7. The table in the drawing shows how the work is distributed between the three broaches in the set.



1st Broach	2nd Broach	3rd Broach
Diameters		
A = 2.675	A = 2.718	A = 2.730
B = 2.725	B = 2.736	B = 2.750
Diameter of Sections		
1 = 2.690	1 = 2.718	1 = 2.725
2 = 2.700	2 = 2.720	2 = 2.735
3 = 2.707	3 = 2.724	3 = 2.740
4 = 2.715	4 = 2.728	4 = 2.745
5 = 2.720	5 = 2.732	5 = 2.750
6 = 2.725	6 = 2.736	6 = 2.750

FIGS. 3 TO 7. DETAILS OF WORK AND BROACHES

Fig. 3—The bushing. Fig. 4—Longitudinal section of one of the broaches. Fig. 5—Cross-section of first broach. Fig. 6—Cross-section of second broach. Fig. 7—Cross-section of third or finishing broach.

Contracts and Contractural Relations—

By CHESLA C. SHERLOCK

The importance of contract law cannot be overemphasized in the business and industrial world. What the law of contracts really includes can best be understood when it is remembered that fully one-half of the entire field of the law arises out of a contractual relation, either express or implied.

FROM the earliest times, particularly in the transaction of business, contract law has played an important part in the history of our development. And by no means a small portion of the litigation which business men have found themselves involved in has been due to a misunderstanding or misapplication of the rules which govern the contractual relation.

It is not possible in a limited discussion of this nature to even hint at all the phases of the contractual relation. We will therefore merely point out to business men the principal features of the relation as they apply to the usual transactions arising in every-day business affairs.

Because of the many relations out of which a contract may arise in business affairs, the subject matter has been divided and subdivided into many kinds and forms. In many instances, different rules of law are applicable to each of these kinds of contracts.

Oral and Written Contracts

In the first place, the most common division is into oral and written contracts. All business men are familiar with written contracts. They enter into them each day. They know that as a matter of evidence, defining the exact agreement at the time it was entered into, there is nothing better than a written contract.

At common law, the courts for a long time refused to enforce oral or unwritten contracts. They held, not to the theory that they were invalid, but rather refused to do anything because of the difficulty of establishing just what the contract had been. Gradually, a change in public opinion brought about a change in regard to oral contracts so that the courts had to take cognizance of them. But even then, for purposes of evidence, the courts established rules which have endured to this day respecting oral contracts. They said that oral contracts relating to certain forms of proper could not be enforced, unless something more than making the mere promise was done at the time.

Mere promises were not considered then as contracts and cannot entirely be said to amount to contracts today. It is, however, safe to say that a mere promise which is enforceable by law is a valid contract.

Then again, we find contracts divided into express and implied contracts. Just what this brief statement means is a matter which has been extremely confusing to many business men. Where debt was the matter in contention, all obligations which were actionable were regarded as contracts.

But the courts soon found that all obligations do not, in fact, arise from debt, so they could not say that they were contracts; so debt came to be superseded by assumpsit, a legal situation created to take care of those obligations which had not arisen out of a pure contractual relation.

The word "assumpsit," translated freely, means "he undertook to promise." Soon assumpsit came to be applied to purely fictitious cases where there had been no actual promise on the part of the defendant. It was then necessary to imply a legal implication of a promise in order to recover under the then existing rules of law.

This policy of implying a promise in order to fit the cause of action to the remedy has survived to this day in many varying forms. Where there has been an actual promise to pay a certain sum or do a certain thing, the contract is said to be express; but where there is no actual promise, it is said to be implied.

Where the promise can be implied from the conduct of the parties, it is said to be implied in fact, and where the promise is merely fictitious, it is said to be implied in law.

There is nothing mysterious about contracts implied in fact. Whenever the relation of the parties to an alleged contract is such that it is reasonably to be inferred that they, in fact, intended mutually to contract, we have a plain example of a contract implied in fact.

In the ordinary sense, the only difference between an express contract and a contract implied in fact is that under an express contract, the parties arrive at their promise either in writing or by words spoken orally, while in the case of a contract implied in fact, they arrive at their promise, not by actual affirmative agreement, but by the natural implication which arises from their acts and relations regarding the matter.

Cases in Point

In a California case, it was said that the only difference between an express and an implied contract was that in the express contract all the terms and conditions of the agreement were expressly set out; while in the case of an implied contract some one or more of the conditions had to be implied by law from the subsequent acts of the parties.

In a Federal case, it was said that if one party performs a service for another, with the assent or knowledge of the latter, who did not protest while the service was being performed or availed himself of it, if such service was customarily paid for, a promise to pay a reasonable value for such service is implied.

Likewise, if a manufacturer installs machinery on the promises of another, and the latter avails himself of its use and adopts it as a part of his equipment and so treats it, there is an implied contract on the part of the latter to pay the manufacturer for it.

In New Hampshire, it has been said that the service rendered must not merely have been a gratuity, and in Indiana, it is added that the person performing the service must show that the person benefited has done

something from which a promise to pay can be inferred.

In Maryland, it has been said that a contract will not be inferred where the facts are wholly inconsistent with the contract to be implied, and in California, it has been said that no contract will be implied which would be contrary to law.

It has been noted that in both express and implied contracts, as a rule, the obligation is founded upon consent. In fact, it seems to be a general conclusion on the part of everybody that contracts are founded upon consent. This is not always true, especially in the case of contracts implied in law. These contracts are technically spoken of as *quasi* contracts.

One authority has said: "They are contracts in the sense that they are remediable by the contractual remedy of assumpsit!"

These contracts arise entirely from implication of law due to the facts and circumstances surrounding the case. The law pays no attention to the intention of the parties. What they have done is the sole criterion in that direction. In an Illinois case of consensual contracts, the agreement defines the duty, while in the case of *quasi* contracts, the duty defines the contract. This is about as clear an explanation of the difference that can be given. Whenever the relation of the parties or their actions are such as to create a legal duty a contract will be implied that they intended to fulfill this duty, regardless of what their actual intention or desire might have been at the time.

It must be remembered, however, that there must be a valid consideration to the contract. The law does not imply in any case the consideration; it implies only the promise. The other elements of a valid contract, which will be discussed later, must be present in order to bind the parties to any implied contract.

Contracts Should Be Reduced to Writing

This should, of course, be a sufficient moral to those who have agreements to make to reduce them to express terms, preferably in writing. While it is doubtless the desirable thing to do, all men do not do the desirable thing at the proper time. There are probably as many implied contracts finding their way into the courts as there are express contracts, and for that reason no conscientious business man can consider himself grounded in contract law until he has mastered this phase of the subject.

Oftentimes, it is urged that contracts may be express in part and implied in part. But this is entirely absurd. In a Connecticut case, it was pointed out that it is only where parties do not agree that the law interposes and implies a promise. They cannot promise as to part and give implication to part any more than two solid bodies can occupy the same space at the same time, as another authority points out.

In a Massachusetts case, it was said that the generally recognized doctrine is that it does not follow from the fact that a contract is invalid, because the minds of the parties did not meet as to some of the essential terms thereof, either because of a mutual mistake or uncertainty therein, that a party thereto who furnishes material or renders services to the other party, relying upon the terms as he understood them, is without a remedy. The promise to pay a reasonable value for the services or the material in this case is implied.

Contracts founded upon consent, or consensual contracts as they are called at law, are divided into executed and executory contracts. In the previous distinctions which we have considered, the distinction was due to the amount of evidence necessary to prove the existence of the contract. In the case of consensual contracts, the difference between executory and executed contracts is not based upon the evidence necessary to establish it.

The United States Supreme Court has said that an executory contract is one where a person binds himself to do, or not to do a certain thing; while an executed contract is one in which the object has already been performed.

In other examples, it has been pointed out that an executory contract is one requiring affirmative action for its establishment, while an executed contract is one which has already been completed and will stand until disaffirmed.

Void and Voidable Contracts

Another common division of a certain class of contracts is void and voidable contracts. A great deal of confusion has arisen in this class of contracts because there has been a tendency, even on the part of the courts, to confuse the meaning of the two terms and an attempt to use them interchangeably.

The law, because of certain standards of public policy, has declared that contracts relating to certain subjects will be void. This means nothing less than that they are an entire nullity. They create no obligation on the part of either party. So far as the law is concerned, the parties to the contract and the subject matter thereof remain in precisely the same position they did before the void contract was entered into. It is a contract which cannot be enforced in any way at law.

In a long line of cases, the courts have said that a contract wholly void is void as to everybody whose rights would be affected by it if it were valid. In a Michigan case, it has been held that where one or two provisions of a contract are void that the parties may avoid the other provisions which are not void. This simply means that any contract which contains even a small portion of matter deemed void at law, is not only void in this offending portion, but void in its entirety.

On the other hand, a voidable contract is one wholly binding upon one party and binding upon the other until he repudiates it. It stands and binds both parties until it has been disaffirmed by the party having a legal right to avoid its terms. A good example of avoidable contract is where a business man enters into a contract with a minor. In the majority of cases, a minor's contracts are voidable; that is, he may repudiate them when he becomes of age. As to the other party, however, they are as binding and may be enforced to the same extent as an ordinary contract between persons having capacity to contract.

Another distinction which might well be observed is that in void contracts, the fatal defect is in the subject matter of the contract. It is something which the law has said could not be contracted about. While in the case of voidable contracts, the fatal defect is not in the subject matter of the contract or its purpose, but rather in the capacity of one of the parties to contract.

Contracts are often further divided into unilateral and bilateral contracts. Ordinarily, it is a theory of law that no contract can be treated as such unless there is a mutual obligation on the part of the parties. This is not altogether true else we could not enforce unilateral contracts at law. These contracts, such as options, a contract evidenced by a subscription paper, or one to enforce a reward offer, or a guaranty, are very common in the business world today.

The courts have said that if the promisor agrees to do a certain thing upon the performance of a condition he sets out, that if a promisee subsequently performs the condition, that he can enforce the promise against the promisor even though there was no mutual obligation between the parties at the time the original promise was made. There was sufficient consideration to bind the promisor to his promise, in the opinion of the courts and as soon as the condition is performed it goes back and clothes the whole transaction sufficiently as to make it enforceable by the promisee whoever he may be.

In the case of bilateral contracts, the parties have undertaken to enter into a mutual relation whereby obligations and duties are mutually entered into. Something must be done on both sides before the purpose of the contract has been accomplished. In such kinds of contracts, the courts are agreed that mutuality is an important element and that the contract cannot be enforced if there is not a mutual obligation between the parties.

Summary

We have found, then, the principal divisions of business contracts, by which we mean those commonly encountered in every-day affairs, to be:

(1) Contracts express and implied. There are two kinds of implied contracts. Those implied in fact and those implied in law.

(2) Contracts implied in law are called *quasi* contracts.

(3) Executory and executed contracts

(4) Void and voidable contracts.

(5) Unilateral and bilateral contracts.

In the next discussion, we will take up the elements of business contracts and explain their features, in the light of the leading decisions.

German Machine-Tool Competition in Holland, Belgium and France

This letter from a Rotterdam correspondent of R. S. Stokvis & Zonen, Ltd., gives a vivid picture of the post-war dumping of German machine tools. What are we going to do about it?

WE HAVE here in Holland conditions such as have never been seen in history and which very probably will never come back again. It is as if at present Germany is liquidating everything she can sell at any price if she only can import food in return. The mark has fallen down to a never-thought-of low value. Today the mark is worth less than two American cents, and all kinds of machinery are offered in mark values at a price, perhaps two to three times as many marks as before the war—but with the mark one-twelfth of its value. It looks as if the Germans have decided to quit industry because machine tools are imported into Holland in such quantities as had not been thought available in Germany. They are not imported by millions of marks, but by *milliards* of marks. Trainloads are unloaded in the open air and sold in the street like toys on Broadway. In a meadow near Utrecht are about 5,000 machine tools in the open air, uncovered, and sold to anybody who is willing to give a handful of marks for them. As machine-tool dealers, we are offered lathes, shaping, planing, and upright drilling machines in lots of 300 and 500 at a time.

A good-looking German lathe with lead screw and separate feed shaft is offered for M. 5,000, which means Fl. 250, equaling $80. A bench sensitive drilling machine complete with a kind of Jacobs' chuck (500 at a time were offered yesterday from stock) sells at M. 70, which means Fl. 3.50, or about $1.25; so the whole machine was much less than the value of a Jacobs' chuck.

A 25-in. shaping machine sold at M. 2,000, equal to Fl. 60, or $20. A toolroom grinding machine of the same size and kind as those made by the Cincinnati Milling Machine Co. and the Greenfield Machine Co. sold at M. 2,400, equal to Fl. 120, or $40.

From the above you will see how really ridiculous the prices are at which German machine tools can be bought. The quality is below the pre-war mark, but to say that they are good for nothing would be wrong. When we offer today an American machine tool in guilders, the customer does not say, "That machine would cost me Fl. 5,000," but he says, "That equals M. 100,000." As long as that business goes on here there is no question of the legitimate dealer doing any business worth mentioning. German lathes which were offered us nine months ago at Fl. 1,200, were considered cheap; but we can buy the same lathes today for Fl. 200.

Machine Tools on the Bargain Counter

This thing will pass over. It is to be considered like a heat-wave, but meantime we have to stand the heat of this queer dumping. What is worse, however, is that at present nearly every manufacturer here buys not because he has needs but because tools are so cheap that even if he does not want them, in three or four years' time, he has a bargain anyhow. And so most of the manufacturers are anticipating their needs for years to come.

It is for the writer personally, who has given so much of his life to have the high-class American machine tool introduced and used in our country, a hard thing that at present Holland is overflooded with the lower-class German tools. Though at present it looks as if Holland is making a bargain by it, we fear that it will set our industry back for years to come, because the manufac-

turers will try to use these machines and by so doing put back real modern production methods.

Though not to quite such a large extent, the same conditions exist in Belgium. Just as here, most of the regular dealers abstain from this present funny gambling, but the Belgian manufacturers and the French as well, are sending their representatives to Germany and buying what they can get at very cheap prices, because of the low rate of exchange between German currency and Belgian and French francs. This comes at a time in Belgium when industry is again in the market for machine tools, having been waiting for quite some time to see what the Belgian commission sent to America could get for their needs. As you know, the American Government put at the disposal of a Belgian commission a large number of machine tools at rather low prices and with long credits, and the Belgian manufacturers were awaiting what that commission could get for them. This is about over now so that the Belgian industrials will have to look to the regular sources of supply and we have already, by some nice orders, seen that there are going to be normal conditions again in Belgium, but this German dumping, in the case of many manufacturers, put an end to proceedings with regard to the buying of American machine tools from the regular agents. There are, of course, many Belgian and French industrials who, even if they could get it for nothing, would not think of buying German material, but a large percentage think and say: "Business is business, and I buy my stuff where I can get it cheap." Even the French Government pronounced this in a circular to industrials in France, encouraging them not to buy from America, but to go to Germany and take advantage of the low rate of exchange, promising the French industrials every facility as to viséing of the passports and the free movement in Germany of the representatives.

Commercial World Upset Over Exchange Being Out of Balance

The whole commercial world is upset at present because the exchange is out of balance all over the world. Compared with America, Belgian and French francs are very low, about half their normal value. Compared with Dutch currency, Belgian and French francs are low, and the guilder high, but if you take the high guilder compared with the franc, it is low compared with the American dollar. If you take the low franc compared with the Dutch guilder, which in its turn is low compared with the American dollar, that same franc, doubly cheap compared with Dutch and American currency, is top-high compared with the German mark and Austrian crown. And so it is no longer a question of what you are willing to buy, but the relation between the different currencies which causes the buying movements in the one or the other direction, and though a country like yours or ours may be proud about the high mark of their currency, it turns to be a nice knife which cuts one's self! The low value of the German mark is still lower than *you* consider it to be, for in Holland, to say that a mark is two American cents is not right, because the Dutch guilder, which usually is worth 40 American cents, today is only worth about 35 American cents. When the German mark and the American dollar were put next to each other in Rotterdam, before the war, the comparison was M. 4 was equal to $1; at present $1 is equal to M. 53 and that, of course, kills business with America and hurts the United States.

What we are going to give you is only a short synopsis. You will understand that because of circumstances as described above, so many conditions are arising that one could write a book about it. The whole world, and especially Dutch, Belgian and French people are discussing the reason, and one hears all kinds of surmises. The one says it is because the commercial balance of the exchange of goods is very much against Germany, and therefore because they have no gold to export the mark must go lower and lower, but seeing the enormous dumping of Germany, many say, "No, it is because the real value of the mark in Germany proper has to be discounted." But yesterday we heard another surmise.

One Bank in Holland Sells Eighty Million Marks Each Day

A business man of importance assured us that one bank alone in Holland sells every day in Holland eighty million marks, and has orders to sell them at any price, and his surmise was that Germany, having to pay the Allied Powers a hundred thousand million marks, has a big interest that that mark be very cheap. If they can reduce it so that instead of M. 4 equaling a dollar—say M. 400 equal a dollar to take an example—that would mean that in reality, instead of having to pay the Allied Powers a hundred thousand million marks, they will only have to pay them a thousand million marks; and with regard to Germany proper, it is in the interest of the German Government as well. He said, "Take a regular employee here in the office with a salary of M. 3,000 per annum, of which, on account of the present enormous debts of the German Government, he would have to pay M. 1,000 taxes. The man could not do it or would become a revolutionary, but if the man, because of the low value of the mark, gets a salary of M. 30,000 per annum he can easily pay that same M. 1,000."

You will see from the above that what happens at present in the central countries is a puzzle, no matter from which side you look at it but what we know for sure is that at present it makes a regular business in American machine tools an impossibility. Truly yours,

R. S. Stokvis & Zonen, Limited.

An Expensive Clamp

By George P. Pearce

There was a near riot in the shop the other day and this is how it happened: Tom Fellows, who is a first-class toolmaker, was drilling some holes in a jig at the sensitive drilling machine, and, finding he wanted another drill, he left the jig and his micrometer on the machine table while he went to the toolroom.

While he was away Jake, the helper, came along and wanted to drill a hole in a piece of brass plate. He started in and almost got the hole through when the drill "caught" and spun the plate around, cutting Jake's fingers.

Jake stopped the machine and, looking around for something to hold the plate, spied Tom's micrometer which looked to him to be a good tool to clamp things with, so he proceeded to clamp the brass plate good and tight so it could not slip again. He was calmly drilling once more when Tom returned and saw his micrometer acting as a clamp, whereupon Tom said things utterly unfit for publication. The foreman finally compromised the situation by requiring Tom to pay 25 per cent toward a new one as a penalty for being so careless as to leave his mikes lying around, and Jake to pay 25 per cent for monkeying with things that he had no right to. The department paid the balance.

Testing Hacksaw Blades

By HOWARD H. GEORGE
Assistant Engineer, Public Service Railway Co.

A well-known engineer once said to his staff, "Opportunities to figure out a way to save the company money are staring you in the face every day, and, if you are only wise enough to recognize and take advantage of them, you can make yourself and your department invaluable to your employer." Here is a case in point.

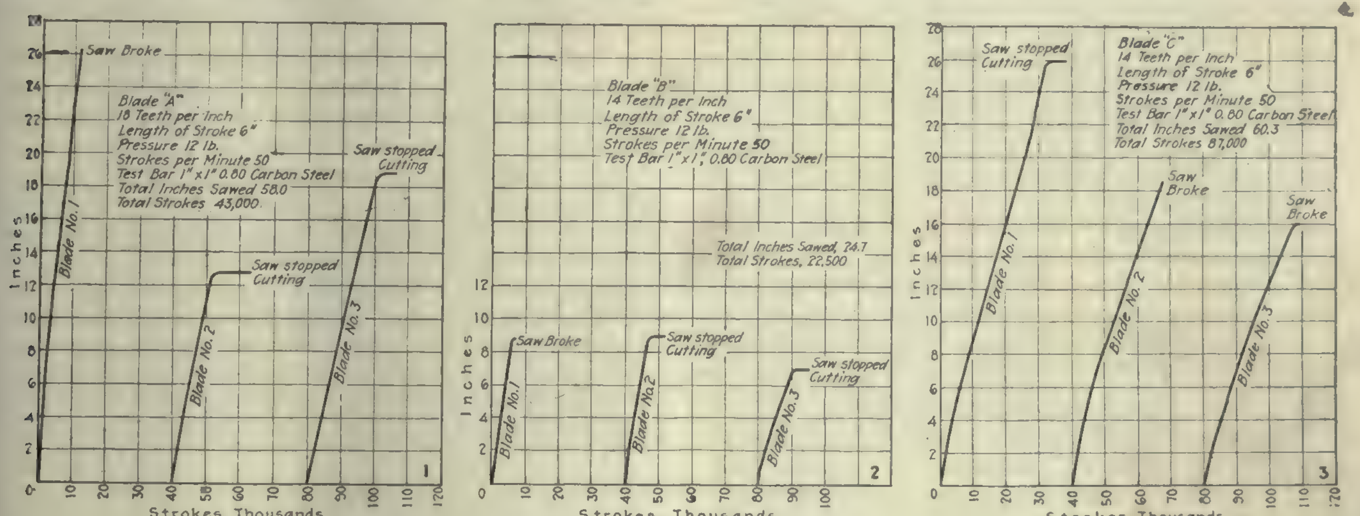
SOME electric railway companies have been inclined to regard the engineering department as a liability rather than an asset and, in a few cases, such an attitude may have been justified. This is perhaps due, to a large extent, to the fact that the principal function of the engineer is to plan and supervise the construction of work which generally involves the expenditure of considerable sums of money, and, too often, the real value of a high-grade engineer in securing a safe design and an economical expenditure of the money is overlooked. But there is another very large field in engineering which should not be overlooked when criticising the profession, in which, if he utilizes his opportunities, the engineer may be of real value to his employer.

The writer has seen and prepared specifications for many track materials but, although thousands are used every year on all railway properties of any size, he has never seen a railway company specification to cover hacksaw blades. It is true that many companies do submit samples of the blades they are using or contemplate using to so-called tests, but the latter are too often made in such a way as to have no real value whatever. As a general thing such testing was limited to a distribution of the samples among the various roadmasters to be "tried out." These men, in turn, handed them to various foremen who turned them over to a track laborer to use. "Reports" were then transmitted to the superintendent showing the "results" of the test, and it was but rarely that two reports would agree as to the merits or value of the same blades. The reason for such adversity of opinion should, of course, be obvious, as should also the worthlessness of such "tests" for comparative purposes.

A hacksaw blade, in itself, may seem like a very trivial article and not one on which very much money might be saved, but a careful analysis of its use should prove that this is not true, and that an occasional test is well worth its cost in order to insure the purchase and use of the blade which will cut the most metal in the quickest possible time. For in these days of high labor rates, this item will generally amount to more than the value of the blade itself.

Some time ago, during a visit to the factory of a manufacturer of testing machines, the writer was shown a machine for the automatic testing of files in which an autographic record of the result of the tests was obtained. The large number of hacksaws being used on the property on which he was employed had previously appealed to him and the thought occurred that such a machine could easily be adapted to the requirements of a suitable test for hacksaw blades. The proposition was put up to the firm and they agreed to equip the machine and make the tests and, the approval of the railway company's management having been obtained, they were arranged for. In view of the present publicity being given to the necessity for economy in every direction, it was thought that the results of these tests might be of sufficient value to bring them to the attention of the many users of hacksaw blades. The results obtained in this test were no different from what might be expected on any property, and it is believed that they are well worth a careful study and analysis by any extensive user of hacksaw blades.

There are many different ways in which comparable tests of hacksaw blades may be made, but it is the writer's belief that the most scientific method and the one which gives the only satisfactory and conclusive results, is one in which the blades are all of the same dimensions, have the same number of teeth per inch, or as nearly the same number as possible, and where every blade is tested to the point of destruction; that is, where the blade no longer cuts. To obtain comparable results,



FIGS. 1 TO 3. AUTOGRAPHIC TESTS OF SAWS A, B AND C

all the blades must be tested in the same machine, at the same length and rate of stroke, the same tension, the same pressure, and must cut the same cross-section of metal from the first stroke till the last. It would also seem desirable that the metal upon which the test is being carried out should approximate, as closely as possible, the characteristics of that in the rail or other steel on which the saws are to be used in actual practice. The test specimen was a steel bar 1-in. square having as nearly as practicable the same chemical analysis as our rail, the same steel being used for every blade. The cut was made lengthwise of the bar so that all saws were at all times cutting through a 1-in. section of metal. This insured that the rate of cutting at any time would be comparable in the case of every saw tested, and permitted the test of all blades to be made on the same bar.

TABLE I. COMPARATIVE ANALYSIS OF RESULTS OF TESTS OF HACKSAW BLADES

Make of Blade	Total Inches Sawed	Total Number of 6-in. Strokes	Average Cut per Stroke in Inches	Total Cost of Blades	Cost of Blades per Inch Cut	Total Time Consumed in Minutes	Time in Minutes per Inch Cut	Total Labor Cost at 18½c. per Hour (Rate Assumed)	Labor Cost per Inch Cut	Total Cost per Inch Cut	Relative Cost per Inch Cut (Cheapest = 100%)	Relative Amounts Cut by 3 Saws (Max. Cut = 100%)
"A"	58.0	43,000	0.001349	$0.11979	$0.00207	860	14.83	$2.6511	$0.04571	$0.04778	109.31%	92.95%
"B"	24.7	22,500	0.001098	0.11811	0.00478	450	18.22	1.3875	0.05617	0.06095	139.44	39.58
"C"	60.3	87,000	0.000693	0.11250	0.00187	1740	28.85	5.3650	0.08899	0.09086	207.87	96.63
"D"	53.1	66,500	0.000798	0.13188	0.00248	1310	24.67	4.0386	0.07606	0.07854	179.68	85.09
"E"	62.4	42,300	0.001475	0.11901	0.00191	846	13.56	2.6085	0.04180	0.04371	100.00	100.00
"F"*	45.9	81,800	0.000561	0.11500	0.00251	1636	35.64	5.0450	0.10991	0.11242	257.19	73.56

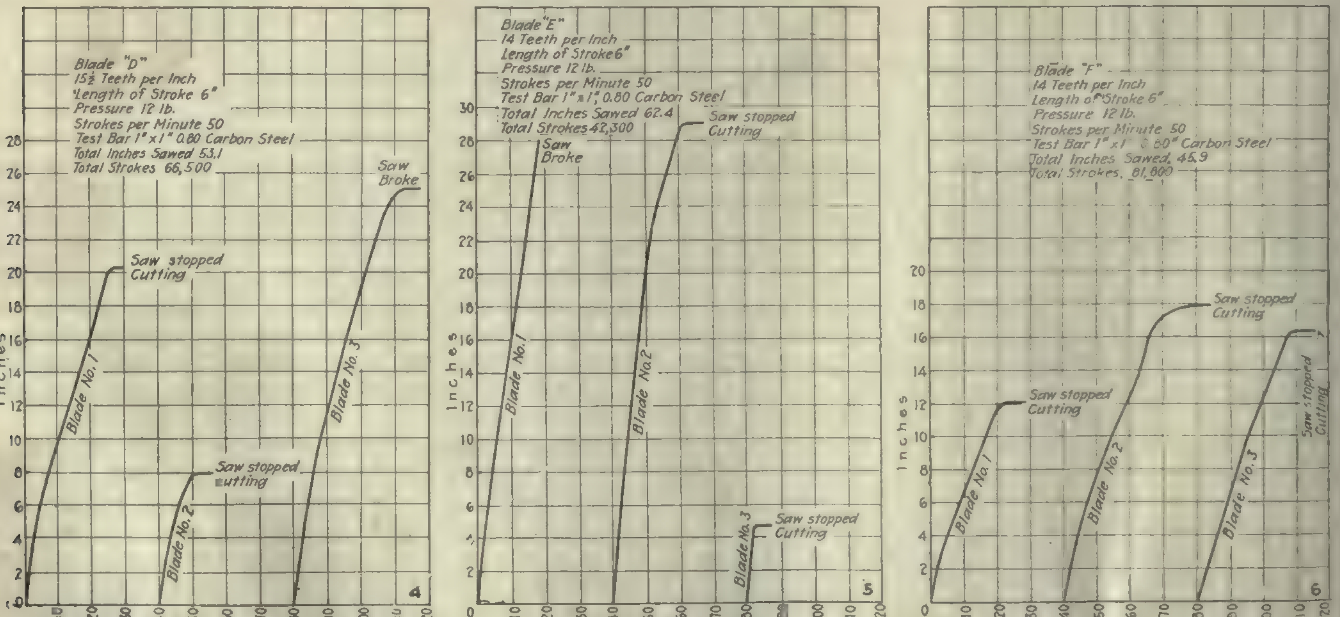
* Special Tungsten Alloy Steel.

A saw that would give entirely satisfactory results on an ordinary rail might fail miserably on some tool steels.

In the actual tests referred to, every effort was made to eliminate the personal element and the greatest care was taken to insure uniform conditions throughout, so that any part of any test could be duplicated at any time. Manufacturer's samples, with but one exception, were not used but the blades tested were either taken from our own stock or were purchased from jobbers' stocks. In the exception referred to, the test of these blades showed them to be the least efficient of all, so there could be no claim made that the blades developing the highest efficiency were "doctored samples" especially prepared for the test.

Six different makes of blades were tested, three of each being tested to the point of failure. The pressure was obtained by means of a weight suspended over a pulley and its amount was determined by a few preliminary experiments. In each case, the cutting was done on the forward stroke only, the saw being automatically raised on the backward stroke. Care was taken to see that the tension was the same in all cases. The length of stroke and the rate was kept uniform, and the number of strokes was recorded by a counting device attached to the machine. The autographic chart was adjusted around a vertical drum so connected as to rotate uniformly a fixed amount for each stroke. The pencil point was held in a device which moved upward on the chart at a rate depending directly upon the rate of cutting of the blade. In tabulating the results, for obvious reasons, the names of the makers of the various blades have not been referred to, the different manufacturers' blades being designated by a letter, individual blades being numbered.

It is believed that the test itself showed the relative efficiency of the various blades submitted to it beyond question. In comparing the results obtained, a value of 100 per cent. was assigned to the blade making the best average showing and the value of all the others was reduced to this basis, as shown in the accompanying table. The cost of the blades was based upon actual quotations at the time of the test, based upon an order for all the saws required for a year. In order to apply the results of the test to actual field conditions to determine as



FIGS. 4 TO 6. AUTOGRAPHIC TESTS OF SAWS D, E AND F

closely as possible what the amount of saving would be by using the most efficient saw, a number of observations were made in the field to determine approximately how long the old make of blades were serviceable before being discarded. The average time was in this way fixed at about 30 min. of actual cutting. The rate paid for labor at the time of the test was 18½ cents per hour, and upon this basis it was determined that, other things being equal in both cases, the use of the most efficient cutting saw (based upon a total requirement of 455 gross per year) would result in a labor saving of over $5000 per year.

The test showed that the blade making the best showing did the same amount of work as that with the poorest record and more than two and one-half times as quickly (see column 8 of table); therefore, it is evident that the difference in time would represent the labor-saving due to the use of the most efficient blade. In addition, the saw showing the greatest efficiency cut a total of 36 per cent. more metal than the saw with the lowest efficiency. This means that the same amount of work could have been done with the most efficient saw with the use of about 26.5 per cent. less saw blades, which in the case referred to would have meant the saving of the cost of about 120 gross of saws per year. In order to see that the saws being supplied continue up to the standard of the specimens used in the tests, additional tests of blades taken from stock should be made from time to time; but this is true of all tools or materials and is not peculiar to saw blades.

Less Scrap and More Production

By John R. Godfrey

Johnson is introducing a "spoiled work" campaign—not to raise the percentage as you might pessimistically imagine, but to wipe it off the books. Of course, he doesn't expect to get into the hundred per cent class in this, but he's cutting it down and learning several things about his machine equipment, his foremen and his men at the same time.

Spoiled work doesn't just happen—there's a reason, as the ads say. And it's Johnson's notion that it pays to find the reason and remove the cause—if possible. Hence the campaign.

Being a great believer in publicity, he staged another exhibition and sent me an invite and, being in town, I naturally dropped around to see the show. And it was *some* show—with a lot of food for thought as well as for the foundry scrap pile.

Johnson had been saving up a fine collection of scrap for some time—not for its amount, but for the variety of causes which lay behind it. (Johnson's strong on reasons and becauses.) Then he arranged it in fairly small groups—sort of sample boards of how *not* to do it—when the pieces were small enough. The larger pieces he had fixed up to show the defects to their best advantage. Where the "botch" was inside a casting, he had the metal all around it painted white as a background to show it off in all its glory.

Many pieces were tagged to tell what ailed them, what caused the trouble and how it could be avoided. Defects of all sorts were shown and it made a striking exhibit of the frailties which beset the average machine shop.

These exhibits were placed where they could be easily inspected at noon and there was a goodly crowd around them when I got there. No names were on the pieces but every man knew his own handiwork and it isn't Johnson's idea to call a man down in public for anything. And the men appreciate it.

"It's at least half our own fault in most cases when a man spoils a piece of work," Johnson told me. "We don't stop to realize that too few of the men have had real training as we used to know it. Foremen are too busy in most cases and training departments are all too few and far between. So I'm going to have a little smoker tomorrow night and have some of the best men we have tell us just how these things happened and how to prevent them.

"There's no lecture hidden away and the boys know it. They're just as anxious for a low percentage of scrap as I am, because they're taking a real pride in the job and there's a bonus in it also for lowering the scrap average.

Paying Men for Not Spoiling Work

"The next show of this kind we stage I'm going to put a price tag on every piece. I want to show the cost of the material, the waste of labor and the total cost to the company. One of the great troubles is that men don't know what things cost and it's up to us to tell 'em—and tell 'em the truth about it too. The old system of fines is bad in every way and it doesn't get anywhere in the long run. Paying men for not spoiling work is a heap better for all concerned. It's more effective and leaves a better taste in the mouth.

"There's more work spoiled because of disturbed mental conditions than anyone realizes. A sick wife or kiddie, lack of coal, the loan shark and even a plain grouch over cold pancakes, may all make a skilled man slip a cog. That's one of the reasons I try to get the wives and families interested in the shop and its work. It adds to a man's pride in his work and that of itself is a big factor in reducing wastage.

"Then too, Godfrey, old man, it's the most economical way of boosting real production—and we sure do need production all over the world. We hear a lot about men holding back in the shop and I presume it's true in some cases. But I'm dead sure you'll find a case of strained relations or lack of understanding at the bottom of it. It's a bad thing to throw a monkey wrench in the gears of any machine, but the fellow who puts the wrenches where they will be handy, or furnishes reasons for throwing them in, isn't altogether blameless.

"You and I have both known shops where the management had heart failure if a man earned 10 or 15 per cent over the regulation wages. Always fudged up some excuse for cutting the piece rate so he couldn't earn 'too much.' We both know it only takes a few such cases to make any man with an ounce of gray matter hold back, if necessary, so as not to earn more than the limit. We've even known 'em to tuck away a few pieces under the bench to help out the average on a day when they don't feel just up to scratch.

"We've both been in the shop, Godfrey, and we know that we'd do the same thing under the same circumstances. And we know we'd blame the management which made us hold back. It's a dern poor kind of management, between you and me, and I don't propose to have it around here as long as I have my usual amount of horse sense left. And I don't mean to give the boys any good excuse for even holding back on the job. If they do—I'm the guilty man and I won't try and lay it on them either."

This production game has several sides and Johnson knows it—and best of all he's trying to play fair.

EDITORIALS

Guaranties Against Price Reductions

SHOULD the sale price of an article be guaranteed against decline? If it should, for how long a time should the guaranty endure? What action on this problem is to the best advantage of the manufacturer? Of the dealer? Of the consumer?

These are some of the questions to be settled by the Federal Trade Commission at a series of hearings to be held in the near future. They are of sufficient importance to machine-tool makers and dealers to warrant careful consideration.

At the request of the commission we are taking this means to inform our machine-tool friends of the coming hearings and to urge them to take advantage of the opportunity to express their views. An extract from the circular letter sent by the Federal Trade Commission and signed by the chairman, Victor Murdock, follows:

FEDERAL TRADE COMMISSION
Washington, 26 December, 1919.

Gentlemen:

This question of guarantee against decline in price has been the subject of so many complaints before the Commission and opinion seems to be so diverse that the Commission has determined to go into the whole matter thoroughly.

As a basis for the necessary expenditures attending upon such an inquiry, such formal complaints have been issued presenting various phases of the subject. To the end that every party at interest may be fully represented, the Commission is inviting, generally, producers, manufacturers, merchants (wholesale and retail) and consumers, to declare their interest so that the Commission may know what parties should be represented.

As soon as this list of the parties at interest in the matter can be compiled, it is the purpose of the Commission to invite each or any of them to submit his observations in writing. This follows the custom of the Commission in numerous other similar cases.

A reasonable time limit for the filing of written statements will be given, after which they will be assembled and, as far as possible, classified, and each correspondent will be furnished with a copy of the whole document.

As soon thereafter as is possible, it is the purpose of the Commission to call a general hearing at Washington at which parties at interest may be present in person, by representative or by counsel, and an orderly method for hearing the matter will be laid out.

As in everything where the public interest is involved, the utmost expedition consistent with care and full opportunity for the presentation of all sides, is to be desired.

Keeping Our Foreign Markets

AMONG the problems which face us during the coming year—and they are many—is the problem of export trade. Do we want it and, if so, what are we going to do about it?

The domestic demand for machine tools is so great that most shops are much behind on orders. And this is practically a cash business, while export trade, to the countries of Europe at least, must be on some sort of a credit basis. Shall we neglect even a part of our domestic cash business in order to supply Europe with machines on time payments?

But the answer is not so simple as it seems. In normal times, before the great war, we exported approximately 25 per cent of our machine-tool output and were very glad of such a market. Shall we allow this outlet for 25 per cent or even less a proportion of our product to slip away from us?

* * *

There are still other sides to this question also. The sooner Europe can get a firm manufacturing basis, the sooner can she pay back our loans and afford a stable market for our product. And if Europe does not recover quickly enough to prevent financial and political chaos, it is bound to involve us as well. Such a disaster can sweep over the 3000 miles of ocean even more readily than did the scourge of influenza, which took more American lives than did the nineteen months of war.

Unless we look beyond the present and even the immediate future, we are courting trouble. We must help the manufacturers of Europe re-establish themselves for the sake of world peace and prosperity. We have too long failed to realize that, whether we like it or not, we are not and can never again be an isolated nation. We must play the business game as part of the world, not as a provincial community.

Foreign business is not a thing to be put on and off like a mask or a glove. If it is worth having, and we have spent a lot of money freely in the past to get it, it is worth cultivating and attending to all of the time. The immediate domestic dollar should not blind us to the return of export trade in the years to come. Only the fly-by-night concern can afford to kill the goose that lays the golden eggs. The man who is building his business for the future cannot afford to take any such chances.

* * *

Some long-headed managers are making their plans for the years to come. They are diverting a certain percentage of their products to their foreign customers, even on long-time credit, instead of taking cash from domestic buyers. This keeps their machines constantly going into the reorganized shops, so that more and more workmen will become familiar with them as time goes on. They are building for a future demand which will come in very handy when the home orders take their next drop in volume.

These managers know that unless they do this, unless they send machines across on terms which can be met, other machines from other countries will take their places, men will become accustomed to them, and it will be difficult to secure this market when it is needed. They are building for the future. Is there any other safe way?

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

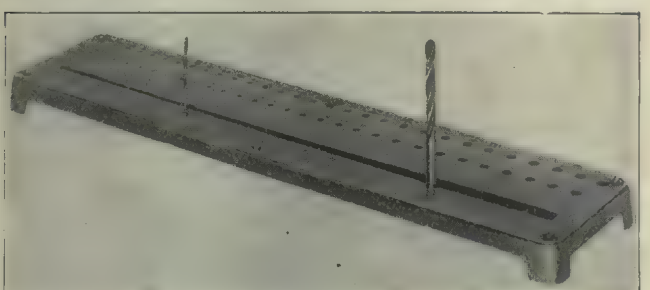
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment •

"Quickbak" Gage and Drill Holder

The combination gage and drill holder just introduced by Russell & Burr, 716 Land Title Building, Philadelphia, Pa., will serve an obvious purpose. The combination provides means for gaging the drill and at the same time indicating the hole where it belongs when not in use. As can be noted from the illustration, guide lines run from the V-slot to the holes, and when placing a drill in the holder it is simply a matter of gaging the drill and then following the corresponding line to the correct hole. When selecting a drill for use the gage will often be found useful in addition to the fact that every hole has the size number stamped beside it. Another feature of the gage, is that on the opposite side of the slot from the guide lines it is graduated in thousandths and can be accordingly used independently to determine exact sizes.

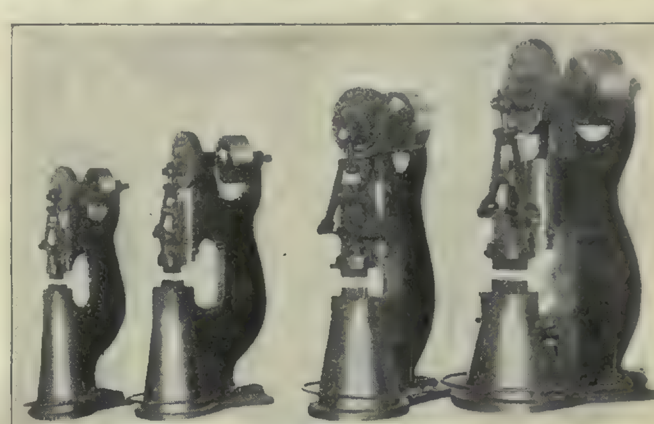


GAGE AND DRILL HOLDER

Mayer Power Hammers

The Kaukauna Machine Works, Kaukauna, Wis., has redesigned its line of Mayer power hammers. The hammers are built with heavy gray cast-iron frames, made in one part for the smaller hammers and in two parts for the two larger sizes. The rams are steel castings and operate in V-guides. The guides are cast integral with the frames with a cored opening between them which makes it possible to spring them apart before machining, thus providing for the take-up for wear and doing away with all gibs. A separate adjustment at the tops and bottoms of the guides makes possible adjustment for excessive wear at the lower ends of the guides where the wear is naturally heavier. The ram connections are designed to provide a cushion at the upper extremity of the stroke which in turn adds to the impetus of the next downward stroke and blow. An alloy steel is used for the toggle-bolts. Provision is made for adjusting the spring tension. The removable bearing bushings used are medium-hard gray-iron castings. The dies are made from crucible steel and are regularly furnished with either standard flat forging faces or with rounded faces for plow work.

The hammers are built in five sizes having a respective capacity of 25, 50, 100, 250 and 500 lb. They will forge round stock from 2 in. to 8 in. and square stock from $1\frac{1}{2}$ in. to 7 in. Flat stock from $2\frac{1}{2}$ in. to 8 in. wide can be handled edgewise. Power required, 1 to $7\frac{1}{2}$ hp. Weight without motor, 750, 1,500, 3,000, 5,800 and 10,000 pounds.



MAYER POWER HAMMERS

"Cruban" Micro-Automatic Taper Turning Tool

The Fairbanks Co. is the distributing agency for a turning tool that is manufactured by the Cruban Machine and Steel Corporation, 63 Duane St., New York.

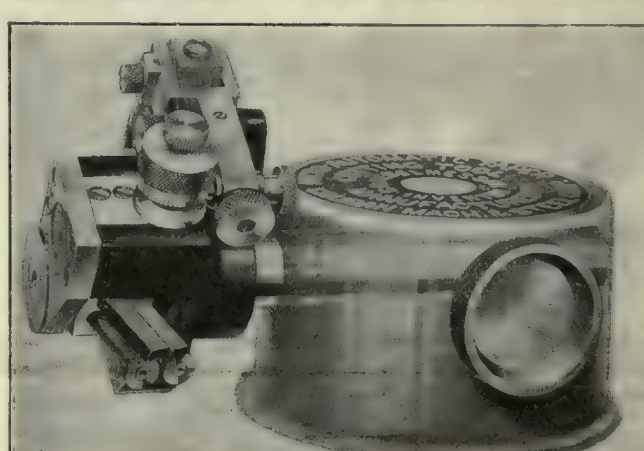


FIG. 1. SIDE VIEW OF MICRO TAPER TURNING TOOL

The tool is designed for use with a hand screw machine, automatic screw machine, or lathe, and is fitted with a straight shank or taper shank as required. It will automatically cut any taper from $\frac{1}{16}$ in. per foot to $\frac{3}{4}$ in. per foot and any length up to 6 in. and it can be furnished to meet greater capacities if desired. The tool is entirely self-contained and is not affected by lost motion in the turret or tailstock.

Two views are shown, Fig. 1 being a side view and Fig. 2 a front view. The cutting of a taper is governed by the feed pressure moving a plunger which guides and regulates the cutting tools. As the feed advances the plunger movement revolves a lead screw, and as a result the cutting tools are backed away evenly and automatically, producing more or less of a taper according to the pitch of the screw. This operation may be clearly followed by reference to Fig. 2. The revolving cylinder *A* is connected to the plunger *B* by a steel belt and as the plunger is pushed back by the work, the belt attached to the inside revolves the cylinder *A* in a similar manner to that of a rack-and-pinion movement. A clock spring inclosed in the cylinder *A* keeps a constant tension on the plunger through its entire stroke. The lead screw *C* revolves with the cylinder *A* and the pivoted lever *D* moves accordingly, owing to the threaded block *E* that connects the two. At the opposite end of the lever *D* the cutting tools *F* are connected and move with the lever. When the cut is finished, the clock spring causes the return stroke of the plunger as the work is withdrawn. The clock-spring tension may be changed by the adjusting screw *H* which engages the small worm gear. A felt washer is provided to keep chips and dirt out of the space occupied by the plunger. Different lead screws are required to cut different tapers, these being readily removable.

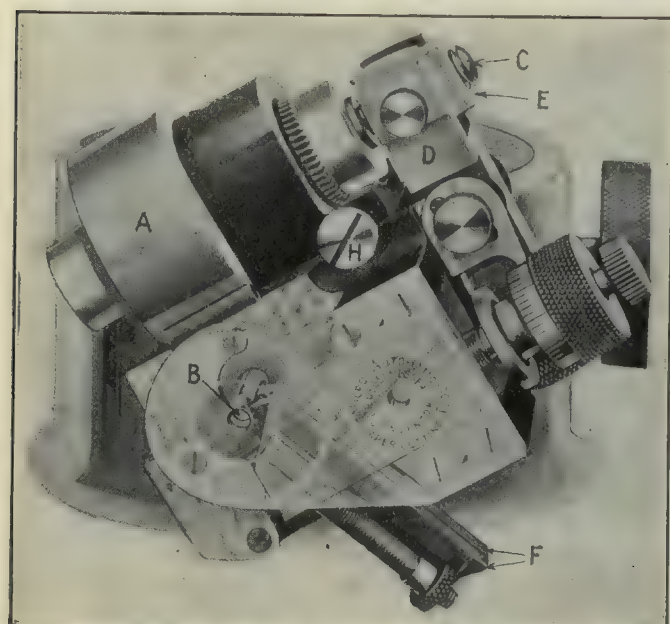
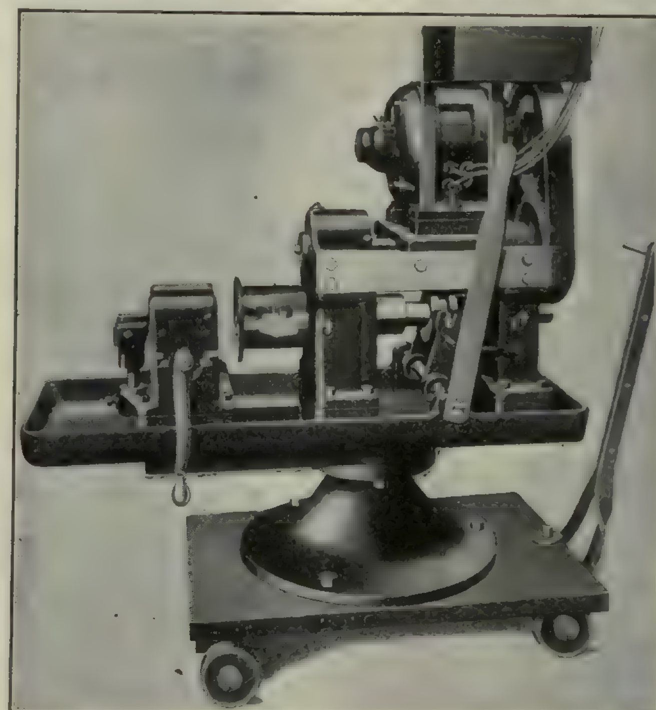


FIG. 2. FRONT VIEW OF MICRO TAPER TURNING TOOL

The roughing and finishing cutters *F* are of high-speed steel and are adjusted initially by knurled-head screws that engage non-slip notches. Final adjustment is made through a micrometer arrangement, graduated to 0.0005 in., and the tool is said to turn out work in thousand lots within a limit of 0.0005 in. With each tool is supplied a chart giving all lengths and diameters of taper that may be turned with the tool.

"Namco" Bar-Pointing Machine

The National Acme Co., Cleveland, Ohio, has added to its "Namco" line a portable motor-driven bar-pointing machine, as shown in the illustration. The machine is used to point the ends of bar stock preparatory for screw-machine operations. Being portable, it can be easily removed from place to place where the stock is stored, thus avoiding unnecessary handling of material. When pointing round stock, the bar is held in the machine vise while the revolving cutter head is brought into position and fed by the hand lever that engages the slidable spindle. Square or hexagonal bars are not held in the vise, but simply pushed against the revolving cutter head, the vise loosely engaging the bar to prevent it from twisting during the cutting action. The vise jaws are adjustable to all standard shapes and sizes of bars. The spindle is gear driven and the revolving cutter head carries a plain cutter that is easily removable for sharpening. A flanged base is provided to prevent the chips from dropping on the floor.


"NAMCO" BAR-POINTING MACHINE

When preparing large amounts of stock, two machines operating end to end may be used to advantage; in such a case it would be unnecessary to reverse the bar. The machine is driven by a 1-hp. motor that is complete with switch and all necessary connections. The dimensions of the machine are: length, 4 ft; width, 2 ft.; height, 4 ft., including motor.

Multi-Graduated Precision Grinding Attachment

The Precision and Thread Grinder Manufacturing Co., 1932 Arch St., Philadelphia, Pa., is demonstrating improved grinding equipment. This comprises several attachments capable of use on a variety of work, though particularly intended for thread grinding.

Threads may be ground with a single attachment as shown in Fig. 1 or two such attachments may be used,

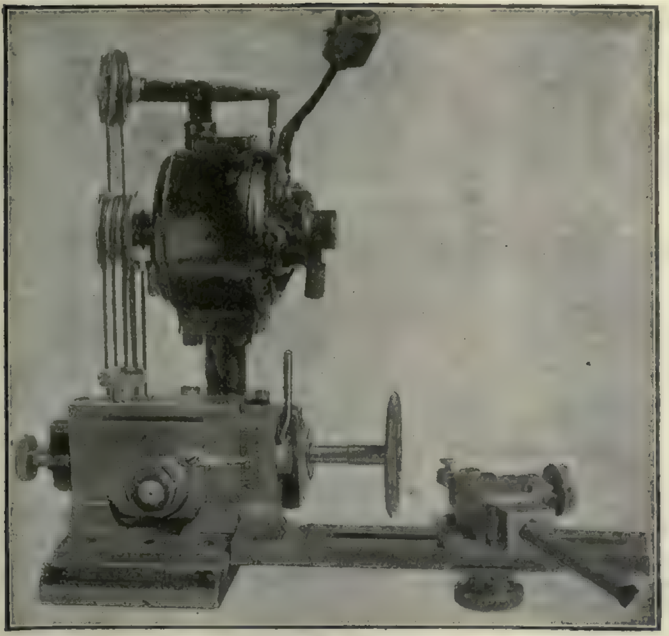


FIG. 1. MULTI-GRADUATED GRINDING ATTACHMENT

one on each side of the work. In the latter case the wheels are beveled so that they grind on opposite sides of the thread angle as shown in Fig. 2. On production work where a large number of duplicate pieces are to be ground, the wheels are set to the thread of the first part. The threads on the following pieces are set to the wheels, provision being made for this by an adjustable dog. After the wheels are once set redressing them does not change their alignment in relation to the thread.

A graduated scale is provided for setting the wheel center to the same height as the work center. The multiple endless belt is kept in constant tension by a spring tightener on top of the motor.

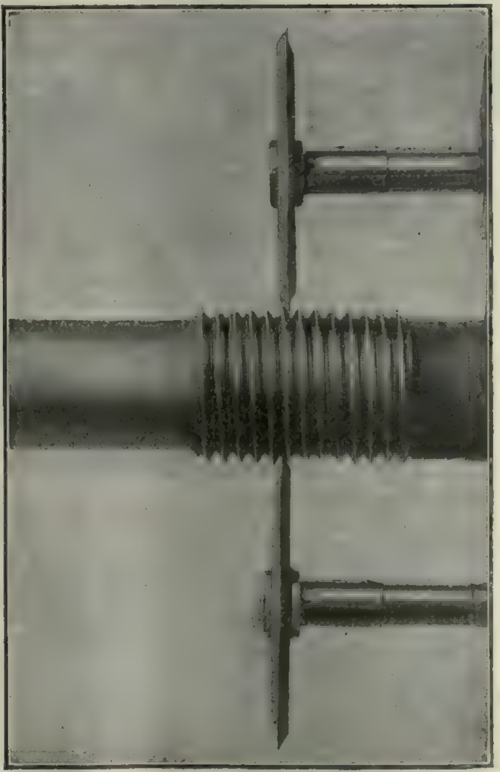


FIG. 2. ARRANGEMENT OF WHEELS FOR DUPLEX GRINDING

The wheel-truing device has the base graduated for angular setting and is also provided with setting pins for accurate location of the device 30 deg. each side of the center. Ball bearings are used throughout and are protected from abrasive dust by felt-lined steel washers. Adjustment is provided for taking up all end motion. The regular equipment includes the truing device.

It is claimed that using two of these machines on thread grinding will result in increased production. In addition to thread grinding a variety of plain grinding, both internal and external, may be done on this machine.

Kremer-Cummins Mechanical Shifter

A belt-shifting device designed for use in connection with cone pulleys and operated by means of two handles, is being manufactured by the Kremer-Cummins Machine Co., 133 East 55th St., Cleveland, Ohio. The device proper is attached overhead near the cone pulley but is supported by independent brackets that are adjustable to suit conditions. A single piece of channel iron of suitable length is used to support a sliding carriage that is moved by means of a rack-and-pinion arrangement. The rack is formed by cutting teeth in one leg of the channel, the pinion being attached to the end of a ½-in. shifting rod that can be turned by means of a handle at the lower end. Attached to the carriage is a loop that surrounds the belt. Hence, as the carriage is moved along the channel, the belt is carried with it. To prevent overtravel of the carriage a stop is made at each end of the rack by bending a tooth at right angles for the carriage to strike against. A separate shifting rod, made of ⅜-in. pipe, is used for the belt at the lower pulley. The top end of the pipe is pivoted to the carriage, while its lower end is held in position by means of a casting that forms a loop around the belt and also serves as an operating handle. No part of the shifting arrangement is attached directly to the machine or countershaft.

KREMER-CUMMINS MECHANICAL SHIFTER

Sparks from the World's

By E. C. Porter,

Ready Market in Palestine for Machinery

American mechanical devices of all kinds will find a ready market in Palestine, according to a request received by the Foreign Trade Bureau from a dealer in Jaffa.

He says agricultural machinery of all kinds, especially tractors, are in great demand, and that there is a good market for automobiles. Other articles for which there is a good market include gasoline motors from one to fifty horsepower, Diesel type motors 200 horsepower, marine gasoline motors, machines for manufacturing ice, cement mixing machines, wood and stone working machines, lathes, planes, vises, motor-cycles and bicycles, presses for the manufacture of oil and stills for oil distillation.

Arranging to Finance Exporting Manufacturers

The War Finance Corporation has practically completed arrangements for two loans of $5,000,000 each to exporting manufacturers. One of these loans will be made to assist in financing the exportation of locomotives to Poland, while the other will be made for the exportation of agricultural machinery to England, France and Belgium.

A third loan of $5,000,000 concerning the exportation of electrical machinery is now being considered by the War Finance Corporation, and it is expected that the negotiations will be consummated in the near future.

An advance is also being made by the War Finance Corporation to the extent of $2,000,000 which will furnish funds for the financing of the exportation of machinery for the reconstruction of steel mills in northern France.

Shipyards Have 805,000 Gross Tons Under Construction

American shipyards, instead of falling back as Government contracts are suspended, cancelled or completed, are forging steadily ahead, according to a statement just issued by the Atlantic Coast Shipbuilders' Association.

Work for private accounts is replacing that which was being done for the Shipping Board and although a number of orders for American industries have been completed or withdrawn during the past few weeks, the shipyards today are building over a quarter of a million gross tons more than they were a month ago and nearly half a million tons more than in October. The total now under construction, exclusive of all Government work, is 805,000 gross tons, the equivalent of more than 1,200,000 deadweight tons of seagoing vessels.

Major Johnson Now Assistant Director of Sales

Major H. S. Johnson, former special assistant to the Director of Sales, has been appointed Assistant Director of Sales to fill the vacancy caused by A. L. Mercer, who resigned to become president of the Needham Tire Co., Needham, Mass.

MAJOR H. S. JOHNSON

Major Johnson assumes his new duties fully conversant with the work of the Office of the Director of Sales, having been in close touch with the various salvage and sales boards in his capacity as special assistant to the Director of Sales.

He graduated from Lehigh University in 1897, shortly after which he became associated with the Niagara Falls Power Co. where he remained until 1901. From 1901 to 1903, Mr. Johnson was general manager of the People's Railway Co., of Dayton, Ohio. He later became connected with the Westinghouse, Church & Kerr Co. and served as assistant to George Gibbs in large construction and tunnelling projects in New York City.

In 1907, Mr. Johnson organized the Johnson, Wahley Electric Co., of Buffalo. At the outbreak of the war, he was commissioned and detailed to design electrical equipment for overseas ordnance storage depots. He developed a guard system for storage depots.

Meeting Dates Announced by the Engineers' Club of Philadelphia

George Otis Smith, director of the United States Geological Survey, Washington, D. C., will lecture at the regular meeting of the Engineers' Club of Philadelphia to be held at Witherspoon Hall, Tuesday, Jan. 20, 1920, at 8.15 p.m. His subject will be "Engineering as Prosperity Insurance," and will be illustrated with lantern slides.

At the Tuesday luncheon, Jan. 20, Grover G. Huebner, professor of the Wharton School of Finance and Commerce, University of Pennsylvania, will make an address, the subject of which will be "Pending Railroad Legislation."

On Jan. 27 at the Tuesday luncheon Colonel Marston T. Bogart, professor of the Department of Chemistry, Columbia University, will make an address on "Chemical Warfare."

The Philadelphia Section and the New York Section of the Society of Automotive Engineers will hold a joint meeting in Philadelphia on Jan. 22, and in the afternoon a special trip will be made to the Philadelphia Navy Yard to inspect the Diesel engine taken from a German submarine.

Foundation for Invention and Research Established

On Jan. 9 about one thousand people interested in the establishment of a National Foundation for Invention and Research, attended a convention at the Hotel Astor, New York City. The purpose of the convention was to make definite plans to mobilize American inventive genius. This mobilization has quietly been going on for the past two years for the establishment of the foundation under the direction of Thomas Howard, chairman of the National Institute of Inventors. The foundation has now nearly three thousand members scattered throughout the country. The project is supported by many representative men of science and industry.

At the convention it was planned to establish the laboratory by independent endowments of wealthy men and the larger industrial firms of the country and then make it self-supporting by a percentage arrangement on the inventions of inventors which the laboratory will help develop and market, giving financial aid to the poor inventor. The election and installation of officers was held in the afternoon, followed by a banquet in the evening, at which a number of representative men spoke in behalf of the movement.

Industrial Forge

News Editor

A New Building for the Vonnegut Machinery Company

The Vonnegut Machinery Co., Indianapolis, Ind., has let contracts and work has been started on a building, 100 x 300 ft., with two stories and basement. It will be of reinforced concrete and metal-sash, factory-type construction. The location is 19-20 West South St., opposite the Union Station. The first floor and basement will be used for the business of the Vonnegut Machinery Co., including office, display floor, and storage for the machine tool and machinery accessories department, as well as machine shop and storage facilities for the used-machinery department.

The Kerbaugh Construction Company Purchased by the Poland Construction Company

The Poland Construction Co., Philadelphia, has purchased the Kerbaugh Construction Co's, plant, between Bellwood and East Altoona, Blair County, Pa. The new firm has taken over the plant to manufacture boilers of all kinds and construction work implements and machinery. Three hundred men will be employed. The grounds cover 154½ acres. The shop is 119 x 224 ft. and the foundry 48 x 48 ft., both buildings being of structural steel. The storehouse is 60 x 208 ft. with a 9,000-ft. railroad siding and a private reservoir with a capacity of 4,000,000 gal. There are six other frame dwellings and farm buildings. The property was leased recently to the Empire Engineering Co., New York.

Working Out a Plan for Distributing Surplus Machinery to Schools

With the receipt of fifty answers to questionnaires regarding surplus machine tools available for educational institutions under the Caldwell Act, the machine-tool section of the Office of the Director of Sales of the War Department is now working on a plan of equitable distribution of the surplus machinery among schools filing applications.

Of the answers already received, a majority of the institutions show a preference for lathes, while drilling and milling machines are second in demand. Many of the schools answering have also expressed a desire for grinding machines.

While the basis of allotment will not be finally decided upon until at least 100 answers have been received, the members of the machine-tool section are considering distribution of the equipment on the basis of enrollment and floor space.

Approximately 1,000 questionnaires were sent out to as many schools, which are entitled to machine tools under the Caldwell Act. The answers that have been received have come from schools in all parts of the country, ranging in size from small academies to large universities.

Atlantic City Selected for U. S. Chamber of Commerce Convention

The United States Chamber of Commerce recently announced the selection of Atlantic City for its 1920 convention, which will open April 26. It will be the first gathering of the organization ever held in Atlantic City.

A preliminary program contemplates the presence of two or more members of President Wilson's cabinet and fully 5,000 representatives of local trade bodies from all parts of the nation.

Nuttall Products To Be Handled by Westinghouse Salesmen

A change in the merchandising policy of the R. D. Nuttall Co., Pittsburgh, Pa., has just been announced, effective Jan. 1, 1920. Under the new arrangement the Westinghouse Electric and Manufacturing Co. salesmen throughout the United States will handle the railway and mine products of the R. D. Nuttall Company.

All Nuttall industrial lines and other products, however, will be taken care of through the main Nuttall office at Pittsburgh, Pa.

Training Course for Foremen

The Bridgeport Brass Co., of Bridgeport, Conn., has inaugurated a plan of training for its foremen and other members of the supervisory force.

A class of seventy-three men has been formed to pursue a course in modern production methods which comprises the study of specially prepared text material, the solution of practical factory problems, and the discussion of this material at six biweekly meetings held in the plant after hours. These meetings will provide an opportunity to bring home the application of the work to the special production problems of the company. At each meeting a lecture will be delivered by an experienced production man and the lecture will be followed by a discussion.

Business Conditions in England

By Our English Correspondent

London, Dec. 12, 1919.

At the moment any attempt to bring the molders' strike to an end has proved fruitless; and, while some of the working people seem inclined to return to work quickly, the majority seem rather intent on securing full satisfaction of their demands and even talk of increasing them. Meanwhile, the engineering industry does the best it can and is in the extraordinary position of having large orders at quite unusual prices, but without the means to carry out these orders. Calling on some eight varied shops in the Halifax district, a correspondent reports that half a dozen of them were closed down, solely for want of castings.

Apart from ordinary labor trouble, another handicap which is general among engineers, and presumably among manufacturing firms as a whole, is the inadequate service now provided by the railways for the transport of goods. Railway working has nothing like recovered from war effects and the two leading causes for a condition that almost amounts to chaos in some instances, appear to be the working of the eight-hour day, plus the shortage of wagons.

Throughout trade and industry the consumer is now receiving scant attention. When an employer concedes to demands for increased wages, he simultaneously advances his prices. This has been shown of late particularly in the building trades and in certain sections of the clothing trades.

The proposal to adopt the 24-hour method of stating time is receiving consideration by a departmental committee of the British home office. It is of course the European continental system, and the recent war made many men well acquainted with it. One advantage is that it prevents mistakes which may arise owing to the a.m. and p.m. notation being the same. At a preliminary meeting, the Federation of British Industries agreed to support the movement.

As was stated in our last letter, the British Engineering Standards Association has been considering the whole subject of limit working in engineering. Accepting the hole as a basis, the committee concerned has been unable to recommend either the uni-lateral or the bi-lateral system of tolerances; that is, either a + tolerance alone or a + and — tolerance. They have, in fact, been circularizing the engineering industry of Great Britain, but received only

about 200 replies which were almost equally divided. Each side can claim firms of importance. It is specially stated that "as showing some of the practical difficulties of the situation, some of the important firms of the country, while agreeing that theoretically the minimum-hole basis may be ideally the best, are prevented from supporting it owing to commercial considerations."

The committee was, in fact, unanimous in feeling that no decision could be made in the light of present conditions. The number of firms in Great Britain actually working on a strictly limit system is not, it would seem, readily ascertainable. A contributor to the European edition of this journal has put the number at about 100, and informal enquiries made editorially tend to suggest that this estimate is not wild. It is suggested, for example, that in the west of Scotland district there are some twenty or thirty firms, while in the Halifax district the number might be a dozen. Altogether, the figures cannot be regarded as high. Yet one firm, who should certainly be in a position to get closely to the true figures, while admitting the difficulty of estimating, put the number at more than 2,000.

Demonstrations of the Constantinesco system of wave transmission of energy are promised for the new year. Put in its simplest form, in this system will be two cylinders each with plunger, the two cylinders being connected by pipe, of any length according to the extent of transmission desired and completely filled with water, or other liquid, all air being excluded. On either plunger being set into reciprocation the other would move in synchronism, not by the actual passage through the pipe of water itself, but by waves of the compressed fluid, the speed being that of sound. Plants can be built up of single-phase, two-phase or three-phase character, and either reciprocating or circular motion could be set up at the far end. At present, very little of numerical character is available, but as a guide it is stated that, using water, ordinary steam quality piping 1 in. in diameter will transmit 10 hp. for moderate distances with good efficiency. In the case of a riveting or calking hammer or the rock drill, the motor forms part of the machine. It is clear that for reciprocating motion the system may easily have advantages over electrical rock drills, etc., electric means being more suitable for the production of rotation rather than reciprocation. A motor car is promised "to prove the practical application of wave transmission to a moving vehicle. The gear box to be entirely eliminated" and "the same equipment will be available for the internal heating of the vehicle." Devised by George Constantinesco, a Roumanian, the system is being worked commercially by Dorman & Co., Ltd., Stafford. Its use during the war for interrupter gear, enabling the airman to fire through the blades of the airplane propeller, has been made public some time since.

The Ministry of Labor has of course a training scheme applicable to ex-service men, grants being made so that the demobilized soldier may be trained for professional, business or technical positions, provided family funds are not available. In the engineering industry the trade unions have objected on three main grounds; namely, that the ordinary industrial apprentice will be "done out of" the better jobs, that many apprentices are still in the army and many trade unionists unemployed, and that the scheme would militarize works. The ministry concerned has modified its scheme with a view to meeting these objections. Candidates are selected by interviewing boards in various centers of Great Britain and, in official language, "in order to ensure that no trade union principles are infringed it is proposed that the engineering trade unions should nominate representatives to sit on these boards."

Excepting the disabled, the candidates for engineering must be men who have not previously entered in any other trade or profession and the number of such men allotted to engineering is no more than 1,750, a mere fraction of 1 per cent of the total membership of the engineering unions. It is further provided that the number of these men under training in any given factory shall not exceed 1 per cent of the total number of employees in the works. The training is intended to qualify the men for the commercial or office rather than the workshop side of engineering. The Ministry of Labor in making a statement has mentioned that more than 50 per cent of the ex-service men who have thus obtained grants were from the ranks, while of officers thus helped to take a place in civil life, many are men who have risen from the ranks.

American Constitutional League Formed by Milwaukee Business Men

Prompted by the need of and demand for a better understanding on the part of the public generally, of the fundamental soundness of the American Constitutional Government and the fallacious and, in some cases, vicious attacks upon it, several influential business men of Milwaukee have formed the American Constitutional League. The league is non-sectarian and non-racial in membership and purpose. Its activities will be confined solely to Americanization work, which will embrace all forms of education and publicity in favor of Americanism and in opposition to all radical doctrines which have for their purpose the overthrow of our existing form of representative government and our present social and industrial order. Frank R. Bacon, president of the Cutler-Hammer Manufacturing Co., of Milwaukee, Wis., has been elected chairman of this new organization.

Company Formed to Erect Workingmen's Homes in Hartford

The various manufacturers of Hartford, Conn., are planning the formation of a housing company for the purpose of erecting several workmen's houses during the coming year. It is the plan of the members of the new project to have a company with a capital of at least one milion dollars, and to erect about 1,400 or 1,500 homes during the year 1920. Charles B. Cook, who is vice president of the Royal Typewriter Co., is the chairman of the committee of organization.

The End of the German Steel Works Association

By Our German Correspondent

There exists scarcely a doubt at the present moment that the days of the German Steel Works Association are numbered, and that the state of affairs today is only the presage of a permanent dissolution. Not merely the Rhenish steel works and the German-Luxemburg Mining and Foundries Co., which have taken little notice of its statutes for some time past (for reasons both tactical and economic) and so hastened its decay, but most other works, too, have come to the conclusion that the association in its present form is a thing of the past. This point of view is mainly resultant from the end of the war with its absolutely altered conditions, and the demands made upon the German iron and steel industry by the terms of the peace treaty. The association was dependent upon the production of Thomas steel, which has increased enormously since the construction of large foundries in Luxemburg and what was formerly German Lorraine. These last mentioned have been confiscated entirely by the peace treaty, and the important Luxemburg works have passed into other hands since their liquidation, with little chance of German participation in anything concerning their administration in the future. The Saar works are still members of the association, but for how long a duration it is impossible to say. Upon their secession—and in reality they have barely counted as a delivering factor for the association for a long time past—the importance of the association will even further be lessened.

The far-reaching influence of these groups may be gathered from the fact that they were represented by a participation of three million tons in the approximate six million tons output before the present economic upheaval. The works concerned are the following: Burbach-Eich-Duedelingen, the Gelsenkirchen Mining Co., de Wendel in Hayingen, the Romach Foundries, the German-Luxemburg Mining and Foundries Co. (Differdingen and Ruemelingen sections), the Lorraine Foundries and Mining Union, Thyssen's Steel Works

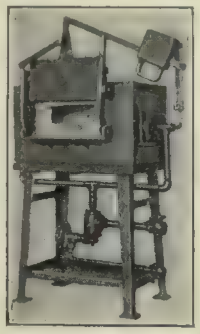
(*Continued on Page 164b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Furnace, Oven Type
Surface Combustion Co., 366 Girard Ave., New York, N. Y.
"American Machinist," Oct. 16, 1919

Size A-25; the door-lifting mechanism does not require the use of chains or pulleys, but is a simple, compact link motion having a dead-center feature that tends to keep the door in either open or closed position without depending upon friction. Specifications: Inside heating space, 12 x 10 in.; size of entrance, 6½ x 10 in.; height floor to hearth, 42 in.; air pipe, 2 in.; gas pipe, 1½ in.; floor space, 27 x 48 in.; net weight, 1700 lb.



Micrometer, Direct Reading
Production Equipment Co., Inc., 1 Madison Ave., New York, N. Y.
"American Machinist," Oct. 16, 1919

The micrometer being marketed by the Production Equipment Co., Inc., 1 Madison Ave., New York City, is said to be very easy to read as the barrel has but 10 graduations instead of 40 and the dial windows show at a glance the measurement registered. The micrometer is of standard size and weight comparatively, and is made in sizes up to 12 in.; with or without ratchet stops and ten-thousandth graduations.

Tester, Hardness
W. & T. Avery Ltd., Birmingham, Eng.
"American Machinist," (English Edition), Oct. 11, 1919

For quick action the vertical straining screw is disengaged in its keyway by a thumb screw at the top of the frame. Also the handwheel for rotating the straining screw can be raised or lowered in order to give a full view of the specimen under test. Weights equivalent to 500 kg. and 3000 kg. load are provided. As the load is applied through a worm drive it cannot be applied suddenly, so that the machine experiences no shock; moreover, the rate of loading during the test is practically uniform, as compared with jerks which may result from the load being added by pumping.

Shaping Machine, Double-Headed
Fairbairns, Leeds, England.
"American Machinist" (English Edition), Oct. 18, 1919

Length of bed, 12 ft. 6 in.; traverse of each head, 3 ft.; work tables, 30 x 20 in. Each headstock is independently driven by 10-hp. constant-speed motor, through double helical gears, and 4-speed gear box, mounted on a foundation casting bolted to the end of the bed as shown. The gear box gives 39.25, 23.75, 16.6, and 9.7 strokes per minute. The overall floor space occupied by the machine is 24 x 8 ft., and its net weight is 11½ tons.

Boring Mill, Vertical
G. Richards & Co., Ltd., Manchester, England.
"American Machinist" (English Edition), Nov. 1, 1919

Net weight, 80 tons; capacity is 10 ft. in diameter, and to admit 10 ft. high under the toolholders and 10 ft. 9 in. under the cross-slide. The machine is fitted with two ordinary swivel tool bars on the cross-slide having 66 in. down feed, and with side head fixed to the right-hand housing and to the base. The table is 10 ft. in diameter and is driven by spur-gear ring, 1½ diametral pitch, 9 in. face, from a six-speed gear box driven by a 50-hp. variable-speed motor. All the tool bars have vertical, horizontal and angular self-acting feeds, with rapid power traverses to these motions.

Keyseating and Mortising Machine
Smith and Coventry Ltd., Manchester, England.
"American Machinist" (English Edition), Sept. 20, 1919

Long pieces to be machined are held in a two-jaw universal chuck and supported at end by tailstock clamp. Cutters up to 1½ in. in diameter are held in spring collets and are driven by bevel gears. Maximum distance between spindles, 15 in.; minimum distance, 4 in. Table has T-slots and 12-in. stroke. Depth of cutter feed, each stroke, 0.004 in. to 0.016 in. Speed of traverse, 36 in. per minute.

Milling Machine, Type-M, Plain, Universal, Vertical
Cincinnati Milling Machine Co., Cincinnati, Ohio.
"American Machinist," Oct. 23, 1919

No. 1 Plain, range, 22 x 8 x 19 in.; net weight, 2200 lb.
No. 1 Universal, range, 22 x 8 x 18 in.; net weight, 2500 lb.
No. 1 Vertical, range, 22 x 12 x 16 in.; net weight, 2300 lb.
No. 2 Plain, range, 28 x 10 x 19 in.; net weight, 2500 lb.
No. 2 Universal, range, 28 x 10 x 18 in.; net weight, 2800 lb.
No. 2 Vertical, range, 28 x 12 x 16 in.; net weight, 2600 lb.
Dimensions common to all No. 1 Machines; tables, 37 x 10½ in.; taper holes, 14 B. & S.; hp., 3; pulley, 12 in.; belt, 1½ in.
No. 2 Machines: Tables, 49 x 10½ in.; taper holes, 14 B. & S.; hp., 5; pulley, 12 in.; belt, 2 in.

Lathe, Large Engine, Movable Bed
G. A. Harvey, Ltd., Govan, England.
"American Machinist" (English Edition), Nov. 8, 1919

Swing, 12 ft.; with bed in center, 6 ft.; over saddle, 4 ft. 10 in.; between centers, 25 ft.; movable bed, 30 ft. x 5 ft. 3 in. x 3 ft. deep; 50-hp. constant speed motor; has oil system and ball thrust spindle; feeds, 3 to 32 cuts per inch; threads 1 in. P. to 16 per inch; floor space, 42 ft. to 6 in. x 22 ft., approximate weight, 86 tons.

Clip, paste on 3 x 5-in. cards and file as desired

(Hagendingen section), Stumm Bros., the Roechling Iron and Steel Works and the Dillinger Foundries.

The future relationship of the Upper Silesian works to the association is still undecided. It is only represented by an entire participation of 324,000 tons, but as remaining in the association, should the latter continue to exist at all, would still be of value. The Rhenish-Westphalian works which at the present moment is the very back-bone of it, together with the Bavarian Maximilian Mine, the Georgmarien Mining and Foundries Union (at Osnabrück), the Pain Rolling Mills, and the Cast Steel Factory at Doehlen in Saxony, form a co-operation of about three million tons. The greater percentage of these works refuses to entertain any further the idea of a steel works' association which would represent a pure agreement of sales with stipulations as to co-operation. The works have widely organized trading associations at its disposal for exploiting "A" as well as "B" products. Through this it has lost still more in prestige, especially as it has proved itself incapable of adaption to the constantly changing circumstances affecting production during the past few years. It was in danger of dissolution more than once during the war, and this was only prevented by official intervention in the interests of a uniform regulation of army supplies. Later on, the Federal Board of Economics (Reichswirtschaftsamt) intervened, but this endeavor to prolong the life of the association by force only partly succeeded.

A number of works went their own way, despite orders to the contrary, looking upon the association as non-existent. On the whole, the conclusion was formed in interested circles that nothing is to be gained by using economic pressure at the present moment, and that the entire organization of the association served rather to hinder than to develop the full productive possibilities of the steel works.

The demand for the absolute release from the administration of iron, has been met with a flat refusal on the part of the government till now, and it is possible to gather from this standpoint that they might not be unwilling to aid the formation of a new steel works association in some form or other. This demand, if made from the point of view of retaining official price control over the formation of prices, might be fulfilled under the conditions of the already existing German Steel Union, the so-called "Mantelsyndicate." Another blow to the association was the fact of its being refused the representation of the German steel industry at international conventions. Whether these conventions will meet again before long is a matter of doubt; in any case the part that Germany might be called upon to play in them would be small enough. If one looks back to the time when the association was founded, in 1904, it is only possible to class the net results accomplished as a failure. The big plans for organizing the German iron industries to which it was to act as a prelude failed utterly; a fact which is less due to its own fault than to the constantly changing circumstances which production had to fight against. The process of concentration in the iron industry shifted the basis of production in the mixed works constantly to its own advantage as regards the further manufacture of the raw products for which sales the association was responsible; this co-operative movement did not encourage the foundation of sub-associations whose functions could be fully carried out by the existing trading organizations. As a consequence, the association lost more and more of its prestige after the "B" products had ceased to be part of it. The attempt to organize the association on a broad commercial basis failed owing to strong opposition in various forms.

Trade Currents From Cleveland, Chicago and Philadelphia

Cleveland Letter

The first week of the new year finds the machinery market of Cleveland and northern Ohio district facing a much more prosperous season than was anticipated toward the end of 1919. With the usual retention in all industry due to the inventory-taking activities, there were fewer orders and less inquiry than was anticipated when early fall buying was at its height. There was entirely too much shopping around to please machinery manufacturers and distributors, as this shopping was not backed up any too definitely with prospects for real orders.

The significant feature, in the minds of leaders in the trade here, is that these earlier inquiries now are bearing fruit in the form of orders for new equipment. That the early part of the new year will be even more active than anticipated is being shown by the variety of equipment required. Up to the last month or so the bulk of business has been coming from the automobile industry, or interests related to it. Now, the business is coming forward from general manufacturing. Any tendency toward curtailment of production or lessening of business generally, as has been indicated off and on by authorities supposedly fairly certain of their predictions, has not only failed to develop, but has not even given a hint that it will for an indefinite period.

One factor that probably is stimulating interest among purchasers, and which is aiding considerably, it is believed, toward the enlargement of purchases when it was first thought only a few fill-in machines would be taken, is the announcement of a new price list by the majority of producers. It can be stated here quite definitely that the machinery industry has been unique in the matter of not advancing prices to the apparent limits that other industries have advanced prices for their products. In effect, the first of the year is an average increase of 10 per cent on machinery and equipment, and though a modest increase, it is sufficient to arouse the buying interest.

Several firms report they are booked ahead, some to March, for equipment for general manufacturing and toolroom requirements. The labor problem, in evidence in this industry as in others, has improved with the turn of the year, but not to the extent that shipments are all up to prompt delivery, and it is not unlikely that this condition will continue for some time to come.

A notable event of interest to machinist interests is the celebration this week of the Lamson & Sessions Co., manufacturer of machinists' small supplies, which marked fifty years in business in Cleveland. A feature of the celebration was a banquet at Hotel Cleveland at which three employees, with the firm since its beginning, were present. They are R. J. Gardner, superintendent, and Herman Brown and Louis Brown, foremen. Each received a gold watch and chain as a mark of appreciation for their long service. Sixty employees have been with the firm twenty-five years, and more than 100 for fifteen years.

The company began business at Mount Carmel, Conn., in 1865. The business was moved to Cleveland in 1869. The organizers were I. P. Lamson, S. W. Sessions and Thomas H. Lamson. It became a corporation in 1885. The control of the company has remained within the family through its entire existence.

Chicago Letter

Reversing the usual order of things, business during the week over New Year's Day kept up at an excellent pace. It is true that there were fewer inquiries than in previous weeks and less shopping around by individual buyers to see what they could find in dealers' stocks, but actual sales and shipments show no decrease. A summary of the year's business among all dealers leads to the assumption that in 1919 Chicago did about 80 per cent as much machinery business as in 1918, and a little more than in 1917. Considering the dullness of January and February, and the steel and coal strikes, this is really surprising.

The new year opens with the railroads doing some buying and much inquiring and the great corporations showing signs of interest. The Burlington has just completed extensive purchases and the C. I. & W. R.R. is making inquiries. J. B. Clow & Co. has purchased equipment for its Ohio plant.

Orders for future shipments are heavy on all dealers' books. This condition is accentuated by slow deliveries of goods from the factory. Turret lathes seem to be hardest to get, from three to nine months being required for delivery on current orders, depending on size and make. Engine lathes

(Continued on page 164d)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Shaping Machine, Crank, Heavy-Duty

Perkin & Co., Ltd., Leeds, England.

"American Machinist" (Eng. Edition, Nov. 8, 1919)

Has variable feed, while running, by adjustable eccentric bull wheel; work table, 16⅜ x 12 in., feed both ways. All gear drive gives eight speeds from 10 to 100 ft. per minute. Speed reduction by 4-speed gear box inclosed. Back gears in machine body, operated by steel clutches. Dimensions, over all, 56 x 42 x 54 in.; net weight, 2000 lb.

Grinding Machine, Internal

Ott Grinder Co., Indianapolis, Ind.

"American Machinist," Oct. 23, 1919

Swing, without guard, 12 in., with guard, 10 in.; will grind hole 6 in. in diameter; table travel, 24 in.; will grind tapers 120 deg. included angle; automatic crossfeed, 0.00025 in. to 0.003 in.; diameter of work-spindle bearings, 2 in.; hole through work spindle, 1½ in.; speed of countershaft, 600 r.p.m.; main pulley, 15 in.; work speeds, 85 to 425 r.p.m.; spindle speeds, 8000 to 20,000 r.p.m.; table speeds, 16 in. to 50 in. per minute; floor space, 38 x 70 in.; weight, 1950 lb. The equipment comprises a 12-in. faceplate, combination straight and radial wheel-truing device, 9-in. collet chuck, pump and complete overhead works.

Hammer, Master Sure-Lox Chipping

Keller Pneumatic Tool Co., Chicago, Ill.

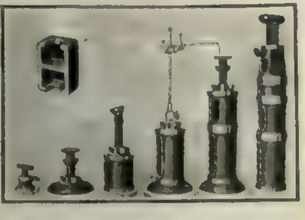
"American Machinist," Oct. 23, 1919

Handle locked to cylinder, without old style clamp bolt, by means of a key in cylinder. Another feature claimed is extra long striking end on the piston, where ⅝ in. is provided instead of the ³⁄₁₆ in. commonly used on clamp bolt types of hammers. This hammer may be furnished with either open or closed handles, piston type of throttle valves, round or hexagon bushings, or other features as specified on order. Made in ten sizes ranging from 1¼-in. to 4-in. stroke with piston diameters of ⅞ to 1³⁄₁₆ in.

Jacks and Bolt Couplers

Roberts Manufacturing Co., New Haven, Conn.

"American Machinist," Oct. 23, 1919

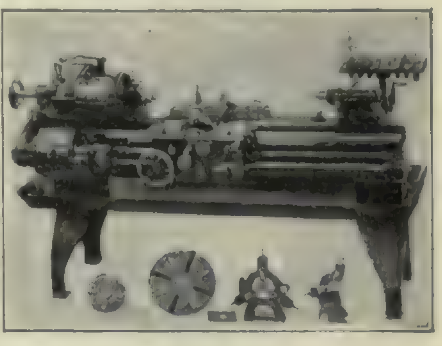


The jacks can be quickly built up to the desired height without the use of bolts or screws as lock joints connect each unit with a simple half turn. Bolt coupler saves making special bolts. Can be used to join two bolts together to get desired length. The equipment not intended for the toolroom, but as part of machine equipment. Jacks made in several sizes having base diameters from 2¼ to 3½ in. and heights of 2 to 5 in. The extension units have varying lengths of 2 to 6½ in. Bolt couplers are made for all standard size bolts from ⅜ to 1¼ inch.

Lathe, Engine, Quick-Change

Rockford Lathe and Drill Co., Rockford, Ill.

"American Machinist," Oct. 23, 1919

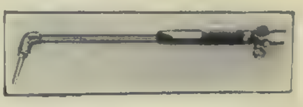


Swing, over ways, 14½ in., over carriage, 8 in.; distance between centers with 6-ft. bed, 37 in.; lengths of bed, 6 ft., 8 ft. and 10 ft.; spindle bearing (front), 2⅜ x 4 in., (back), 1⅞ x 3 in.; hole through spindle, 1⁵⁄₁₆ in.; ratio of back gears, 3.42 to 1 and 9.07 to 1; width of belt, 2½ in.; spindle speeds, 20 to 435; will cut threads from 4 to 56 per inch; feeds, 18 to 252 per inch; weight with 6-ft. bed, 1600 lb.; shipping weight, with 6-ft. bed, 1850 pounds.

Torch, Airco Welding

Air Reductions Sales Co., 120 Broadway, New York, N. Y.

"American Machinist," Oct. 23, 1919

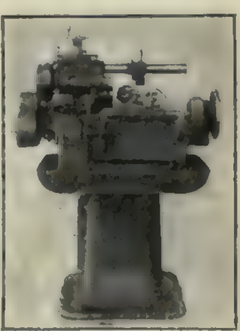


Strong, light construction and easy to handle; has pressure table on handle; both handles on left side; tubes of seamless tubing; mixture automatic; tip of special alloy; drop-forged head; torch made in four sizes.

Gear-Hobbing Machine No. 2

Barber-Coleman Co., Rockford, Ill.

"American Machinist," Oct. 23, 1919

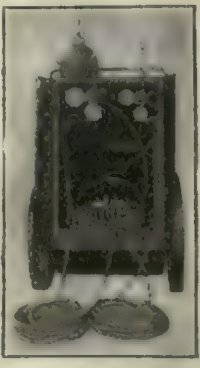


Capacity, diameter, 3 in.; width of face, 7 in.; diametral pitch, 24 and finer; diameter hob spindle, ½ in.; maximum diameter hob, 1¼ in.; taper hole in spindle, No. 9 B. & S.; floor space, 27 in. by 42 in.; driving pulley, 6 in. by 1⅜ in.; speed of driving pulley, 800 r.p.m.; number of changes of hob speed, eight; range of hob speeds, 200 to 800 r.p.m.; range of feed per revolution of work, 0.015 to 0.150 in.; net weight, 950 lb.; shipping weight (crated), 1,200 lb.; shipping weight (boxed), 1,360 lb.; measurements of box, 48 x 34 x 62 in.

Truck, Cutting and Welding Outfit

Davis and Bournonville Co., Jersey City, N. J.

"American Machinist," Oct. 23, 1919



Width over all, 31 in.; depth over all, 28 in.; height over all, without cylinders, 45 in.; height, over all, with cylinders, 56 in.; net weight, without equipment, 163 lb.; net weight, with full equipment, 500 lb.; diameter of wheels, 24 in.; face of wheels, 2½ in. The cabinet is so designed that when fully equipped the operator has only to open the doors, take down the torch, turn on and adjust the gases to be ready for work.

Clip, paste on 3 x 5-in. cards and file as desired

require from two to eight months, planing machines from three to six months and boring mills from three to five months. The machines most scarce in the market today are drilling and punching machines, about sixty days being required for delivery.

Collections have been excellent throughout the year and stocks are low; therefore, all dealers are in excellent condition financially. The optimism with which they view the coming year presents a sharp contrast to the feeling pervading the trade last January.

But a small quantity of new industrial enterprises is now being announced in the Chicago district. The Excell Motor Truck Co. has let a contract for the erection of a $300,000 factory and the Chicago Coated Board Co. is contemplating a three-million dollar plant, but the date of commencing work thereon is still undetermined. It is thought that when the holiday lull is passed, industrial announcements will be made with greater frequency.

Philadelphia Letter

Indications are that 1920 will be the banner year for the machine-tool industry. Practically every line of manufacturing has entered the machine-tool market. The automobile houses and the makers of auto accessories, as usual, lead the field in this respect, but it would be difficult to say just which of the various other kinds of producers rank second in their demands for machine-tool equipment. Even such companies as manufacturers of linoleum and the various silk mills are persistent with inquiries for machinery with which to repair their present supply.

Business is so brisk that machine-tool dealers are perfectly well satisfied to have the railroads, car builders and locomotive plants keep out of the market for the present at least. Delivery has become so much delayed, owing to the tremendous demand for machinery, that an entry now of the railroads with their usual long lists of requirements would only confuse matters rather than help the machine-tool business.

Machine-tool nouses experience no fear regarding the disposal of goods on hand. High-grade material is snapped up almost as soon as it appears in a dealer's showroom. Second-hand equipment is inspected a little more critically but this, too, is meeting with a constant demand.

A large manufacturer of power presses is now searching for a four- or five-acre plot of ground near Philadelphia on which to erect a plant having some 100,000 sq.ft. of floor space. Labor conditions in Philadelphia and vicinity are better than where this firm's present plant is now situated.

Turret lathes and disk grinding machines for the manufacture of piston rings are in constant demand, and Philadelphia houses are quoting on June and July delivery for these goods.

The L. R. Meisenhelter Machinery Co., situated at 4th and Arch Sts., suspended operations after the first of the year.

The E. G. Budd Manufacturing Co., manufacturer of auto steel bodies, has recently placed an unusually large order for grinding machines and various other types of machine tools, with a Philadelphia concern.

The Wicaco Screw and Machine Works, 7th and Woods Sts., has denied the rumor that it will take up the manufacture of gear cutters along with its usual machine-screw output.

The Sherritt-Stoer Co., Inc., now holding offices in the Finance Building, will move to its new warehouse and office building at 20th and Market Sts. in about a month.

Personals

W. G. Cookman is no longer connected with the United States and Cuban Allied Works Engineering Corporation, 50 Broad St., New York City.

Clyde W. Blakeslee, Chicago manager of the Abrasive Co., has resigned to become associated with the N. A. Strand & Co., as general sales manager, with headquarters in the Machinery Hall Building, Chicago, Ill.

Walter E. Sargent, formerly of Detroit, is now connected with the New York sales office of the B. M. Jones & Co., Inc., 192 Chambers St., New York City, selling agents for mushet steels and Taylor iron.

F. W. Sinram, president of the American Gear Manufacturers' Association, was elected president of the Van Dorn & Dutton Co., Cleveland, Ohio, at the last meeting of the board of directors. Franklin Schneider was elected vice president at the same meeting.

A. A. Blue has been appointed by the Duff Manufacturing Co., Pittsburgh, to take charge of its heat-treating department. Mr. Blue is a graduate of the chemical engineering department of Cornell University. For two years he was connected with the Midvale Steel Co. in the heat-treating department, and during the war served as assistant superintendent of heat-treating and forge shop of the gun plant at the Watertown Arsenal.

Frank O. Wells, president of the Greenfield Tap and Die Corporation, has sold his entire holdings to Frederick H. Payne, vice president. Mr. Wells retires as president and member of the board of directors, and Mr. Payne has been elected president in his place. F. G. Echols, vice president and general manager, has been elected a director of the corporation to fill the vacancy caused by the resignation of Mr. Wells, but Mr. Wells will remain with the corporation in an advisory capacity.

Business Items

The Production Machinery Co., a new corporation that will manufacture machine tools, has leased a newly constructed building at 329-331 East Pearl St., Cincinnati, Ohio.

The Dayton Pipe Coupling Co. has installed additional equipment to its forge department and has 90 x 100 ft. more space to this department. In the machine and tool departments a number of lathes, milling, planing and shaping machines have been added.

Marshall & Huschart Machinery Co., 17 South Jefferson St., Chicago, Ill., has made extensive additions to its office. Space on the ground floor has been glassed in for the sales force, and a rest room for the women employees has been fitted up on the second floor.

The Reising Arms Co., West Hartford, Conn., has been organized to manufacture and deal in machinery, machine parts, etc. The organizers are William Ainslee, of the Ainslee Machine and Tool Works, West Hartford, and J. S. Woodward, 12 King St., Hartford, Conn.

Chas. W. Lawser, president, and Allison Sharp, vice president and treasurer of the Wicaco Screw and Machine Works, have purchased a tract of land at Wayne Junction, Philadelphia, Pa. They are erecting a three-story office building and a two-story factory of 50,000 sq.ft. floor space, fully equipped with modern machinery for the manufacture of screw-machine products and thread milling. This company was established in 1868 and incorporated in 1915.

Forthcoming Meetings

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Second Annual Aëronautical Exposition of the Manufacturers Aircraft Association, Inc., will be held at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, on Mar. 6-13, 1920. S. S. Bradley, 401 Fifth Ave., New York City, is the general manager.

January 22, 1920 American Machinist Vol. 52, No. 4

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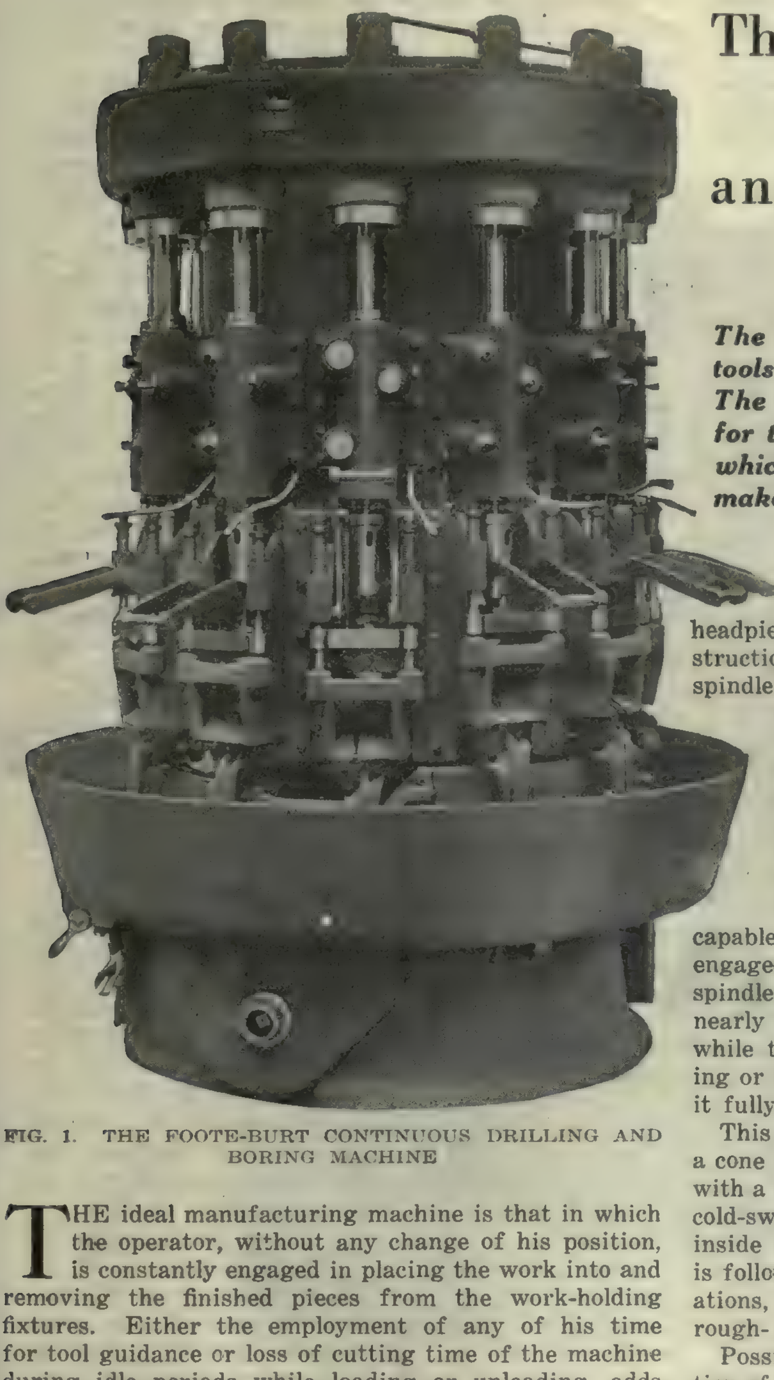


FIG. 1. THE FOOTE-BURT CONTINUOUS DRILLING AND BORING MACHINE

The Foote-Burt Company's Continuous Drilling and Turning Machines

By J. V. Hunter
Western Editor, *American Machinist*

The development of some of the latest machine tools shows the trend in manufacturing methods. The high cost of labor accounts in a large part for the commercial exploitation of these tools, which are now more than ever serving to make every moment of a man's time productive

THE ideal manufacturing machine is that in which the operator, without any change of his position, is constantly engaged in placing the work into and removing the finished pieces from the work-holding fixtures. Either the employment of any of his time for tool guidance or loss of cutting time of the machine during idle periods while loading or unloading, adds to the overhead cost of manufacturing.

General attention has recently been attracted to the developments in the line of continuous milling. Machines for continuous drilling and turning operations advance manufacturing methods still further. Some of these are continuous in the true sense of the word, and lose no time while indexing either the work or the cutting tool from one operation to the next.

The Foote-Burt Co., Cleveland, Ohio, is building the line of continuous drilling and turning machines described in this article. These are essentially single-purpose machines, designed to function with precision of movement on either a single or a simple combination of cutting operations.

The machine shown in Fig. 1 which appears as the headpiece of this article, illustrates the type of construction which has been employed. This is a 12-spindle continuous boring or drilling machine which is tended by only one operator. Twelve spindles! One operator! Can the reader realize the great significance of these two points with their productive possibilities and the low labor cost ratio of a machine where one operator can successfully attend 12 working spindles, each spindle constantly producing to the full limit of its cutting capacity? What labor can be found today capable of attending 12 or even four lathes per man engaged in a simple boring operation? The ordinary 4-spindle gang drilling machine reaches the capacity of nearly every operator on single drilling operations, while the operator of this 12-spindle continuous drilling or boring machine does not overtax himself to keep it fully at work.

This machine is arranged to bore out the center of a cone forging for a roller bearing. The cone is forged with a taper on the outside, and after this operation it is cold-swaged so that the outside is cylindrical and the inside is finished to the required cone-shape. This is followed by a simple combination of machining operations, on machines that will be described later, which rough- and finish-turn the outside and face off one end.

Possibly the reader can better understand the operation of this machine, from the statement that everything seen of the machine, Fig. 2, above the chip pan, revolves constantly around an inside center column. In other words, all of the fixtures, spindles and spindle heads which constitute the upper structure of the machine are steadily moving toward the observer's left as he stands before it. When viewed from above the machine, this would be in clock-wise rotation. In operation, the spindles of the machine do not feed longitudinally, but the feed is obtained by a constant rising of a saddle which carries each fixture. This occurs individually as the fixtures proceed in their course around the column of the machine and is governed by the cam *A*, which surrounds the column. The cam has a helical surface on which runs a roller *B* on the inside of the bracket *C*, that forms the lower

portion of the fixture. The work-holding fixture *A*, Fig. 3, is a portion of a saddle which slides in ways *B* finished on the sides of the main superstructure. The saddle is held in place by the gibs *C*. The helical surface of the cam starts and continues the feed while the fixture proceeds in its rotation by constantly lifting the work against the tool until it again comes to the loading station where the feed roller on the fixture reaches a drop in the cam that permits the saddle to fall into the starting position, where it remains long enough for the fixture to be reloaded.

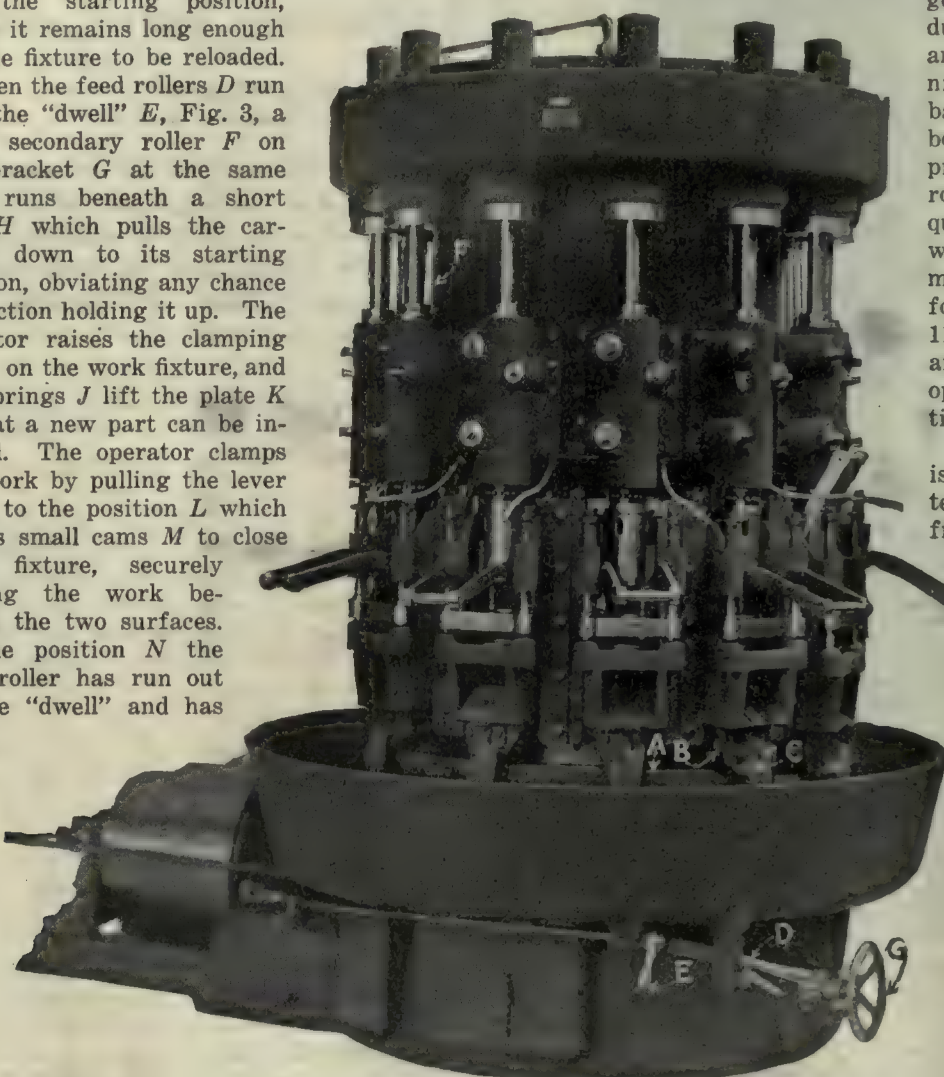


FIG. 2. SIDE VIEW OF CONTINUOUS DRILLING MACHINE

When the feed rollers *D* run onto the "dwell" *E*, Fig. 3, a small secondary roller *F* on the bracket *G* at the same time runs beneath a short cam *H* which pulls the carriage down to its starting position, obviating any chance of friction holding it up. The operator raises the clamping arm *I* on the work fixture, and the springs *J* lift the plate *K* so that a new part can be inserted. The operator clamps the work by pulling the lever down to the position *L* which causes small cams *M* to close the fixture, securely holding the work between the two surfaces. In the position *N* the feed roller has run out of the "dwell" and has climbed onto the main cam surface bringing the work into contact with the tool, thus starting the boring or drilling operation. Unfortunately, neither tools nor work are shown in the illustration.

The spindles have a vertical adjustment of 8 in., making it possible to take care of the wear on the tools, and also to raise the spindle for removal of the tool. To raise or lower the spindle, the two clamping bolts *O* are released and a wrench applied to the square head of the pinion *P* which engages with a rack on the quill. The spindles have upper and lower ball bearings, the lower bearing distinctly showing in this view.

On the bed is mounted a heavy column which carries all of the rotating superstructure or spindle body and the weight of this is borne by means of ball bearings. The spindle body is steadied and held in accurate position by means of long bronze-lined bearings. Ball bearings are an unusual feature in such a position on a machine tool, but it must be realized that the operating and cutting functions of this machine are all self-contained and carried on the sides of the spindle body casting so that these bearings actually have no influence on the quality of the work produced.

Power is furnished to the machine by belt drive to a three-step cone pulley. The spindle head is rotated by a drive from the main shaft through a set of change gears which have further reduction through a worm gear, and this drives a pinion running in an internal gear in the base of the rotating-spindle body. The change gears are provided so that the speed of rotation can be altered if required by the character of the work or the material. The machine as shown is timed for one complete rotation in 110 sec. This indicates that after once being started in operation, its possible production is 392 pieces per hour.

The drive for the spindles is carried up through the center of the column by a shaft, from which suitable gearing connects to all spindles, and these all run continuously while the spindle body rotates. Its rotation may be stopped at any time by means of the control lever *D*, Fig. 2, which of course stops all feed to the tools, although these will continue to revolve until the power is shut off from the whole machine by the lever *E*. This lever disengages a friction clutch in the large end of the cone pulley on the main drive shaft.

The total height of this machine is 8 ft. 6 in. and the diametrical distance from center to center of the work spindles is 48 in., while their chordal center to center distance is 12½ in. The coolant is pumped from a reservoir at the base of the machine to the center of the top and then down into a hollow chamber which runs around the whole spindle-body casting. Holes drilled and tapped into this chamber connect the numerous coolant supply pipes for the spindles. All coolant and chips are collected by the trough about the base of the machine, and after separation of the coolant from the chips the former returns to the storage reservoir.

The lubrication of the machine has been made as near fool-proof as possible. A circulating pump constantly forces oil from a large storage chamber, provided in the base, to the upper portion of the spindle head. The latter is kept full of oil and from each upper spindle bearing a small tube *F* carries a supply

down to the spindle bearings, from which the surplus is drained back into the spindle body by a small overflow hole. The lubrication of the slides must be taken care of by the operator, as it is not practical to have self-lubricating devices on them. When making adjustments on the tools or setting up the machine the operator can turn the column by means of the handwheel *G* which rotates it through the regular gear drives.

The ability of such a machine will be noted for taking care of drilling operations where the drill must pass through two walls of a casting having an intermediate space between them. After feeding through one wall of the casting the cams can give a rapid advance for the interval while the drill is idly feeding through the intervening space and then can again be slowed down for the second cut. This system could be applied indefinitely if there were a large number of short cuts to be made, but the particular adaptations which one could consider for such work would be the drilling of the pin hole through a piston or drilling through two sides of a clevis.

In making a study of the turning and facing machine, we find that it is somewhat similar in general appearance as shown by the view of the loading side, Fig. 4, but it differs vastly in many of its operating details. The loading station occurs at a point slightly to the left of the center and at this point the feed rollers descend from the operating surface of the cam into the "dwell." In the drilling machine the tools are revolved by the spindles and the work is stationary, while this machine, in true lathe fashion, carries the work on the spindle and the tools are stationary. The production possibilities of this machine are amazing. It is as though one operator could take care of eight

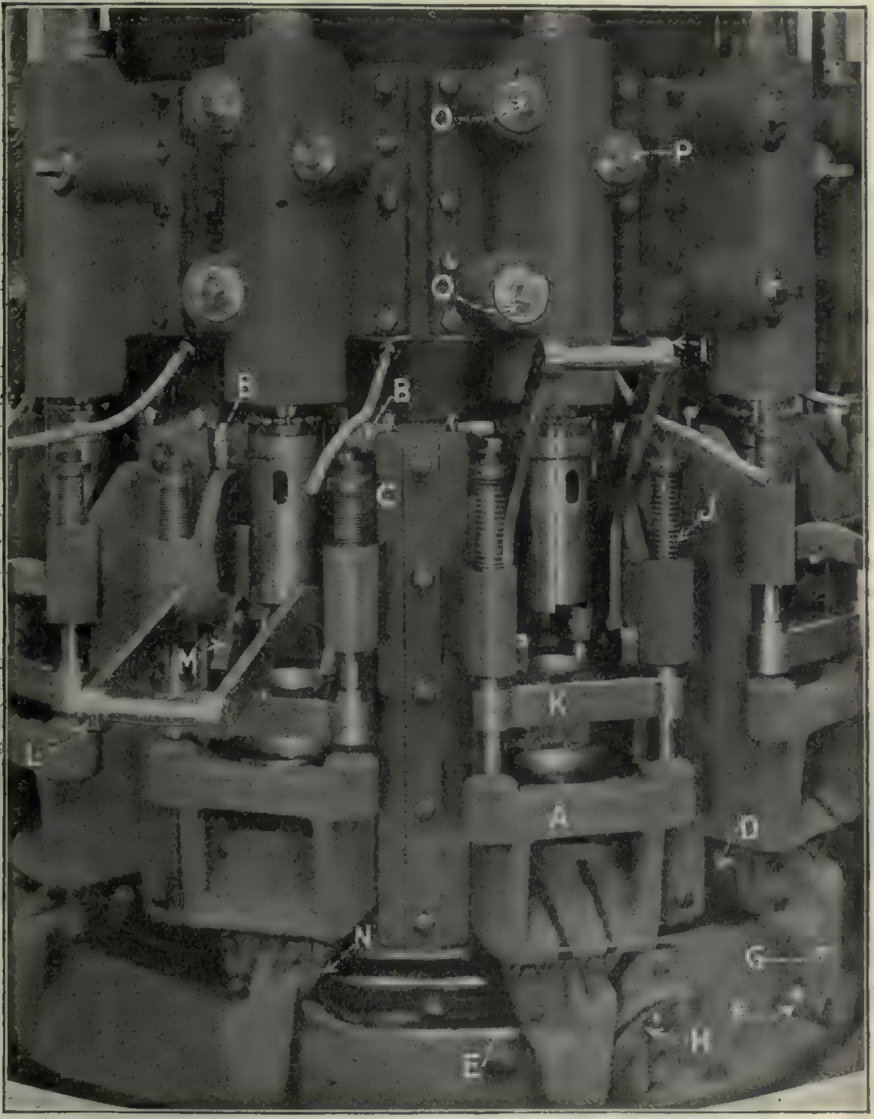


FIG. 3. THE WORK-HOLDING FIXTURES AND DRILLING SPINDLES

single-purpose lathes each engaged simultaneously on a very short turning and facing operation.

This machine has eight spindles or stations, and each of these constitutes what can practically be considered a complete lathe including the headstock, tailstock, tool carriage and crossfeed slide. The head and tail stocks and crossfeed slide ways have no motion on the column, while the longitudinally fed turning tool is carried on a long saddle which slides in vertical ways corresponding to the bed of a lathe, and is fed upward by a roller acting on the cam surface in the same manner as in the drilling machines.

The illustration of the operating parts of the machine, Fig. 5, shows the spindle at the right empty, with its feed roller *A* just entering the "dwell" of the cam

and its tailstock B drawn back to permit the insertion of a fresh piece of work. In the spindle station at the left the tail spindle C has been raised, holding the work D in place against the cone-shaped section of the headstock which may be seen at E on the other spindle. A flange F on the upper end of the tailstock spindle comes against the base of the work and rides on a ball-thrust bearing. The tailstock spindle is closed by swinging the handle G from left to right, and is then held by a trigger H which catches in a small notch and holds it until released by the operator.

On this machine there are two distinct tooling operations. The first is by two tool bits K and L carried in the block J; the upper taking a roughing cut and the lower following with a finishing cut. The reader should understand that the tool feed is governed by the roller A which mounts onto the cam M from the "dwell" at the loading station, shown in the center of the view. As the spindle column continues its rotation, the roller is constantly mounting on the helical surface of the cam and raising the tool carriage N with a constant rate of feed. To remove the chips which might fall on the cam surface before the roller, a sliding, spring-controlled felt pad is provided.

The motion of the tool carriage N also provides the feed for the cross-slide P. A diagonal slot cut in the side of the tool carriage guides a roller on a stud on a cross link. When the main tool carriage is lifted, this diagonal slot pulls the link toward the left, causing the toolholder to be drawn in toward the center of the spindle at a constant rate of feed so that its tool faces off the upper surface of the work. When the main spindle head of the machine has completed one revolution and the roller again drops into the "dwell," the reverse motion in the diagonal slot causes the cross-slide to return to its original position. A large notch in the diagonal slot provides a short, quick action to relieve the tool from the work at this time.

The cone-surfaced arbor E is provided with a number of steel balls rolling in inclined ways which act at any slippage of the work and rise higher in their grooves, thus locking it more tightly into position. It was found that the use of a plain cone did not prevent the work from turning during the cut, but this method holds securely under all service.

The general internal design of the turning and facing machine is similar to that of the boring and drilling machine, but among a few of the features are the headstock spindles which, like those of a lathe, have no end adjustment. Should it be desired to adapt this machine for other classes of work which would require it to carry tools for such operations as boring or facing where it would be necessary to remove the cone-shaped arbors, a special arrangement has been made for drifting them out of the spindle. The small cover plate A, Fig. 6, may be swung to one side uncovering a drift-pin hole in the hollow spindle, from which an auxiliary pin extends to the shank of the tool,

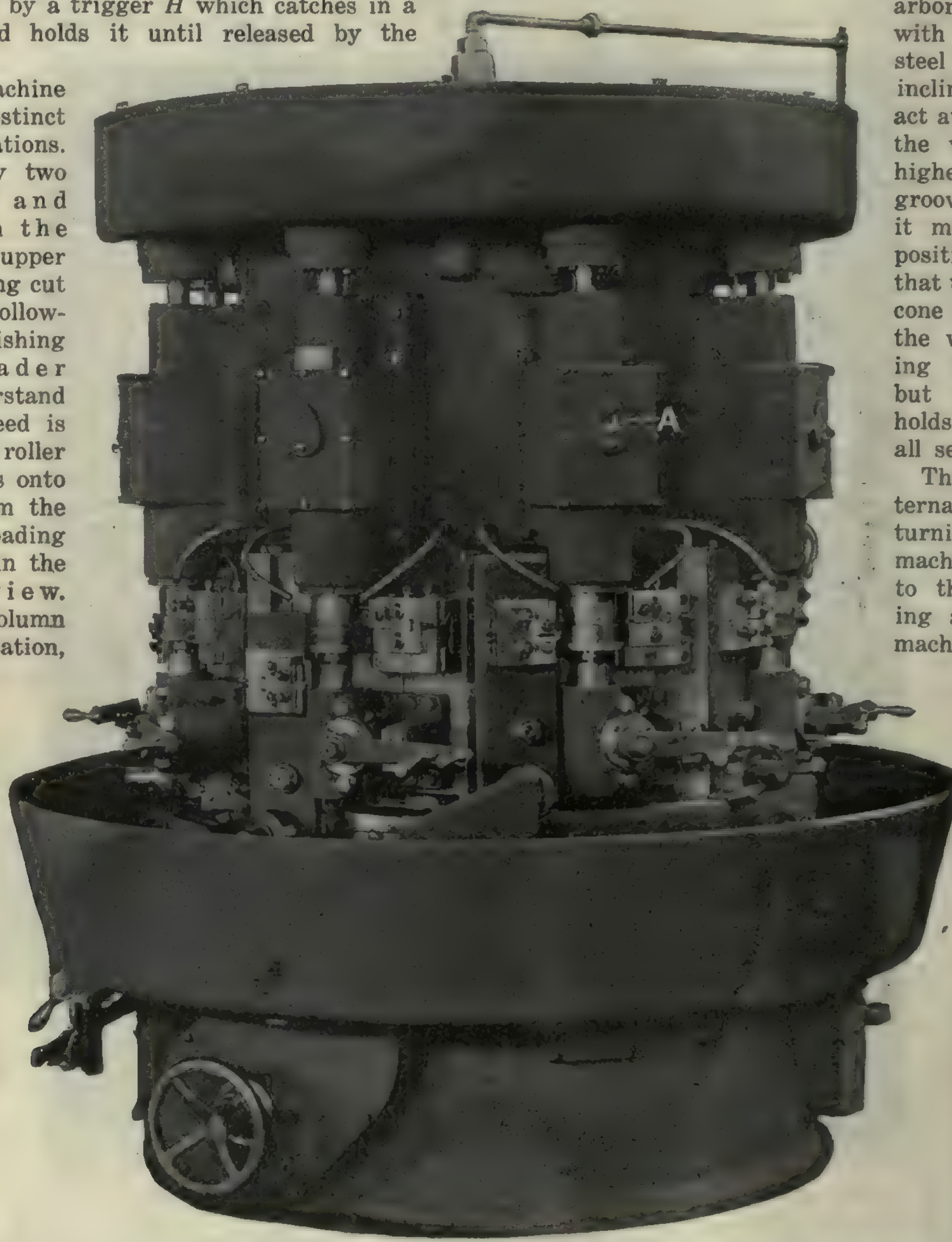


FIG. 4. LOADING SIDE OF THE FOOTE-BURT CONTINUOUS TURNING MACHINE

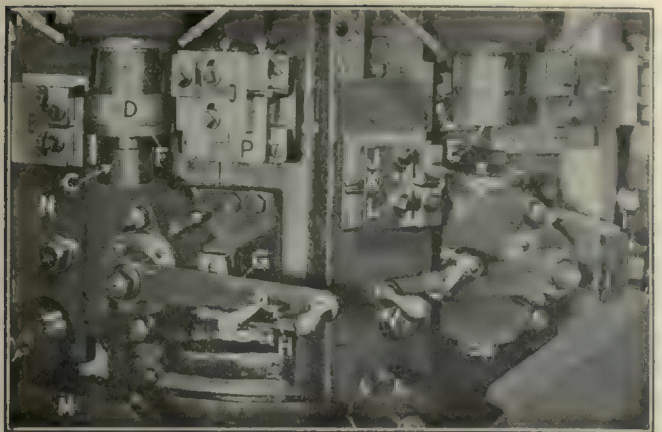


FIG. 5. THE TOOL MECHANISM FOR TURNING AND FACING OPERATIONS

thus affording an aid for its removal when desired. The machine as set up for this operation runs with a spindle speed of 75 r.p.m. and has a tool feed of 0.00975 in. per revolution. The spindle speed is judged proper for this particular piece of work and is geared down from a pulley speed of 300 r.p.m.. At this speed and feed the total time per cycle of the machine is 3.6 min., or 16.6 revolutions of the spindle head per hour. This gives a rate of machine production equal to 132 completed pieces per hour.

The success of the two machines described leads to the hope that they will be more fully developed for application to a variety of work beyond that for which the present ones were designed. There seems to be no doubt but that with the rising cost of labor there will be an increasing demand for machines of this character, where the time of the workman can be constantly employed in handling the work, rather than in waiting for the machine to complete each successive cut. A factor to be considered is that the workman remains constantly at the loading station while the machine is operating, and with modern production methods this enables the arrangement of a shop so that the parts may be brought to him from one side by any of the usual transportation methods, and, after passing through his machine, can be carried away on the farther side by conveyors, thus making production almost a continuous process.

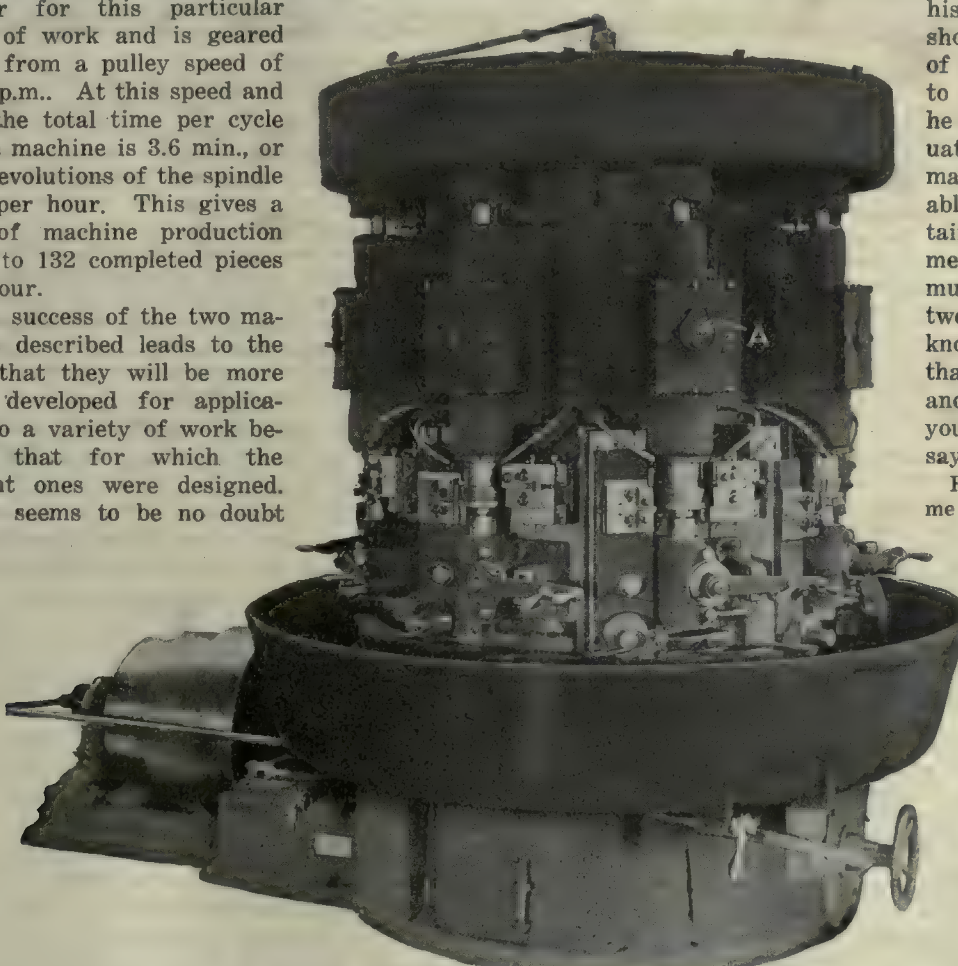


FIG. 6. SIDE VIEW OF CONTINUOUS TURNING AND FACING MACHINE

The Status of the School Shop

By W. D. Forbes

It would seem from what Professor Phillips said on page 650, Vol.. 51 of the *American Machinist*, that I have little respect for professors. If I conveyed that idea I am indeed sorry, for I did not at all mean to reflect on the profession of teaching in my answer to the professor's questions as to the status of craft-school graduates. A man with the experience of Professor Phillips is, to my mind, the ideal instructor and I consider the young men under his direction to be fortunate.

In my letter published on page 122, Vol. 51, I answered Professor Phillips' previous questions, as to whether or not a craft-school graduate should be given credit for his school work and who should determine the amount of that credit; now I will try to answer the other question he asks as to what the graduate should know and what machine tools he should be able to handle in order to obtain a reasonable credit. (Let me say at once that there must be a clean cleavage between what a young man knows and what he can do—that is, between knowledge and skill.) I would take the young man to a bench and say:

Here are some castings. Show me which is cast iron; which malleable; which steel; which composition.

Which of these pieces of bar material is cast, or tool steel? Which is machine steel?

If you were in doubt as to whether a piece of bar material was tool steel or not, how could you satisfy yourself as to its quality?

Do you know what are drill rods? What quality of material is in such rods? Do you know what screw-machine stock is, and how it differs from drill rods?

What are the ordinary market forms of steel, iron and brass usually required in a machine shop?

Do you know that steel tubes can be obtained that are finished bright and quite close to size, both in the bore and the outside diameter?

If you wanted a piece of sheet metal, how would you designate its thickness?

If you wanted a piece of octagon stock, how would you specify the size—measured across the flats or across the corners?

What do you know as to the sizes of ordinary pipe?

Show me a setscrew; a capscrew; a fillister-head screw; a bolt. What usually goes with a bolt that does not go with other kinds of screws?

Has the setscrew more than one kind of end? What condition is usual in a setscrew which is not, as a rule, found in other screws?

How are the sizes of small screws designated? What forms of thread are used in this country on bolts and screws? Are there standard pitches for various diameters of screws? What do you understand by the pitch?

In asking for a screw or bolt, what measurements would you give? Have you ever been warned that half-inch screws and bolts of two different pitches are to be commonly found on the market?

What are the three styles of finish obtainable for nuts? What are the two usual forms of nuts? What is a washer?

How does the threading of pipe differ from that on bolts and screws? Why does this difference exist?

How would you designate a taper pin?

How would you ask for a piece of belting? Can you lace a belt? How have you been taught to run a belt—with the flesh side or the hair side next to the pulley?

Here are a lot of tools: show me a reamer; a tap; a drill; a counterbore; a countersink; a drill chuck; a lathe dog; a drill holder.

Name the several styles of reamers and files you see before you.

What are the two styles of shanks usually on twist drills?

Are there several kinds of lathe dogs? What are they called?

How are the small taper reamers designated?

What are the two styles of fixed gages?

What is an arbor? Point out a surface gage; a depth gage; a thread gage.

What are the names of the three taps that make up a set?

In this set of lathe tools show me a side tool; a diamond point; a half diamond point; a threading tool; a parting, or cutoff tool; a boring tool; an inside threading tool.

Which of these tools is of the proper shape for use on brass or soft metals?

How, and with what, do you set a thread tool?

In this lathe, what are the main parts of the machine?

Throw in the back gearing; set the lathe so as to use the direct drive of the cone.

How do you take out the live center when the lathe has no hollow spindle? How do you take it out when the spindle is hollow? How do you get out the dead center? How do you start and stop your lathe? Can you run the lathe backward? How is this done?

Can you change the direction of the feed; that is, make the carriage run toward the headstock or toward the tailstock? How is this done?

Show me how to set up the lathe to cut a 12-pitch thread. Do you always have to run the lathe back in cutting a thread? How do you tell whether or not you can drop out in cutting a thread?

If the crossfeed screw has a micrometer dial divided to show thousandths, how much would you reduce the piece being turned if you set in the tool two divisions?

If you find that the lathe is turning taper how could you correct the trouble? Do you know what a taper attachment is?

What are the three styles of chucks usually found in a machine shop?

Have you been shown how to swing up a piece by using an angle plate? Why do you have at times to counterweight work when it is swung up?

Do you know what a draw-in chuck is?

When you are to start work on a lathe or any machine tool, what should first be done? How should you leave a tool?

What is the reason that the belts on a planing machine are much narrower than those used on other machine tools? Why is it that such machines usually have no way to change speeds?

When you bolt work on a planing machine, what must be avoided in order to insure that the work shall come out true?

When you take a side cut or down cut, which way must you swing the clapper box to avoid dragging the tool?

Would you rough a piece all over first before taking any finishing cuts? If so, why?

Can you start and stop the platen of a planing machine without handling the belt shipper? How is this done?

What is a "bunter?" How do you use it?

Show me a good tool for roughing cast iron. What name do you give to the stops that govern the stroke of the platen?

In this drilling machine, how do you put on the power feed? Why is a lever feed advisable at times? What is the advantage of the worm feed?

Can you tell me what distinguishes the horizontal from the vertical boring mill? What is it that makes the horizontal boring mill, milling machine, and the drilling machine common as to the cutting tools?

What can you tell me about the grinding machine? On what material is it of special value? Do you know enough of the screw machine to tell me for what class of work it is best suited? Do you know of the flat turret lathe? The slotter? The chucking lathe?

In grinding any hardened tool what must you be careful to avoid?

Tell me how you would harden and draw a tool which is too soft.

Do you know how to use the cutting-off machine?

What causes a power hacksaw to cut crooked?

What is a bolt machine? Can you do any other work on a bolt cutter than threading?

Have you any knowledge of gear cutting?

What instructions have you had as to the speed at which work should be run on various metals?

How are grinding wheels designated?

Can you read drawings? Have you had any instruction in making drawings?

Can you read a micrometer?

Set these calipers to one inch on this scale for a shaft. Set these inside calipers to one inch for boring a hole.

How are scales usually divided?

If you get a set of taps from the toolroom would you ask the toolkeeper for anything besides the taps? Have you been taught the size of drill to use with half-inch taps, or do you ask for a "half-inch tap drill?"

In almost all these questions the point is to get a general idea as to what knowledge the young man possesses and upon what lines he has been instructed.

The answers would not, of course, show the candidate's skill but I think any student should answer all the questions if he had completed his course, and no doubt he could go very much further in showing what he had been taught.

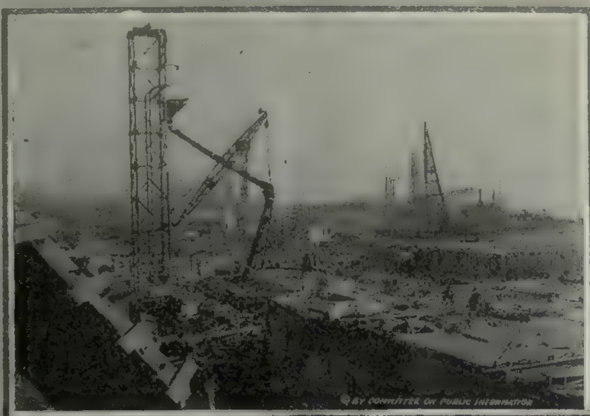
In order to test his skill I would give him drawings, one of which would be a machine-steel shaft calling for several diameters, and one end of which would be threaded. Another drawing would show some faceplate work calling for a bored hole, an internal thread to fit a gage, and faced off. Another drawing would require the use of an arbor.

On the planing machine I would give him a piece of work that required to be squared up on three sides and brought to given sizes. On the milling machine all I would ask would be that the young man finish a key having a head, and square a tap or bolt head with an end mill. I would ask for no work on either style of boring mill but the setting of a piece of work.

All this would show skill, but if the work came out well I would pay very little attention as to the time taken. If the work was done in what I considered commercial time I would add to his credit not in time, but pay. If the questions were satisfactorily answered I would allow 18 months on his four years' time.

Let us have a word from Professor Phillips as to his views on my questions.

Pre-assembly in Ship Construction



By
R. D. Gatewood,
COMMANDER U. S. N.
U. S. NAVY YARD,
PHILADELPHIA,
PENN.

II. Foundations

This completes the data concerning the methods by which a shipyard with only 12 slips is turning out an 8800-ton ship every two weeks.

WATER-TIGHT FLAT. — This is assembled complete with the deck beams, fore-and-aft girders and deck plates. All the work is riveted. The only connections not being on this flat are the staples to shell which are lifted from ship. From bulkhead No. 10 to frame No. 18 these staples form the regulating point and the work is lifted to suit conditions. From frames No. 8 to No. 10, which is inside the afterpeak, these staples are gotten out from the loft and riveted to the flat, holes being left blank to shell. Up to and including hull No. 16, these staples were lifted from the ship and riveted on the ship. This work forms one of the most difficult jobs that could possibly be developed in any shipyard work. It is of such a difficult nature that the best mechanics available can, in very rare cases, make a first-class job. On testing the tank, due to the inferior workmanship which was possible by doing the work in this way, trouble was experienced in getting this tank passed.

BOILER AND ENGINE CASING; UPTAKE COVER AND BULKHEADS NO. 82 AND NO. 84.—These sections are assembled and riveted complete with the exception of bounding angles to the decks. The bounding angles are left loose for fairing up and regulating the casing to the deck. No trouble has been experienced up to the present time by the method employed. The saving on staging alone by erecting this section on the ground has been the means of the early beginning of work in the boiler and engine space, which could only be possible by this assembly.

TRANSOM.—This section is assembled complete including transom bulkheads, floors, frames, beams, shell plates M-1, M-2-3 and M-4, port and starboard. This section is riveted complete. Side frames No. 1 and No. 2 have just recently been put with this assembly and are valuable for fairing up L-1 and M-4 shell plates. See Figs. 13, 14 and 15.

CHAIN LOCKER.—This is a box extending from frame No. 167 to No. 170. The bottom of this box is 18 in. above the second deck. Beginning with the eighth boat this section was assembled, riveted and calked complete. Owing to this box being such a short distance from the deck, the work of riveting was in such a tight place that it could not be performed by the best workmen advantageously. By ground assembly this becomes work that can be performed to advantage, instead of work that is closely difficult.

The foundations are composed of small pieces which become misplaced. To overcome this all foundations are assembled in the shop and sent to the ship in units. In many cases work becomes difficult or inaccessible when these foundations are riveted; consequently, each and every foundation is dealt with separately and only those foundations that do not present obstacles in construction by being in a permanent piece are riveted.

Auxiliary - Condenser Foundation — This foundation is assembled in two pieces and bolted only.

Auxiliary Circulating-Pump Foundation.—These foundations are assembled and riveted complete.

Ash-Hoisting-Engine Foundation.—This section is assembled, bolted and reamed, but not riveted.

Ballast-Pump Foundation.—This unit is completely assembled and riveted, except angle connections to tank top, which are left loose.

Condenser-Pump Foundation.—Same remarks apply as to ballast-pump foundation.

Chain-Stopper Foundation.—Same remarks apply as to ballast-pump foundation.

Evaporator Foundation.—This section is assembled and riveted complete, except two angles connecting to the bilge brackets and angles to the tank top which are left loose for adjusting.

Engine-Room Bilge-Pump Foundation.—This unit is assembled and bolted only.

Engineers Oil-Tank Foundation.—This foundation is assembled and riveted complete, except the three angles which connect to bulkhead No. 70. These angles are left loose for regulating.

Feed-Water-Heater Foundation.—This section is assembled complete, except the four angles which connect to bulkhead No. 83, these angles being left loose for adjusting.

Feed and Fiber-Tank Foundation.—This section is assembled, bolted and reamed only, all connections being left loose for fairing up or connecting other parts accessible.

Feed-Pump-Manifold Foundation.—Material for this foundation is assembled and bolted only.

Fuel-Oil Service-Pump Foundation.—This unit is assembled complete and riveted, except the angles to bulkhead No. 83, which are left loose for fairing up.

Fuel-Oil Transfer-Pump Foundation.—This unit is assembled and riveted complete, except the connections to the bilge brackets and tank top which are left loose for regulating.

Fuel-Oil Settling-Tank Foundation.—This foundation is assembled and bolted together where more than one piece is in a section.

Fresh-Water-Pump Foundation.—This foundation is assembled and riveted complete, except the two angles connecting bulkhead No. 70 which are left loose for fairing up.

Fire and Bilge-Pump Foundation.—This foundation is assembled and riveted complete, except the angles connecting bulkhead No. 83 and tank top angles which are left loose for fairing up.

Gravity-Tank Foundation.—This foundation is assembled and riveted complete.

Lubricating-Oil-Cooler Foundation.—The material for this foundation is bolted together and shipped out as a unit, no riveting being done.

Lubricating-Oil-Pump Foundation.—This foundation is bolted together and shipped out as a unit, no riveting being done.

Main Feed-Pump Foundation.—This foundation is assembled and riveted complete, except the angles connecting tank top and bulkhead No. 83 which are left loose for adjusting.

Main Circulating-Pump Foundation.—This foundation is assembled and riveted complete, except the tank top angles which are left loose for regulating.

Oil-Heater-Bracket Foundation.—This foundation is assembled and bolted together, no riveting being done.

Refrigerator-Machinery Foundation.—The material for this foundation is bolted together and shipped out as a unit, no riveting being done.

Sanitary-Pump Foundation.—This foundation is assembled and riveted complete, except the two angles connecting bulkhead No. 70 which are left loose for fairing up.

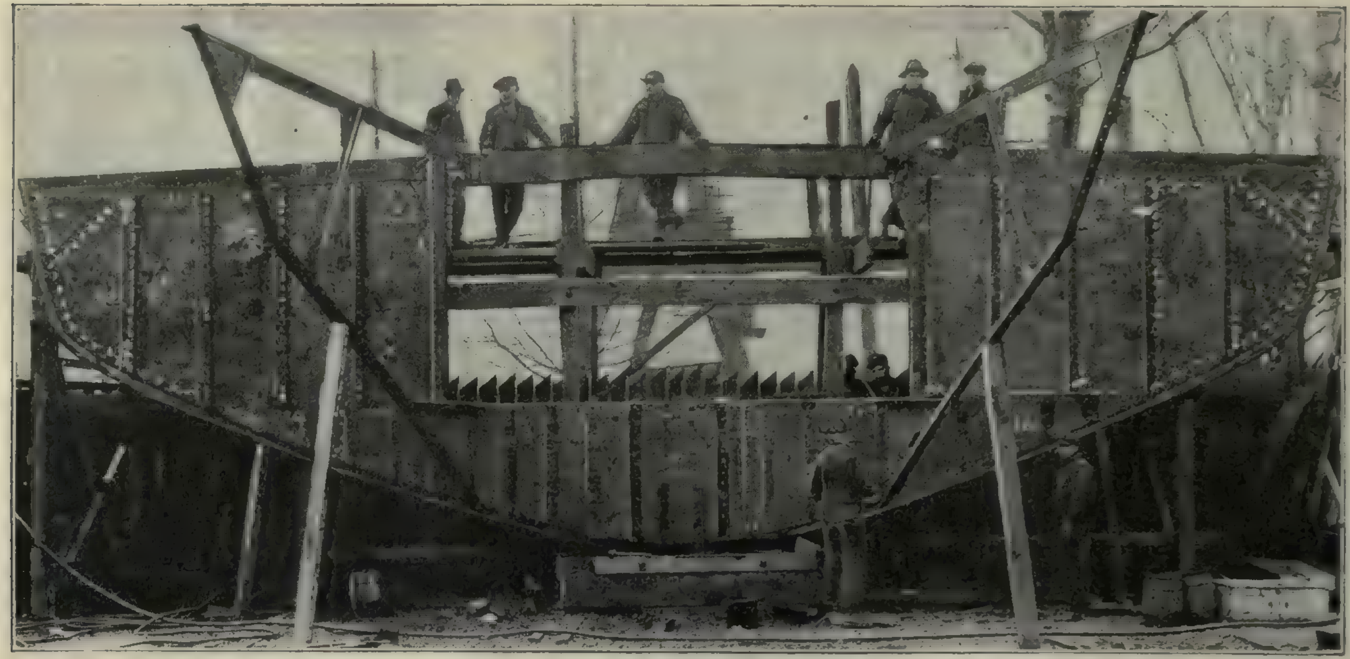


FIG. 13. BEGINNING A TRANSOM

Signal-Light Foundation.—This foundation is assembled, bolted and shipped to the general stores, and then shipped to Philadelphia to be galvanized.

Five-Hundred-Gallon Light Oil-Tank Foundation.—This foundation is assembled and bolted together, no riveting being done.

Inspection-Tank Foundation.—This foundation is assembled and bolted together, no riveting being done and all parts being left loose for regulating.

Settling-Tank Foundation.—All angles and brackets are bolted together and shipped as a unit.

Mast Step.—This is assembled and bolted together.

Main-Condenser Foundation.—This foundation is assembled in 16 parts and shipped to the hull in two different units. Riveting is performed wherever possible. Many small parts are left loose for adjusting; all tank top-angles are left loose for fairing up this section.

Lubricating-Oil Reserve-Tank Foundation.—This foundation is shipped to the hulls loose, except the two plates and the two angles which are riveted together.

Lubricating-Oil Gravity Settling-Tank Foundation.—The material for this foundation is bolted together and shipped to the hulls as a unit.

Lubricating-Oil Discharge-Strainer Foundation.—This foundation is assembled and riveted, except the channels connecting bulkhead No. 70.

Lubricating-Oil Filter Foundation.—This foundation is assembled and riveted complete, except the angles connecting bulkhead No. 70.

Lubricating-Oil Drain-Tank Foundation.—The material for this foundation is bolted together and shipped as a unit.

Cooling-Water Settling-Tank Foundation.—The material for this foundation is bolted and shipped as a unit.

Hand Steering-Gear Foundation.—This foundation is assembled and riveted, except clips connecting upper deck which are left loose in order that the foundation can be properly adjusted, clips riveted to deck and foundations removed until afterpeak tank is tested.

Winch Foundation—Bridge Deck.—The material for this foundation is bolted together and shipped as a unit. Work is left loose for adjustment.

Turbo-Generator Foundation.—This foundation is assembled and bolted together.

Telemotor Foundation.—This foundation is assembled and riveted, except the angles connecting upper deck which are left loose for fairing up.

Main Steam-Casting Foundation.—This foundation is assembled and riveted, except angles connecting bulkhead No. 83.

Landing Support.—Assembled and riveted complete.

Grating Support.—Assembled and riveted complete.

Fire-Room Brackets.—Assembled and riveted complete.

CROW'S NESTS.—These sections are assembled and riveted complete, except the angle which connects to the mast. After assembly, material is shipped from shop to stock until required for assembly with masts.

DAVIT BOXES.—These sections are assembled and riveted complete in shop and are stored until required by assembly yard for fitting on deck houses.

ESCAPE TRUNK—UPPER DECK TO POOP DECK.—This unit is assembled and riveted complete, except the bottom angle which is left loose for adjusting to deck. The section of escape trunk below upper deck is assembled with bulkhead No. 10.

BOOM TABLE AND RESTS FOR MAIN AND FOREMASTS.—These sections are assembled complete, except the bottom angles which connect to the upper deck. The angles are left loose for adjusting and regulating on ship.

FIG. 14. DURING THE ASSEMBLY

FORE AND MAINMASTS.—These masts are assembled complete with all rings, fittings of all description, ladders, crow's nest and all rigging fitted complete ready for installation. The wood topmasts are fitted complete and the entire mast painted. See Fig. 16.

METAL LADDERS. — All rung and tread ladders are assembled complete. The tread ladders are riveted complete with the exception of top and bottom clips which are left loose for adjusting. Treads are riveted to stringers. Rung ladders are riveted complete.

ENGINE - ROOM SKYLIGHT. — The engine-room skylight is assembled and riveted complete. After completion of this section it is used in conjunction with the assembly of engine-room casing top. Work on the cas-

ing is faired up with the skylight. The skylight is then sent to the wet dock where hatch-cover lifting-gear is fitted in place.

ENGINEERS' WORKBENCH.—This section is assembled and riveted complete, except the angles which connect to the tank top and the two center legs, all of which are left loose for adjusting.

KING POSTS.—All work is assembled complete including electric welding of top plate. Angles to the deck are left loose for fairing and regulating.

FORECASTLE DECK.—This unit is assembled complete with the deck plates, beams, girders and fore and afters. The stringer angle is lifted from the ship and is the adjusting point for fairing up work in this section.

FIG. 15. NEARLY COMPLETED

POOP DECK.—This unit is assembled complete with all beams, fore and afters, deck plating, doublers, skylight coamings and angles. The waterway bars and stringer angles are left off. The stringer angles are left off for adjusting the after end of the ship. The plating is not riveted aft of frame No. 1. This is left loose to properly regulate the work of the transom which is assembled on the ground.

Up to hull No. 17 the assembly of one poop deck plate was included with the transom assembly, but it was found that a better adjustment could be obtained by assembling this plate with the poop deck.

SECOND DECK—FRAMES NO. 10 TO NO. 21.—This section is assembled complete with beams, fore-and-aft girders and angles. All work is riveted except the shell clips which are left loose for fairing up. See Fig. 17.

SECOND DECK—FRAMES NO. 158 TO NO. 169.—The same remarks apply to this section as to the second deck between frames No. 10 and No. 21.

SWASH-PLATES IN DEEP TANKS, FRAMES NO. 93 TO NO. 105, P & S.—These sections are assembled and riveted complete.

SIDE-STRINGERS IN DEEP TANKS, FRAMES NO. 93 TO NO. 105.—This work is assembled complete and riveted.

SECOND-DECK LONGITUDINALS AND HATCH FORE AND AFTERS.—The longitudinal girder in way of second deck hatches is intercostal between athwartship strong-beams at the fore-and-after end of the hatches. The hatches *F* and *A* are intercostal between the same point.

Beginning with hull No. 20 these sections were assembled on the ground with the separator plates. Beginning with hull No. 23 this assembly was completed in the assembly yard and the separator plates riveted. This riveting is very close work on the hulls and was done to much better advantage by ground riveting.

WEB FRAME NO. 99.—This is a new assembly unit beginning with hull No. 21. This web frame, which is additional to the original design, is necessary on account of the shifting of bulkheads in the way of deep tanks. This frame is assembled complete with frame bar, face bars and clips, and is riveted complete, except the two clips and the diamond face plate in the way of side stringer.

BULKHEAD NO. 71—BRIDGE TO BOAT DECK.—This section is assembled and riveted complete with the galley coal box attached which is also riveted. The galley coal box runs only one frame space and is more or less a difficult job to rivet up. The assembly of this unit was started beginning with about the ninth hull.

STACK FOUNDATION.—This is assembled complete with all the connections riveted, except the clips which connect to the casing and which are left loose for fairing up.

FIDLEY TOP.—This section is assembled complete with hatches, hatch covers, ventilator rings, smoke-stack coaming and angles. All work is riveted, except the ventilator rings which are left loose for shipping ventilators.

ENGINE-CASING TOP.—This section is assembled complete, including the engine-room-skylight coamings and angles, galley skylight complete and rings for ventilating trunks. The skylights are assembled separately and fitted to this section for regulating purposes. The skylight, as mentioned before, is then sent to the wet dock for having the skylight training-gear fitted.

ASH CHUTE.—This section is assembled and riveted complete in the shop, except the angle which connects to frame No. 88 which is left loose for shipping.

THREE LONGITUDINAL BULKHEADS, FRAMES NO. 65 TO NO. 70.—These bulkheads are assembled and riveted complete.

WASH-ROOM BULKHEADS, FRAMES NO. 0 TO NO. 4.—These bulkheads are assembled and riveted complete, except the bottom bounding-angle which is bolted to the upper deck

FIG. 16. FORE AND MAIN MASTS

FIG. 17, SECOND-DECK ASSEMBLY

FIG. 18. BEGINNING BOW ASSEMBLY

in order to get an earlier test on the after compartment.

LONGITUDINAL BULKHEADS, FRAMES NO. 67 TO NO. 70, BETWEEN BRIDGE AND BOAT DECKS, PORT AND STARBOARD.—This section is assembled and riveted complete.

BULKHEADS AT FRAMES NO. 166 AND NO. 169, BETWEEN UPPER AND FORECASTLE DECKS.—This work is assembled and riveted complete except bottom bounding-angles.

FRAMES IN THE AFTERPEAK AND FOREPEAK.—The frames in the after and forepeaks have reverse bars fitted. These frames are assembled complete on the ground and bull riveted. Some of these frames are further assembled with other sections which are enumerated in other places.

FRAMES NO. 170 TO NO. 179 INCLUSIVE.—These are all forepeak frames and come below the second deck which is the flat over the forepeak. These frames are assembled complete with second deck beams and brackets, upper and lower stringer beams and brackets and reverse angles; also channel stiffeners which are fitted on every other frame. When forepeaks are assembled piecemeal these frames are assembled, bolted and reamed, and riveting is performed on one side, one side being left loose for adjustment.

FRAMES NOS. 3, 4 AND 6, FROM TOP OF FLOORS TO UPPER DECK.—This unit is assembled complete with upper deck and stringer beams. These sections are assembled primarily for the purpose of fairing up the after end of the ship; that is, holding the shell plating together until it can be properly shored. This section is bolted only, being left loose in order that work in this end of the ship may be faired and adjusted.

FRAMES NOS. 1, 2, 3 AND 4, UP TO UPPER DECK.—These sections are assembled complete with frame bars, floors, reverse angles and connections to upper deck. All work is left loose for fairing and regulating.

FRAMES NOS. 8 AND 9, WATER-TIGHT FLAT TO UPPER DECK.—This section is assembled complete with the frames, upper deck beams and bottom floors which connect to the water-tight flat. All work is left loose for adjustment except the reverse frames to the frames, which are bull riveted.

THE BOW ASSEMBLY.—The design of ship being constructed at this yard permits the assembly of the bow complete in such a way that it can be readily handled and faired up. The main frames cut at the second deck, which is the flat over the forepeak, and the deck plating of the second deck stops at the forward and after side of bulkhead No. 169, making this unit separate and distinct.

In the erection of this unit the following descriptions will show that each step has been carefully considered and the assembly carried along in such a way that regulating and adjusting is permitted.

The second deck, as stated before, extends from bulkhead No. 169 to the stem and is assembled complete with the second-deck beams attached. The main frames are cut at the second deck; therefore, the clips which form the bracket connection of the upper section of frames must be made water tight. Considerable trouble was experienced in the yard on the first 12 hulls in making this section water tight under test, but by assembling decks, work on bracket connections can be performed in an open space where it is possible to obtain the best class of workmanship. This deck is entirely assembled and riveted complete. See Fig. 18. This section is then inverted. By laying the section flat in an inverted position the fairing up and adjusting of all work is simplified to a degree that would be impossible by erecting the frames on the ship, where no definite point can be established without ribbands and shores.

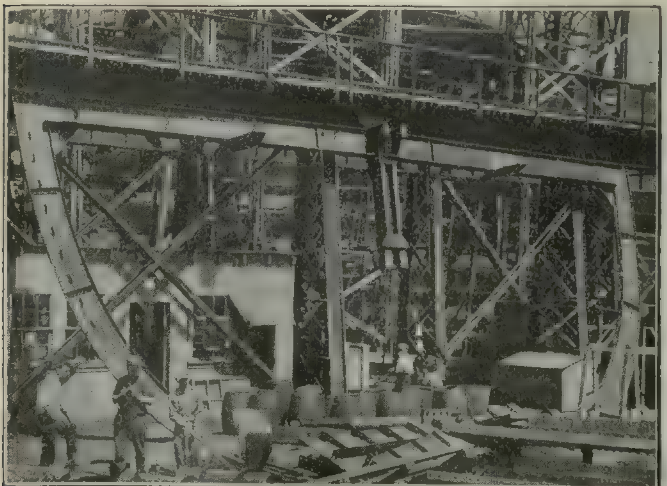


FIG. 21. ONE OF THE WEB FRAMES

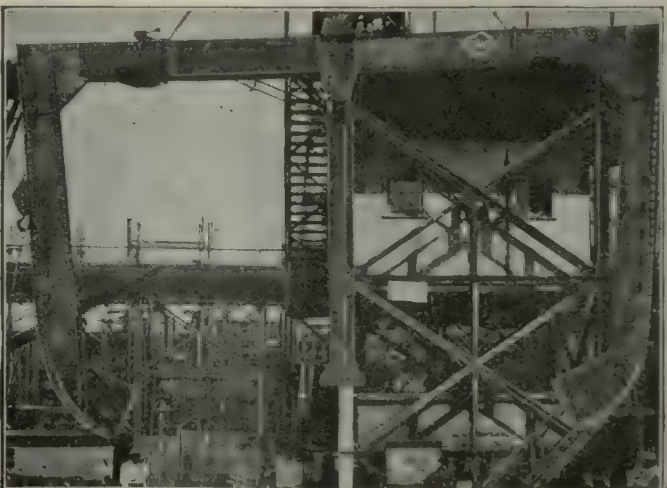


FIG. 22. WEB FRAME ASSEMBLED BY CRANE CREW

The frames are next set in place, having been previously assembled in separate units with the reverse angles and bull riveted; after the bull riveting of the frames is completed they are further assembled with the floors, stringer beams and stiffener stanchions. After the frames are set in place they are properly adjusted and eight shell plates fitted, four port and four starboard. These shell plates form a rigid connection and assure the fairing up of this section. The shell plates are bolted—no riveting being done, in order to take care of slight adjustments which may be necessary when section is erected. Figs. 19 and 20.

The swash plate is next put in place and fitted, then the upper and lower side stringer which has been previously assembled and bull riveted with the exception of shell clips which are left loose.

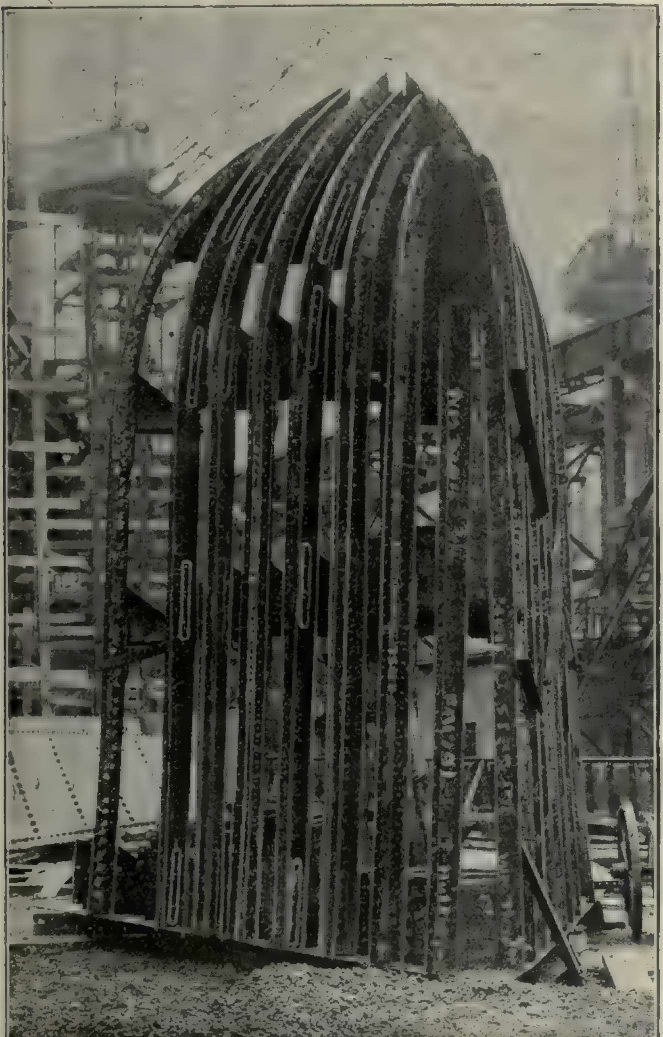


FIG. 19. BOW FRAMES IN PLACE

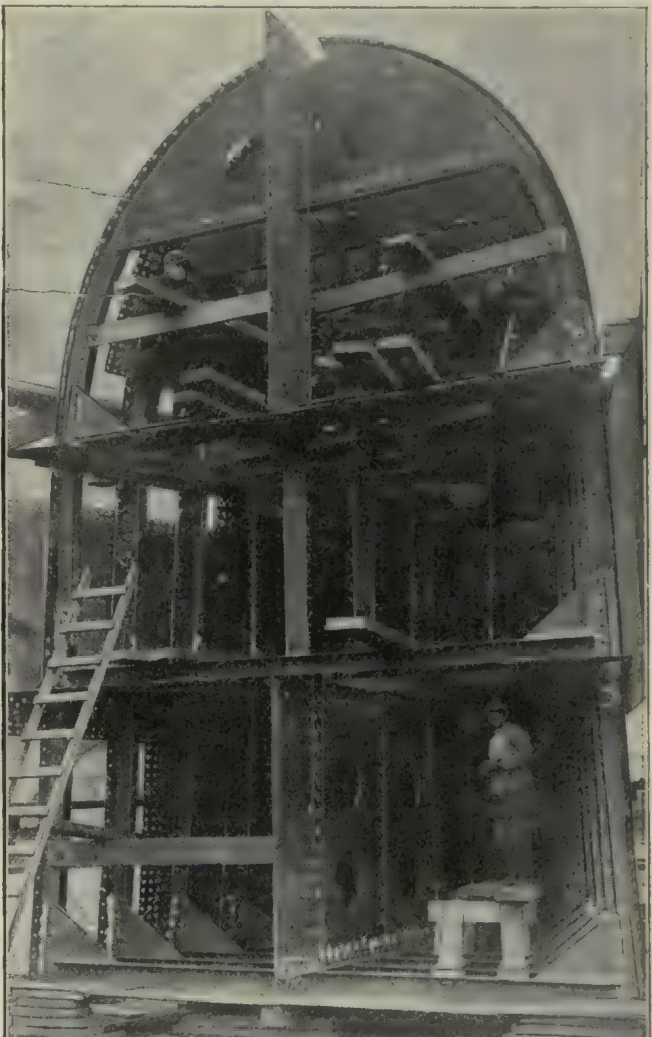


FIG. 20. BOW NEARLY ASSEMBLED

To complete the unit all breast hooks, lower section of stem, forward flat keel plate, intercostals and clips are fitted.

Ground Assembly.—The ground assembly in front of all ships is carried on by crane crews. Prior to the launching of a ship the crane crews are not kept busy at all times. The crane crews are reduced to a minimum at this time, but they must be kept on the cranes to take care of lifts required by machinists, shipwrights, carpenters, acetylene workers and occasional lifts required by the hull construction department, but with all this small and miscellaneous work, they are not kept busy 100 per cent of the time. In order to use to advantage this idle time certain assembly in front of the hulls has been introduced.

The assembly of these units, starting approximately six or seven weeks before a ship is launched, has served as a means of furthering the progress of the ship by assembling many small pieces in one large unit which can be readily lifted to the ship, and has been the means of expediting the erection of the ship in the early stages in order to open up work for the trades that follow. In assembling work in this way it can be readily understood that all work put together by crane crews is a saving of time that otherwise would not be possible.

The greatest saving in this respect is the assembly of floors, intercostals, margin plates and bilge bracket clips. This work is assembled complete with the enumerated parts. The size of each section is the length of the margin plate. This gives 14 sections port and 14 sections starboard for the entire assembly of the bottom of the ship. Up to hull No. 16 a great deal of trouble was experienced in pulling up the floors and margins, but this has been entirely overcome by the assembly just referred to. It is accomplished by fitting the bilge bracket clips on the ground and pulling this work up tight before it is erected. Any small discrepancies, which are never more than $\frac{1}{8}$ in. can be made up on the clip connection to the vertical keel. This has proved successful and is eliminating almost entirely the cutting out of rivets on the outboard clip connecting floors to margin plate.

The next most important of these ground assembly units and which comes along at a later stage in the erection of the ship, is the web frames, strong beams and stanchions, Figs. 21 and 22. The ground assembly of these units comes along at a time when there is a lull in the erection aboard ship; that is, just after the completion of bottom shell plates, floors, tank top, bilge plates, etc. These units are assembled in one piece and bolted; when ready for erection on the ship they are picked up in one piece.

The saving in this class of erection is the turning of idle time into productive time. It is always necessary in the erection of a ship only to erect to a certain point, and at this point erection must cease until other trades have completed their work.

The shaft alleys which are assembled in the assembly yard are further added to by having stanchions and diamond plates fitted by the erectors in front of the hull.

It is intended that when opportunity and suggestions develop this method of assembly be increased. It should be particularly noted, however, that there are only certain units that can be advantageously handled by the erecting crew, it being always borne in mind that no assembly should be undertaken by the erectors unless it is to fill in their idle time. The point where the greatest amount of idle time occurs is just prior to a launching, and after the completion of the tank top when erection is held up until certain riveting is completed.

A Ship Every Two Weeks

Some idea of the success attending this pre-assembly method and its practical value to shipbuilding may be had from a consideration of the fact that within two years from the time ground was first broken for this plant of only 12 slips, 8800-ton ships were being delivered at the rate of one every two weeks. About 30 per cent. of the total tonnage of each vessel is pre-assembled and over 70,000 rivets are driven on pre-assembled units out of a total of 500,000 rivets in each hull. The saving in riveting alone is estimated as well over $3000 per hull. The average drive for all assembly work is approximately 100 rivets per hour per gang, which has never been obtained as an average on board ship under any conditions or circumstances.

The other advantages claimed for this pre-assembly practice are:

1. Saving in staging.
2. Work accessible sooner to all trades.
3. Lower priced and smaller number of men in gangs handling material.
4. Possibilities of specialization.
5. Reduction of time on shipways estimated at not less than 15 per cent.
6. Earlier delivery of ships permitting vessel to be placed on an earning basis sooner.
7. Total saving in labor while on ways of from five to eight per cent.

A Kink in Indexing

By A. R. Durant

A simple and reasonably accurate scheme for indexing work to divisions not provided for on the regular index plate is here described. No special index plate or gearing is necessary and no change need be made in the dividing head.

Select a circle on the regular index plate which, if the number of holes was increased two, three or four times, would figure right. A small templet, or gage, is made, which, when placed over one space of the index circle selected, will divide that space the number of times required. The advantage of a high-number circle is thus obtained.

The templet may be made of ⅛-in. stock, ½ in. wide and long enough to cover two adjacent holes of the circle selected. Two points are located on one side, by lightly spotting through these two holes in the index plate with a twist drill.

The spots are now connected by an arc corresponding to the radius of the circle. Next, this arc is carefully divided into the number of parts by which the circle is to be multiplied. Holes to fit the index pin are drilled as accurately as possible at the division points, and another hole is drilled through one of the spot marks. A small stud the same diameter as the index pin is fitted to this latter hole, projecting about $\frac{3}{16}$ in. from one side of the templet.

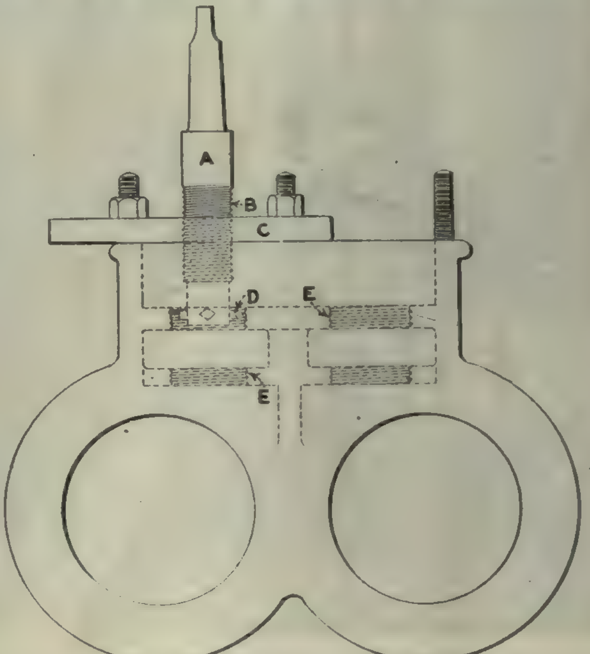
To use the device, each division of the index circle is counted as two, three, or more spaces as the case may be, and the handle moved to the last regular hole possible. From this hole the movement is continued by placing the stud of the templet in the hole and moving the index pin to the proper subdivision of the templet. Further indexing is continued from this point and the templet moved around as necessary.

For example, to cut a gear of 51 teeth, use the 17-hole circle and divide the templet into thirds. Figuring the 17-hole circle as 51, the handle must be moved 40 spaces (40/51); or, as a 17-circle, 13⅓ spaces (13⅓/17).

Steam Pump Repaired by the Aid of a Drilling Machine

By Winthrop D. Washburn

The illustration shows an outline of the delivery end of a Worthington steam pump which was repaired by the aid of a drilling machine and a little ingenuity on the part of the man in charge. The valve mechanism is retained by the threaded holes *EE* and, as these are subject to corrosion, they have to be occasionally re-



METHOD OF REPAIRING PUMP

moved. This article describes a method of cutting new threads, using a drilling machine and no other mechanism excepting the threaded plate *C*.

The bar *A* is turned on the upper end to fit the drilling-machine spindle and also threaded at *B* with the suitable thread to act as a guide for the threading tool. The plate *C* is threaded to fit the bar *B* and is held in place on two studs as shown. The lower end of the bar carries the threading tool *D* which is held in place by a setscrew. As shown, this is held by one screw and fed into the work by tapping on the back end with a light hammer between the cuts. By making this tool short, so as not to extend clear through the bar, a setscrew can be placed behind the cutting tool and used for feeding it into the work. This allows the holes to be easily threaded and the job can be done in a short time with a very limited shop equipment.

Adjustable Trimming and Shaving Dies

BY FRANK A. STANLEY

Reference has been made in earlier articles regarding the possibility of using trimming dies for cutting blanks of uniform pattern to different lengths in order to save duplication of blanking dies for each and every different size of piece in a series. An illustration of this principle is contained in the views that follow, which show the method of blanking, trimming and shaving a set of nine steel cams for a calculating machine, these cams varying in length throughout the group of nine parts. Only one set of blanking tools is required, and one second-operation die accomplishes the trimming and shaving of the entire lot of cams.

THREE of a set of nine cams for a calculating machine are shown in detail in Fig. 1. The range for the cams is from 50 deg. down to 10 deg. as measured from center to point of throw. The cam ends at the arc *A* are all alike and this arc is struck from a radius of 0.570 in. in all cases. This makes it possible to utilize one trimming die for all sizes of cams, as the portion operated upon in finishing the blank is uniform throughout the series of cams.

The blanking tools are shown in Figs. 2 and 3 and the latter shows the method of locating the stock gage so that it drops into the opening in the scrap immediately ahead of the blank that is being punched out. The stop is of the trigger type with projecting end for operation by the adjustable striking screw in the punch head when the latter descends. At the right is a spring-actuated pressure finger for holding the heavy stock closely to the back guide under the stripper. It will be noted that this stock is 0.120 in. half-hard steel.

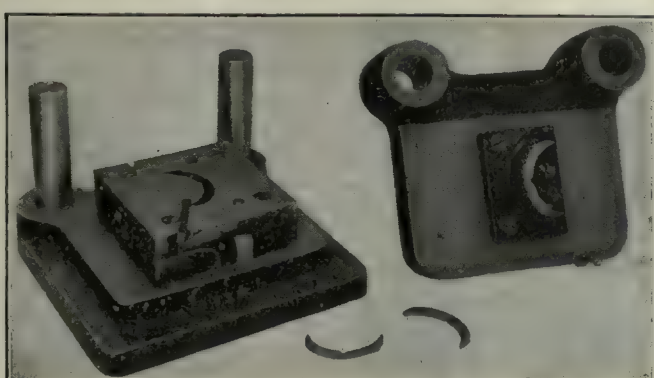


FIG. 2. BLANKING TOOLS FOR CAMS

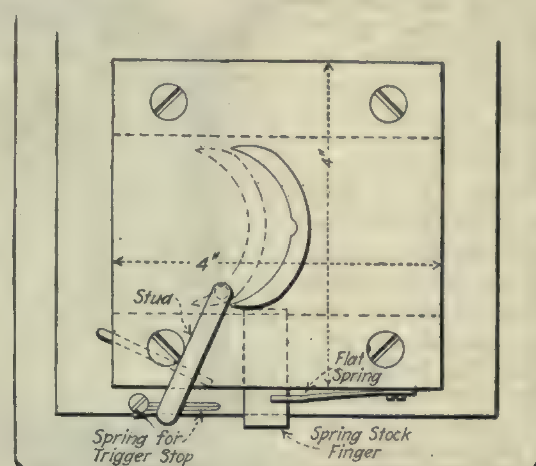


FIG. 3. DETAILS OF BLANKING DIE

The trimming dies (which are also used for the shaving operation) are shown by Figs. 4 to 9 inclusive. In the first of these views the entire series of nine cams of different lengths are shown in the foreground, and the locating nest is seen empty with three knock-out pins projecting slightly above the bottom of the work seat just as they are thrown up by the handle in front when the trimmed cam is ejected. In Fig. 5 the middle length cam, No. 18 as it is called, is seen in position in the nest which is here shown adjusted to central position. In the preceding view, Fig. 4, this locating nest is seen at the extreme right-hand position or in the place in which it is set for the longest cam of the series, namely, No. 14. In Fig. 6 the graduations at the front of the die for giving the nine positions for all of the cams may be plainly seen.

It will be gathered from these views that this die is arranged to give the ends of all cams the same form; but each number of cam is cut to a different length from the other cams in the series, so that more metal is trimmed off from some cams than from others, the amount removed varying with each cam member.

Referring to Fig. 7, there is shown at *A* a half-round lug on the locating device *B* that is used for positioning all lengths of cams from the similar notch blanked in their concave sides. When the adjustable nesting device *B* is set by the front graduations *C* to the right position, the cam placed in the nest will be cut off to correct length and form. After the entire lot for one length of cam has been

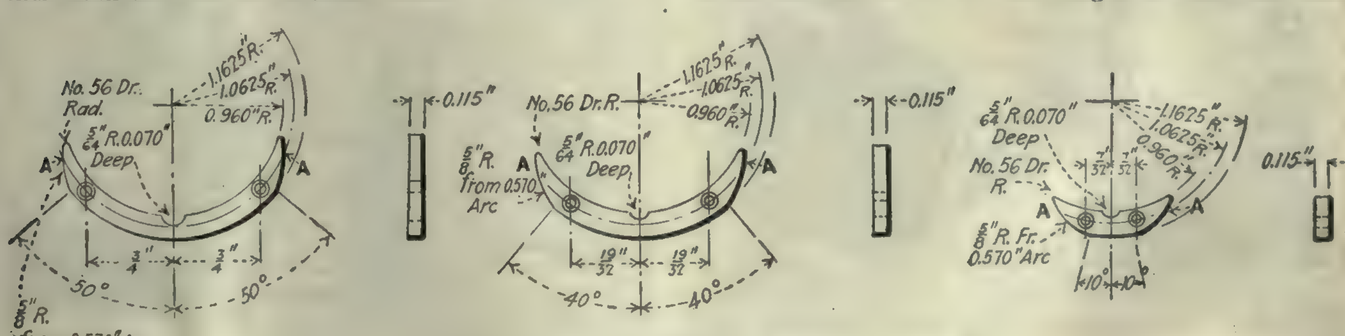


FIG. 1. THREE OF THE CAMS

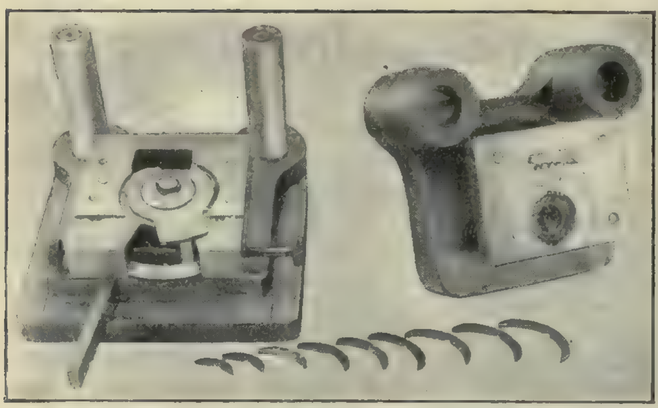


FIG. 4. THE DIES AND THE CAMS

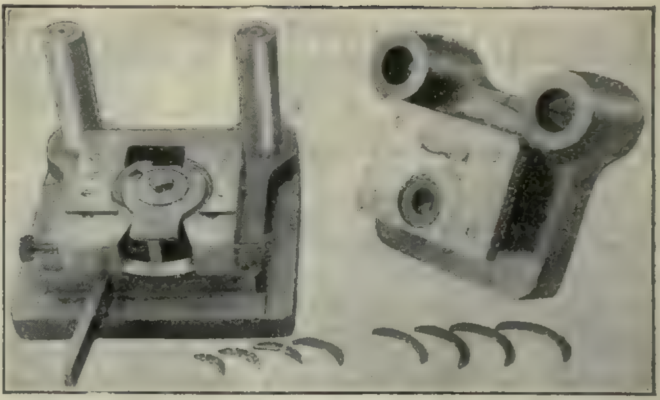


FIG. 5. THE DIES WITH A CAM IN POSITION

trimmed, the device B is reset to another graduation and the next length trimmed, and so on. This is brought out by the sketches, Figs. 8 and 9, which show the settings for two cams, one long and one short, and indicate the amount of movement of device B in the change from one cam to the other. The intermediate settings are all established by the graduations on plate C.

The Cutting Edges

The front end of any cam trimmed in this die is located against the stop gage D and as the blank cam rests closely in the circular channel or nest E with its half-round notch over the lug A, the work is well secured against shifting under the cut. This notch, by the way, is the locating medium for the finished cam when assembled in the calculating machine, hence the importance of finishing all ends from this central point is emphasized. Both ends of each cam are trimmed alike, the blank being turned over for the cut on the opposite end.

The trimming punch has only a short length of cut but is itself of liberal proportions for rigidity. It fits at the back and sides in the oblong die opening which acts as a further guide for retaining the punch in alignment. The back of the punch as indicated at F, Fig. 7, is $\frac{1}{4}$ in. longer than the face so that it has an opportunity to become well located in the die opening before the cutting edge strikes the work. The punch is inclosed in the spring-controlled stripper and pressure pad G which holds the blank firmly during the trimming operation.

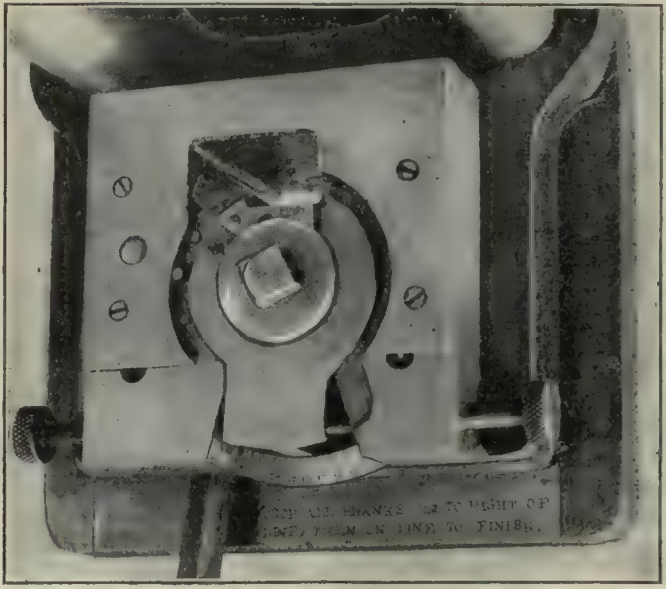
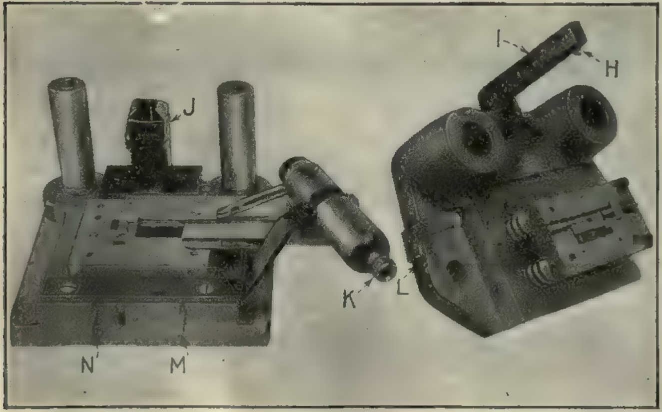
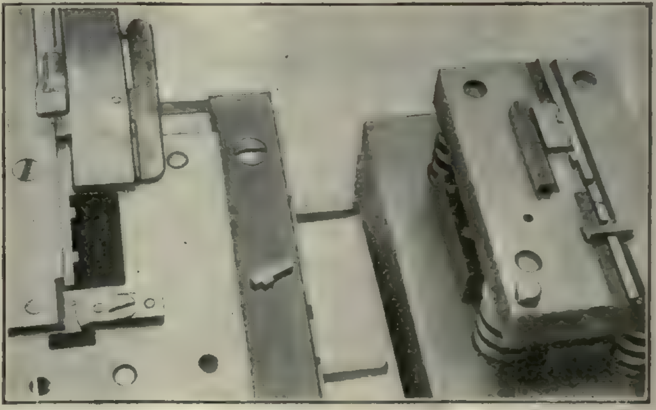


FIG. 6. FACE VIEW OF THE DIES

In operation, the die is first set for trimming the cams to specified length by bringing the vertical zero line 0 on the wing under locator B) to within $\frac{1}{32}$ in. of the required graduation on scale C. This offset is enough to allow the dies to trim the cams longer than finish size by about 0.010 in. which amount is left for shaving in a second operation in the same dies. For the shaving cut, which is taken after the entire lot has been trimmed as above, the locating device B is reset to the requisite graduation and the work run through as before the removing of the thin chip which smooths the cam ends perfectly and brings them to an exact length.

There is another type of die that should be of interest in this article—the progressive trimming and shaving





FIGS. 10 AND 11. PROGRESSIVE TRIMMING AND SHAVING DIES

arrangement illustrated by Figs. 10 to 12. These tools are for the manufacture of a small key of the dimensions given on the part detail in the last illustration. The material used is steel lengths about ½ in. wide by 0.078 in. thick. The dies perform their work by cutting away the material from one side only, thus producing the piece complete by the trimming and shaving process.

The key is finished 0.458 in. long and has a projection at one side 0.015 in. high by 0.090 in. wide. The method of running the stock through the dies will be understood upon examination of the plan views of the tools in Figs. 11 and 12.

The material is fed in through the narrow channel guide at the right of the die openings and with the first stroke of the press the trimming punch *A* takes a cut along the edge indicated at

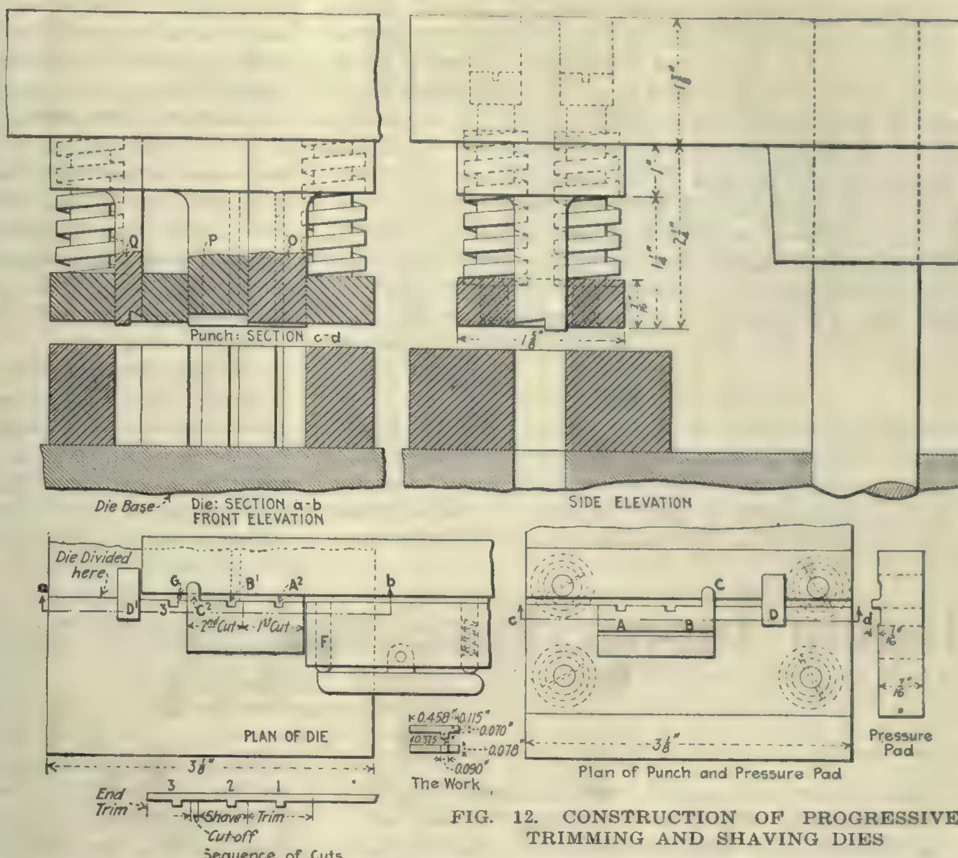
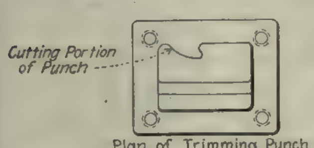
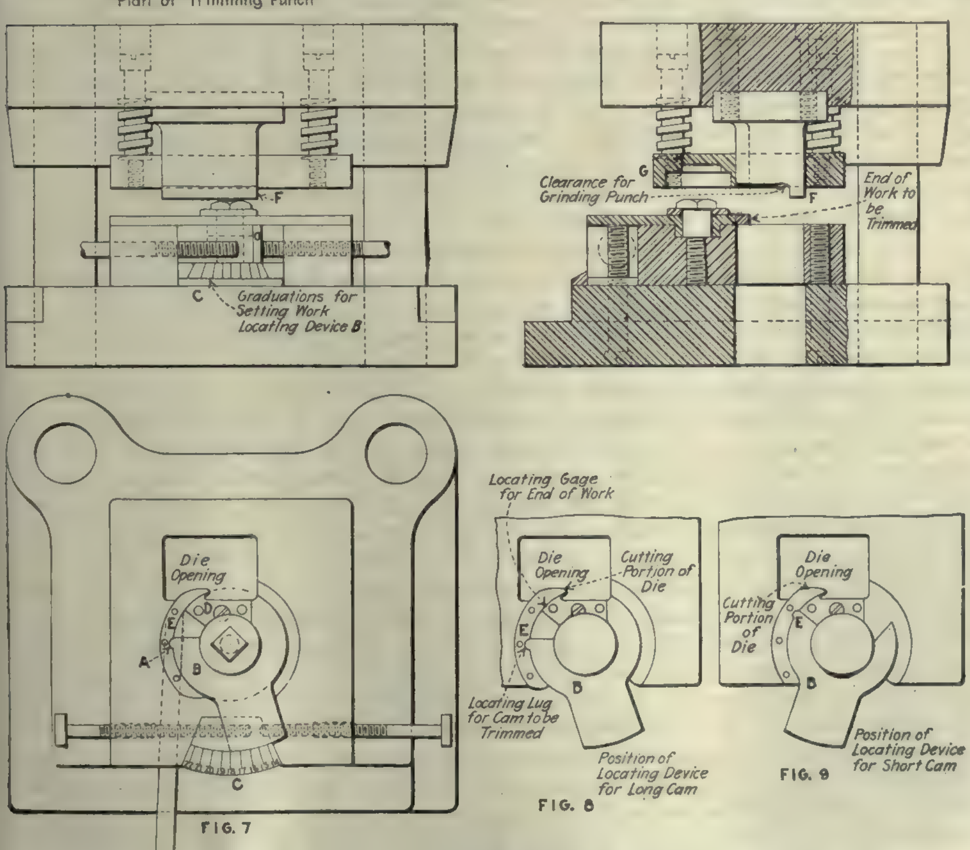


FIG. 12. CONSTRUCTION OF PROGRESSIVE TRIMMING AND SHAVING DIES

A^2. At the next advance of the stock, the portion already trimmed is shaved as at edge B^1 by the punch *B*, and the trimming punch *A* operates on the next cut. At the same stroke, the extension *C* on the shaving punch *B* cuts off the key at the point *d* and when the work is advanced to the third position the end of the key is trimmed by the punch *D* and die D^1. Each succeeding stroke of the press then causes one portion of the stock to be trimmed closely to the key width, the preceding portion to be shaved to size and cut off, and the leading end of that piece to be shaved to length.

Fig. 12 shows the principal features of the tools but certain details are best seen in Figs. 10 and 11, particularly the air nozzle and control for blowing the finished blank from the dies. The narrow strip of stock is pressed back to the guide by the spring-actuated finger *F* at the front, this being shown by dotted lines in the plan view of the die in Fig. 12. At *G* is a small knockout pin which is operated by a wedge-shaped member underneath to lift the finished work slightly and so allow the compressed-air charge to blow the piece clear of the dies. The wedge for





FIGS. 7 TO 9. DETAILS OF TRIMMING AND SHAVING DIES
Fig. 7—Construction of the dies. Fig. 8—Adjustment for the longest cam. Fig. 9—Adjustment for the shortest cam.

operating this is itself moved forward against spring pressure by a pivoted latch *H*, Fig. 10, which is carried on a vertical arm *I* adapted to operate in tube *J* at the rear of the die. The pivoted piece *H* on the down stroke rocks up sufficiently to swing past the end of the wedge and on the ascent of the punch it drops back to its seat and acts against the end of the wedge which then slides forward and operates the knock-out pin *G*, Fig. 12.

The air nozzle is controlled by the plunger *K*, Fig. 10, and the hooked finger *L* on the punch head which acts upon the plunger head when the punch rises with the press slide. The stop for the first position of the stock is operated by lever *M*, and the second stop by lever *N*.

The Form of the Punches

The different views, however, show the form of the punches and stripper, as well as the die itself which is made in halves to facilitate construction. The trimming and shaving punches *O* and *P*, Fig. 12, are of different height of cut so that the trimming tool does its work before the shaving die strikes the stock. Both punches, and the end punch *Q* as well, are made with back portions extended downward sufficiently to enter the guides formed by the die openings before the cutting portion contacts with the work. The cutting edges are cleared as shown and the relief along the center of each punch end enables the tool to be ground readily.

Another set of dies of this same construction is used for trimming and shaving a longer key and here the punches are sheared from end to end to enable them to take the longer cut easily and with smoothest possible result. The shearing angle on the cutting edges is about 3 deg.

The pressure pad and stripper for the punches shown is backed up by very heavy springs at the four corners and the pad face is milled away as shown to leave a narrow bearing surface along the face for contacting with the work. This holds the narrow stock strip securely against possibility of rocking during the taking of the cuts along the one edge.

Patent Interferences and How to Meet Them

By E. H. MICHAELIS.
Consulting Mechanical Engineer

Many dollars and much time have been wasted on inventions which were conceived almost simultaneously by several people. Of course, this cannot be helped, but certain precautions can be observed which will assure the inventor that he cannot be robbed of his patent if he really was first in the field. Some good advice along this line appears in this article.

FREQUENTLY, patent attorneys and others whose business brings them into contact with inventors hear the complaint "somebody must have stolen my idea, because there is another application for letters patent pending in the Patent Office and an interference is declared. I am sure that I am the first and only inventor."

The men speaking thus forget that there are one-hundred million people living in this great country of ours and that it happens frequently that two or even three individuals living far apart are working along the same lines and come to the same conclusions. The consequence is that there will be made two or three applications for letters patent on the same invention.

Rule 93 of the Rules of Practice in the U. S. Patent Office defined interference as follows: "An interference is a proceeding instituted for the purpose of determining the question of priority of invention between two or more parties claiming substantially the same patentable invention."

It is easy to see that it is impossible to prevent the occurrence of interference proceedings because every one of the inventors making a bona fide application believes himself to be the first and sole inventor. The U. S. Government will issue a patent to and protect the man who proves that he really is the first one who has invented a useful article, but it is not enough that the inventor makes a statement as to when he first started to develop his idea; he has to bring proof for his statement.

But let us for the sake of better understanding follow the proceedings of an interference case. Two men who have never heard of each other, one living in Bangor, Me., the other in San Francisco, Calif., make application for letters patent on the same invention. Suppose that Mr. Bangor files his application first. When the examiner finds that an interference is necessary he will notify both parties that probably an interference will be declared, and he will ask for an informal statement regarding the date when each first conceived the idea of the invention. In all following proceedings Mr. Bangor will be the senior party and Mr. Frisco the junior party, according to the time of filing their applications. The informal statements will not be kept on the files but will be returned to the senders.

After examining both statements the primary examiner will follow Rule 96 of the Rules of Practice: "Whenever the claims of two or more applications differ in phraseology, but relate to substantially the same patentable subject matter, the examiner, when one of the applications is ready for allowance, shall suggest to the parties such claims as are necessary to cover the common invention in substantially the same language. The examiner shall send copies of the letter suggesting claims to the applicants and to the assignees as well as to the attorney of record in each case. The parties to whom the claims are suggested will be requested to make those claims and put the applications in condition for allowance within a specified time in order that an interference may be declared. Upon the failure of any applicant to make the claims suggested within the specified time, such failure or refusal shall be taken without further action as a disclaimer of the invention covered by the claims, and the issue of the patent to the applicant whose application is in condition for allowance will not be delayed, unless the time for making the claim and putting the application in condition for allowance be extended upon a proper showing. If a party makes the claim without putting his application in condition for allowance, the declaration of interference will not be delayed, but after judgment of priority the application

of that party will be held for revision and restriction, subject to interference with other applications."

Mr. Frisco and Mr. Bangor adopt the suggested claims through their attorneys and put their applications in condition for allowance. Thereupon the examiner of interferences takes jurisdiction of the case, which now is called a "contested case." The contestants are notified to prepare and file a preliminary statement, under oath, showing the following facts:

1. The date of the first conception of the idea.
2. The date upon which the first drawing of the invention and the date upon which the first written description of the invention were made.
3. The date upon which the invention was first disclosed to others.
4. The date upon which the invention was first reduced to practice.
5. A statement to what extent the invention has been put to use.
6. The date and number of any applications for the same invention filed within 12 months, before the filing date in the United States, in any foreign country adhering to the International Convention for the Protection of Industrial Property or having similar treaty relations with the United States.

If a drawing or written description of the invention has not been made or if the invention has not been reduced to practice or disclosed to others, the statement must show these facts.

These preliminary statements are very important and should be prepared very carefully, because the parties will be strictly held in their proof to the dates given therein. If a party proves an earlier date than mentioned in the preliminary statement, such proof will be held to establish the given date and none other.

Our two friends filed their statements with the examiner of interferences according to rules in sealed envelopes, containing nothing but the statements and marked as follows: Name of the party filing it, title of the case and the subject of the invention.

After both had filed these statements, they were opened by the examiner in charge and then the attorneys of the applicants looked into the matter. They examined the statements made by their opponents. It was found that Mr. Bangor, the senior party, had not reduced his invention to practice nor had he disclosed it to others, but he claimed in his statement that he had conceived the idea at a date 11 months prior to the filing of his application, while Mr. Frisco claimed to have made the first sketch of his invention 13 months before the filing date, that he had made and used his newly invented appliances in his own shop and that he had sold some of them to other firms. Both attorneys called for substantiating evidence. So Mr. Bangor went with his lawyer to a notary public in his home town and Mr. Frisco did the same.

Mr. Bangor could not prove his statements, because like very many inventors he was afraid to show anybody his invention or even talk about it before he had it patented, and so the earliest date he could prove was the date upon which he employed his patent attorney to prepare his application.

Mr. Frisco had his sketch with him and could prove when it was made because he had it dated and attested by a notary public at the time he made it. He could prove when he started to make his first apparatus, because he had the receipt of a patternmaker and the check with which he paid the man who made the patterns for this first apparatus, and for later dates he had orders and affidavits of other firms proving that they were using his invention.

The attorney of Mr. Bangor told his client the best thing to do was to concede priority to Mr. Frisco, because in order to fight the case further it would be necessary for them to go to San Francisco and cross-examine the witnesses, and as the case looked very bad for Mr. Bangor, he would advise him not to spend his money foolishly. But Mr. Bangor thought differently. He was well to do and did not care if it did cost money, as long as he could beat the other fellow. So to San Francisco they went and before a notary public a cross-examination of Mr. Frisco and his witnesses was held, which proved conclusively that Mr. Frisco, in spite of being the junior party, was really the first inventor.

From the foregoing it will be clear that every inventor should heed the following advice:

1. Make a sketch showing the main features of your invention as soon as you conceive the idea, or if you can not make any sketch, write a description of your general idea and have this sketch or description dated and attested to by a notary public.
2. When you start to reduce your invention to practice (which means when you have drawings or a model made), get a statement from the man who does the work for you that you ordered from him a drawing or model on this certain date, and have this statement attested to by a notary public.
3. In case you make your own drawing, have it dated and attested to by a notary public.
4. If you intend to make your own model, have a part at least made by someone else; get a receipt from him and see that your payment is entered in his books with your name and article paid for mentioned.

If you follow the advice given above you will be well provided in case your invention should be involved in an interference case.

Bad Features of Drilling-Machine Tables

By Fred D. Hood

Why is it that so many drilling-machine tables are made on the underside like bad roads—a succession of hollows and humps?

Some are made like *A*, Fig. 1, with T-slots and a few innocent slots in between leaving the highway underneath like a road after the gas company has finished with it. Others, again, fearing perhaps that the open slots will accommodate too large a variety of bolt heads, have a ridge along one side, presumably to keep the bolts

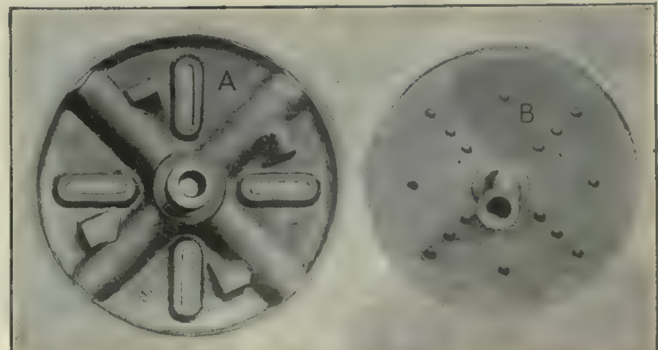


FIG. 1. TYPES OF DRILLING-MACHINE TABLES

from turning, but actually keeping most bolts from earning a living. Using bolts under these circumstances is bad enough, but when it comes to getting a footing for a faithful friend like a screw clamp, it needs a chart to avoid the rocks. And if all the other obstacles were removed, the rib around the outer edge of the table would block the channel.

The circular table is not the only offender in this category. Note the inverted settling basin under the square one, shown in Fig. 2; also the clamp repeller around the edge.

Unfortunately for my point I am unable to get within reach of some samples of this type that I have

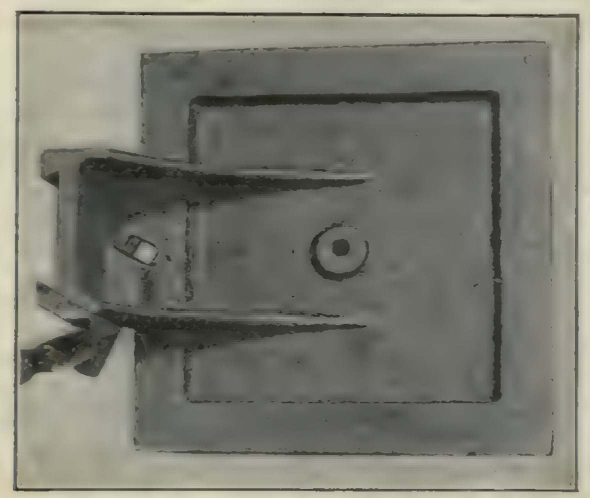


FIG. 2. ANOTHER KIND OF TABLE

come across, but those shown will probably call to the minds of readers other bright specimens f a similar kind.

In Fig. 1 at *B* is a new kind of table which is replacing the sculptured one. It is perfectly plain on its upper and lower sides, has a bored hole through the center and four radial rows of four holes each for bolting down work. This appears to answer all purposes. Cored slots would do equally well, but in this case beginners frequently run a drill halfway into the slot and the table, usually breaking the drill. The new table is thick enough to be equally as stiff as the other kind and allows for occasionally truing up—a luxury seldom enjoyed by this class of machinery.

The solid type of table is about 1¼ in. thick and weighs the same as the cored type, about 85 lb. for an 18-in. table. It is also more convenient for the use of clamps.

Outside of the features noted above, it should in justice be said that the machines from which the illustrations were taken are excellent ones, having given uninterrupted service for years.

In Retrospect

By W. D. Forbes

In continuing the line of thought that was started some months ago in the *American Machinist* under the above title, concerning the origin of things mechanical, I have a word to say on the subject of chucks.

The first lathe chuck I ever saw was made by Judson. It was in the year 1874, in the shops of the Hoboken Ferry Co. When the work was grasped in the jaws, a system of wedges drew the latter down to the body of the chuck, but how this was done I cannot clearly remember. Perhaps some of the readers of this journal may be able to explain it.

I have not been able to find out where this chuck was made but the Hon. L. D. Whiton, of New London, Conn., told me that he thought it was made in Rochester, N. Y., or in some city in the center of that State. Here again readers may supply information. The chuck referred to was a four-jawed independent.

Mr. Whiton also gave me these facts concerning the history of lathe chucks. The first chuck was made in Stafford, Tolland Co., Conn., in 1843 by a man named Fairman. It was of the scroll type with four jaws; consequently, it was what we now call "universal."

The first combination chuck that I can remember was made by the National Chuck Co. A ring was placed back of the circular rack on which were cams. In the body of the chuck, bosses were cast so that when the ring was turned the cams on it met the bosses and put the rack in mesh with the pinions on the jaw screws. A stem was made fast to the ring, this stem passing through a slot in the rim and having a thumb-nut on it to secure it against shifting. Later, another chuck of this class had the same system of cams on the ring but employed three or four movable cams (according to the number of jaws) to throw the rack into mesh.

Universal chucks in which circular racks were used I had heard about before I saw the Judson, but I had not seen one. What is known as the "box" chuck was made, according to Mr. Whiton, for use on brass finishing lathes, but where or when he could not say. I should think those who first made the Fox lathe could shed some light on this matter.

In the early eighties I bought from the Whiton Co. a small chuck of the scroll type, called the "amateur's chuck," and the front half was furnished with a circular rack. This rack was moved by means of a pinion key which was removed after closing or opening the jaws, just as any wrench would be. Later, this system was used in small drill chucks and, if I remember rightly, a long legal battle was fought over the design.

In the early drill chucks very little attention was given to balance but with the higher speeds now used for drilling, balance is of prime importance and the workmanship on some of these chucks is about perfect. I once gave a friend in France one of these drill chucks, and, after looking at it, he said, "this is more perfectly made than any watch I ever saw."

In a previous article I referred to the origin of the blueprint process. A friend writes me that I could have gone further back if I had consulted a certain work which placed the first suggestion of this valuable process about 1790. I have not been able to consult the work but I am told that the original idea of the system dates back to the Middle Age. Lace makers and architects in those days laid their patterns on a piece of green cloth, covered it with a glass, and let the sun shine on it for several days; when the pattern was removed its form was found in darker color, as the exposed part of the cloth had faded, leaving the darker pattern.

My informant told me that in a book belonging to the late W. F. Durfee of Bridgeport, Conn., published in Italian about 1770, a description of this sun printing process was given. I think Mr. Durfee gave his books to the American Society of Mechanical Engineers, and the book referred to was named "The Magic of Nature."

Tool Storage in a Gas-Engine Factory

EDITORIAL CORRESPONDENCE

The tool-storage room where the attendant goes pawing over the shelves to find the desired tool is a dead issue in the best of our modern shops. This article describes the storage system of a large gas-engine plant which is building a wide range of engines, and, consequently, has many tools and fixtures to care for.

SEVERAL articles in the past have told the readers of the *American Machinist* something of the methods used by the Fuller & Johnson Manufacturing Co., Madison, Wis., in the production of its small power gas engines and engine-driven lighting unit sets. The quality of the machining methods throughout the shops is reflected in the corresponding degree of care used in the tool department of the shop for the storage of the many cutters, jigs and fixtures that are used to insure interchangeability.

The toolroom has been handled on the theory that there shall be a place for everything and each piece in its appointed place; certainly, this is well exemplified by such a milling-cutter storage board as that shown in Fig. 1. This board has been fitted with suitable rows of wooden pegs upon which each separate size of cutter may be hung as it is returned from the shop. Below each peg is a small aluminum plate which carries the size designation of the part hanging above. In some cases an additional plate carries further information for the guidance of the tool-crib tender, such as "plain," "two pair" or "special." One end of the plate is fastened by a tack; the other is held by a hook-eye upon which the attendant may hang the tool check of the workman who draws out the tool.

The only tools left in the shop after a job is finished are heavy special fixtures which are so difficult to move that it is considered impractical to have them in the regular tool-storage rooms. Even many of the regular lathe dogs are hung on the storage racks, Fig. 2, so that the workman knows just where he can obtain them instead of trying to borrow a dog from an adjacent machine. In this section of the tool crib will also be seen a number of the different types of gages.

The writer has visited a number of machine-tool-building shops that make it a practice to make up a complete new set of tools and fixtures for each machine part to be made, even though this may involve numbers of duplications of standard cutters and reamers that may be used on similar parts. The idea of this is that there shall always be a full set of useable tools for each part in process, so that the production of one piece will not delay the production of another piece which may be desired at the same time, nor will the damage or

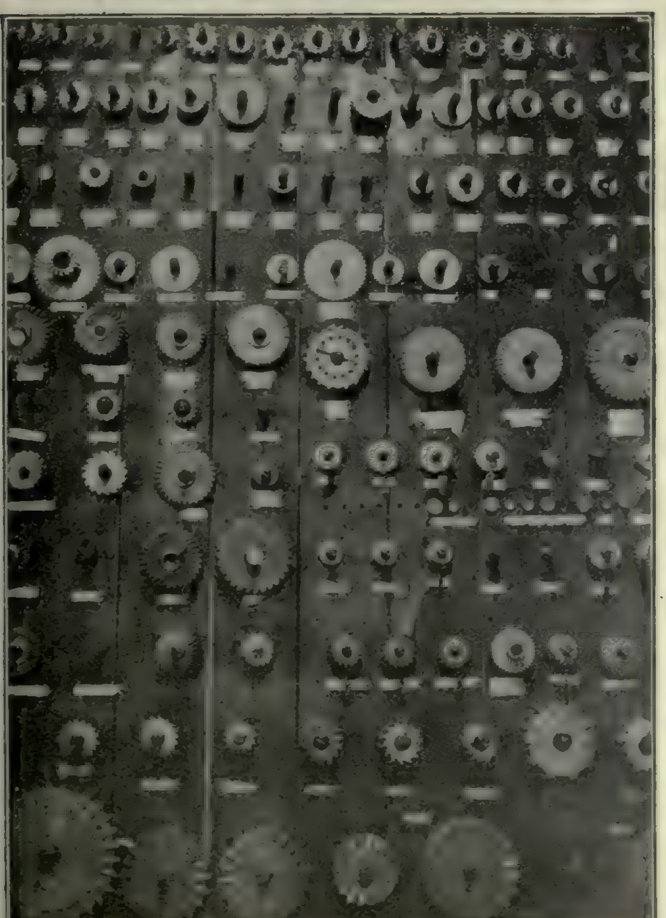


FIG. 1. TYPE OF STORAGE BOARDS PROVIDED FOR MILLING CUTTERS

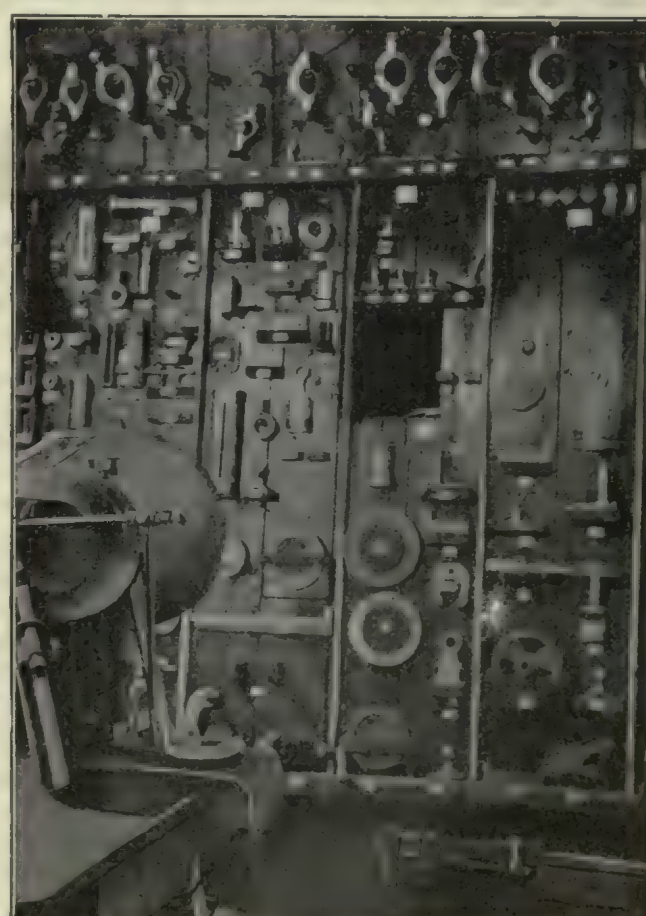


FIG. 2. STORAGE FOR LATHE TOOLS AND GAGES

FIG. 3. TOOLS FOR SPECIAL PARTS GROUPED IN CONTAINERS

breakage of any one tool delay the product on more than one piece. Such groups of tools are then assembled in separate containers ready to be drawn out from storage by the workman when he commences an operation on that particular part.

To a certain extent this same practice is followed at the Fuller & Johnson plant where special tools and fixtures for a part are assembled in group containers which bear the part designations to correspond with the parts of the different engines. Such group containers may be seen arranged on the tool-storage shelves shown in Fig. 3, and here again each one bears a numbered aluminum plate which corresponds with the designation of a particular part of an engine. Larger fixtures that are too bulky to box are laid in corresponding order on the lower shelves of this same tier.

In numbering the engine parts, a system has been followed in this shop which makes it much easier to identify the parts for which different tools are to be used. This was accomplished by numbering all the same parts on different engines with the same number and then adding a prefix letter with a dash before each to indicate the engine size. Thus, the camshaft might be part "22N," and when written with the engine size might appear as part "J—22N." This system cuts the memory work down to remembering the part designations for one complete engine, and the few necessary letters to identify the different sizes of engine types. This numbering system is utilized in the tool crib by placing in proximity to one another all group containers intended for the same operation on similar parts. Thus, all the containers for perhaps the second operation on the connecting-rods for the different sizes of engines would be grouped together on one shelf, or more; while the tools for the following operations on the same parts would be found in the proper sequence on the adjoining shelves.

Special fixtures are drawn from the tool crib by the workman on his tool checks just as are his other tools so that the responsibility for lost or broken parts may always be fixed. Everything that comes back to the tool crib goes to certain shelves reserved for incoming tools and remains there until the foreman of the tool department has an opportunity to inspect it. Should any fault be found, the tool is taken immediately to the toolroom and put in perfect condition before it is returned to its proper storage place in the crib.

The Foreman Not Held Responsible for the Care of Numberless Blueprints

In this plant the busy foreman is not held responsible for the care of the numberless blueprints; these likewise are kept in the tool crib, under a similar system of checking and supervision. The drawings have been entirely standardized with each individual part shown in a separate sketch. The blueprints are mounted on a heavy manila or fiber paper and given a thin coat of varnish or shellac to prevent them from absorbing oil and dirt when being handled. When delivered to the tool crib they are placed in numerical order in the vertical filing bins seen in the foreground of the illustration, Fig. 4. The swinging panels above are covered on both sides with rows of hooks, each one of which carries a small tag bearing a number and designation to correspond with the blueprints filed in the bin below. When a workman requires a blueprint he draws it in the same manner that he would a tool and leaves a check that is hung on the proper hook on the board above. Thus a record is always kept of where each blueprint may be found and should some one else have occasion to refer to the same blueprint, he can find out here which workman he should look for to find the desired print. Blueprints are always inspected when they are returned, and when they begin to shown signs of wear they are laid to one side until the drawing-room boy, in the course of his daily inspection, can make a note of the numbers of the prints needed and prepare them for delivery on his next round. Varnished prints which are merely dirty can usually be cleaned a number of times with a piece of clean waste and gasoline.

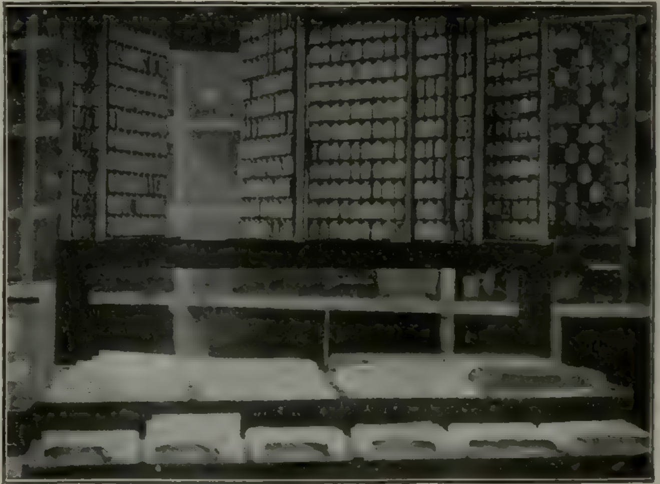
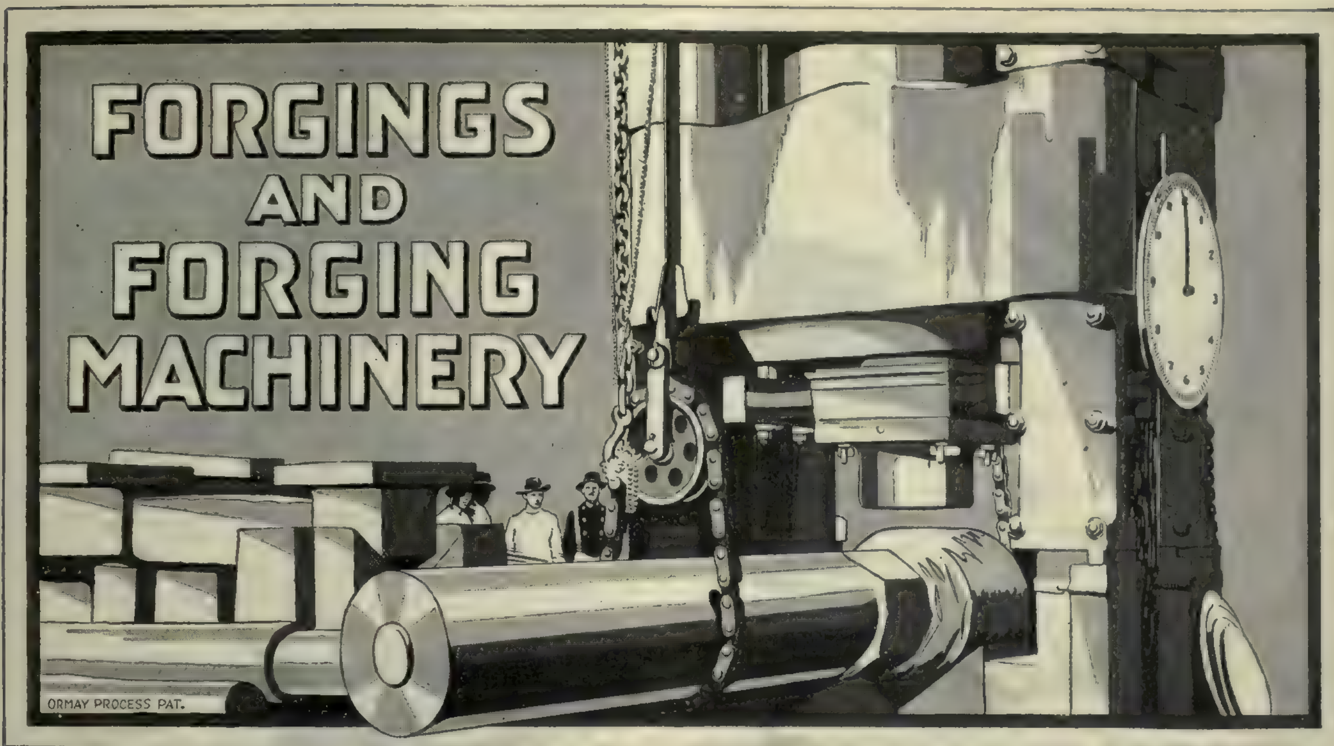


FIG. 4. STORAGE AND CHECKING SYSTEM FOR SHOP WORKING DRAWINGS



Forging Round and Shaped Pieces Under the Steam Hammer

By A. S. Hesse

It is as necessary to have dies and tools for successfully forging round shapes under the steam hammer as it is for the more irregular shapes. Likewise, it is necessary to have swages for forging rounds if these are to be worked commercially to close dimensions.

MANY hammersmiths work round forgings between the flat faces of the hammer, using light blows for finishing. This practice is very injurious to the material, as light blows with a flat die give a spreading, or bulging, effect, as indicated by the diagram *A*, Fig. 1. This bulging leaves the center of the bar with a different structure from the outside, and the latter alone is refined and well worked by the light blows. The weight of the blows struck by the hammer determines the depth, measuring from the outside to the center, of the refining influence upon the material.

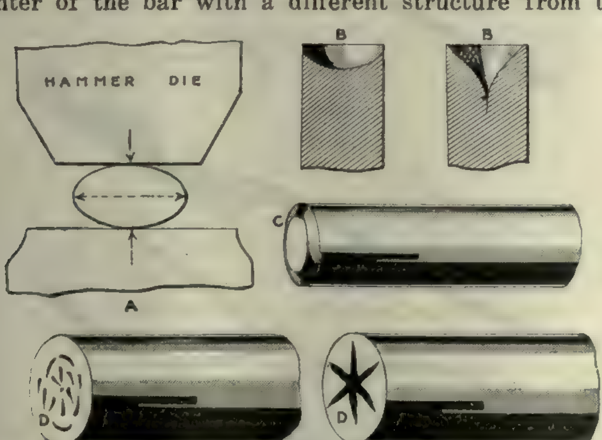


FIG. 1. EFFECT ON THE STOCK, OF DIFFERENT METHODS OF FORGING

A competent hammersmith will always know when the metal is being damaged in this way. It evidences itself by the ends of the forging becoming concave, "cupped" or "dished," as such an end is variously termed. It occurs because the outer layer of the steel has been flowed to a greater extent than the center, and is shown at *B*.

When the forging is properly worked (and this applies to either round or other shapes), the blows of a hammer which are of sufficient weight to penetrate through the forging will produce the opposite result. The center will protrude slightly at the end of the bar, as indicated at *C*, because the center is hotter and so flows more readily while at the same time its crystalline structure will be thoroughly refined.

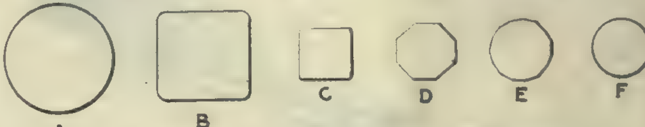


FIG. 2. SEQUENCE TO BE FOLLOWED IN REDUCING ROUND STOCK TO SMALLER DIAMETER

When the light forging blows which have caused the end to cup, are continued after the heat on the outside of the forging has fallen, cracks will develop in the center of the end of the forging, as shown at *D*, and these always start on the surface. If, with the

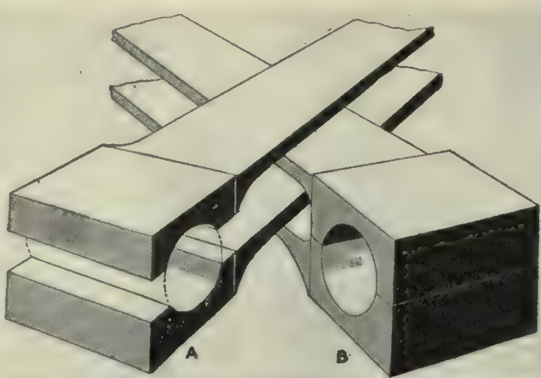


FIG. 3. OPEN AND CLOSED TYPE OF SWAGES

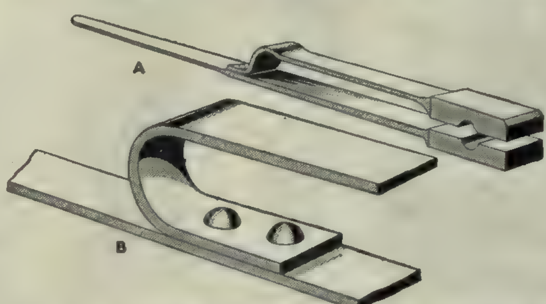


FIG. 11. OTHER FORMS OF SPRING HANDLES

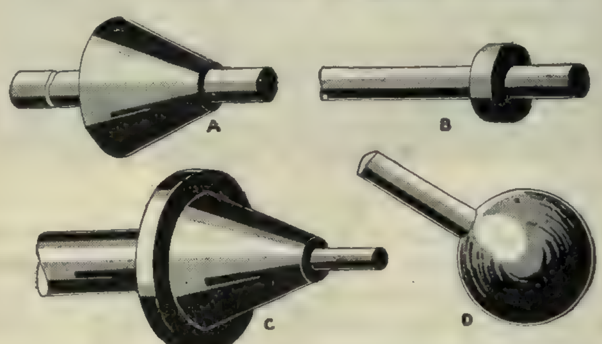
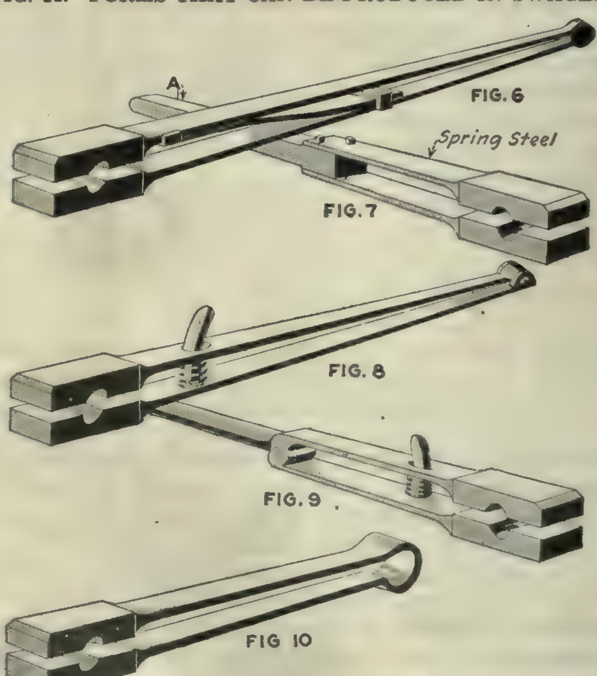


FIG. 12. FORMS THAT CAN BE PRODUCED IN SWAGES



FIGS. 6 TO 10. DIFFERENT FORMS OF SWAGES

Fig. 6—Hinged swage with flat spring. Fig. 7—Spring swage with wooden handle. Fig. 8—Hinged swage with guide pin and spring. Fig. 9—Hinged swage with long handle. Fig. 10—One-piece spring swage.

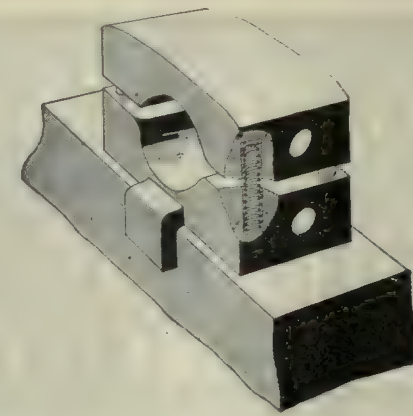


FIG. 5. SWAGE WITH COIL SPRINGS FOR LIFTING TOP HALF

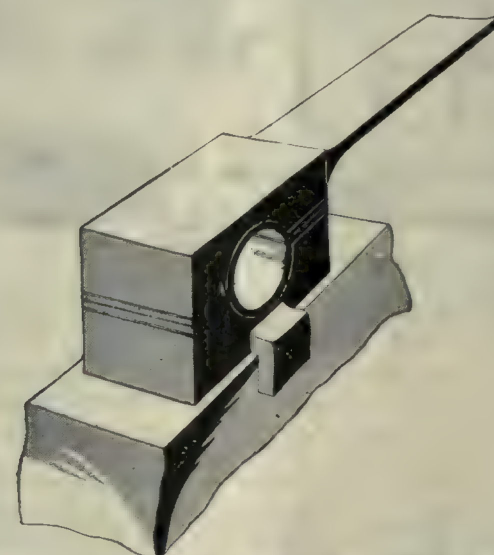


FIG. 4. EARLY FORM OF SWAGE WITH LUGS FOR HOLDING ON HAMMER DIE

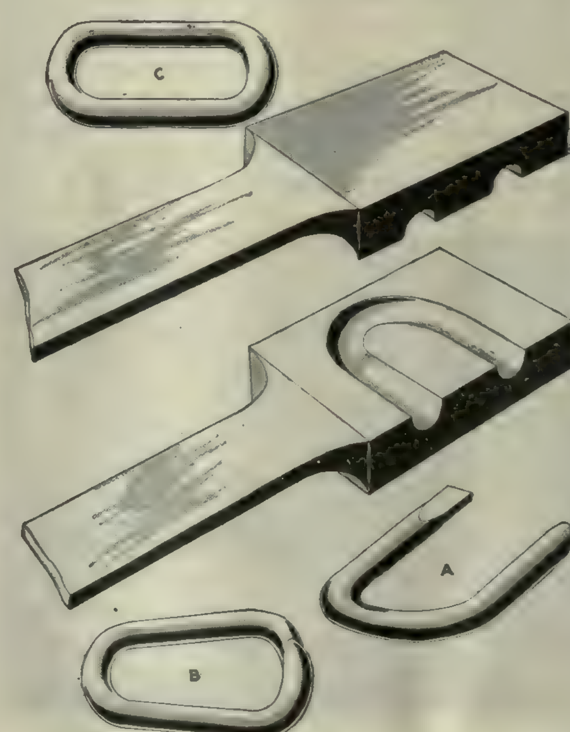


FIG. 13. LINK WELDING WITH A SWAGE

forging at low heat, the working is continued the cracks will finally extend its whole length. Light blows on the forging do not tend to draw the material lengthwise, but only to work it in the shortest direction, which is sidewise; they therefore exert only a crushing effect on the structure of the steel.

When a piece has been worked until the heat has become too low it is not good practice to attempt to finish the outer surface by using very light blows of the hammer. When a great deal of finishing is required it is better to reheat and work the forging the long way of the die. When no swages are available for finishing, this method of working lengthwise of the die may help to save the forging.

Some hammersmiths offer a variety of excuses when these flaws or defects develop in a forging, a frequent claim being made that there was a flaw or crack in the billet or stock from which the forging was made. In the majority of cases, however, the trouble is entirely

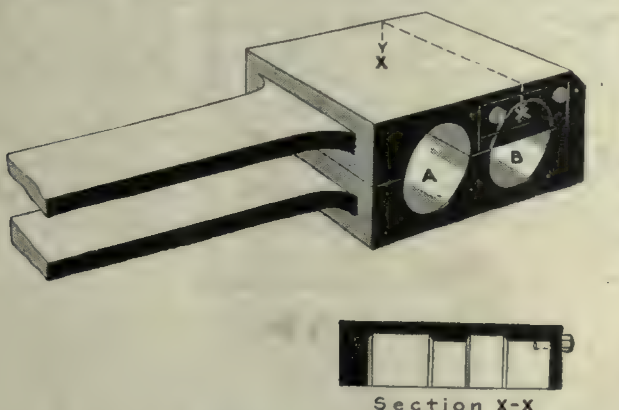


FIG. 14. SWAGE WITH PERMANENTLY ATTACHED TRIMMING TOOL

due to the smith's incorrect manner of working it. A mistake of many hammersmiths when drawing a forging to a smaller size is to advance the work nearly the full width of the die for each blow. The hammer should strike new material on each blow equal to only one-third or one-half the width of the die. A drawing operation performed in this way requires only from one-half to two-thirds of the time that would be required by the wrong method, and the material of the finished forging will be improved rather than injured by the operation.

A mistake less frequently made is that of working a round piece to a smaller size, and at the same time keeping it round throughout the operation. No other method is so injurious to a piece of iron or steel as this, as it quickly opens up seams and faults throughout the entire forging. The proper way to draw down a forging that is afterward to be shaped round is shown in the sequence *A* to *F*, Fig. 2. This shows a start made from a round forging, which is first squared, then drawn down to a smaller size, and finally worked through an octagon into the round required.

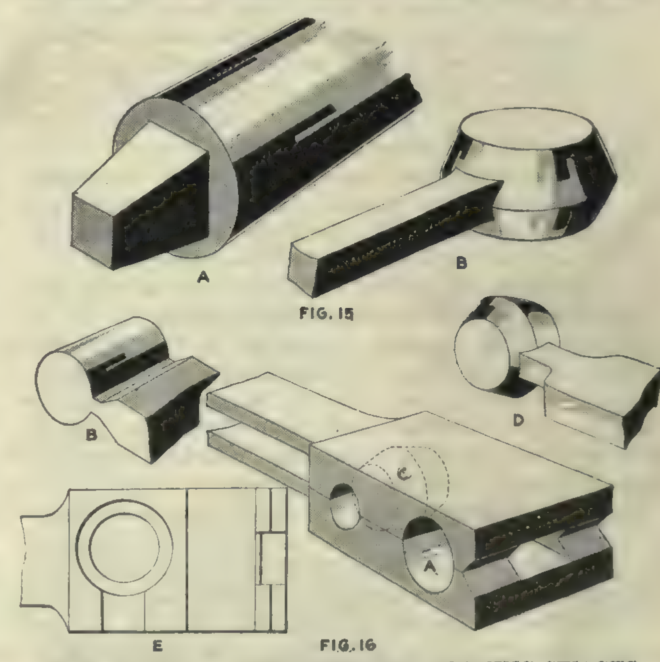
The use of proper swages will aid greatly in overcoming the faults of bad practice and careless workmanship. Hammersmiths express various views in regard to the best type of hammer swages and the shape of the different passes. Some prefer the open type, as at *A*, Fig. 3, while others prefer the closed type *B*. My opinion is that the latter type is the better, as it eliminates guesswork and avoids frequent stops to caliper the forging. When the closed type of swage with dies of the correct size is used the smith knows that the forging is to size when the swages come together.

A common mistake of blacksmiths is to think that one size of swage will do for three or four sizes of round forgings. The use of over or undersized swages adds to the other faults of hammer-forging methods and does not lend itself either to rapid production or to uniform and accurate sizes.

A shop should have a full set of swages, and for general service these should range from ½ in. in diameter to 3 in. in diameter, increasing by eighths of an inch. Above 3 in. in diameter the increase may be by ¼-in. steps, according to the general character of the work being done. The swages should be graduated in strength for the different sizes of hammers in the shop. In other words, swages for use on a 2000 or 3000 lb. hammer must be built much sturdier than those for a 500 or 800 lb. hammer.

An open swage is permissible for forging round tapers. To use a closed swage for this purpose would necessitate having the swage either wide enough to inclose the whole length of the taper or else separate swages for the various sections of the taper. However, the use of open swages for this kind of work depends somewhat upon the length of the latter, but all work requiring the use of an open-type taper swage requires considerable skill. I have seen some very nice tapered work done on large pieces by using a tapered V-block under the hammer.

In the past many shops making heavy forgings did not use swages for this work, as they considered it cheaper to forge it roughly to size between flat dies and turn-off the surplus stock in the lathe, wasting this excess stock rather than to bother with the heavy



FIGS. 15 AND 16. REDUCING AND FORMING SWAGES
Fig. 15—Drawing a square extension from a bar or forging. Fig. 16—Swage for forging a ball

swages or forging dies required. The high prices of good grades of forging steel under war conditions have rather modified this situation, and the surplus weight of stock which can be saved by forging between round dies and swages, will pay for the extra cost of the additional labor necessary.

Thirty-five or forty years ago the swages used for heavy work were made from blocks of iron overlaid with shear or "blister" steel, as it was then called. The lower block was provided with lugs to hold it on the hammer die; the upper one had a handle to hold it on the work. This type is illustrated in Fig. 4. There were also spring swages, shown in Fig. 5, which were heavy, clumsy affairs, made of wrought iron faced with steel and having four coil springs set in recesses in the corners to spring them apart after each blow of the hammer. They had pin holes in the bottom block for the insertion of bars, which were used to lift them into and out of the hammer. They required two helpers to keep them from jumping out when a blow was struck.

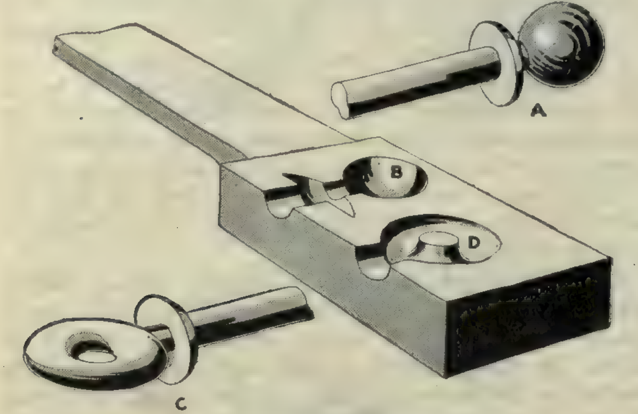


FIG. 17. SWAGE FOR FORMING EYE-BOLT

The Hinged-Spring Swage

A later development is the hinged-spring swage, which is made of wrought iron, with the working surfaces faced with steel, welded to the wrought iron. These swages shown in Fig. 6. are made in one piece with the handle, and there is a hinged joint at the outer end. A flat spring is riveted to the handle of the lower half of the swage to hold it open.

The swage shown in Fig. 7 has a piece of spring steel welded to each member and these springs are bolted to a wooden handle as shown at *A*. Some of these swages may still be found in the older shops.

The spring swage shown in Fig. 8 has a long pin in the lower handle which passing through a slot in the upper handle guides the upper half. A heavy coiled spring surrounding the pin holds the swage open.

Another similar type with an extension handle is shown in Fig. 9. The guide pin should be located not over one-third of the distance from the center of the head to the hinges.

The swage shown in Fig. 10, and known as the one-piece spring swage, is made of the same material throughout. This is the easiest swage to make and when made right it gives good satisfaction, but the reins will lose their set if the swage is used on too heavy stock. The reins should taper from the head to the roll then widen slightly, and the bottom member should be the heavier of the two.

Some hammersmiths think that the two styles *A* and *B* of swage handles shown in Fig. 11 are the best.

These are the easiest to make of the two-piece swages, and are also a little easier to hold on the hammer die, and they arc easier to dress when worn. Swages are serviceable in handling shapes entailing duplication of forgings. Forms such as shown at *A*, *B*, *C* and *D*, Fig. 12, can be readily made in swages, giving satisfactory results for a limited output.

The link-welding swage, Fig. 13, is an application of this type of tool, and its use here is as follows: The link is first bent and scarfed as at *A;* then the two ends are bent together as at *B*, leaving the link wider than the impression in the welding swage, which is made the size of the finished link. The previous spreading of the link results in the ends being closed together when struck by the hammer on the scarf, and assures a full-sized weld.

Cutting-off tools are occasionally applied to the swage to insure duplicate forgings of definite length. Such a swage, Fig. 14, is sometimes made with two passes, the forging first being done in the pass *A* and then transferred to the pass *B*, where a cutting-off chisel on the upper half is driven through the stock which is turned in the pass after each blow to cut it off to a specified length leaving a nice smooth end. The section *D* through the upper half of the swage at this point shows the manner in which the chisel is let into the block to prevent the bolts from shearing off.

Swages are used for square or tapered ends on bars like that shown at *A* in Fig. 15. A boss, as shown at *B* in the same illustration, is made by flattening a ball forged on the end of a rod and then shaping it in a swage.

A Two-Pass Swage

A two-pass swage for forming a boss from a full-sized bar is shown in Fig. 16. The work is started in pass *A*, which necks down the bar and gives it partial form, as shown at *B*. The neck can then be drawn down a little further under the hammer dies without a swage. It is then worked in the pass *C* to the form shown at *D*. The plan view of the lower half of this swage is shown at *E*.

Such parts as the eyebolt shown in Fig. 17, usually made in a forging machine, may be made in swages under the steam hammer. The first operation *A* is performed in pass *B*, and the eyebolt *C* is completed in *D*.

Where a large variety of shapes is swaged the type of swage reins with replaceable heads shown in Fig. 18 may be used to advantage.

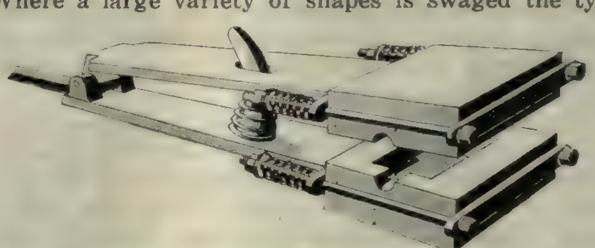


FIG. 18. SWAGE WITH RENEWABLE WORKING FACES

The placing of coiled springs under the clamping bolts prevents the breaking of the bolts. Even with springs few bolts will stand the strain for any length of time but bolts of Swedish iron will last longer than any other material I have used for the purpose. The use of such a swage form with replaceable heads is of no service in shops that have a helve hammer, but for many shops that are equipped only with the standard types of steam hammers some of these forms of swages will undoubtedly be of value as an aid in the production of the work.

Plastic Arc-Welding on Ship Work

BY J. O. SMITH

The engines of interned German ships, damaged by their crews, were successfully repaired by plastic arc-welding. This method of welding had been in use on a large Eastern railroad for some time previous to the entry of the United States into the World War and the results achieved in welding heavy cast-iron locomotive and other parts led the engineers of the Navy Department to try it as a means for repairing the damaged engines of the German ships.

THE repairing of the damaged engines of interned German ships by arc-welding brought into practical use a branch of the electrical industry that had not up to that time been employed on so extensive a scale or with the same incentive. The successful repair of the large cast-iron cylinders and other parts of the German ships by the Williams' plastic arc-welding method led naturally to consideration of arc welding in the manufacture and repair of metal products and parts of all kinds. The attention of engineers generally has been attracted by its possibilities, and the great achievement of successfully repairing the damaged engines has naturally given the subject great prestige among shipping and shipbuilding interests.

When the matter of welding in connection with ship-construction is considered, immense possibilities immediately suggest themselves. It has been definitely determined by exhaustive technical study and experiment that welding can be satisfactorily employed in ship construction, that ship plates joined by welding will be as strong or stronger than the oriignal metal at the welded joint, and that welding can be employed for ship-construction work at a saving of 25 per cent. in time and 10 per cent. in material, as compared to riveting.

In actual figures, as determined by experiments of the Emergency Fleet Corporation's electric welding committee, it was determined that, by welding, in the case of a 9500-ton ship the saving in rivets and overlapped plates would amount in weight to 500 tons, making it possible for the ship to carry 500 tons more cargo on each trip than would be possible if the ship plates, etc., had been riveted, instead of welded.

An investigation by the same committee has definitely established the following points: That electric-welded ships can be built at least as strong as riveted ships; that plans for ships designed to be riveted can easily be modified so as to adapt them for extensive electric welding, and thus save considerably in cost and time for hull construction; that ships especially designed for electrc welding can be built at a saving of 25 per cent. over present methods and in less time.

An electrically welded ship is credited with many advantages over a riveted ship. In a 5000-ton ship, about 450,000 rivets are used. A 9500-deadweight-ton ship requires 600,000 or 700,000 rivets. By the welding process the saving in labor on the minor parts of a ship is reckoned at from 60 to 70 per cent. on the hull, plating and other vital parts; the saving in labor, cost and time of construction by welding is conservatively placed at 25 per cent.

That electric welding will some day largely replace riveting is also the judgment of the electric-welding committee which is composed of many leading experts in both the electrical and metallurgical branches of the welding field.

Considerable investigation of the subject of welding instead of riveting has been made in England by Lloyd's Register of Shipping, particularly with regard to formulating rules for application to the electrical welding of ships. As a result of the investigations and ex-

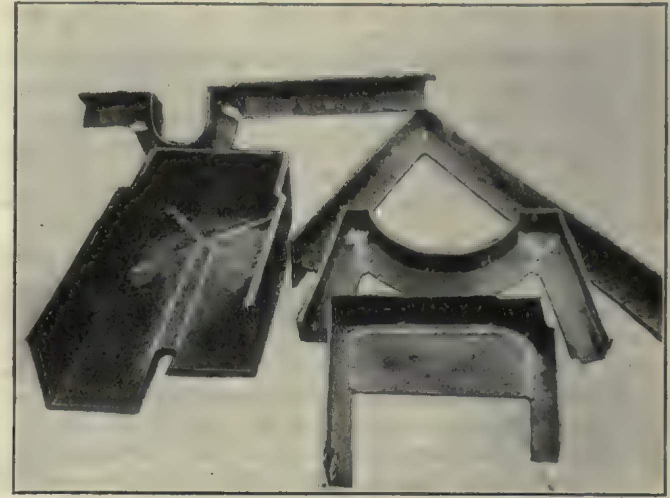


FIG. 1. WELDED PARTS FOR SHIPS

periments made by the technical staff, it was determined that the matter had assumed such importance as to warrant the formulation of provisional rules for electrically welded vessels, and these have been issued, for the guidance of shipbuilders, by *Lloyd's Register*.

The experiments conducted in England followed three well-defined lines of investigation: Determination of ultimate strength of welded joints, together with their ductile properties; capability of welded joints to withstand alternating tensile and compressive stresses, such as are regularly experienced by ships; and a microscopic and metallurgical analysis to determine if a sound fusion was effected between the original and added metal.

It was determined that the tensile strength of the welded joints was from 90 to 95 per cent. of the original plates, as against a strength of from 65 to 70 per cent. in riveted joints, showing a margin of 25 per cent. increased strength in favor of the welded joints.

The result of the tests of the elastic properties of welded joints determined that there was a slight difference in favor of the riveted joint, but the art of welding has made such great strides recently that it is now believed entirely possible to make a welded joint in ship plates that will stand as great a number of reversals of stresses as a riveted joint.

Microscopic and metallurgical analyses have determined that a good, solid, mechanically sound weld was made between the original and the added metal, the two having been fused together so perfectly that no line of demarcation could be seen.

The rules so far promulgated by Lloyd's have been necessarily of a tentative nature and will no doubt be

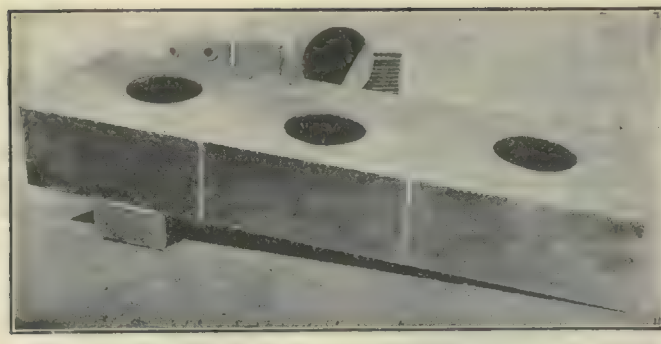


FIG. 2. WELDED FUEL-OIL TANKS

modified and enlarged from time to time in view of the experience that will be gained after welded ships have been in service for a time.

It does not require a great deal of imagination, however, to enable anyone to form the opinion that the shipbuilding industry is on the eve of great modifications in constructional lines, and the guidance given by the tests and comparisons so far made will undoubtedly lead to important, radical departures and developments.

In addition to the increased cost of riveting as compared to welding, it is practically always true that there is a certain percentage of imperfectly fitted rivets, that do nothing more than add weight to the ship. The main purpose of a rivet, of course, is to bind two or more thicknesses of material together, but if the rivet is bent, loses part of its head in the riveting process, or otherwise fails in its proper purpose, there is no method by which such faults can be corrected after the rivet cools. If the importance of the riveted part requires a perfect joint, the faulty rivets must be removed entirely, and this is frequently a time-killing, expensive course to follow. When it is considered that a 5500-ton ship requires approximately 450,000 rivets to bind the various parts and plates and also that a certain percentage of these rivets is not fulfilling the purpose for which they were put into the ship, it is quite evident that practically every ship is burdened with a good-sized load of dead, useless weight. Such defective rivets are, in fact, more than a useless weight, in that they are a menace to the ship, for while they have been built into the ship for a purpose, and are supposed to be fulfilling that purpose, there is no telling how much the ship has been weakened structurally by their failure.

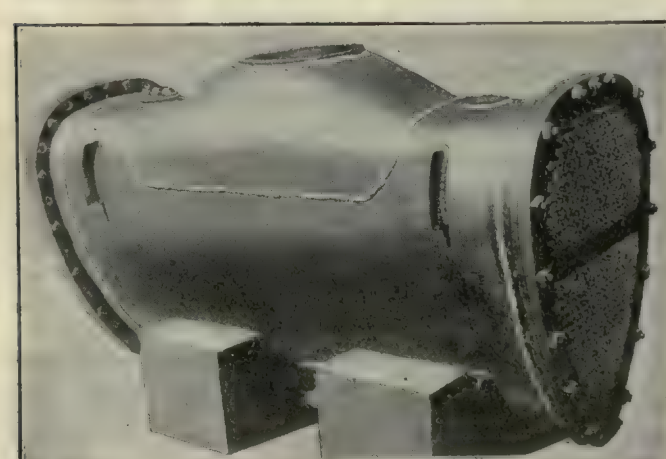


FIG. 3. WELDED STEEL-PLATE CONDENSER. NO RIVETS IN ITS CONSTRUCTION. SIZE 4 X 7 FT.

There are many reasons for defective rivets, and one of the greatest of them is the inaccessibility of the parts to be riveted and the consequent difficulty on the part of the riveter in putting the rivets properly in place. Another reason is that there is no certainty that rivets are at a proper, workable temperature; in consequence of which if they are too cold, the pneumatic hammer now generally used in riveting is unable to round off the end of the rivet properly, so as to insure a proper binding together of the plates the rivet is supposed to hold.

In many cases, when such faulty rivets are discovered, the present-day method is to weld such defective spots, which immediately brings up the natural question as to why the plates should not be welded in the first place.

The ability of a welder, using a direct-current, low-voltage arc with automatically regulated current to make sound mechanical welds in cramped, confined spaces, on overhead or vertical walls, in fact, anywhere a man and a wire can go, naturally suggests that welding ship plates together should be the primary operation in shipbuilding; and from present indications and the trend of current events, it seems more than likely that this will be the outcome in the near future.

A Homemade Lathe

By Donald A. Hampson

After some persuasion from a friend, the writer visited an elderly man about 10 miles distant to see a model automatic machine. The workmanship was so good and the model operated so well that it elicited the remark that some good shop must have done the job. "No," replied my new friend, "I did all the work myself, every bit of it, in my own little shop."

Natural interest in that shop disclosed the lathe on which the work was done and it is shown in the accompanying illustration. It is run by foot power, has a compound rest and its bed is made of wood. The only other tool in the shop was a drilling machine, also made of wood. The owner made this lathe as he makes his models; of any old parts he can get of household goods, country blacksmith's and farm-machinery scrap—but never calling on machine shops. What is most remarkable is the fact that he never worked a day anywhere except on the farm, though that did not prevent him from reading, thinking and applying basic principles of physics and machine design to his products.

A HOMEMADE LATHE

Contracts and Contractural Relations—II

BY CHESLA C. SHERLOCK

There are certain elements entering into every valid contract which must be present if such contracts are to be enforceable at law. Stated briefly, these elements are: assent or agreement; definiteness or certainty; consideration; mutuality and legality. (Part I appeared Jan. 15.)

IN ORDER for there to be a valid agreement to a subject matter for a contract, there must be parties competent to enter into an agreement. This presupposes a promisor and a promisee. A careful study of the contract relation, and particularly of the decisions upon the point, will convince anyone that the promisor's assent is essential to the formation of a contract. It has been stated so many times by the courts that it is practically undisputed that, except in the case of *quasi* contracts where the assent is supplied by law, no valid contract can exist without the assent of the person on whom the obligation rests.

This, in itself, however, is not sufficient in consensual contracts; for they require the concurrence of intention of both parties, one who promises to do a certain thing and the other who assents to it. Both parties must give their assent to the matter before a valid contract comes into existence, and the assent of one of the parties alone is not sufficient, unless there are circumstances surrounding the case which will give rise to a presumption of law or fact which will supply that assent by fiction.

Since there must be assent on the part of the promisor as well as the promisee, this naturally precludes the possibility of one person giving assent in an individual capacity to himself in a representative capacity. For instance, an officer of a corporation cannot agree with himself to sell himself property of the corporation at a cheap price. One person cannot occupy the position of both parties at the same time.

The law recognizes very clearly the necessity of having parties capable of assenting to the contract. This, of course, is not necessary in the case of *quasi* contracts because the contract there is based upon a duty imposed by law. Since the duty is imposed by law, it may be imposed upon persons incapable of giving assent to a contract as well as those capable of it.

In most instances, where one party is incapable of giving consent to the agreement, the contract is rendered voidable and not void, as one might suppose.

The first test to determine whether a certain person is capable of giving assent to a contract is to look to his legal ability. It is obvious that a person must be of sound mind, and it is desirable that he be of full age. While a minor may enter into valid contracts which will be binding upon him in certain instances, such as for necessities, the rule generally is that his contracts are voidable. This means that he can repudiate them, and even though the other party may faithfully perform his portion of the agreement, he cannot, upon that showing, recover from a minor who repudiates his share of the agreement. It is desirable, then, to be sure on the age proposition.

But aside from these considerations, there are several instances where the law has said that certain persons are incapable of entering into contracts of any nature. A case in point is that of married women at common law. A married woman's legal existence was deemed to have been merged with that of her husband. Having no legal existence she was not deemed capable of entering into contracts on her own behalf after marriage. While this rule has been expressly changed in many states by statutory enactment, it still holds true in those states where no express statute has been passed expressly conferring the right to contract upon married women. Prior to marriage, even at common law, a woman had a right to contract with the same freedom enjoyed by the opposite sex. But marriage destroyed this power. As the old joke went at common law: "Man and woman are one, and man's the one!"

Persons of insufficient mental capacity are not capable of entering into valid contracts. One must be of a sufficiently sound mind to understand the nature of the agreement, to appreciate its effect upon the future or property of the individual, and to be able to freely give consent.

For many years, under the common law, it was believed proper and just to permit persons claiming to be *non compos mentis* the opportunity of proving their insanity in court in defense against their contracts.

But in the time of Lord Coke, it was held to be improper for the courts to allow a man of full age to stultify himself and to set up his own disability in avoidance of his acts.

It was said that if a man is insane and then recovers himself sufficiently to set up his own disability, that he could not, properly speaking, know what he did when he was *non compos mentis.* It was also feared that a great amount of fraud and deception would result if it were permitted to plead insanity in defense of one's own contracts, because it is possible for one to fraudulently pretend insanity with little likelihood of being discovered.

While this opinion held until comparatively recent times, it was argued that it was contrary to the laws of justice and the practice of civilized peoples to prohibit a man from pleading his mental incapacity in defense of his acts. Indeed, one authority has said that the theory that a man should not be permitted to stultify himself has been exploded, and this contention seems to be borne out by the later decisions. And under these decisions, the right rests entirely upon the degree of the insanity of the person.

Business men, then, must be sure that they are doing business with people of sound mental capacity at the time contracts are made, if they are to save themselves harmless from loss, as there is always the possibility of the other party proving his own lack of mental capacity.

It is generally known that persons under the influence of liquor are not deemed at law to be sufficiently capable mentally to enter into valid contracts. Since the passing of the saloon the courts may not be concerned with this matter so much in the future, but it is well to keep it in mind.

The same is true of persons under the influence of any other agency sufficient to rob them of their normal

mental capacity. However, it must at all times be remembered that even though the person may be under the influence of some such other agency, his contracts are not void unless it be shown that he was so far deprived of his mental capacity as not knowing or being capable of understanding the nature of his acts. Persons may be slightly affected but if they still retain sufficient mental powers to understand what they are about their contracts entered into at such a time cannot be said to be wholly void.

In speaking of the matter of capacity, it must be kept in mind that no valid contract arises between parties until there has been a "meeting of the minds" of two parties capable to contract in the eye of the law. This meeting of the minds presupposes that the minds are equal in power to function. The assent must be given and it must be given freely and without coercion, duress, fraud or fear, or by means of any outside agency which interferes with the normal functioning of the normal mind.

This simply means that the assent must have a degree of sufficiency adequate to show what the intention of the parties was. While the minds of the parties must meet, it has been pointed out in many cases that it is not necessary that they should meet at the same instant, though the expression of an intention to give assent at some time in the future is not a sufficient assent to make a valid contract. In Michigan, it was said that a contract was not created in an instance where the matter was entered into in a spirit of fun and frolic.

In another Michigan case, it was pointed out that the meeting of the minds of the parties was not determined by their secret intentions but by their expressed intentions, which often are widely different from their secret intentions.

Contracts are generally formed by the medium of an offer and an acceptance of such offer. In order for an offer to amount to a contract when accepted, it need not be addressed to any particular individual, although it generally is. It may be addressed to the public through advertisements, as has been decided by a number of cases both in this country and in England. But in order to be binding, it is essential that it be definite. A mere vague or indefinite statement cannot be construed to be an offer sufficient to found a contract upon.

One authority says: "An offer, to constitute a contract, must be one which is intended of itself to create legal relations on acceptance, and if it is an offer merely to open negotiations which may ultimately result in a contract it is not binding. An invitation to enter into negotiations is not an offer which can be converted into a contract by acceptance. . . . General offers must therefore be distinguished from general invitations to make offers. Performance of the conditions of the former makes a legally binding contract, whereas compliance with the requirements of the latter is nothing more than an offer which may or may not be accepted by the other party."

Most business contracts today are consummated by means of telephone, telegraph or by mail, for the reason that the bulk of our business is no longer merely local in nature, but is carried on in every section of the country.

The business that is conducted by means of the telephone is governed more or less by the same rules that apply to a conversation face to face. An offer may be given and accepted over the telephone and give rise to a valid contract just as it would had the meeting of the minds taken place while the parties were together personally.

There are two points, however, which for purposes of safety every business man should keep in mind in making trade agreements over the telephone. The first is the possibility of the other party not clearly understanding the offer made. It is well to take particular pains to be sure that the other party understands exactly what you mean.

And at the same time the business man should be making a memorandum of the agreement for reference in the future. This will often serve to avoid costly litigation and to keep the matter straight in case a long time elapses before the terms of the agreement are questioned.

The other point is the likelihood of not being able to have witnesses to the agreement, as would be the case where a contract was entered into by the presence of the parties themselves. Where witnesses are desirable, it is well to connect others to the phone so they can hear the conversation. These points may appear trivial to the busy man, but they are worth the effort, even if they prevent only one law suit in the course of a life time.

Where contracts are transmitted by mail, they reach the other party in the same condition in which they left the offeror. The terms are in writing and are definite and fixed as to their conditions. There is no opportunity for change in the terms.

Offers Made by Telegraph

This is not true in case where the offer is made by telegraph or cable. Through the carelessness or inefficiency of the employees of telegraph companies, these offers often reach the offeree in an entirely different condition from that in which they left the offeror. They may be so entirely changed that the whole nature of the offer has none of the features it had when made.

The question that always arises in cases of this kind is whether or not the offeror is bound to the terms of the offer as delivered to the offeree. This depends entirely upon whether or not the telegraph company is to be considered as the agent of the sender. If it is the agent of the sender, then the sender must be deemed responsible for its negligence.

In earlier decisions in England, it was pointed out that the sender did not enter into such a relation with the telegraph companies as would give rise to an agency; that the telegraph companies were servants of the government and that the government could not be held responsible for the negligence of its employees. There is government ownership in England. Obviously, the same reasoning could not be applied here where we have private ownership.

A majority of the cases decided in this country have been to the effect that where one selects a telegraph company to transmit a message for him that he, for the purpose of the one transaction, constitutes the telegraph company his agent. This means that the sender is bound by any mistakes which may be made, and in case of acceptance by the offeree, he will have to make good to the offeree. Questions as to whether he can in turn recover damages from the telegraph company are not pertinent to this discussion.

The sender's liability, however, is qualified by the question of whether or not the offeree has acted in

good faith or innocence. If the offeree knows that a mistake has been made, or if there is anything about the offer which should lead him to believe that a mistake has been made, he cannot be said to have accepted the offer in entire good faith.

Offers often take the form of continuing offers or options; that is, the offeree is given a certain limited time in which to make up his mind to accept the offer. For some time the courts were in doubt as to the effect of these offers, but they have come to say that they confer no greater rights on the offeree than a mere offer; namely, that the offeree has a privilege to accept the offer before it has been withdrawn, and nothing else. A continuing offer cannot be deemed a contract for the reason that there has not been assent to it on the part of two parties, such as has been necessary to constitute a valid contract.

An offer imposes no mutual obligation until it has been accepted according to its terms, so that if the offer has not been accepted or rejected the matter is still open between the parties. The offer may be rejected or withdrawn, in which case the parties stand precisely as if no offer had been made.

There is no question, in the minds of the authorities, but what the offeror has a right to revoke or withdraw his offer at any time prior to acceptance. While it has been contended quite vigorously at times that an offeror has no right to revoke a continuing offer, or one which is to run for a specified length of time, the courts have not adopted this view. They have announced as a rule, that where one party gives another a definite time in which to accept or reject an offer, that he is not bound to wait until the full time is up to ascertain whether the offer will be accepted or not.

Acceptance, we have seen, is an important element of every offer. In fact, aside from technical points, a contract is nothing more than an offer and an acceptance of a certain proposition. Acceptance must be in the same terms as the offer, and it must relate to the subject matter of the offer and be made in the conditions set out in the offer. It must be definite as to the matter and be made within a reasonable time.

Acceptance cannot ordinarily be made, in part, of an offer and part rejected; for this does not amount to an acceptance of the original offer, but is a new offer.

After acceptance, an offer cannot be rejected any more than it can be withdrawn, for a meeting of the minds has taken place which has created a contract.

Acceptance may be either express or implied. In the latter instance it is inferred from circumstances from which an acceptance can be implied, while in the former instance it may either be by writing, by word of mouth, or by any other communication possible. It is, however, necessary that acceptance be precisely according to the conditions of the offer, if there are any relating to acceptance.

If an offer is communicated under the injunction to wire acceptance, acceptance by mail will not satisfy the terms. If it is desired to have acceptance by letter, and it is given by wire, the same fault can be found, although to give acceptance by two methods when only one is called for is not fatal. It is customary for business men, who wire, to confirm such wires by letter as speedily as possible, in order to avoid any errors which might be committed by the telegraph company. The mere fact that one took an additional precautionary measure would not operate to defeat him of his rights under the contract, for that contract was accepted when the meeting of the minds took place, by assent and fulfillment of the terms.

Acceptance must be within a reasonable time. If no method or manner of acceptance has been set out in the offer, the offeree has a right to use the usual method pursued in his community. He must, however, use all reasonable diligence to see that the acceptance reaches the offeror speedily and without delay.

It is obvious that if the acceptance is not made until after the offer has been withdrawn that there is no contract. Mere silence for the time being will not operate to deprive the offeree of his right to accept the offer, but if he does something from which it can be inferred that he did not intend to accept the offer, he cannot later change his mind, revive the offer and accept it.

The courts have said that where a limitation of time has been placed upon an offer that it is equivalent to a withdrawal of the offer at the time the limit expires. The offer is considered as a continuing one until the time limit expires; that is, it is considered in the nature of being constantly repeated until accepted or until the limit has expired. After that there is no longer any offer, and there is nothing that the offeree can do to revive the offer, unless it is repeated on the part of the offeror. It is not necessary for the offeror to expressly withdraw his offer when the time limit expires. The offer was limited in the first place to a certain date and when that time has passed, the offer no longer exists, having passed out with the time limit.

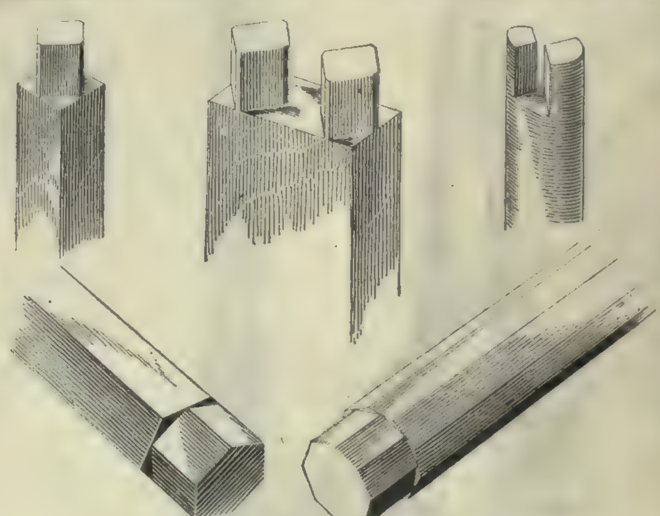
(To be continued)

Making and Using Drifts

By M. J. Zimmer

In reference to H. F. Pusep's article entitled "Making and Using Drifts," on page 757, Vol. 51 of *American Machinist*, I would like to submit the following:

In cutting metal, we are always confronted with the problem of chip removal. It often happens that the

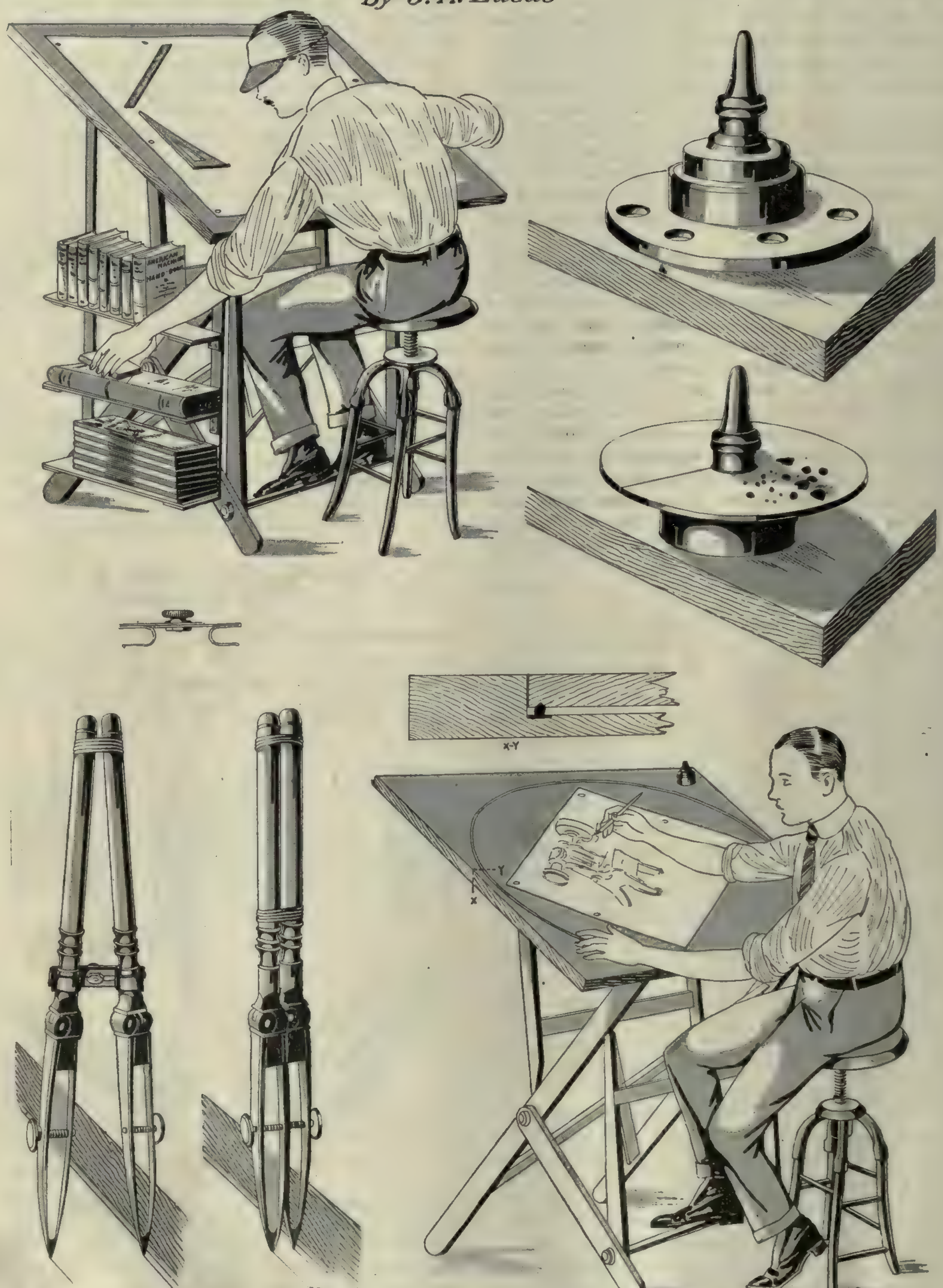


BROACH PILOTS WITH CHIP SPACE

size of a square hole is so small or the hole is so deep that the removing of the surplus metal after the impression has been made, chipping with a chisel or otherwise, is difficult. When this drift is applied to the work, at the first hammer blow the metal to be removed starts crowding to the pilot. It has no other place to go, and the result is a broken pilot and a ruined drift.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS

Industrial Motor Control—I

BY C. W. STARKER

The present-day operating requirements of electric motors are so varied that it has been necessary to develop and manufacture a multitude of controlling devices to suit individual conditions. In this and following articles, the author has classified and brought out the distinguishing features of manually operated and automatic industrial control apparatus, for the ready reference of the average semi-technical user.

SMALL fractional horsepower motors require, as a rule, merely a snap or a knife switch for starting purposes. with a protection against overload by fuses. With larger motors, however, the use of a simple switch or "throwing the motor directly on the line," as this is termed, is not permissible on account of the large inrush of current at starting, particularly if the motor is required to start on the load. Such starting would be disturbing or damaging, not only to the motor itself and the driven apparatus, but to other devices on the same circuit. With these sizes, a controller is used which limits the starting current or the starting time and permits a gradual acceleration. There is no definite dividing line beyond which a motor may or may not be thrown directly on the line, as this depends on local conditions and on the design of a motor. Again, local conditions often require modifications of the standard construction of starters. Starters which are to be installed in damp places, or where there is dust or explosive material, should be inclosed, and the resistor protected by suitable moisture-proofing compound. In certain applications, it is practical to use controllers on direct-current motors for sizes as small as ¼ horsepower.

DIRECT-CURRENT CONTROLLERS

A controller is defined by the rules of the Association of Motor Manufacturers (Power Club) as a device which serves to govern, in some predetermined manner, the quantity of electric power to be delivered to the device (motor) driven, and to understand the principle upon which controllers for direct-current motors operate, it is only necessary to have the following two conceptions clear:

(1) If a resistance is inserted in the armature circuit as at *A*, Fig. 1, the counter e.m.f. which must be generated within the motor is less than the full-line voltage for the amount of resistance inserted. The motor, therefore, will run at a slower speed than would be required to generate full-line voltage.

(2) If a resistance *B* is inserted in series with the shunt field winding, the field is weakened, and the motor must therefore run faster in order to generate full-line voltage.

From the foregoing it can be seen that in principle a controller consists of a resistance and means of inserting this resistance in varying predetermined amounts in the circuit. It is obvious that this inserting or cutting out of resistance may be done by manual control, or by automatic means, or a combination of the two, semi-automatic, full-automatic or full-magnetic control. It is apparent, therefore, that there may be armature control only, or field control, or combined armature and field control. The control apparatus may also be designed for adjusting the speed during the starting period only, or for continuous running at various speeds. Apparatus of this type are called starters or speed regulators.

Constructively, the resistance may be made of resistance wire suitably disposed on insulating supports or of grids from cast material. In either case, it should be kept in mind that it is the function of the resistor to transform electrical energy into heat, and that this heat must be dissipated. In selecting control resistance, it is more essential to know the number of watts which the resistor must be capable of carrying and the time period, rather than the horsepower of the motor.

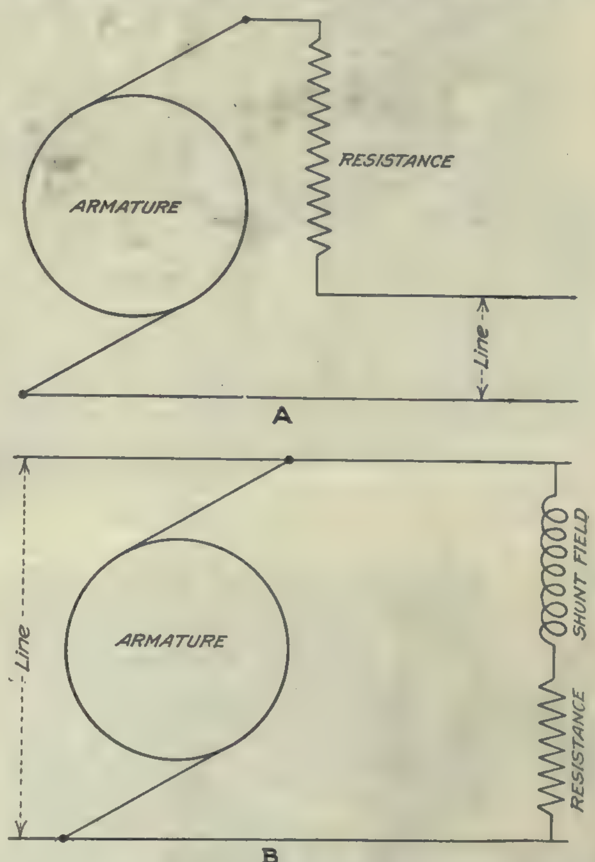
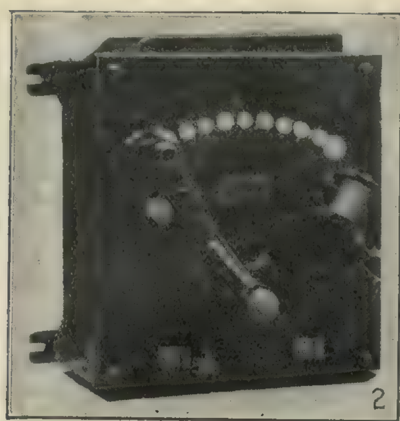
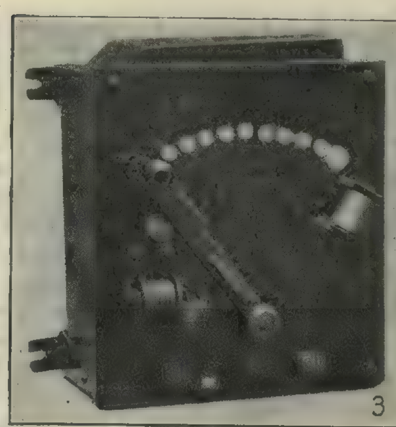


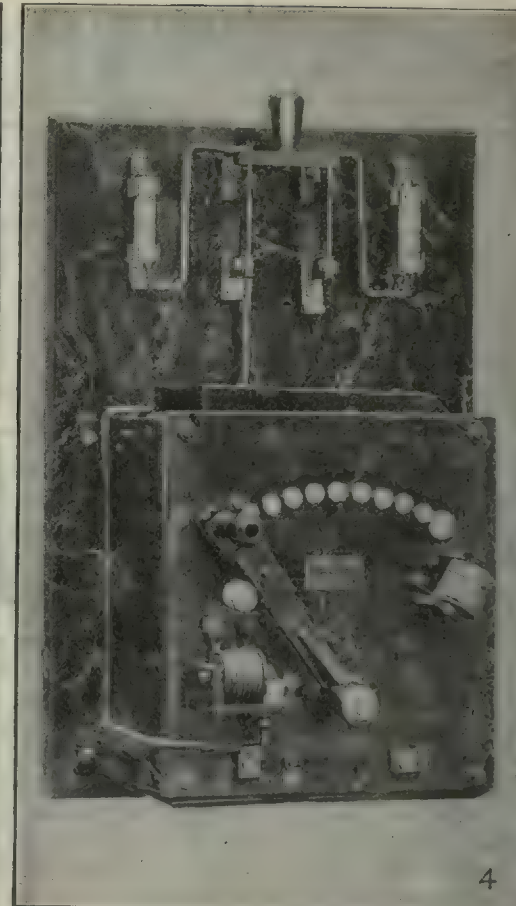
FIG. 1. *A*—CONTROL RESISTANCE INSERTED IN ARMATURE CIRCUIT. *B*—CONTOL RESISTANCE IN SERIES WITH SHUNT FIELD WINDING

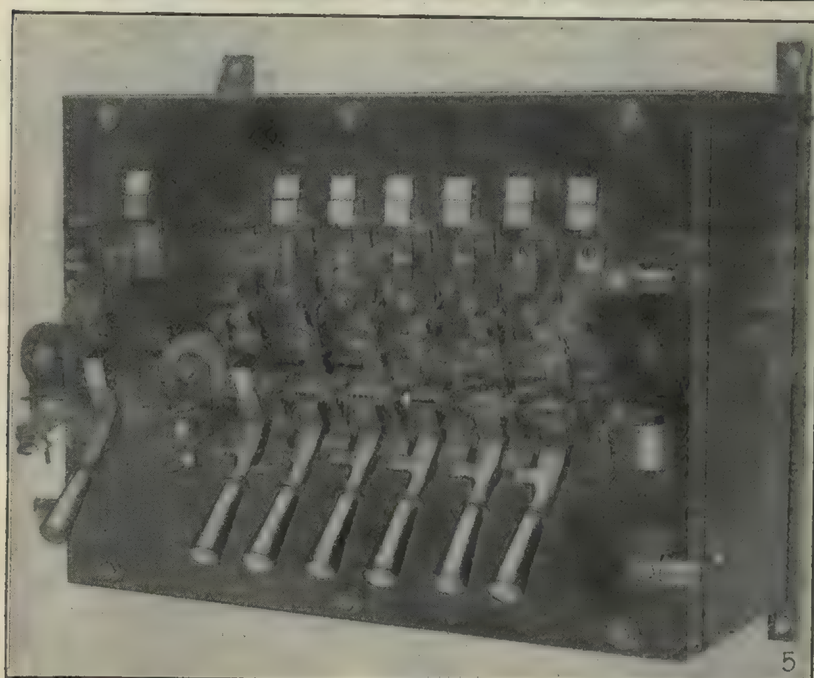
This phase will be touched upon more in detail in connection with the different apparatus.

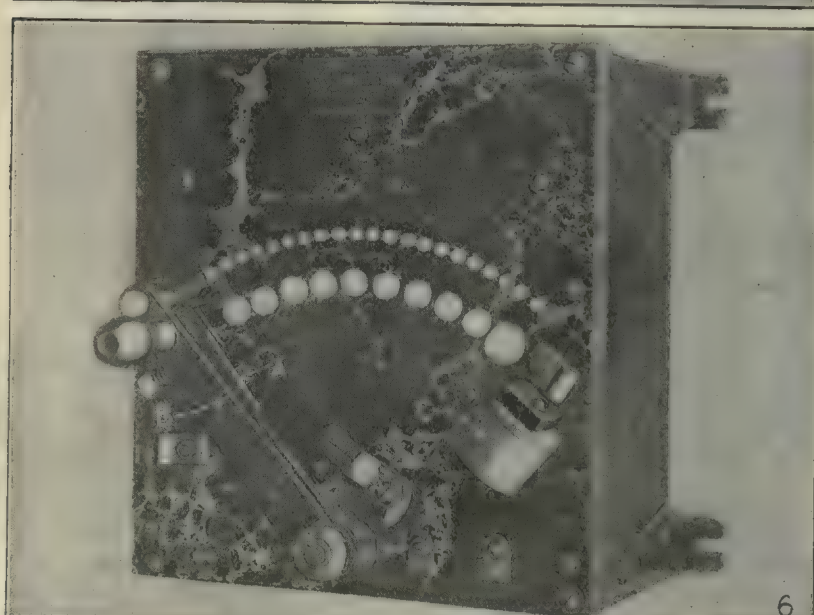
A simple standard-duty, direct-current starter of simple form is shown in Fig. 2. Starters of this type have contact buttons or removable contact segments, according to their capacity, to which the tops of the various points of the resistance are connected, and over which a contact arm or lever is shifted by hand. Commercial starters of this type are designed on the basis of 150 per cent. full-load current, maintained for a starting period varying from 15 sec. to 1 min. A protective device called a low-voltage release is an important detail of the starter, and is usually con-











FIGS. 2, 3, 4, 5, 6 AND 8. TYPES OF DIRECT-CURRENT MOTOR STARTERS

Fig. 2—Standard-duty d.c. motor starter with no-voltage release. Fig. 3—Standard-duty d.c. motor starter with no voltage and overload release. Fig. 4—Universal d.c. motor starter with no-voltage and overload release mounted together with switch and fuses on a single panel. Fig. 5—Multiple-switch d.c. motor starter with no-voltage release and overload circuit-breakers. Fig. 6—Compound d.c. motor starter with no-voltage release suitable for machine tools requiring ¼ to 50 hp. Fig. 8—Universal compound d.c. motor speed regulator with no-voltage and overload release, knife switch and fuses, armature and shunt field resistance for speed regulation.

FIG. 7. D.C. MOTOR SPEED REGULATOR WITH SPEED REGULATION BY ARMATURE RESISTANCE ONLY AND NO-VOLTAGE RELEASE

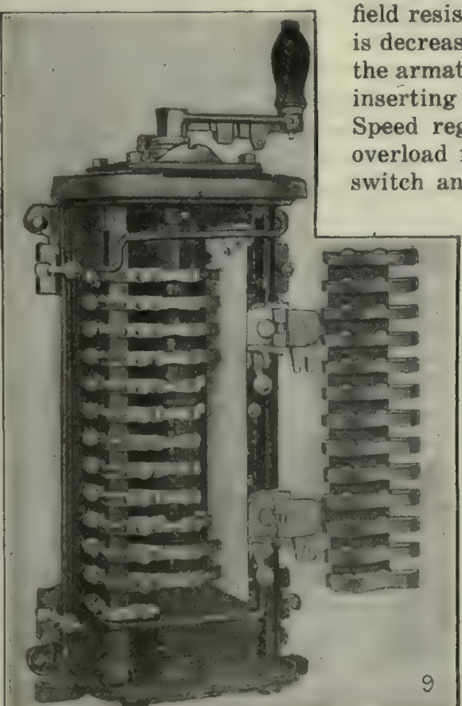
nected in series with the shunt field winding. If the shunt field circuit was accidentally opened, the motor would speed up or run away, thereby damaging the motor or the driven machine as well. This is prevented, however, by the magnet of the no-voltage release which normally holds the controller arm or lever after starting in the run position, and, in case of current failure, this magnet becomes deënergized and releases the lever which is returned by spring to the off position, thereby stopping the motor. With the device just described, it is necessary upon return of the current to return the lever to the starting position and starters of this type should be used on machine tools where serious damage might be done by an unexpected starting up of the motor. Fig. 3 shows a type of starter equipped with no-voltage and overload release relays. The no-voltage release feature is identical to the preceding type, while the overload release consists of a simple relay, which on occasion of excessive overload, short-circuits the release spool, thus allowing the lever of the starter to return to its off position. Fire underwriter rules prescribe that starters should not be mounted directly upon combustible material, and to meet these requirements, the resistance box with all current-carrying parts are mounted on a slate panel. The line switch and fuses are often mounted on the same panel, so as to combine, in one piece of apparatus, everything essential for a complete starting equipment, as shown in Fig. 4.

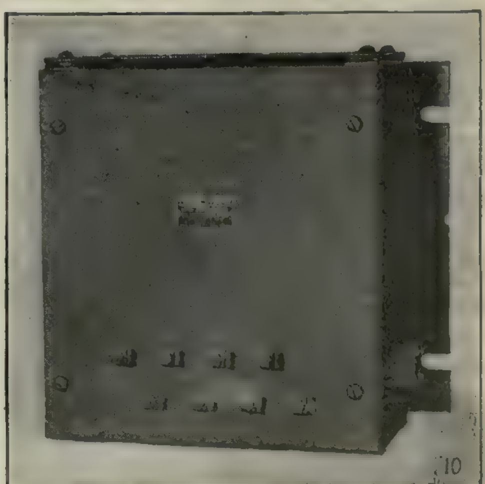
Multiple-switch starters, Fig. 5, with or without the usual protective features, are preferred for larger motors of 50 to 200 hp. or for very severe service of smaller sizes. These starters have individual switches or contactors which take the place of contact segments or buttons, and are especially designed to handle heavy current and to withstand frequent breaking of the circuit. In starting the motor, the lever at the left is first closed, followed by the others in rotation. In closing the switch in this manner, a time element is introduced between each lever, which prevents accelerating the motor too rapidly.

To meet the demand for variable speeds in machine tools, adjustable-speed motors capable of running at different speeds have been designed. These motors are regulated by compound starters which bring the motor up to normal or full speed by a starting resistance in the armature circuit by means of the contact arm *A*, Fig. 6, which is actuated by the lever *B*. The no-voltage release *C* holds the arm on *A* in the run position while the lever *B* is moved to the left in contact with the series of small buttons. These are connected to a field rheostat which regulates the speed of the motor up to six times normal. In ordering, it is important that the shunt field resistance cold and the shunt field current at maximum speed should be given, in addition to horsepower, voltage and speed range, and, last but not least, manufacturers of these devices can give better service if the serial number of the motor and the name of the manufacturer are also given.

Direct-Current Speed Regulators

Speed regulators for direct-current motors are divided into two classes, fan duty and machine duty. The term, fan duty, signifies a motor load on which the torque increases or decreases as the speed increases or decreases, as in the case of ventilating fans, centrifugal pumps, ice-cream freezers, etc. Machine duty implies a constant torque load such as in certain types of printing presses, positive-pressure blowers, and machine tools. The speed regulation may be by armature resistance alone, Fig. 7, or by both armature and shunt field resistance, Fig. 8. In the latter case, the speed is decreased below normal by means of resistance in the armature circuit, and increased above normal by inserting resistance in series with the shunt field. Speed regulators are supplied with no voltage and overload releases, and mounted on slate bases, with switch and fuses. They are also built as multiple-





FIGS. 9 AND 10. A TYPICAL REVERSIBLE DRUM CONTROLLER WITH FRONT REMOVED AND A UNIT-TYPE RESISTANCE

switch regulators for large capacities, or as regulators with wide speed range using both armature and field control, Fig. 8, for either wall or floor mounting. Operating devices have been designed to meet every demand; by treadle, for lathe, drilling machines, sewing machines and machine tools in general; by rope, for cranes and hoists; by bellows, for air supply for organs; by pressure, for fans, pumps and pressure systems; by vacuum, for vacuum cleaning systems. Reversing controllers of this type are also available for crane, hoist, and small machine-tool service. The resistance with reversing-plate controllers for crane and hoist service is usually proportioned for a speed reduction of 50 per cent. below normal, with 50 to 75 per cent. of normal current flowing. The use of blow-out magnets is desirable with larger sizes to disrupt the arc and prevent burning of the contacts where the circuit is broken.

The foregoing apparatus are of the faceplate type having their contacts mounted on a flat plate. In the drum type, however, the movable contacts are mounted on a cylinder which, by means of a handle, may be rotated so that different movable contacts may be made to slide over stationary contact fingers, as shown in Fig. 9. Controllers of this class are used in service requiring frequent starting and stopping, the speed regulation being had by either armature resistance or by both armature and by field control. The resistance unit, Fig. 10, as well as the protective devices, is installed separately, and may be arranged for non-reversing or reversing service. Drum-type controllers are also easily equipped with different styles of operating devices to meet insulating conditions.

In crane and hoist service, it is possible to take advantage of dynamic braking; that is, the motor, after reaching a certain speed, is automatically transferred into a generator causing it to act as a brake.

The Trade-Trained Boy

By CLARENCE MacNIVEN
Instructor of Mechanical Drawing, Connecticut State Trade School at New Britain

It is not news to the readers of "American Machinist" that in the evolution through which our industries are passing, conditions have been imposed which seem to have nullified, or at least rendered inadequate the old system of trade training, or apprenticeship. Of the various plans that have been put into execution for the purpose of supplying industry with trade-trained workers, the state trade school idea has probably occupied the most prominent place in public view and has been the target for much criticism, some, at least, of which is undeserved. The following article, the first of a series from the pen of a man who has devoted many years to the study of the problems involved, may serve to give us all a better understanding of the subject.

THE industrial world of today is looking with increasing favor upon the results obtained from the system of public or state trade education, for the reason that it is coming to realize that the problems which engage the attention of the professional instructor—and upon which he is able, by virtue of his position, to concentrate his energy and bring to bear the experience with which years of association with the many-sided human factor have endowed him—are the same in essential details as the problems which must be solved by industry itself in order to meet the constantly growing demand for trained men.

Many industrial concerns have installed departments for the education of prospective employees along lines that will better fit them for the work they are to do. Some of these departments—variously called training departments, vestibule departments, apprentice schools, etc.—devote their attention solely to mechanical or manual training; others teach the students mathematics, English or other studies that may be useful in conjunction with their trades.

Each company, however, attacks the problem from its own individual viewpoint, and students are trained along the lines and to the system that will bring the greatest immediate benefit to the employer, overlooking the fact that the broader the scope of the fundamental training, the less will be the future need for re-training men that have been trained in other shops and to other systems.

I believe that the boy graduate of any trade school should be, as far as possible, familiar with all systems followed in his chosen trade, so that no matter where he may be employed he will not need to be taught over again in order to fit him for his particular job.

Probably no two concerns have precisely the same system, the same way of doing work, but the fact remains that in all concerns the systems and methods follow along lines sufficiently related to enable a boy who has received the broader fundamental training of the trade school to quickly adapt himself to any.

The first and last consideration of the Connecticut State Trade School at New Britain is the boy. We study him; analyze him; find out his likes and dislikes. Some boys are interested in screw machine work; others in gasoline engines, and still others in jigs and fixtures. When we find the kind of work that holds the boy's interest we endeavor to develop him along that line. We visit various concerns that are doing that class of work and learn as much as possible of their methods. We look up the best authorities upon each particular subject, and by combining the information available from all sources, endeavor to formulate a system which shall constitute the broadest possible basis upon which to build the boy's training.

We try to give the boy every opportunity to exercise his own initiative and often find our efforts in this direction justified by the development of original ideas of practical value. It is our aim to make every boy graduated from the school a capable workman, able to hold his place in competition with tradesmen educated by other methods, without the necessity for re-training him to meet the conditions of his employment. In this, we have thus far been successful and practically every boy that has gone out from our school is rendering service satisfactory to his employer.

Employers sometimes ask us to send them undergraduates either for temporary service or for permanent

positions, but this is contrary to our principles. We do not believe in allowing a boy to leave the school until we are satisfied that he has thoroughly mastered the fundamentals of his trade.

Our drawing course is so arranged that a boy may pass almost unconsciously from simple plates to those more complex, from simple projections and intersections to those requiring greater knowledge of detail, from simple machine parts to more and more complicated construction, and finally into original design, his studies being graduated and his steps planned so that in his progress from the elementary to the higher planes, he does not feel the pull.

The Instructor's First Duty

The expressions "I don't understand" or "I can't do it" are seldom heard in our classrooms. It should be the instructor's first duty to discourage this tendency in any boy. Those who "can't," seldom "do"; and, by taking the boy in hand, gaining his confidence and inspiring his confidence in himself, it is usually easy to overcome the difficulty which is largely due to lack of self-confidence and a diffidence due to strange surroundings, for it is generally the new boy that is thus affected.

When a boy has finished with his plates; has reached a stage where he is independent of models and capable of original work, he is given regular commercial work, such as machine parts, tools, jigs and fixtures, etc., which are regularly used in the school shop, or, not infrequently, built to order for some factory outside.

We try to run the drafting department in exactly the same manner that such a department would be run in an industrial establishment. An organization chart that shows the station and duties of each student, is hung on the wall. The chief draftsman gives out the work to the different leaders, who in turn distribute it directly to those boys who are best qualified to do it. When the work is completed it is submitted to the leader, who scans it for possible errors before turning it over to the regular checker for final examination. The checkers are held responsible for each drawing that they sign and pass over to the chief draftsman.

Drawings Checked by Fellow Students

The chief draftsman, as well as the checkers, is a student, and this checking up of drawings by fellow students puts the boys upon their mettle and inspires them with the ambition to get their work through clean and above criticism.

We do not ask the boy to memorize a lot of formulas that can be kept to better advantage in a book than in his head. Each boy is the possessor of a copy of the handbooks of *American Machinist* and *Machinery,* and we thus leave the working out of formulas to the men who compiled these books, keeping the boy's thinking capacity clear for work on his own constructive problems.

The boys are not allowed to fall behind in their complementary studies. Each student is obliged to devote a certain time each day to the study of English and mathematics, and it is as important that his averages are kept up in these studies as faithfully as in the more mechanical ones.

We sometimes overestimate a boy's mental capacity, but oftener our error is in the other direction and we are agreeably surprised at his capability. I believe the average boy's mind is underestimated, and that any boy has the power of right thinking along these lines if he is properly instructed and if he is taught the art of mental concentration which develops the subconscious mind that we use so much and yet know so little about.

I do not contend that we have the only or the right answer to the problem of supplying the world's need of trained men but I know we are getting results. We try to acquire the viewpoint of the employer's needs by putting ourselves in his shoes, so to speak—by visiting factories where work similar to ours is being carried forward and by adapting the methods we find there to meet our requirements.

We aim to so equip our boys that when they step out of our school into the world of industry they will be capable of taking up their duties upon the firm basis of a broad, comprehensive knowledge of the fundamental principles of their trade that will adapt them to meet whatever conditions may confront them. That we are successful is amply attested by the satisfaction of the employers of our graduates and the urgent demand for more to fill vacant positions.

Apprentices—American and European

By K. Saldiz

Permit me to relate from my experience—which is the experience of most of the foreign-born mechanics —why the European mechanic is more skillful than the domestic product. The American boy is in every respect superior to the European boy except in the matter of obedience; therefore, the difference in skill would seem to find its explanation in apprenticeship methods, but length of time is not the deciding factor.

Now let us see what happens to the embryo mechanic. In my time (twenty-six years ago), twelve years was the school age. Those desiring to go in apprenticeship, informed the school superintendent and were allowed to finish their studies one month ahead of time.

Out of school, they went to a shop (chosen by their parents mostly) for three months' trial, in order to find out the ability and inclination of the boy. After three months, if everything was satisfactory to all parties concerned, a contract was drawn up for from three to five years and sworn to by the parents or guardian of the boy as well as the master. The contract was a legal obligation that could not be broken by either party without penalty and could be cancelled only on the ground of cruelty to the boy or insufficient instruction in the trade.

The boy worked all day (quality—not quantity—was expected) and spoiled a lot of time and materials. He got plenty of good advice on how to do it right next time and a few wallops (same not being recognized as cruelty) to make him remember the advice. The masters were not stingy with either advice or wallops, both being considered necessary for the good of the boy's future.

Besides absorbing the rudiments of the trade all day, with forceful assistance if necessary, in the evening the boy had to go to school three times a week, from 7 to 10 p.m. The classes being graded, he received instruction in grammar, business management and correspondence, bookkeeping, shop mathematics, etc. Sunday, from 8 a.m. to 1 p.m. he studied mechanical drawing and design.

The attendance was compulsory and no expense to the boy attached. Play "hookie?" Not on your life. The boy had a book in which the date of attendance was stamped, the master being required to countersign. If the stamp was missing, the boy got what was coming to him from the master, who was held responsible, under penalty, for the boy going to school regularly. If the signature of the master was missing, the boy got it (not the signature) in school. So, *willy-nilly*, the boy had to get trained. If he ran away, the strong arm of the law brought him back and he was made to realize that a contract may not be broken.

It is impossible to measure the value of this lesson in stick-to-it-iveness, and that is one of the indispensables of a good mechanic in the making.

The boys in the United States have all the advantages, except compulsion. I speak of compulsion as an advantage because, so far as I know, American boys (including my own son), when apprenticed, prefer play to school, which is natural but does not help to turn out good mechanics. A boy getting from three to five years of this kind of training will not ask a fellow workman for the loan of a "bevel subtractor," nor, when looking for work and being asked his training, answer: Oh hell! I want a job. Both these cases have come under my observation.

I do not say that the methods outlined above are the best or the only ones, but it is certainly a good thing to keep the boy to one trade. And here the parents are to blame, in most cases. A boy should not be expected to make a living while learning a trade. I know of several concerns where first-class mechanics are turned out, after four years' apprenticeship, but they do not pay as much as others, where the boy is a producing unit. Also, even after the European boy is a journeyman, he sticks to his trade, because he is compelled to do so.

Interesting Mrs. Machinist

By Geo. W. Childs

Referring to the article, "Johnson Interests Mrs. Machinist," by John R. Godfrey, page 701 of *American Machinist*, it is the writer's opinion that Johnson is on the right track.

I was brought up in the old-fashioned shop and firmly believe that it was that sort of thing that helped the employer to get close to the men and their families and that made employees think as well of, and take as much interest and pride in their place of employment as they did in their own homes.

I graduated from a large industrial plant in a thriving manufacturing town of 20,000 inhabitants where the owners knew not only their employees (about 600 of them) but their wives and children as well; where every employee would have fought at the drop of the hat, not only for their employers but for their families too.

I was with the firm nearly 10 years and not once during that time can I recall any "spirit of unrest" or grievance against the firm.

Believe me, that was, and is today, some works. They have been going along without a shutdown for over 50 years. The owners, being men brought up in the shops, knew a mechanic and a good job, and did not hesitate to slap a man on the back and give him credit for his work.

Those were the days of the apprenticeship system and a boy had to be some boy to get a chance in that shop to learn a trade at $2 a week to begin with, and to have learned a trade there was a sure guarantee that a mechanic knew his business.

Several years ago, when times were dull, I happened to be in another manufacturing town looking for an engineering job. I was informed by the chief engineer that he had nothing to offer me and really did not have any more than enough work on hand to keep his force busy. I then told him that I came from the shop mentioned above and he immediately said, "I will make work for you. We have several of their old employees; they all make good and I dislike to turn one down."

I believe that if men in charge today would look out for the little things, and apply the Golden Rule a little more, many of our troubles would disappear.

How Do You Meet the New Man?*

Do you ever try to make the new man feel that he's welcome?

He has a hard lot at first. He comes into a new organization, meets a lot of fellows he's never seen before, handles work that is perhaps more exacting than any work he's ever worked on before, gets blueprints the like of which are found no where else (because of the necessity for accuracy and precision) and by the end of the day he begins to wonder if he wouldn't do better to look around for a job that wasn't so full of hard problems.

He's bordering on the edge of discouragement and "quit without notice."

You can help us cut that down. Before a man is hired he must have received the approval of the employment manager and the final approval of the foreman of the department.

Granted that they make as many mistakes as the average individual they're not always going to make the same mistakes—so, one checking the other means that the new man must possess a lot of the qualifications we require.

Regardless of how good the new man may be, if he is not made welcome in the department he starts under a handicap.

If the fellow at his side grouches and snarls he begins to think that maybe he isn't working in such a good place. If the fellows all run away at lunch time without tipping him off how to get to the restaurant we fall another notch in his estimation. If he gets a piecework job, and one of the men tells him he'll have to "kill himself to make out," he marks up the talk about the "square deal" as "bull" and wishes for the end of the day so he can quit and hunt some other place.

Think more of the new man. Help him over the hard spots. Tell him about the restaurant, toilets, production system, and other good points of the plant.

Let's all help to keep these good men interested. Put yourself in his place. You went through it once. You know how it feels and how grateful you were to the fellows who helped you out.

The new man gets his urge to make good from those around him.

You do your part—and in most cases he'll do his!

*From the "Center Punch," published by the American Multigraph Company.

Some Details of Airplane Manufacture

By FRED H. COLVIN
Principal Associate Editor, *American Machinist*

The growth of airplane manufacture brings new problems to the shop man who must for the present combine small production with economical methods. A study of some of the fittings will show how great a problem this is in some cases. This will also serve to impress those who remember the crude construction of earlier machines, with the great advances in the mechanical design of important details.

ALTHOUGH the Glenn Martin Co. did not receive orders for their bombing machines in time to have them render real service in actual warfare, their capacity and reliability were thoroughly demonstrated in this country, and their satisfactory performance was acknowledged by all who are familiar with aircraft. The end of the war found them with a number of fighting machines under way, but a transformation is now being made and the view in Fig. 1 shows in the assembling department a commercial machine designed for carrying six passengers in the foreground. The first step is to assemble the upper or horizontal longerons on the assembling stand in front, and, after the framework has been tied together by struts and ten-

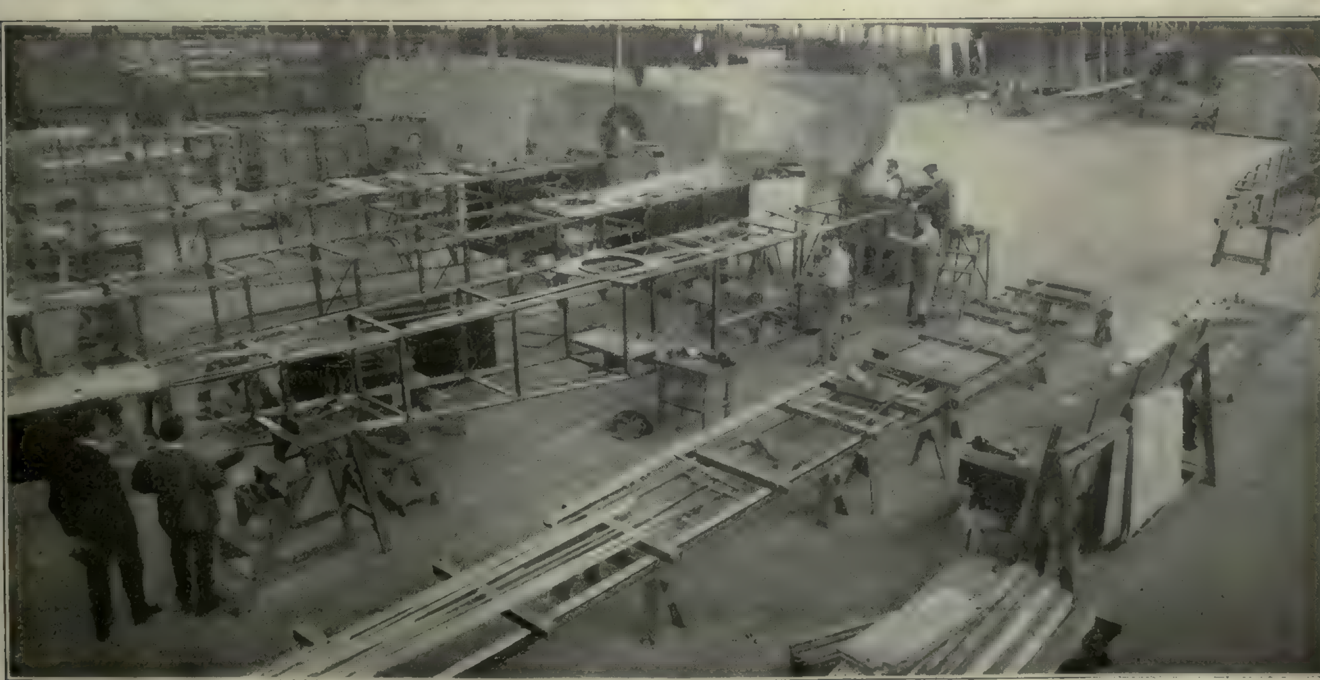


FIG. 1. GENERAL VIEW OF ASSEMBLING SHOP

AUTOMOTIVE CONSTRUCTION

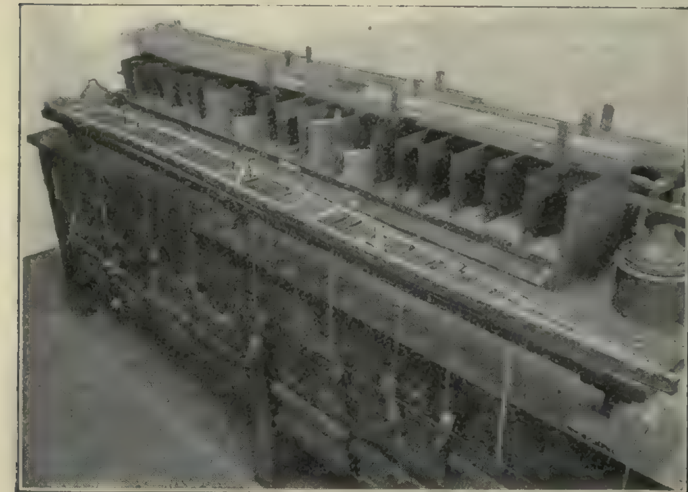


FIG. 2. BEGINNING A WING-RIB ASSEMBLY

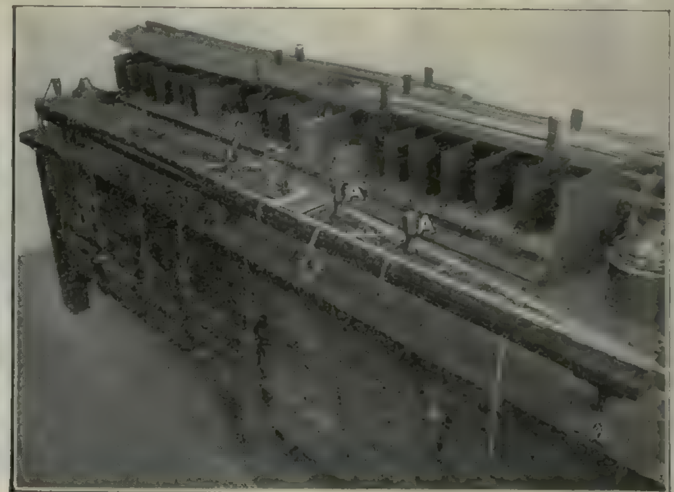


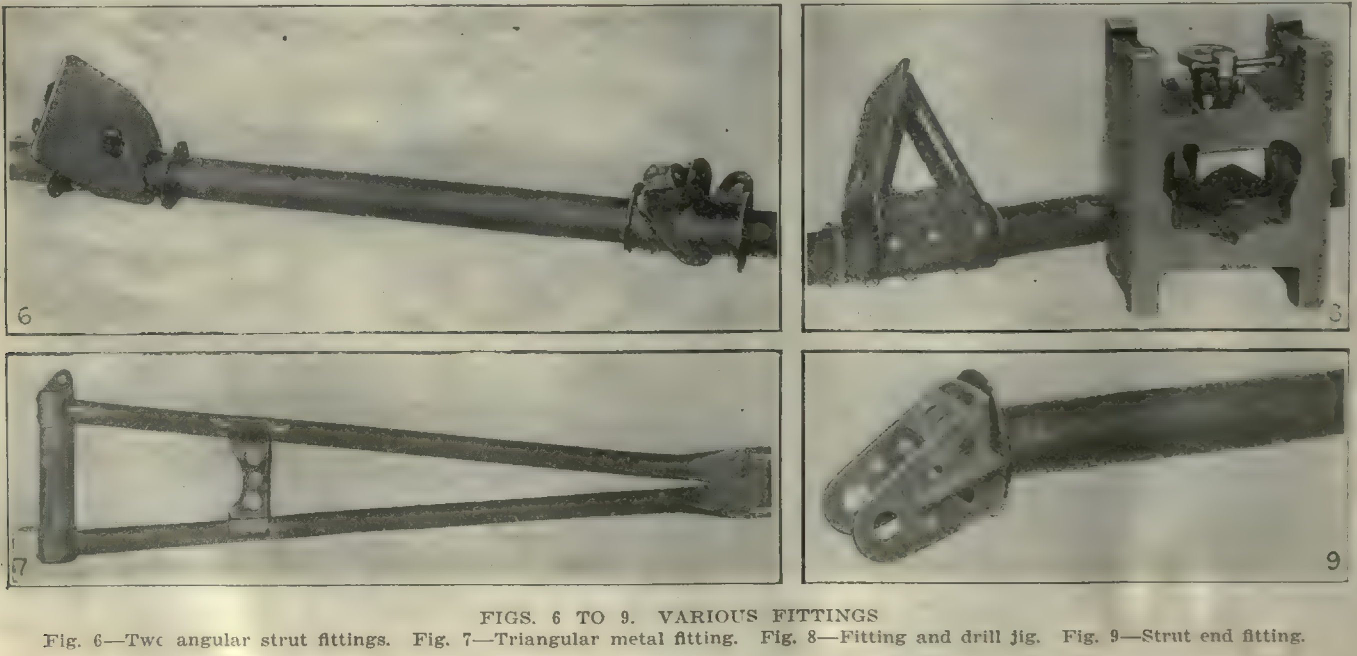
FIG. 3. CLAMPING RIB PARTS FOR NAILING

sion wires, the fuselage is turned over into the position shown for its finishing touches. The machines at the left are for military purposes. The gun mount is shown in position, as is also the huge gasoline tank indicating a large cruising radius. The machine in the distance is not a Martin but a Caproni, which nosed over into the mud on landing at the Martin field.

While there is a tendency to substitute metal in many places, the wing ribs are still being made of spruce, the various component members being cut to exact sizes, inspected and numbered, and brought to the assembling bench shown in Figs. 2 and 3. Fig. 2 shows the wing rib partly assembled, while Fig. 3 shows the same bench and fixture but with the blocks spread by the taper pins *A*, thus forcing the various pieces into their correct positions while the outer strips are being nailed into place through the openings.

FIG. 4. BRAZING METAL AILERON FRAME

As in all careful work of this kind, particular attention is paid to the condition of the glue, which, as will be seen, is electrically heated. It is especially prepared every morning in order to secure the best results. The building up of metal framework is shown in Fig. 4, which is a layout bench and brazing stand for the frame of the ailerons, these being made of steel tubing. Both brazing and



FIGS. 6 TO 9. VARIOUS FITTINGS
Fig. 6—Two angular strut fittings. Fig. 7—Triangular metal fitting. Fig. 8—Fitting and drill jig. Fig. 9—Strut end fitting.

AUTOMOTIVE CONSTRUCTION

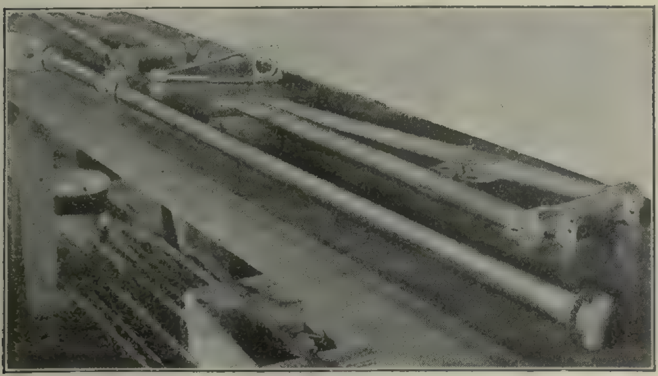


FIG. 5. LAYOUT BENCH FOR METAL PARTS

soldering are used in these fittings, the surplus metal being trimmed off on the stand shown in background.

Another assembling stand or surface plate is shown in Fig. 5, where the long struts are laid out and placed in correct position for brazing. The strut in the foreground forms part of the landing gear and contains some very intricate fittings owing to the different angles at which some of the plates must be located. Two of these are shown in detail in Fig. 6. They are built up from flat pieces and brazed or welded in position. The details of one of the pieces shown in Fig. 5 can be seen in Fig. 7, this being a substantial brace which must withstand considerable pressure.

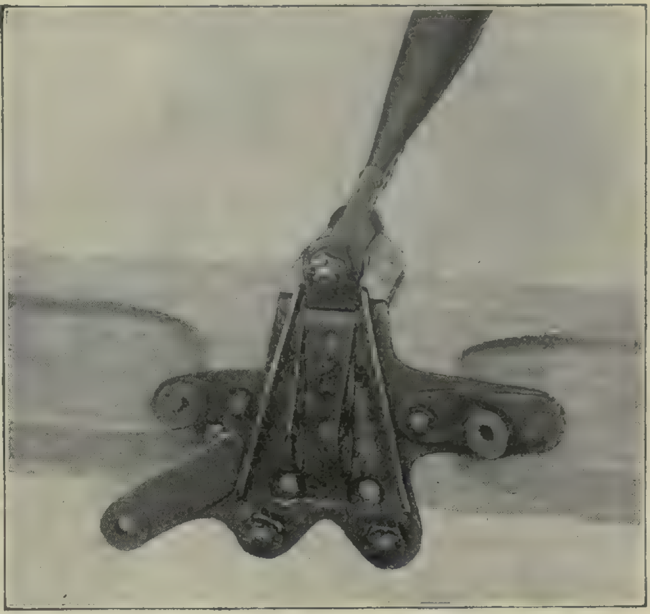


FIG. 12. A FITTING IN PLACE

Another view of the strut fittings is shown in Fig. 8, together with the drilling fixture used in connection with it. This also gives a good idea of the fitting itself and the way in which it must be built up around the barrel of the thimble. Another fitting, which, though

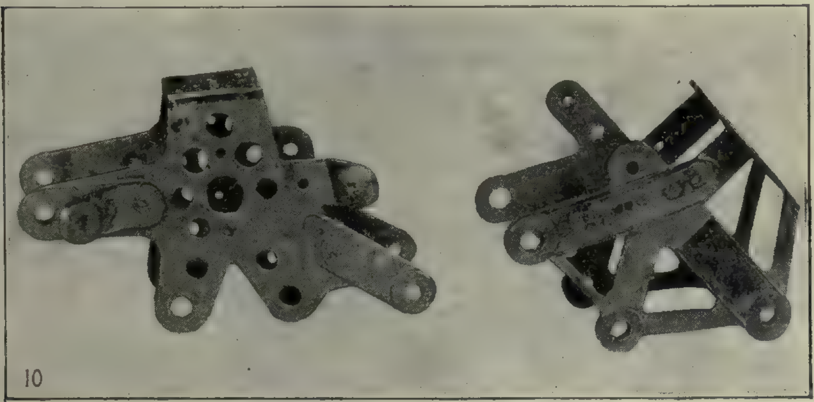


FIG. 10. TWO FITTINGS COMPLETED

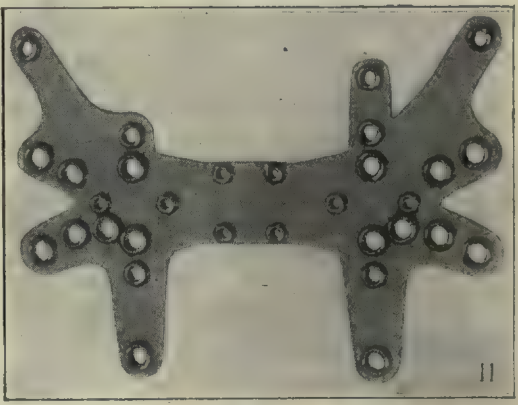


FIG. 11. DRILL JIG FOR LONGERON FITTING

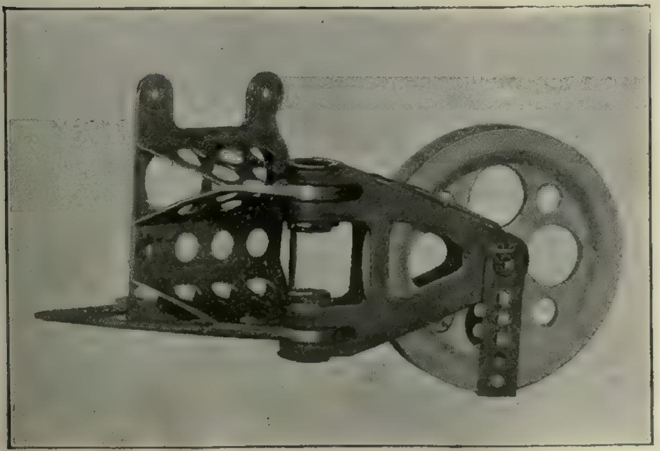


FIG. 13. CONTROL PULLEY AND STAND

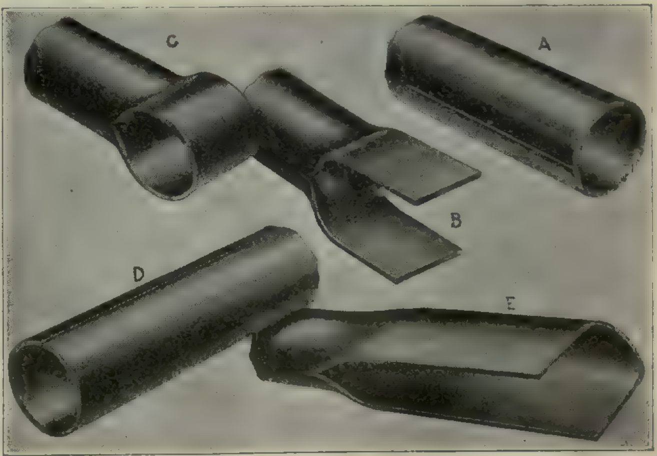
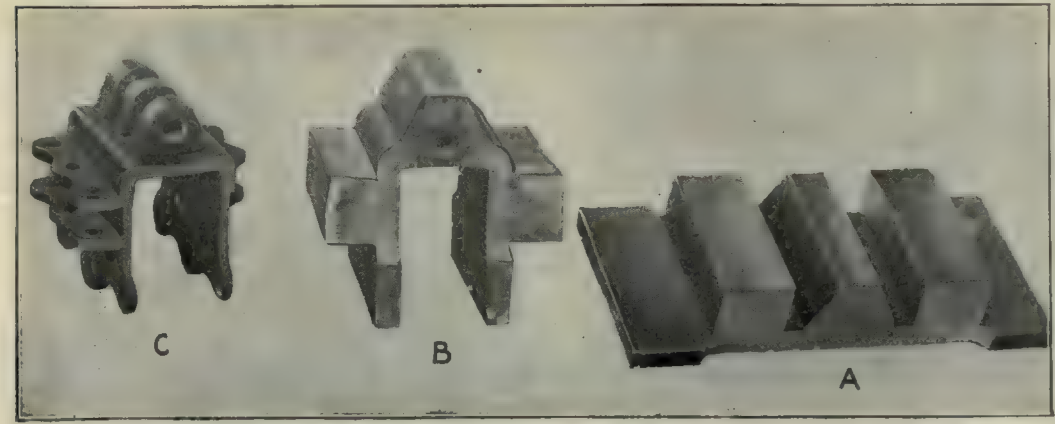


FIG. 14. HOW TUBE ENDS ARE SHAPED

AUTOMOTIVE CONSTRUCTION



FIGS. 16 AND 17. MACHINING THE HEAVY FITTING, AND SHOWING HOW IT IS DRILLED

comparatively simple, must be built of several pieces, is shown in Fig. 9. This requires little explanation. Two longeron fittings are shown in Fig. 10, these being bent-up sheet metal after being drilled and otherwise lightened. They have reinforcing strips on the side as well as ears to which such attachments can be made.

Holes Drilled Before Bending

Fig. 11 shows the jig, which is practically the shape of the developed flat piece, and in which all the holes are drilled before bending. One of these fittings is shown in position on a longeron in Fig. 12 which also shows how the angular brace shown in Fig. 7 fits in between two of the ears of the fitting. The small bearing block shown in position is of aluminum and takes the thrust of the triangular fitting.

Another fitting used in connection with a wheel for guiding control cables is shown in Fig. 13. This shows how strength and lightness can be secured by using perforated steel of the proper shape and proportions.

An interesting method of shaping tube ends for different purposes is shown in Fig. 14. In the first case, the tube is split for a comparatively short distance along the center line on each side as at *A*. The ends are then flattened as at *B* and finally shaped around a suitable mandrel as at *C*, which gives the proper shaped fitting. The cross piece is then fitted in position and the whole thing brazed, after which the desired connection is ready for use. A somewhat different fitting of a similar nature is also shown in the same illustration. The tube is split on one side as at *D* and this is then opened out as at *E*, a suitable form being employed for this purpose. This is a variation of the old art of coppersmithing which finds many opportunities in airplane work of the present day when the quantities being built are comparatively small. It is this lack of quantity production that makes the cost of a well-built airplane so high at the present time, and is well illustrated by the longeron fittings shown in Fig. 15. There are four of these fittings on each plane, these forming the connections for the struts in the main part of the fuselage. The particular fittings in question are shown at *A*, *B*, *C* and *D*. These are made of chrome vanadium steel and are worked out of a solid slab as shown at *A*, Fig. 16. This shows one of these fittings after it has been machined on the shaping machine ready for bending. The piece is heated for the bending operation, *B* showing it ready for final machining. The fitting is finished in the milling machine as shown at *C*, the holes being drilled in the special fixtures shown in Fig. 17.

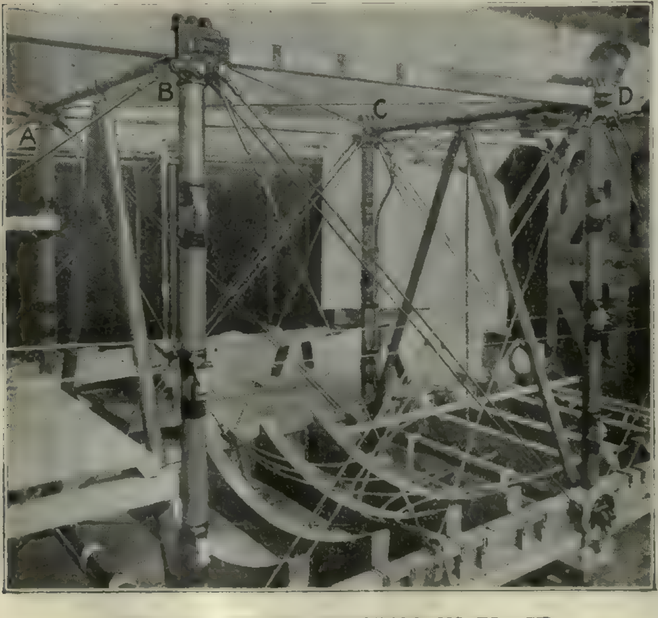
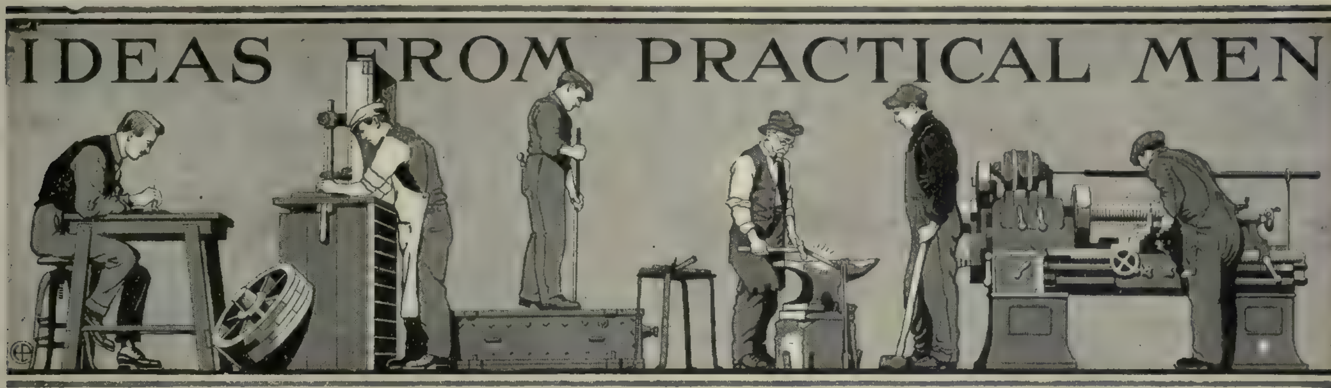


FIG. 15. HEAVY FITTINGS IN PLACE

Criticism of Section Lining Kink

By George W. Childs

Referring to the article "Section Lining Kinks," by H. A. Hayden, page 824, Vol. 51 of the *American Machinist*, I am wondering whether Mr. Hayden has read my article on the same subject published on page 322 in which I criticised the use of "section liners" of any make. I would like to know how many real good, old-time draftsmen find it necessary to use such useless tools in order to help draw their pay envelopes. Also, how many real good chief draftsmen would allow one to be used in drawing rooms under their supervision. I do not mean some of the chaps who had the nerve to go around and pose as draftsmen during the war times. I mean by a draftsman, the kind of a chap who chews tobacco, cusses, takes a drink if he can get one, and who can not only make a drawing of general heavy and light machinery, buildings, etc., but who can create in his own mind original designs.

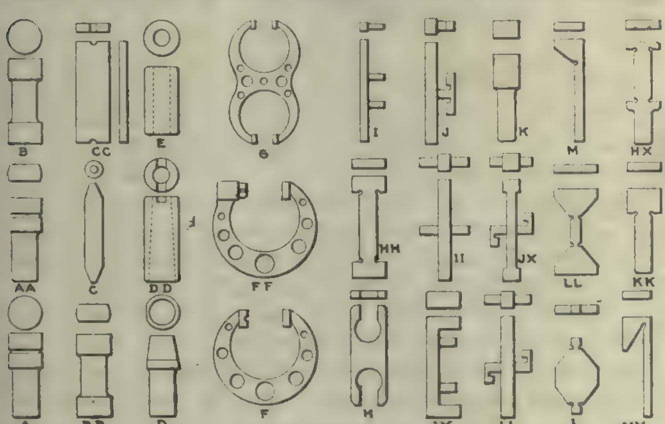


Standard Inspection Gages

By O. H. Gerlat

In production work it is necessary to have duplicate gages to be used by the machine operator and the inspector, and it is desirable that these gages be held as closely as possible to a standard type, thereby eliminating a great amount of work in the drafting room, and also saving time in teaching operators how to use them.

By having a set of gages drawn and lettered according to type, the person ordering needs only to specify the type of gage desired, the high and low limits, and to send along with the order a print of the part it is to be used on.



STANDARD GAGES

A set of gages as shown in the illustration can be used to advantage on automobile and tractor production.

A. Two limit, single end, sound plug; to be used on small, narrow work.

AA. Two limit, single end, flat plug. This gage has an advantage over a round plug, as the user can tell when a hole is out of round.

B. Two limit, double end, round plug; to be used on small, wide work.

BB. Two limit, double end, flat plug. This gage has the same advantage over *B* as *AA* has over *A*.

C. Single limit bar or pin gage; to be used on large holes.

CC. Two limit, bar gage; to be used on large holes.

D. Two limit, male taper gage.

DD. Two limit, female taper gage.

E. Single limit, ring; very useful on valve stems, kingpin, etc.

F. Two limit, snap; useful in measuring large diameters.

FF. Two limit, adjustable snap; also useful on large diameters.

G. Two limit, double end, snap (large diameter); can also be made in adjustable type.

H. Two limit, double end, snap (narrow); used on small diameters.

HH. Two limit, double end, snap (wide); to be used on large, narrow diameters.

I. Two limit, single side, depth gage.

IX. Two limit, straddle depth gage; useful in measuring over a ridge.

II. Two limit, two side, depth gage; very useful when work will not allow both pins to be on one side.

J. Two limit, single side, hook gage.

JJ. Two limit, two side, hook gage; used when work will not permit single side hook.

JX. Two limit, straddle hook gage; used in measuring over ridges.

K. Two limit, square, groove gage.

L. Two limit, internal bevel; useful on small bevel gears.

LL. Two limit, external bevel; useful on small bevel gears.

M. Single limit, obtuse bevel; useful on large bevel gears.

MM. Single limit, acute bevel; useful on large bevel gears.

KK. Two limit, flat, groove gage; used in measuring a groove in a bore.

HX. Two limit, double end, hub gage.

A Friction-Driven Drilling and Tapping Head

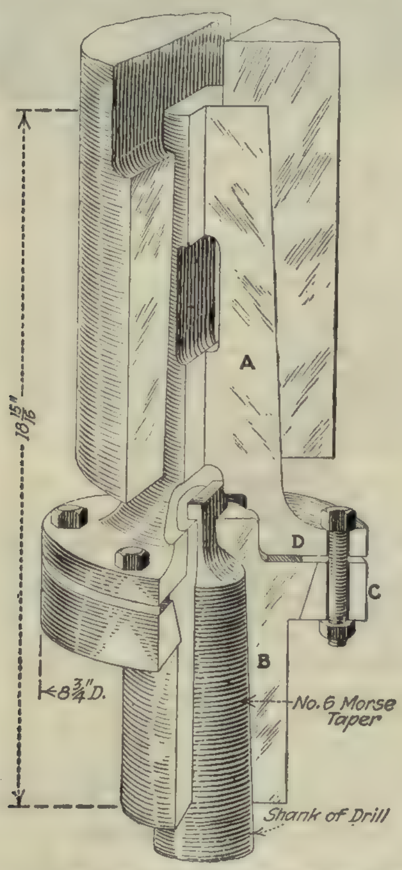
By Harry F. Pannepacker

The illustration shows a friction tapping head designed for drilling and tapping holes ranging from 2½ to 4 in. in diameter and from 2½ to 4 in. deep in nickel-steel armor plate. The drilling is done on a post drilling machine, using successively a flat drill, a bottoming drill and a special boring head for recessing or undercutting for clearance so that the taps can be run clear to the bottom of the hole. Following this operation, the holes are rough-threaded with a single-point tool held in the boring head, the drilling machine having been designed and fitted with change gears for this purpose.

The tapping had previously been done by hand, using five taps consecutively. The work was placed on trestles at a convenient height from the floor and the taps turned in by means of a long tap wrench. Seven men—a leader and six helpers—were assigned to this job and the time required to complete one hole averaged 20 minutes.

Some opposition to the idea of tapping by power developed because it was thought that the threads would be torn out or stripped, but as this trouble was sometimes experienced even with the hand-tapping method, it was finally decided to proceed with the experiment, the result being the tapping head here described.

The shank A of the tool was fitted to the spindle of the drilling machine, a dowel key passing through the spindle and the shank assisting in holding the latter from turning or twisting out of the spindle. The head B has a taper hole to take the shanks of drills or special tools that may be used in it. The upper end of the hole is made the right shape to receive the tang which projects a short distance through the head. An elliptical hole though the shank enables a taper drift to be used for the purpose of taking out the tools. The upper



FRICTION-DRIVEN TAPPING DEVICE

end of the head B is turned to fit a recess in the shank, thereby steadying and holding it in a central position.

The brass collar C holds the head to the shank by means of six machine bolts equally spaced around it. A tapered shoulder on the head fits a correspondingly tapered bore in the collar, furnishing one of the friction driving surfaces, the fiber ring D being the opposing surface. The friction may be increased or decreased to suit conditions by adjusting the six holding bolts.

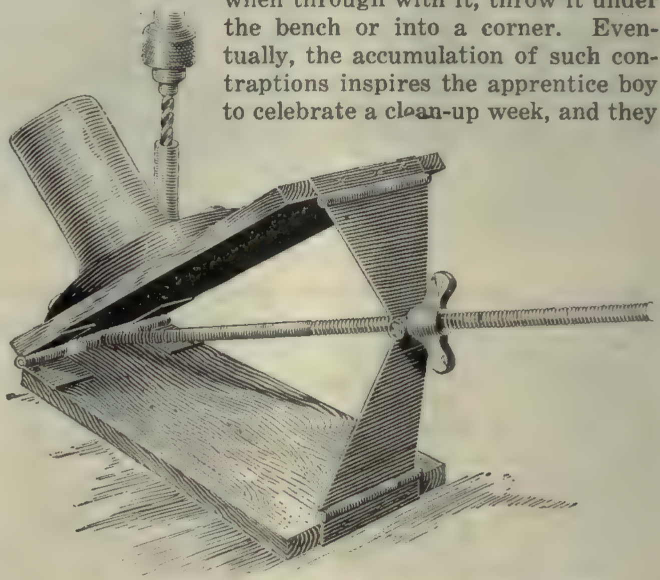
The holes in the work are drilled, recessed, and rough-threaded as if for hand tapping; the shanks of the tools used fit the tapered hole in the head. This hole is squared to $2\frac{13}{32}$ in. (the size of the square on the largest tap) to a depth of $2\frac{1}{2}$ in. Smaller taps are accommodated by short adapters, one end fitting this squared recess and the other end having in each case a squared recess to fit the square of a certain sized tap.

Instead of using five taps to each hole, only the second and fifth taps are used, reducing the time of tapping by more than one-half; while the work is done by the two men handling the drilling machine, thus reducing the number of men required from seven to two.

Adjustable Angle Plate for Job Shop

By Wm. Denton

In a job shop there is likely to be a sudden demand for a special fixture for use upon some repair, with no certainty that when the particular job is completed the fixture will ever be needed again. It is customary in such cases to cobble up some device out of wood and when through with it, throw it under the bench or into a corner. Eventually, the accumulation of such contraptions inspires the apprentice boy to celebrate a clean-up week, and they



AN ADJUSTABLE ANGLE PLATE OF WOOD

are broken up and used to start a fire under the boiler —usually the day before some one of them is wanted for a "repeat order."

When there is a job of drilling to be done at an angle other than a right angle to any surface upon which the work might rest, the favorite custom is to hunt up a wooden box that is not quite big enough to hold the job and let the work stand cornerwise in it at an angle somewhere near the one desired.

The illustration shows an adjustable angle plate made of wood and some old hinges, that is just as good for many purposes as one made of cast iron with more elaborate tilting devices. It does not cost much more to make than it usually does to hunt up the right size box, and is enough better to warrant keeping it in the tool crib. The construction is so obvious from the picture that no description is needed.

Are Toolmakers Ignorant of Drifts?

By Amos Ferber

On page 757, Vol. 51 of the *American Machinist*, is an article by H. F. Pusep, "Making and Using Drifts," which carries ample evidence of the author's familiarity with the tool he describes. I would, however, question the statement in his opening paragraph that its "mysteries * * * are almost a closed book to the majority of younger mechanics."

I have met but few diemakers, old or young, who were not tolerably conversant with this tool; which is practically indispensable to the makers of small piercing and blanking dies. Some are more familiar with it than others—that is, some realize its possibilities to a greater extent, exercise greater care in making it, and use it to better advantage—but this condition is a matter of personality and is equally true of a lathe.

Annual S.A.E. Meeting

The annual meeting of the Society of Automotive Engineers was held Jan. 6 to 8 at the Engineering Building, New York. The Standards Committee, which occupied the first session, had for consideration the following subjects: Aluminum alloys, ball bearings, ball-and-socket joints, brake shaft bushings, cast-iron carburetor flanges, connecting rods and bolts, engine support arms, generator mountings, grinding wheel sizes, high chromium steel, kerosene-engine testing forms, malleable iron, marine reverse couplings, motorboat control levers, motorcycle spark-plug shells, nickel steel, pneumatic tires, radiator and fuel-tank caps, roller transmission chains, side lamp glasses, solid tires, spline fittings, stationary-engine testing forms, taper fittings, trap-door belt feed, trap-door flywheel housings, trailer hitches, tungsten steel, motor capacity rating and water-tight flanges.

The second session was devoted to business, with the exception of a symposium on the "Needs and Tendencies of Engine Design," by F. H. Trego and L. H. Pomeroy. Retiring President Manly pointed out the dangers which beset any society in getting into ruts and not daring to go outside of the beaten paths in engineering matters. The automotive industry is particularly fortunate in having few traditions and much depends upon a continuation of this policy.

In his paper on the above subject, Mr. Trego contended that the supporting of crankshaft bearings by hanging them from an aluminum crankcase is out of date, and suggests that we should follow the practice of letting crankshaft bearing bolts clear through the crankcase and the cylinder base, using them as holding-down studs for the cylinders as well. These bolts should be of large size and threaded into the case at the lower end to prevent the crankcase from falling down when the cylinders are removed. This construction would act as a support, using the aluminum crankcase as a spacer only and tying the bearings firmly to the cast-iron cylinder block.

Mr. Trego also pointed out the effect of heating the carburetor at various speeds. At all speeds from 400 to 2,800 r.p.m., less power was developed with hot air than without it. He further advocated that the intake passages should be made as small as possible without the loss of too much power at the higher speed. He sums up with the suggestions to close the intake valve early, have the intake passages small, and to apply heat to the gas mixture *after* it leaves the carburetor.

The paper by L. H. Pomeroy on "Tendencies in Engine Design" dealt with several phases of the problem, summed up as follows: The effort toward obtaining absolute mechanical reliability, the application of modern views of gasoline-engine thermodynamics, improvements in mechanical efficiency, improvements in engine balancing, improvements in carburetion and the capacity to deal with low-grade fuels, the principles of light engine design and the cleanness of the design. Mr. Pomeroy points out that the engineer is far less limited in this country than in Europe in attaining his end and for this reason the goal of complete mechanical reliability is well within sight when an automobile will be as reliable as a watch.

Engine speed is no longer limited by considerations of piston temperature, owing to the use of aluminum pistons allowing the designer to adopt large bore cylinders if he desires. He also points out the possibilities arising from the use of forged aluminum connecting rods in reducing the inertia effect of the big end of connecting rods. Mr. Pomeroy's paper contains numerous illustrations, and details will appear in a later issue.

The subject of Aluminum Pistons was considered at length by E. G. Dunn, while the paper on "Automotive Steam System," by L. L. Scott tended to keep alive interest in the steam car.

"Automobile Body Design," by William Brewster, gave the experience of many years in custom body design and manufacture. "Springs and Spring Suspension," by E. Savory, set forth without the use of complicated mathematical analysis, the elements to be considered in the design of vehicle suspensions; while a paper by Benjamin Liebowitz dealt with the measurement of vehicle vibrations. Other papers were:

"Adapting Engines to Use Available Fuels," by J. G. Vincent, deals with various methods for handling present fuels, including a novel method applied in one instance. "High-Speed Indicators," by P. S. Tice, Thomas Midgley, Jr., and H. C. Dickinson. "Super-Chargers and Super-Charging Engines," by Major Geo. E. A. Hallett, gives the results of tests at McCook Field in high altitude flying. "Velocity of Flame Propagation in Engine Cylinders," by R. K. Honoman and Donald McKenzie, shows how the experiments were conducted.

"Dilution of Engine Lubricants by Fuel," by Gustave S. Kramer, dealt with a subject of interest to all engine users and leads the author to believe that new features in engine design are necessary to prevent the accumulation of liquid fuel in the cylinders and the lubricating system.

"Bettering the Efficiency of Existing Engines," by H. G. Gibson, outlined various methods of meeting the increasing demand for more efficient engine operation. This dealt constructively with the problems of improving car performances through the use of equipment for better handling of present fuels.

Prof. O. C. Berry, of Purdue University, presented a paper dealing with "Mixture Requirements of Automobile Engines," covering tests under a number of different conditions of load, speed and mixture. Then there were papers on "Fuel Blends," by Dr. Joseph E. Pogue, and "Thermodynamics of Carburetion," by C. F. Hopewell. Some well qualified engineers consider that blended fuels will probably be widely used in the near future while the data bearing upon the many problems encountered in carburetor research make both of these papers of extreme interest. The usual S. A. E. dinner took place in the Grand Ballroom, Hotel Astor, on Jan. 8, with over 1500 diners and a long list of disappointed late comers.

A Compulsory Metric System and—YOU

Do you realize that there is a well organized movement under way to get a bill through the NEXT session of Congress making the metric system COMPULSORY?

Many Congressmen have been convinced by the pro-metric propaganda of the World Trade Club of San Francisco, that there is a real public demand for the metric system.

This so-called "club" which is merely the nom de plume of a millionaire with a hobby, sent out thousands of circular letters all over the country and, as a consequence, a miscellaneous collection of approximately 58,000 pro-metric letters has been sent to Washington.

This has been done in an endeavor to prove to the Committee on Coinage, Weights and Measures, and others, that the salvation of American industry lies in the adoption of the metric system.

If a compulsory metric system were adopted now American industry would be set back so far that Germany would be on her feet again before we could recover.

Machine tool builders are one solid unit in opposing metric adoption, and would suffer the most by its compulsory use.

The Machine Tool business is the backbone of the whole industrial system. Without it the entire industrial body would collapse.

Without machine tools not even the steel mills could obtain machines to turn out their product. Printing presses, textile

machinery, steam hammers, mining machinery, and the vast amount of machinery that supplies our every-day wants—are *all* the offspring of the machine tool.

Only the very crudest and lowest grade of machine of *any* kind can be built without the use of machine tools—and the compulsory use of the metric system would hopelessly cripple the machine tool builders for many years and add millions of dollars to the cost and throw thousands of people out of work during the readjustment period.

One well known machine tool builder said the change from the English to the metric system would cost him $500,000 and cripple him for two years. He is already a year behind on his deliveries, and his machines are urgently needed in scores of manufacturing plants, anxious to get to work on material needed in the world's markets.

Delay caused by any change in the system of measurement means non-employment and expense to many—in other words the American people, will, in the final analysis, pay heavily for the unwarranted interference with our measuring system.

Now Mr. Toolbuilder and Mr. Machinery Manufacturer, it is up to *You* to counteract the poisonous propaganda of the prometric people. And Mr. Shop Man, it is up to you, too.

Write or see YOUR Congressman and tell him the plain cold facts as to what any change in our system of measurement would mean to *you* and to the American people who are dependent on the products of machinery—as *all* of us are.

Act, *everyone of you,* and do it QUICK.

Ethan Viall
Editor

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Taylor & Fenn Two-Spindle Spline Milling Machine

The two-spindle spline milling machine described and illustrated in this article, has been recently placed on the market by the Taylor & Fenn Co., Hartford, Conn.

This machine, which was designed by B. M. W. Hanson, is automatic in operation and will simultaneously machine two spline grooves on opposite sides of the same piece, single splines of the same or different dimensions simultaneously on two pieces, or through slots such as drift-pin slots or cutter slots in boring bars and similar work.

A V-shaped vise affords a positive clamp for the work beyond the cutter traverse at one end while the other end, if centered, is supported on a male center and if uncentered is supported in a female cone. Long work is free to project beyond the confines of the machine at both front and back.

It is claimed that splines of exact duplicate lengths and uniform finish and accuracy can be produced in a minimum period of time, the duration of which, of course, depends on the length, width and depth of the spline and the cutting resistance of the metal being worked.

No countershaft is necessary, as the drive is direct from a pulley on the line shaft to a tight and loose pulley to the left at the rear of the machine. The shifter rod extends through to the front of the machine where all other controls are located.

The spindle speeds are obtained from a speed box within the column and the controls are within easy reach of the operator when in operating position in front of the machine. The machine must be stopped while speeds are being changed, thus providing positive protection against damaged gearing. The speed gears are of alloy steel, hardened, and run in an oil bath.

The table feeds are obtained from a speed box containing a cone of five gears and a two-speed clutch, controlled from the front of the machine. Each one of the table feeds is available with each one of the spindle speed graduations.

The work table obtains its motion through a lever from a cam mounted at the front under the work slide of the machine. This cam is driven by shafts and gears from the feed box. A simple, easily adjusted mechanism is provided whereby the table movement may be varied from zero to the maximum of six inches.

The feeds to the spindle housings are transmitted through crank and link mechanism from a cam mounted behind the table reciprocating cam.

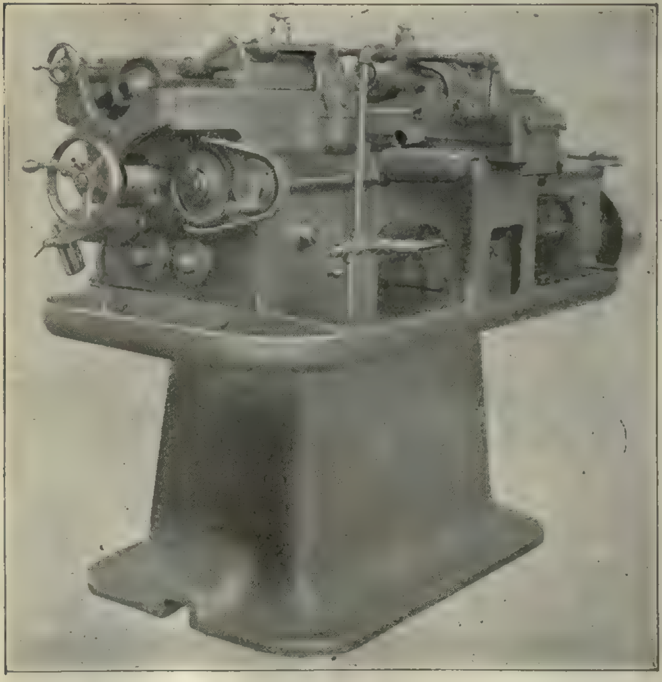


FIG. 1. TAYLOR & FENN SPLINE MILLING MACHINE

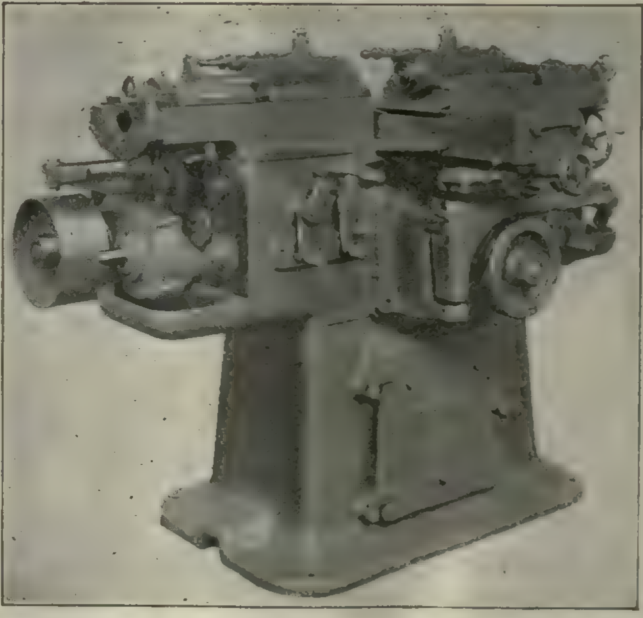


FIG. 2. TAYLOR & FENN SPLINE MILLING MACHINE (SIDE AND REAR)

Specifications: Will spline work up to 5 in. in diameter and 6 in. long; longer work may be splined by resetting; spindle speeds, (6) from 302 to 1,885 r.p.m.; table feeds, 10.

The depth to which it is desired to sink the cutters into the work, is controlled by handwheels at the ends of the machine.

When the machine is started the feed mechanism causes two feed nuts to rotate but as they are held against lengthwise movement, the screws push the two opposed cutter heads inwardly against the pressure of compression springs. Feeding of the cutter heads continues until the predetermined depth is reached at which point the screws run out of the nuts and feeding stops. In cases where the slot is milled through, as for instance the drift slot in drilling-machine spindles, it becomes necessary to avoid leaving a small fin in the center of the work. This is accomplished by withdrawing one cutter just before it reaches the center of the work and allowing the other cutter to continue its feed movement beyond the center. After the center of the work has been passed by this cutter the head which carries it recedes. This synchronized movement of the cutter heads is of course performed automatically by power.

A reservoir for the cutting lubricant is secured to the door of the column within the body of the machine. When the door is opened this reservoir swings out with it and the supply of cutting lubricant can be readily replenished or the reservoir cleaned. The coolant pump is driven at constant speed from the main drive pulley, thus making the supply of coolant uniform at all times and independent of the speed at which the cutters are driven. From the pump the coolant passes through a system of telescopic tubes to the hollow cutter spindles. Passing through the spindles and through grooves in the shanks of the cutters it is projected under considerable pressure direct onto the lips of the cutters, cooling them and at the same time ejecting any chips immediately they are formed.

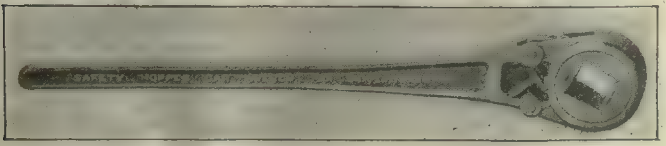
Provision is made so that the table, attached fixture and work as a unit are easily and quickly adjusted from the front of the machine to exact relation with the cutters after the work has been clamped to approximate position in the fixture.

The locations of the cutter lips in the splines are at all times indicated on an easily read, plain flat scale on the spindle adjustment slide to the right of the machine.

The cutters can at will be made to advance either in unison or alternately and either to knock off in unison or alternately.

Safety Wrench for Hopper Cars

Opening a drop-bottom car with an ordinary wrench is, at times, a risky undertaking due to the loaded door sticking, when the catch is released, and then suddenly falling when it is forced open by the load. In such a case the wrench would "kick back" in a violent manner, endangering the operator. As a guard against such accidents, the safety wrench shown in the illustration has been developed. It is said to have automatic features that protect the workman at all times against injury, when opening the car; also that the car can be



SAFETY WRENCH FOR HOPPER CARS

opened much quicker than by the usual method. The handle is offset, to permit free movement, and two pawls are provided for the ratchet, one of which is ready to act in case the door should stick. In operation, the car dog is held up and the wrench lowered with a quick motion; the pawl will then automatically spring out, allowing the hopper door to drop. If the door does not start, the handle is raised and then pressed down, thus forcing the door open.

The socket of the wrench takes a secure hold on the square of the shaft, even when the shaft is in a battered condition. A bushing or special socket, for smaller shafts, can be furnished if required. The wrench is made from electric process steel castings of high tensile strength. It is being marketed by the Safety Wrench and Appliance Co., 13th and Cherry Streets, Philadelphia, Pa.

Harrington Crankshaft Oil-Hole Drilling Machine

Edwin Harrington, Son & Co., Inc., 17th and Callowhill Sts., Philadelphia, Pa., has brought out a machine for drilling oil holes in the rod bearings of crankshafts. The machine, as shown in the illustration, is provided with four spindles, each having its own driving motor and feed control. The spindle heads are mounted in

HARRINGTON CRANKSHAFT OIL-HOLE DRILLING MACHINE

Specifications: Drilling capacity in steel, $\frac{5}{16}$-in. holes; distance between spindles, maximum $10\frac{1}{2}$ in., minimum $7\frac{3}{8}$ in.; spindle traverse, 8 in.; height, spindles above table $4\frac{3}{4}$ in., table above floor, 31 in.; taper hole in spindles, Morse No. 2; spindle speeds, 1000 r.p.m.; feeds per revolution of spindle, 0.002, 0.003, 0.004 and 0.005 in.; size of each motor, $\frac{1}{2}$ hp.; speed of each motor, 1750 r.p.m.; floor space, 69 x 48 in.; weight, without motors 2150 lb., with motors 2415 pounds.

pairs on plates that permit adjustment of the distance between the spindle noses and the work.

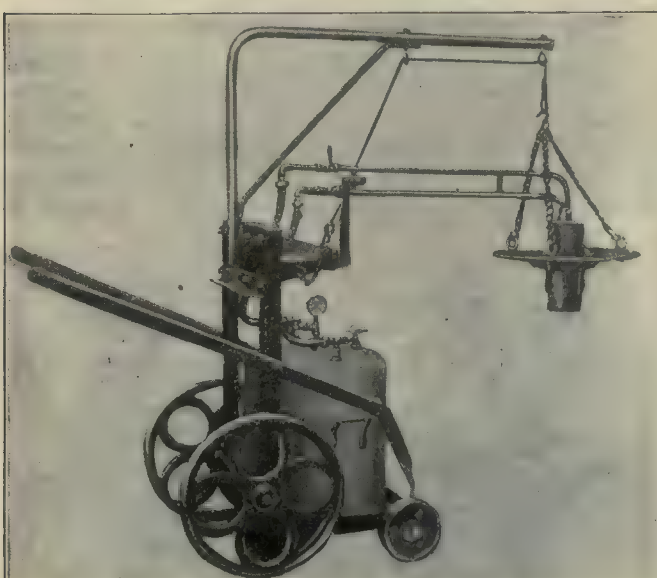
The spindle drive is through belts from the motors to pulleys at the rear of the spindles and the belt tension is taken by ball bearings so arranged as to relieve the spindles from belt strain. Only one spindle speed is provided for, but permanent changes in speed may be made by changing the motor pulleys. The spindles run in long sleeves having bearings their full length. The feed is by the usual rack and pinion, the drive being by spur gears through worm gearing and

so arranged that the driven gear may be changed to get different rates of feed. Provision is made for disengaging the feed either by hand or automatically at any predetermined point.

The plates on which the heads are mounted are provided with T-slots to allow changing of spindle center distances. The tank and two pumps for cutting lubricant comprise a separate motor-driven unit, which is placed on the floor beneath the machine. With the exception of the jig the machine is furnished complete as shown.

"Hauck" Drier for Bull Ladles

The Hauck Manufacturing Co., Brooklyn, N. Y., is manufacturing a portable drying device that is said to heat thoroughly and dry the lining of a fifty-ton ladle in 15 min. or less, depending upon the amount of heat supplied. The apparatus comprises a 20-gal. steel oil



"HAUCK" DRIER FOR BULL LADLES

tank equipped with a 150-lb. pressure gage, oil and air regulating valve; one length of special oil-resisting hose; one length of high-pressure air hose, and one burner with a long handle and deflecting plate. The tank is mounted on a truck that is well built of angle iron and provided with two substantial 18-in. wheels and two wheels of smaller size. Attached to the truck is a davit, from which is suspended by a steel cable the burner and deflecting plate which may be raised or lowered by means of a small windlass. The burner which operates with compressed air at a pressure from 20 to 100 lb., burns fuel oil, crude oil or kerosene, and lights instantly. The flame spreads evenly and quickly and is directed downward toward the bottom of the ladle. The drier heats the bottom and sides of the ladle white-hot, if required, and it is claimed to be a more efficient and less expensive method than the use of wood fires.

Zubar Tipped Tools

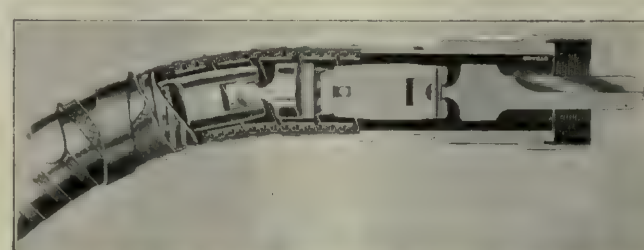
A special method of welding a high-speed-steel tip to a shank of inexpensive material has been developed by the Zubar Manufacturing Co., Inc., 5701 McMahon Ave., Germantown, Philadelphia, Pa. By this method it is claimed the weld is effected over the entire surface of contact between the two metals so that the possibility of the tip breaking off at the joint is reduced to a minimum. This line of tools includes all standard shapes and sizes and is furnished in special shapes to suit requirements. The design is intended to combine

ZUBAR TIPPED TOOLS

the advantages of a solid forged tool such as heat conductance, strength, etc., with the economical features of the built-up tool. The material in the shank allows the tool to "give" before it will break and the tip may be rehardened at any time in the usual way. The tools can be tipped with any make of high-speed steel desired by the customer and are furnished ground, ready for use.

"Strand" Link-Type Flexible Shaft

N. A. Strand & Co., 549 West Washington Boulevard, Chicago, Ill., is making the Link-type flexible shaft together with its couplings shown in the illustration. It



"STRAND" LINK-TYPE FLEXIBLE SHAFT

Specifications: Standard length, 7 ft.; links, 1 in. in diameter; diameter over casing, 1½ in.; maximum speed, 1750 r.p.m.; power delivered, 2 hp. at 400 r.p.m.; will operate grinding wheels up to 10 x 1½ inches.

is claimed that in shafts of this type the wear on the joints is reduced to the minimum.

Cherrying Attachment for Jackson Die-Sinking Machines

The illustration, Fig. 1, shows the type of cherrying attachment which is now being put on the No. 5 and No. 6 Jackson duplex typeless die-sinking machines. This redesign of the attachment has been adapted from a similar attachment which was first brought out for the No. 10 machine by the Jackson Machine Tool Co., Jackson, Mich.

Fig. 2 shows the interior of the housing of this at-

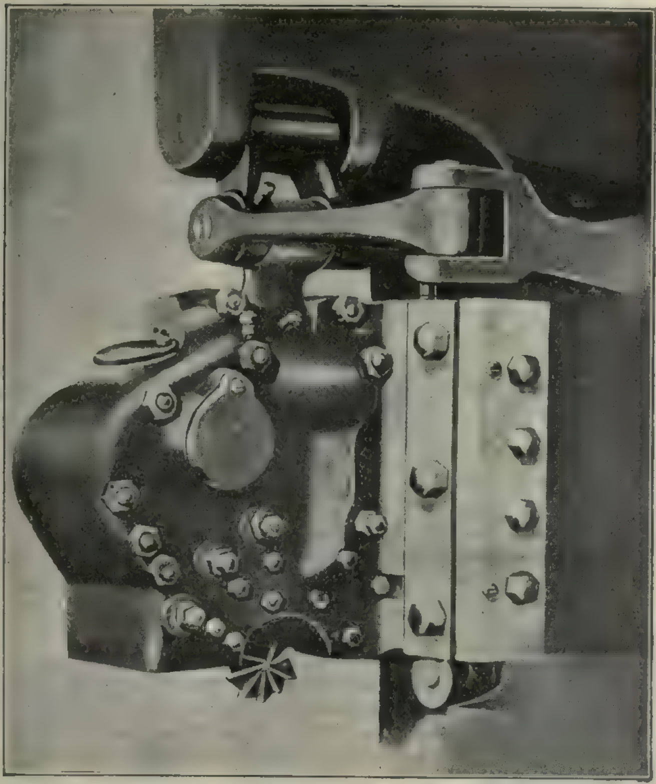


FIG. 1. CHERRYING ATTACHMENT FOR JACKSON MACHINES

tachment which is made with a circular guide in which the toolholder oscillates with a motion which has the center of the cutting tool as its center. This rotary oscillating motion is provided by means of a connecting-rod attached to the lug on the upper side of the toolholder.

The tool housing has a small movement so timed

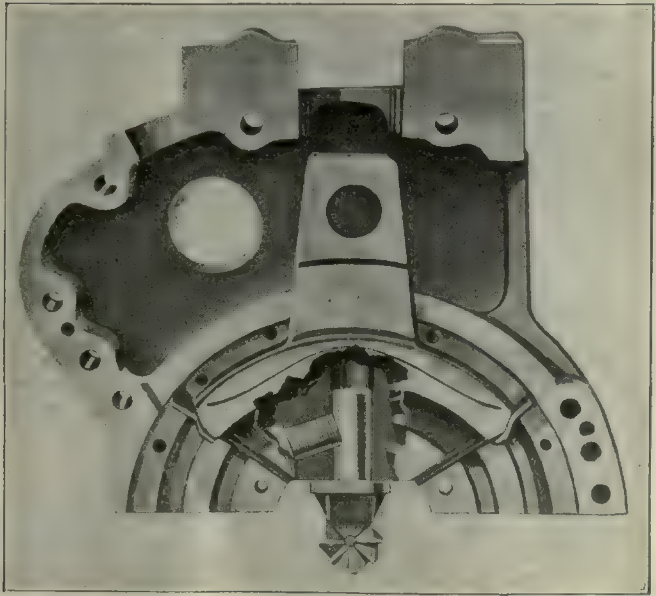


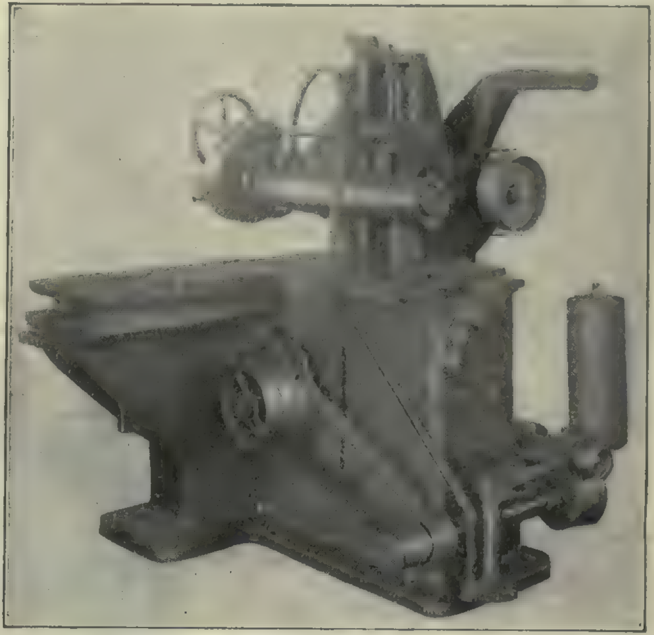
FIG. 2. INTERIOR CONSTRUCTION OF CHERRYING ATTACHMENT

tnat the cutter is lifted from the cut on its return stroke and again lowered on the cutting stroke. Ample bearing ways and take-up gibs insure it against wearing loose.

Improved Diamond Surface Grinding Machine

The Diamond Machine Co., Providence, R. I., has lately improved its automatic surface-grinding machine as shown in the illustration herewith.

One improvement is in the elimination of one motor. In the older type of machine separate motors were used



IMPROVED DIAMOND SURFACE GRINDING MACHINE

for the spindle and table drives while in the improved type but one motor of 3 hp. is used for both purposes. Power is transmitted to the spindle by chain and belt drive, and to the table by chain drive through worm gearing and a belt.

The second improvement is in the method of hanging the counterweight. By use of the overhanging arm shown in the illustration, the cable for the counterweight is kept free from contact with any part of the machine, thus preventing wear and assuring its free movement.

Putting the Back Gears in Front

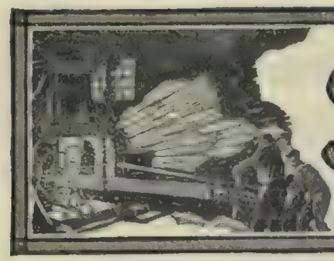
By Charles F. Whyte

Every once in a while someone trots out the old trick of boring (or threading, or some other operation) on the back side of the lathe; a practice often resorted to by the writer.

Now will some one tell me why the "back gears" should not be on the front side instead of at the back, and so reverse the direction of thrust of the driving pinion?

As the gears are located in contemporary design the action of the tool tends to lift the work while the pinion does its best to lift the lathe spindle and between the two the work commences an up-and-down movement, limited only by the amount of play in the bearings, resulting in a chattered job.

Reversing the direction of rotation and cutting on the back side often gets away with an awkward job, but if designers had an eye to holding revolving parts steadily to one side, machines would often do more and heavier work than at present.



Sparks from the World's

By E. C. Porter,

Negotiations Under Way for the Export of Railroad Equipment

Negotiations are being conducted by the War Department with France, Poland, Czechoslovakia, and the Kingdom of the Serbs, Croats and Slovenes, for the sale of large quantities of railroad equipment and such other material as may be available for export. It is quite probable that these negotiations will be concluded in the near future and the sale effected of practically everything for which a ready domestic market does not exist.

F. M. Feiker Becomes Vice President of McGraw-Hill Co., Inc.

Frederick M. Feiker, formerly editorial director of the McGraw-Hill papers, has been elected vice president in charge of editorial matters.

A little over four years ago Mr. Feiker joined the McGraw organization as editor of the *Electrical World*, coming from Chicago, where for three years he had been chairman of the editorial board of all the publications of the A. W. Shaw Company, among them being the magazines *System* and *Factory*.

The new vice president of the McGraw-Hill Co. was born at Northampton, Mass., in 1881, and in 1904 was graduated from the Worcester (Mass.) Polytechnic Institute in electrical engineering. After special research work in the field of high-tension transmission with Prof. H. B. Smith, he served from 1906 to 1907 as technical journalist with the General Electric Co. While in that work, which brought him intimately in touch with the trade and business publications of the country, he conceived the idea of a management paper devoted to all phases of manufacturing. His forward thinking in this connection resulted in his going to Chicago in 1907 as a member of the staff of *System*. Shortly afterward this idea of his became concrete in *Factory*, a magazine of management, of which he became managing editor. In 1912 he became chairman of the board of editors of all the A. W. Shaw publications.

With his early training in electrical engineering and his later experience in the field of selling and production economics as a background, Mr. Feiker, on returning to the electrical field in 1915 as editor of the *Electrical World*, quickly sensed the pressing character of the commercial problems to be solved by the electrical industry ana with characteristic vision and insight at once pointed out that the greatest development of the manufacturing and central-station groups could come only with the establishment of sound business principles and harmonious relations in the trade and distributing branches.

Mr. Feiker is a constructive thinker, with a resourcefulness of commonsense ideas that amazes even his associates who know him best. He has never been content in his editorial work to be a looker on but has gone down

F. M. FEIKER

into the industry and there rubbed elbows with other leaders on committees in various electrical associations. No small share of the constructive thinking of the electric vehicle section of the National Electric Light Association in the past four years has been his. He is this year chairman of the New York Section of the Illuminating Engineering Society. He is also a member of the other principal engineering societies.

At the annual meeting of the editorial conference of the New York Business Publishers' Association, Inc., held at the Automobile Club on Jan. 13, Mr. Feiker was elected chairman of the conference for the ensuing year. His three years' service as secretary-treasurer of this organization eminently fits him for the new office.

Wickwire Steel Absorbed

The Clinton-Wright Wire Co., a recent consolidation of a number of independent wire concerns, has acquired the Wickwire Steel Co., Buffalo. The merged company will be known as the Wickwire-Spencer Steel Corporation.

Ohio and Michigan Schools Lead in Filing Questionnaires

Ohio and Michigan educational institutions are leading the institutions of other states in filing questionnaires with the War Department as the first step toward obtaining the surplus machine tools which are to be sold under the Caldwell Bill. The Ohio and Michigan schools that have filed questionnaires will have first choice of the machine tools to be sold them by the War Department at 15 per cent of their original cost to the Government. Coupons entitling the institutions to obtain machine tools will be issued in the sequence of filing questionnaires. The last schools to fulfill the requirements of the War Department, as a result, will obtain their orders from the stock left by those who took advantage of the offer first.

The Director of Sales will pass upon the eligibility of institutions applying for tools. Those qualifying will be issued coupons for the number of machines allotted to them, each coupon being good for the purchase of one machine. Eligible institutions will be furnished from time to time by the various bureaus having surplus machine tools descriptive bulletins of such equipment from which selection may be made.

Ball Bearings in Steamship Engines

The Swedish ball-bearing manufacturers, after introducing ball bearings in rolling stock on the state railways, are now going to introduce the ball-bearing principle in ship construction, in connection with propeller shafting, according to a report from Consul Walter H. Sholes, at Coteborg, Sweden. The problem completes the construction of a bearing able to withstand all axial pressure from the propeller and excluding all possibilities of hot-box troubles.

The World's Largest Sale of Commercial Airplanes

What is said to be the world's largest sale of commercial airplanes was made at the Aëronautical Show, Chicago, Ill., Jan. 12. One company sold 440 planes to B. L. Brookins, Tulsa, Okla., for $2,500,000. It is stated that airplanes are now in great demand in oil fields as operators are using them to reach new fields when an oil strike is made. The directors of the show estimated that 1,700 planes were sold during the week of the show.

Industrial Forge

News Editor

Disposal of Surplus Road-Making Equipment

Practically all road-making equipment which has been declared surplus by the War Department here is being transferred to the Department of Agriculture. That department has been unable to obtain sufficient quantities of this class of material in the United States and was forced to secure the return from France of a large part of the equipment which was surplus there.

A New Industrial City

A new industrial city which promises to combine not only the latest ideas in factory construction and machine equipment but also the most modern ideas on housing accommodations, and the welfare of its people, is Marysville, Mich., just below Port Huron on the St. Clair River. This is the site of the new plant of the Wills-Lee Co., which is to build a new automobile, and such allied interests as the Pressed Metals Co., Ltd., Detroit Edison Co., Detroit Aluminum and Brass Co., Detroit Gear and Machine Co. and others. Some of these plants are already under construction.

Marysville will be unique in many respects. It has been planned to the smallest detail, including residence districts, manufacturing areas, retail business section, parks, playgrounds, streets and boulevards. It is probably the only city that is designed, just as a building is designed, for generations to come.

Messrs. Wills and Lee state that there are two principles upon which the town of Marysville is founded and is being built; the first is good, honest, well-paid work; the second is good, wholesome, clean, and contented living. They want Marysville to realize the highest ideals of American industry, to be a city of the best workmanship, the best citizens, and the most contented and prosperous American families. Everybody in Marysville is going to be busy. But everybody is also to have the surroundings, the opportunity, the time and the reason to be happy.

Houses of various sizes are being built and will be sold at low prices and on easy terms. Community houses or bachelors' quarters are being built on an entirely different plan than the usual "bunk" house. The rooms are of good size, well furnished in an attractive manner, and every effort will be made to provide a home atmosphere. It is not the desire to attract men from the large industrial centers, but from the smaller towns. Provisions are being made for the growth of the Wills-Lee Co. to a point where it can employ 60,000 people, which gives some idea of the future of Marysville.

New President of the Johnson Bronze Company

At a meeting of the board of directors of the Johnson Bronze Co., New Castle, Pa., last November, P. J. Flaherty was elected president of the company to fill the vacancy created by the death of G. W. Johnson.

P. J. FLAHERTY

Mr. Flaherty organized the Johnson Bronze Co. and in reality has been the executive head of the firm since January, 1909, at which time this company was known as the American Car and Ship Hardware Company.

Government Gets $4,990,692 for Surplus Machine Tools

The surplus machine tools which have been disposed of by the Government up to the end of 1919 brought in $4,990,692. The original cost to the Government of those tools was $5,245,568.30. Other types of machinery and engineering equipment sold as surplus property brought in $4,535,910. The original cost of that equipment was $7,679,494.

Banking Corporation in Spain Buys Surplus Automobile Tires

All the automobile tires of millimeter size which were declared surplus by the War Department have been sold to a banking corporation in Spain, and are in process of delivery. One million yards of meltons have been sold to Greece and delivery is being arranged.

The 1920 New York Automobile Show

The great growth of the automobile industry is reflected in the ever-increasing exhibits at the New York Annual Automobile Show, and this also gives us a good idea of the extent to which the automobile-accessory business has grown. In spite of the growth of a number of the large companies, new automobile builders and assemblers seem to be coming into the field with considerable rapidity. In most cases the assemblers are using motors and other parts which are more or less well known and generally employing what might almost be called standard body lines. Even some of the older and well-known cars have dropped almost every trace of their distinctive appearance and have become standardized so far as lines and general fittings go.

Although the present year will see at least two new eight-cylinder cars, there seems to be a tendency back toward the six-cylinder motor; while in a few cases firms which formerly used sixes are now using fours. Many believe that this is the trend and that motors with more than six cylinders are likely to be the exception in a few years. One of the tendencies is toward accessibility of motor fittings, such as carburetor, magneto, pump and other parts. The vacuum feed enables the carburetor to be placed high on the cylinder block, making adjustment and repair much less difficult. There are, however, many points yet to be redesigned with a view to easy repair and replacement—notably the speedometer driving gear, which is on the propeller-shaft end of the transmission. In almost every car this is a solid gear which cannot be replaced without taking down the propeller shaft and in some cases the transmission itself.

A new valve motion is shown on one of the light sixes, in which the valves are set at a slight angle and the throw of the cams increased by levers which act as valve lifters. The placing of the valves on an angle is also done by a builder of an eight-cylinder motor, the theory being that the gas flows more readily around the valve than when these are parallel with the cylinder bore.

There are practically no changes in transmissions in spite of the acknowledged need for a more flexible method of transmitting power from the motor to the rear axle. The electric gear shift appears in a more convenient form but does not add to the flexibility, while the magnetic drive seems to have undergone no changes.

The locking, positive or nonskidding differential, by whatever name it may be called, seems to be making slow headway in spite of its apparent advantages, especially in the passenger-car field. Some truck makers are using it as standard equipment and reporting good results.

The use of aluminum pistons seems to be growing, although not as rapidly as expected by some of its advocates. There are, however, eighteen passenger cars so equipped, and drop-forged aluminum connecting rods are not only being talked of but are exhibited by at least two different makers of aluminum alloys. One of the somewhat surprising uses of aluminum is for cylinder-block castings on a truck and tractor engine, cast-iron liners being used in the cylinder bore. This is in line with a marked tendency to eliminate excessive waste in truck construction as well as in passenger-car motors. Along this line several experiments are being made with aluminum castings for rear-axle housings and for wheels for trucks and large motor buses.

The proportion of closed cars to open-body models is steadily increasing, and some makers expect to produce at least 40 per cent of this year's cars in closed bodies. The contest between magneto and battery ignition still goes merrily on, with the numbers favoring battery, although the old magneto has many staunch friends. A somewhat similar contest is being waged in the case of wheels, the steel disk wheel seemingly making greater headway than the wire wheel, which a few years ago seemed destined to be much more widely used than it is at present. In one instance a disk wheel is made of $\frac{1}{8}$-in. saw steel so as to give flexibility as well as lightness.

Steam cars are still confined to the Stanley, which always attracts an interested crowd. The air-cooled motor was represented by two concerns with somewhat similar motors, although the newer car has worked out some of the details in a different manner.

Sale of Steel at Dodge Brothers' Detroit Plant No. 3

The Director of Sales announces that the Ordnance Salvage Board through the Detroit District Ordnance Office is offering for sale by negotiation approximately 980,000 lb. of steel, located at Dodge Brothers' Plant No. 3, Detroit, bids for which are now being invited by the District Ordnance Office.

Included in this lot of material is flat, round, square and hexagon cold-rolled stock; flat, round and square machine steel; round and flat screw stock; hot rolled rounds, and round forging steel in various sizes.

Offers for this material or any part of it will be accepted by the Detroit District Ordnance Office by letter or telegram. Further information, together with a complete description of the steel offered for sale, may be obtained from the Detroit office.

George R. Cullingworth

George Rhodes Cullingworth, vice president of the Garvin Machine Co., died at his residence in New York City on Dec. 15, 1919. Mr. Cullingworth was born on Aug. 24, 1837, in Manayunk, Pa., which at that time was a suburb of Philadelphia. He attended public school there until he was about sixteen years of age when he entered his father's machine shop to serve his apprenticeship.

GEORGE R. CULLINGWORTH

In 1857 he worked as a journeyman for Bement & Dougherty (now the Bement works of the Niles-Bement-Pond Co.) and continued there until 1859, when he went to work at Colt's Armory, Hartford, Conn. He afterward was employed as a toolmaker at the Star Armory, Yonkers, N. Y. From Yonkers he went to Trenton, N. J., and took a contract for making guns. In 1865 he was foreman for E. E. Garvin & Co., New York. Leaving there in 1887 he entered business as a member of the firm of Sargent & Cullingworth, New York. Here he did pioneer work in the manufacture of air compressors and rock drills. He also did some work in connection with the erection of the elevated railroads in that city and was the inventor of the well-known ticket chopper which is still in use. Later the Ingersoll-Sargent Co. (Now the Ingersoll-Rand Co.) bought his interest in the business. When E. E. Garvin died, Mr. Cullingworth was made a trustee of his estate and this bringing him in close touch with the Garvin Machine Co. (successor to E. E. Garvin & Co.) he entered its employ and was in charge of much of the experimental and special work.

A thorough mechanic and possessor of a genial disposition, Mr. Cullingworth was greatly beloved by all who knew him. He was a member of the American Society of Mechanical Engineers and vice-president of the Garvin Machine Co.

Revalidating American Trade-Marks in Germany*

By F. H. Williams

Vice President Trade-Mark Title Company

This article, which is based on special cable despatches, includes an illuminating and timely discussion of the entire domestic and foreign trade-mark situation, of immediate interest to every concern which has or thinks it has a property right in a mark or trade name.

Under a recently outlined course, the German commissars have indicated that the taking over of American trade-marks in Germany was only the result of a compulsory administration; and that in order to give absolute protection to American trade-marks in the future and remove any doubt of their legality, the present German Government is willing to accept registrations for American trade-marks at this time to the end of revalidating and registering the same.

This indication assures American manufacturers interested in a desire to continue to do business in Germany and to protect their mark there, and all who formerly registered their mark in that country, an unusual opportunity; and business executives should give these matters immediate attention, that their board of directors may act and take advantage of the new situation at the next meeting.

It is to be regretted that in American business circles our busy executives do not give their trade-mark matters personal attention: it very seldom reaches the board of directors' meetings, as it should do. Trade-mark details have been passed to minor clerks, or clerks who have had an inkling of patent law, and more or less handled as a side issue to the patent features of large business interests when they deserve a much larger consideration. The result has been that until a concern saw its trade-mark in litigation, it deemed the matter of secondary importance. When once in litigation, and executives are compelled to sit in a court room for days or weeks and listen to testimony concerning a trade-mark, hear the argument of counsel, and the importance of their situation, then alone are they awakened to what a trade-mark really is. Whereas, had their trade-mark matters received the attention they really deserved within their business and advertising household, very few would see their marks in jeopardy. Instead of that, hundreds and hundreds of trade-mark owners are continually put on their inquiry to defend their marks from year to year, and go to endless expense in lawsuits, all of which could be avoided.

With the foreign trade-mark situations, business executives are daily signing at the request of patent attorneys blank powers of attorney, which are forwarded to all parts of the world. The practice has been part of a loose system concerning foreign registration of trade-marks for many years, and has caused an endless amount of trouble

(*Continued on page 216b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Wheels, Abrasive.
Wolf New Process Co., Meriden, Conn.
"American Machinist," Oct. 23, 1919

The Wolf New Process Abrasive Wheels is a new and secret process which produces a free cutting wheel at a low cost. Any desired abrasive may be used, the company's process concerning only the bond and the modifications of methods of handling made possible by it. Wheels may be made of any size or shape within the limits of present commercial standards.

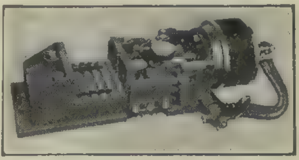
Gage, Cylinder Testing.
Federal Products Corp., 393 Harris Ave., Providence, R. I.
"American Machinist," Oct. 30, 1919

Designed to detect slightest variation in the bore of cylinder and to operate in vertical or horizontal position; centralizing support operated by handwheel holds apparatus in position and permits device, including the dial, to turn freely, in either direction. Dial is graduated in thousandths of an inch; hand is operated by a steel rod actuating rack and pinion. A small lever is used to depress the feelers when inserting them into the cylinder, after which, by releasing the lever, feelers are automatically released against the walls of the cylinder.

Chest, Utility Tool.
Union Tool Chest Co., Inc., Rochester, N. Y.
"American Machinist," Oct. 30, 1919

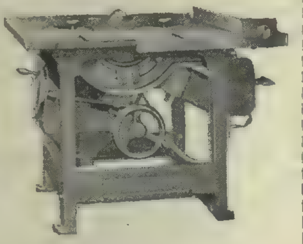
The frame is constructed of kiln-dried oak with joints lock-cornered. The tray is built in the same manner and fitted with movable partitions. The top and bottom of the chest are rabbeted, nailed and glued. Inside dimensions (type L): Length, 15¾ in.; width, 7 in.; depth, 6¾ in.; tray, 14½ by 4 in.; depth, 1½ in.; weight, all wood, 6 lb.; leather covered, 8 lb. Type LL is 18¾ in. long, other dimensions including tray being the same. Weights, 7 and 8 lb. each, respectively.

Vise, M. E. C. Air-Operated, Machine.
Manufacturers Equipment Co., Waller and Filmore Sts., Chicago, Ill.
"American Machinist," Oct. 30, 1919.



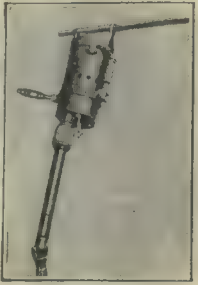
Serves the same purpose for milling and drilling machines that the air-operated chuck serves for a lathe. Not intended for universal use, but is best adapted for handling large numbers of pieces on a production or manufacturing basis. The movable jaw has a power stroke of ½ in. and is double acting, being controlled by a small lever valve. The cylinder used is either 6 or 8 in. in diameter, designed for 80 lb. per square inch. Length over all, 28 in.; width, 12 in.; height to top of jaw, 6¾ in.; size of jaw, 8 in. by 3½ in.; capacity, between jaws, 6 in.; total weight, 225 pounds.

Saw Bench.
Baxter D. Whitney & Son, Inc., Winchendon, Mass.
"American Machinist," Oct. 30, 1919



Two motors, having a speed of 3450 r.p.m., are mounted on saw arbor. Motor housings are part of the yoke carrying saw arbor and the ball bearings, all of which are tilted as a single unit to the desired bevel cut of the saw, instead of the usual method of tilting the table. The method of mounting the motors eliminates all extra bearings. By the movement of a handwheel the saw arbor can be tilted to saw at any desired angle up to 15 deg. The motors can be started and stopped by inclosed switch mounted on the machine.

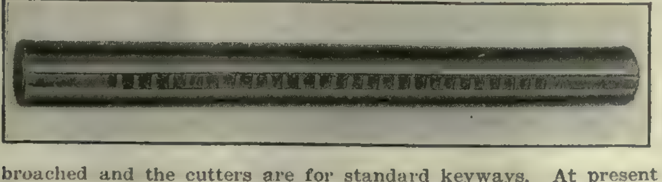
Screwdriver, Power.
H. Hollingshead, 55 Liberty St., N. Y.
"American Machinist," Oct. 30, 1919



Screw or drill driver. The motor will run on either alternating or direct current of 110 to 120 volts. The drive from the motor to the spindle is through worm gearing provided with ball bearings. The spindle can be started and stopped at will by means of a clutch; can be used as a hand wrench so that a tight screw or nut can be started by hand before turning on the power. The machine weighs 14 lb.; the body is 4 in. in diameter and 10 in. long. The motor is 3 to 5 hp.

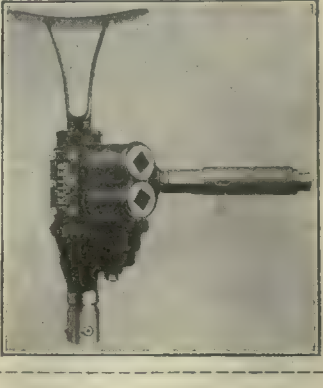
Cutters, Push Keyway, Velco.
V. E. La Pointe Manufacturing Co., Manchester, Conn.
"American Machinist," Oct. 30, 1919

Are intended for use in an arbor press or similar machine although they can be driven through the holes with a soft hammer. One pass through a hole finishes the keyway. The bodies are the same size as the holes in which the keyways are to be



broached and the cutters are for standard keyways. At present these tools are made in sizes ranging from ⅜ to 1 in., varying by 16ths. The cutter blades are interchangeable and, when worn or broken, may be replaced with new ones. The blades can be furnished with straight teeth or with "Velco" staggered teeth.

Drill, Air, Keller Master Valveless.
Keller Pneumatic Tool Co., 20 E. Jackson Blvd., Chicago, Ill.
"American Machinist," Oct. 30, 1919



Drill is light weight, compact and consists of four single-acting pistons arranged in pairs at right angles, each pair being connected to opposite wrists of the crankshaft. These drills are built in nonreversible and reversible types, including a reversible wood-boring machine and a reversible grinding machine.

to many American manufacturers. The abuse of these powers of attorney has occured, not in a few instances, but in hundreds, in almost every country of the world.

Another interesting situation taking place with regard to foreign registrations as a result of these powers of attorney has been the filing in several countries of documents that do not meet the requirements of the laws of the respective countries. It has been the rule with many to file any kind of document in order to secure the registration of the mark. In many countries the laws call for the filing of a certified copy of the United States Trade-Mark Registration. This has not been done, and other documents have been filed in lieu of same. Should the time ever arrive when any of these trade-marks, registered in this way, come into question and they reach the stage of a lawsuit, these very points will throw the trade-mark registration out in favor of a third party, and thus invalidate the whole registration, perhaps not alone in one country but in many countries.

The foregoing situation is mentioned because Germany was one of those countries that heretofore required a United States Trade-Mark Registration, and proceedings along the line indicated were often taken where it was impossible to secure a United States Registration to overcome these points.

Under the new situation regarding trade-marks, these former objections can now be overcome legally where a United States Registration cannot be secured and those who are familiar with these new regulations will have no trouble in filing the necessary and proper specifications to secure the registration of their American trade-marks.

Trade-mark rights in Germany will continue to remain property rights in the Republic of Germany, just as they remain property rights in the several states of the United States.

There is no such thing as a "common law right" in trade-marks in Germany, and even here in the United States the so-called common law right in a trade-mark is a very much misquoted term, as expressed in encyclopedias and other reference works.

Common law rights in trade-marks in countries that recognize common law exist only where there are no statutory laws upon the subject. In view of recent court decisions in the United States on trade-marks, there is not much left to the idea of a common law right in trade-marks in this country.

Because of the foregoing stituation, trade-mark "gorillas" have made their appearance within our own gates, and daily American trade-marks are being grasped right at our doors by unethical legalized stealings.

Correct protection of trade-marks, and litigation concerning trade-marks is of such unusual character that it becomes a specialized law practice, not alone in the United States, but in nearly all foreign countries. It can hardly be said that the average patent attorney is fully competent to handle trade-mark matters; the best proof of this is that the majority of patent attorneys are not admitted to practice law. When it comes to a litigated case they usually employ counsel and simply sit in the case themselves in an advisory capacity. The net result of this has been that upon reaching the court room the average American client was surprised to be introduced to new counsel in his trade-mark litigation.

Considerable litigation over trade-marks has reached the courts as a result of American manufacturers believing that they were properly registered with some government department either in this country or in some foreign country, whereas as a matter of fact all that had been done was to register their trade-mark with some private registration trade-mark bureau. Thousands of American trade-marks today are relying upon this sort of trade-mark registration for their protection: a registration that is worthless, and usually made under false pretenses in connection with some alleged vigilance service.

Thousands of these American marks are likewise recorded with private foreign registration bureaus.

One would not record his deed to a piece of real estate in any other office than with the county clerk or the registrar of deeds, or the proper official receiving such documents for record. Likewise, one should secure his property rights in his trade-marks along the same line, through proper, recorded official sources. Laws afford this protection and record in every country in the world, and all that is necessary for the American manufacturer is to seek correct service.

The expenditure of a few thousand dollars for correct world-wide service is better than later expending thousands of dollars for the taking of testimony and the trial of a lawsuit. The burden is on the American manufacturer to seek every avenue of protection. If he does not do this, that is his fault; he must sooner or later pay the penalty.

The law of no country concerns itself with the motives of men when their acts are lawful. This is true in the United States and in foreign countries. Nor do the courts concern themselves with the injuries that result from the exercise of lawful rights and privileges, and this is true where the aggrieved party had the opportunity to take advantage of the laws of property in trade-marks but neglected to do so.

It might be of interest to know that no trade-mark rights have been sold by the German trustees under their compulsory administration.

There is serious doubt as to whether the American Alien Property Custodian ever acquired a property right in any United States Trade-Mark Registration or even the property itself of the alleged German enemy whose property was confiscated. These trade-marks were confiscated as if such property right existed. No one has ever secured a property right in a trade-mark through a United States Patent Office registration; all that has been secured has been a certificate of registration showing that through the statement of the applicant, and as a result of a certain examination and procedure in the Patent Office, the trade-mark has been allowed to become registered, and from that act it has what might be prima facie evidence of title to the trade-mark. The same is always in a situation where it may become void through a court action.

That considerable doubt on the part of the Alien Property Custodian existed as to his right to dispose of these trade-marks is evidenced by the fact that whenever any assignment of a trade-mark was made it carried with it the following clause:

"It is expressly provided, however, that this sale is made without recourse of any kind, or by any one, upon the undersigned as Alien Property Custodian, or upon any successor in office or the undersigned, or any agents, liquidators, or employees of the undersigned, as Alien Property Custodian or his successor in office, and is accepted subject to such condition."

The next few years will witness an endless number of lawsuits in the courts of the United States and foreign countries regarding trade-mark situations that have arisen as a result of the conditions due to the war. A number of very interesting questions will be brought out.

Hundreds of the German trade-marks sold by the American Alien Property Custodian will become involved, with millions of dollars being spent in litigation, and every American purchaser of these trade-marks should now take every precaution to anticipate these lawsuits and protect themselves from every angle.

A leading trade-mark, on which millions of dollars have been expended in the United States and Canada, was confiscated by the American Alien Enemy Custodian. It was duly sold to Americans here in New York, and the title shows the corporation to be a New York corporation composed of American citizens. As a matter of fact, documents are on file in Canada showing these same persons to be subjects of Germany. If they are Americans, their case, handled by a leading patent attorney in Canada, is being very poorly handled: because if the court documents in Canada allege true facts (under the Act of Congress Approved Mar. 28, 1918, it is provided that

"Any property sold under this Act, except when sold to the United States, shall be sold only to American citizens. . . . Any person purchasing property from the Alien Property Custodian for an undisclosed principal, or for resale to a person not a citizen of the United States, or for the benefit of a person not a citizen of the United States, shall be guilty of a misdemeanor and upon conviction shall be subject to a fine of not more than ten thousand dollars or imprisonment for not more than ten years, or both, and the property shall be forfeited to the United States.")

These people have placed themselves in jeopardy in Canada.

In the same lawsuit the documents

(*Continued on page 216d*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Quenching Compounds, for Steel.
Wheelock, Lovejoy & Co., Cambridge, Mass.
"American Machinist," Oct. 30, 1919

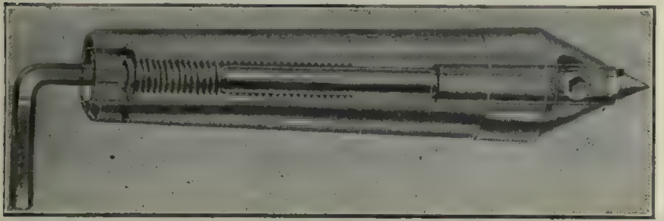
Are known as Quenchoid and Feusalt, the former being used for carbon and the latter for high-speed steel. Are used at a temperature of approximately 300 deg. F., and, in spite of this temperature, seem to secure the desired hardness without increasing the heat of the steel beyond the usual point. Temperature at which they are used greatly reduced the shock to the piece being heat-hardened, and in this way greatly lessens the tendency to crack.

Drilling Machine, Oil-Pan Base.
Weigel Machine Tool Co., Peru, Ind.
"American Machinist," Oct. 30, 1919

The pan which is cast integral with the base is 6 in. wide, 8 in. deep and rises 4 in. above the upper surface of the base. The coolant can be pumped from and returned to the reservoir without spattering on the floor. Bolts for holding down the machine are placed outside of the pan, so that there is no danger of leakage through the bolt holes. The 21-in. drilling machine can also be furnished with an oil pan of the above type.

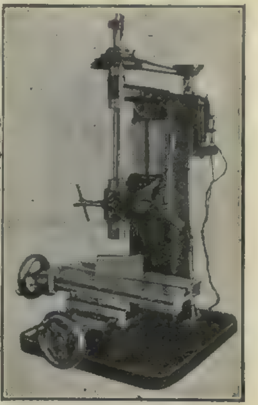
Center, Lathe with Adjustable Point.
Robinson Adjustable Center Co., Detroit, Mich.
"American Machinist," Oct. 30, 1919

A lathe center with an adjustable point. The body of the center is made of carbonized steel while the point is of high-



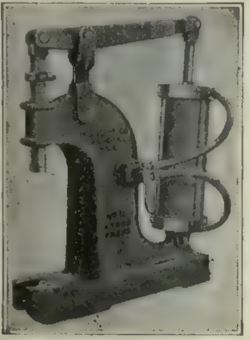
speed steel, hardened and drawn enough to relieve the strain from hardening. The point is interchangeable and can be adjusted for length and clamped by means of the safety setscrews as shown.

Profiling Machine.
R. M. Clough, 327 Colony St., Meriden, Conn.
"American Machinist," Oct. 30, 1919



Spindle runs in ball bearings, and is driven by a ⅛-hp. motor mounted on column; motor can be connected to lamp socket. Drive is a round belt on a pair of cone pulleys, giving range of speeds, 500 to 3000 r.p.m. Spindle has No. 5 B. & S. taper hole. Vertical movement of 3 in. at sleeve head may be raised 12 in. Sleeve movement by hand lever or treadle. Table has movement across face of the column 12 in. and in-and-out range of 5 in. Micrometer dials provided on screws; table has micrometer stop. Adjustable stops, not graduated, provided for other movements. Machine weighs 300 pounds.

Press, Arbor M. E. C. Air.
Manufacturers Equipment Co., Waller and Filmore Sts., Chicago, Ill.
"American Machinist," Oct. 30, 1919

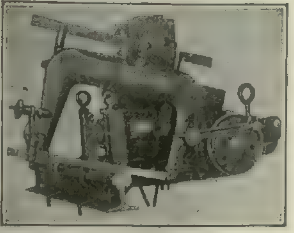


Made in two sizes, ram has lock collar to stop downstroke. Specifications (both sizes): Number of press, 11 in., 12 in.; maximum stroke, 6 in., 7 in.; maximum distance, top of base to ram, 15 in., 24 in.; minimum distance, top of base to ram, 9 in., 17 in.; cylinder bore, 6 in., 8 in.; capacity at 80 lb. per square inch, 6600 lb., 10,900 lb.

Vise, Milling Machine, Air-Operated.
Neidow & Payson Co., 9 South Clinton St., Chicago, Ill.
"American Machinist," Oct. 30, 1919

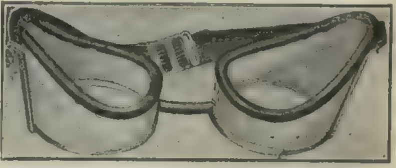
Specifications: Made in four sizes; cylinder diameters, 3 and 4 in.; jaw width, 4, 5, 6, 7½ in.; jaw height, 1⅜ in.; screw adjustment, 2, 3, 3½ and 4 in.; total opening, 2⅜, 3⅜, 4½ and 4⅜ inches. Piston works jaws through double toggle joint, giving great power and preventing releasing the work should air pressure go off the line. The body of vise is a steel casting; jaws faced with hardened-steel plates. All lever movements inclosed. Air valve mounted on the cylinder. Vise is made in four sizes with air cylinders of 3- and 4-in. diameters.

Sawing Machine for Cutting Rails.
Racine Tool and Machine Co., Racine, Wis.
"American Machinist," Oct. 30, 1919



Complete with motor and starting box; frame and body are steel castings. Motor is interpole, ball bearing fully inclosed; will operate on direct current 260 to 600 volts. Current may be taken from trolley wire or third rail. Motor mounted on frame of the machine drive through worm gearing. Clamping devices allow the machine to be easily placed at work, and the clamps may be readily adjusted to cut any size of rail within the range of the machine. Machine will cut a 9-in. girder rail in from 15 to 18 min.; one blade will cut from 8 to 10 rails. Weight with motor and starting-box, 225 lb.; length of stroke, 6 in.; number of strokes per minute, 60; will cut rails up to 9 in.; time for cutting 9-in. rail, 15 to 18 min.; current, 260 to 600 volts.

Goggles, All Purpose.
T. A. Willson & Co., Inc., Reading, Penn.
"American Machinist," Oct. 30, 1919



Aluminum-cup goggle that can be equipped with either plain glass or colored lenses and if desired to be dust-tight can be furnished without the ventilating perforations. The lenses are held by safety flanges which, in case of fracture, hold the pieces of glass together and prevent them from being driven into the eyes. Goggles of this type can be furnished in transparent cellulose instead of aluminum if desired; also with lenses of the regular chipper's grade, super-tough glass, laminated glass or triplex glass.

Clip, paste on 3 x 5-in. cards and file as desired

show an alleged assignment made in 1913, and only recorded in 1919. No court will look upon assignments thus recorded with the same notice as if it had been properly recorded in 1913. Belated assignments have caused the disbarment of many an attorney in the United States and meant serious consequences to the notary public who subscribed to the documents. Sometimes the examination of water marks on the typewriting paper has indicated in will contests the non-manufacture of the particular typewriting paper on the alleged date of the will. Not long ago in a will contest such a fact was proven by a secret water mark of the manufacturer on the paper. Such facts cannot be covered up, even though the transactions be handled by well-known law firms. Disbarments of even well-known lawyers have not been infrequent in recent years in the United States.

The Government of Canada is entirely separate from that of Great Britain, and trade-mark rights in Canada are property rights and are of course assignable in Canada. The Ministry of Justice in Canada ordered property rights of the enemy confiscated. It takes along with such action all trade-mark rights, and no assignment of such trade-marks can undo this action. Therefore it is doubtful if a belated assignment recorded after such action is good.

The result of this lawsuit in Canada is looked forward to with interest; and it can now be stated that the Canadian judges will examine every part of the transaction with the greatest care. Any one who has enjoyed the privilege of practicing before the Canadian courts will appreciate the high standing of its judges and their unwillingness to have something slipped over on them.

Trade Currents From New York, Cleveland, Chicago and Philadelphia

New York Letter

The first two weeks of 1920 closed with business booming along briskly in the New York machine-tool trade, delivery being the ruling factor affecting closures, and with several firms withdrawing from solicitation of business along certain lines in order to catch up with deliveries scheduled on 1919 orders. It is also reported that in several cases orders have been booked solid for the entire year for certain kinds of machine tools.

A leading machine-tool firm is the authority for the statement, through its president, that the business for the first ten working days of 1920 is far ahead of that returned in any similar period in the history of the local companies. With this as a criterion, it looks like a big year ahead.

While there are no large sales, these are compensated for by a large volume of small group and single item orders for a wide range of equipment. It is this class of business that occupies the boards at present, but large orders, due to numerous expansion and replacement programs now under advisement among local industries, may be expected within a reasonably short time.

Quite a number of Mid-Western firms were inquirers in the local market during the week past.

Replacements are contributing substantially to machine-tool sales. One firm reports that most of its business for a week past has been for replacement items, and from present indications this class of business will continue heavy for some time. Robert Gair & Co., of Brooklyn, is doing a great deal of replacement, but, for the time being, is out of the market for any more new equipment.

Trading in used machine tools continues brisk with little apparent change. There is some tendency on the part of buyers of this class of equipment to look askance upon offerings salved from Government operations as a great deal of it is not adapted to peace-time usage without extensive, and sometimes costly, alterations. There is a large amount of used machinery on the market that was designed for special use on classes of work that were met with only in munition making. There is very little demand for this equipment.

The export market for machine tools is still adversely affected by the low exchange rates prevailing with Continental countries, but this situation is not apparent in the Far Eastern and South American fields. Inquiries continue steady with many really good opportunities offered.

Everything considered, the machine-tool situation in and around New York City is satisfactory, with most of the companies doing a capacity business, and in many instances turning it away. It looks like a record year for the local dealers.

Cleveland Letter

A marked change in machinery-market conditions in the districts served by the Cleveland machine-tool trade is noted in the last ten days. Continued stock taking by some of the largest users gives the market a hesitant tone, but, generally, consumers are again following up their inquiries with orders.

Much of the new business is placed contingent on immediate delivery. Many buyers specify periodic deliveries over the year based on present prices, with some deliveries scheduled as far back as September. It is believed that apprehension on the part of machine-tool buyers of prices increasing rather than remaining stable or decreasing is responsible for delayed delivery requests.

Orders for standard equipment prevail, with but little demand showing for special and "tailor-made" machinery.

Unstable prices for the first two weeks of 1920 have been interpreted as an indication of coming shortages in equipment for the last half of the year. Thus, the tendency of buyers is to order now for delivery later, and be sure of having their equipment when it is needed.

The outstanding feature for the immediate future, in the opinion of the Cleveland trade, is the trend that industry will take with the return of railroads to private ownership March 1, as planned at Washington. The attitude of labor generally with this change will have much to do with future progress. It is felt that if labor is prone to make sensational demands, industry will be affected, while if the present attitude is maintained, a rush of business exceeding even that of 1919 will be seen during the last half of 1920.

Chicago Letter

A peaceful and prosperous world makes little news. As peace and prosperity reign in the machine-tool industry in the Chicago district, there is but little of interest to report. All dealers report an excellent volume of business, both in current sales and in delivery of tools ordered at some time in the past. So far as buying is concerned, conditions of the past few months continue. A feeling that some higher prices may be anticipated in the near future is felt throughout the trade, and this feeling is undoubtedly stimulating purchasers to some extent.

Railroad inquiries have not developed any sales of moment. In this connection there are two divergent opinions. One is that, immediately before Mar. 1—the date set for returning the roads to private ownership—material numbers of tools will be bought by the Railroad Administration in an effort to return the roads in their original condition. The other is that no buying will be done by the Government, but that immediately after the owners resume control they will buy to bring their shops up to that state of efficiency which active competition will require. One guess is as good as another. The evident fact is that very soon a great deal of machinery will have to be bought by the various railroad interests.

Philadelphia Letter

Business continues steady in the local machine-tool market, with orders contingent largely upon delivery. There is a substantial increase in the volume of business reported for the last two weeks over the corresponding period in December, with a predominating demand for lathes and milling machines.

Woodworking machinery has taken a prominent place on the inquiry lists released lately due to the establishment of several new furniture factories, and expansions by the numerous firms in the Philadelphia district who specialize in wood products.

The delivery situation is still unsatisfactory, and at this writing is without change, or signs of improvement. Floor stocks are disposed of rapidly, and it is a problem with most machine-tool dealers to keep any stock at all on hand for any length of time.

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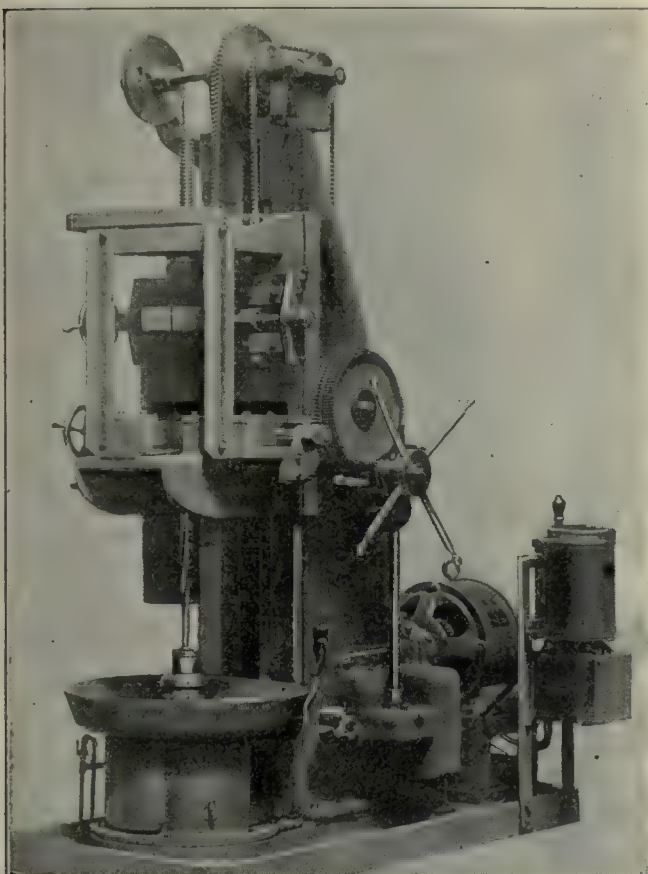
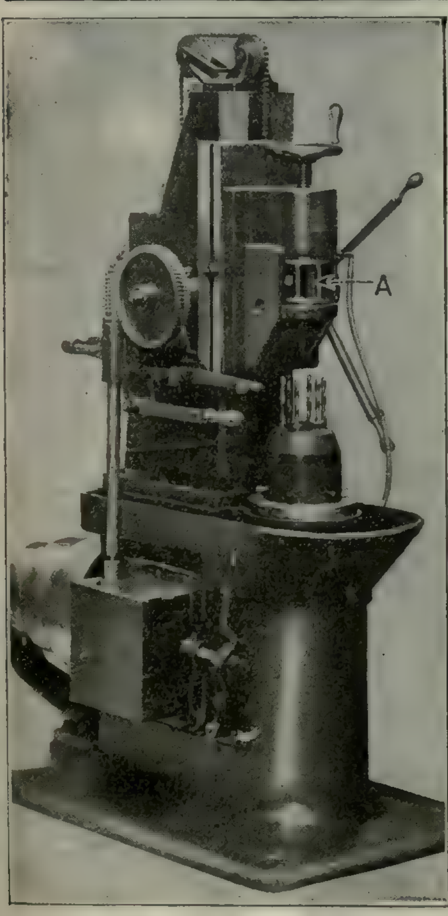


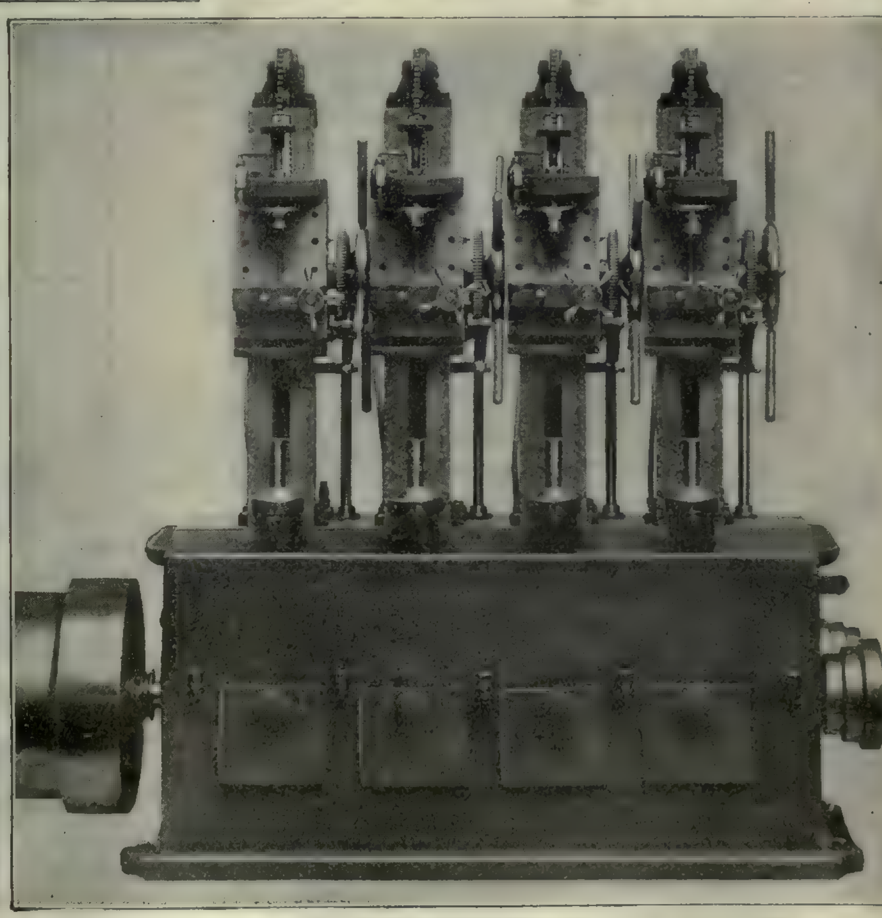
The Foote-Burt Inverted Drilling Machines

By J. V. HUNTER
Western Editor, *American Machinist*

The inversion of the spindles of a drilling machine is so unusual a feature that one is impelled to notice such a machine when found in any manufacturing plant. A considerable number of such machines are in use but the majority have been built for special purposes, and therefore are not found in the general run of shops. A number of types of machines of this character are described in this article.

THE drilling machine is built with inverted spindles for three reasons: First, for deep-hole drilling, since the inverted spindle greatly facilitates the clearance of the chips from the drill and avoids constant withdrawal of the latter to remove chip accumulations; second, for handling pieces that can be drilled in a standard machine only with great inconvenience; third, as a result of modern manufacturing methods where the bases of heavy castings, which pass through the shop on long transveyors, are to be drilled and it is desirable to use inverted drilling





FIGS. 1 TO 3. SINGLE-SPINDLE, MULTI-SPINDLE, AND GANG-TYPE INVERTED DRILLING MACHINES

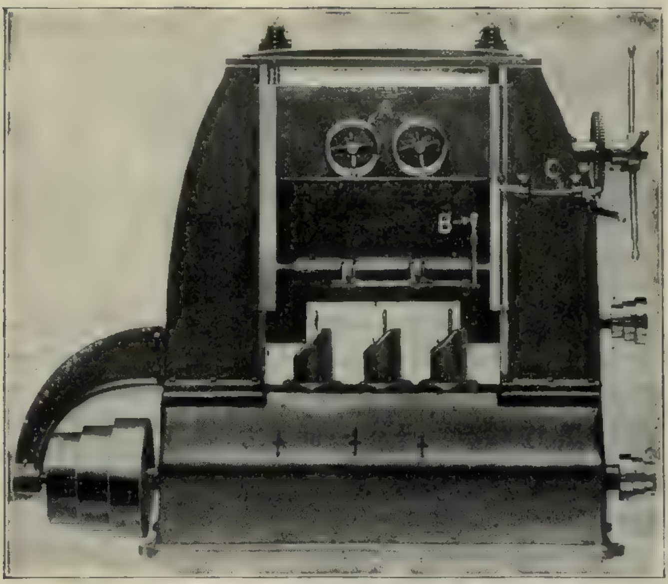


FIG. 4. DOUBLE-COLUMN MACHINE FOR HEAVY AUTOMOBILE WORK

methods to avoid rolling over for drilling. This latter reason is actually closely bound up with the second reason and in some cases it is hard to make a distinction between them.

The Foote-Burt Co., Cleveland, Ohio, has been building a line of inverted drilling machines to meet all of these conditions and from the nature of its work, the majority are special in design to meet the engineering requirements of the job. One of the main difficulties in inverted drilling has been caused by dirt and chips which work into the spindle bearings, but this trouble has been eliminated in a way which will be described later.

In taking up the study of inverted machines for deep-hole drilling, possibly no better example can be found than that shown in Fig. 1. This machine was built for drilling a 1½-in. hole, 30 in. deep, through a tool-steel billet.

In operation the billet is lowered by a crane through the top of the work-holding cage and is clamped cen-

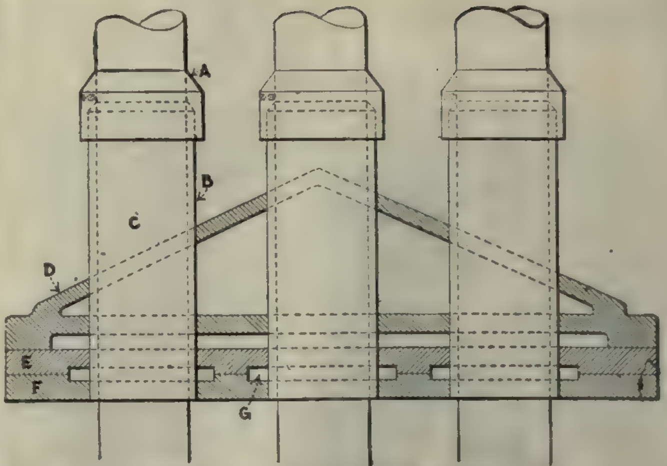


FIG. 6. DIAGRAM OF INVERTED-SPINDLE PROTECTION AGAINST DUST

trally in position by hand-operated vise jaws. A swinging door at the top of the frame carries a heavy pressure screw which is brought down against the billet to take the end-thrust of the drill. The spindle on this machine has no vertical movement and the feed is obtained by lowering the work-holding fixture, which is mounted on a saddle sliding on the vertical ways of the column. Counterweights are used to compensate for the weight of these moving parts. An oil-tube drill is used and coolant which is contained in a reservoir

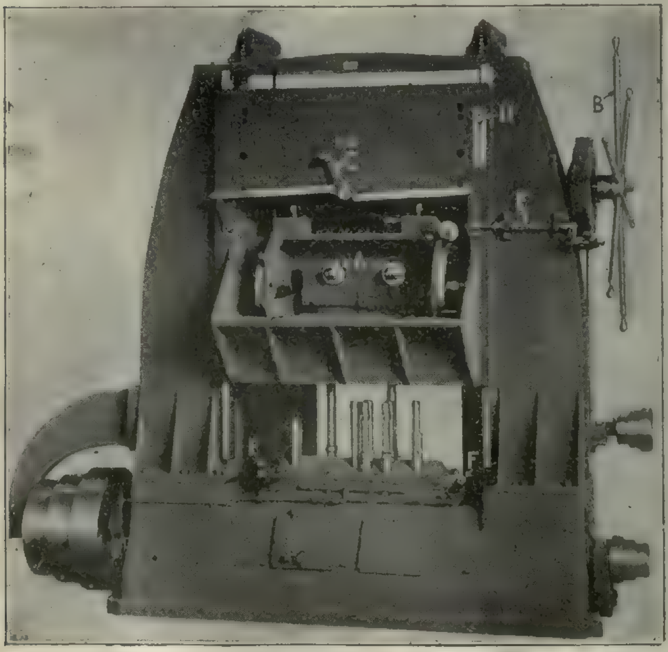


FIG. 5. MACHINE FOR DEEP DRILLING IN AN ENGINE BLOCK

FIG. 7. DRILLING REAR-AXLE HOUSING FOR CONVENIENT HANDLING

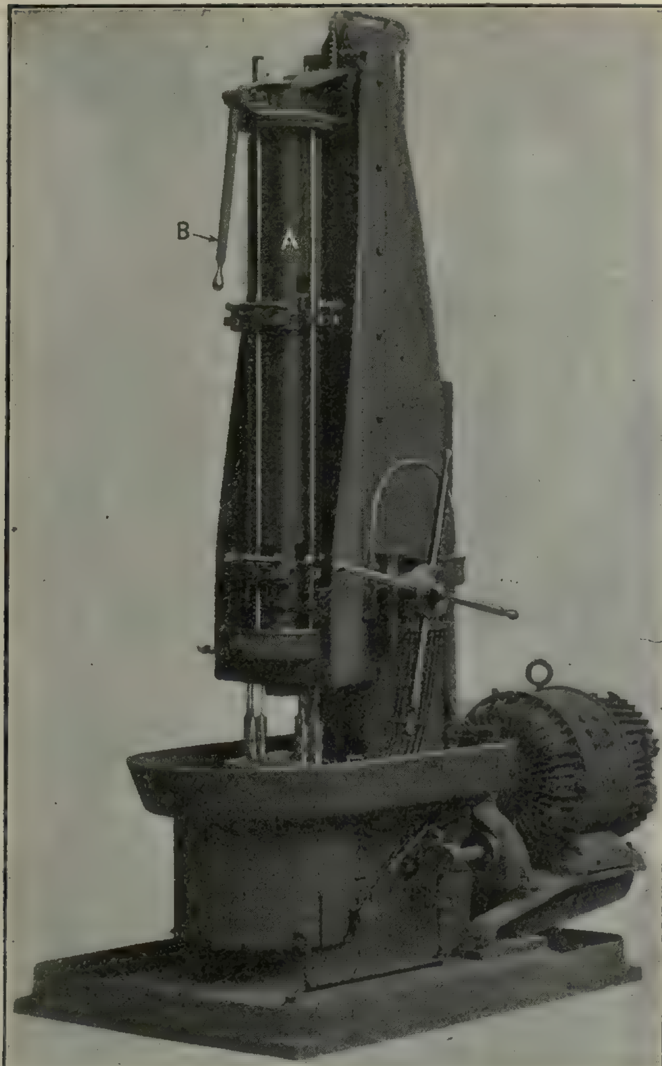


FIG. 8. SPECIAL CONSTRUCTION FOR DRILLING STEERING RODS

in the base is fed constantly by a pump to the cutting point of the drill.

These machines are also built in multi-spindle and gang type as shown in Figs. 2 and 3. The work fixture heads are counterbalanced and may be easily raised. Power feed is provided for drilling.

A Two-Column Machine

A machine with two columns between which slides a heavy carriage carrying the work, is shown in Fig. 4. The two handwheels *A* on the upper side of the carriage together with the lever *B* near its bottom are provided for locking the work in place. The three peculiar-shaped thimbles on the base of the machine each carry two drills, the larger for a deep and the smaller for a shallow hole. On the right-hand column is a knockout *C* for the feed.

Another double-column machine, Fig. 5, was built for drilling several oil holes in an automobile-engine cylinder block. These are $\frac{19}{32}$-in. holes drilled to a depth of 8 in. The casting while lying on its side is slid into the jig, and after locking it into place the jig is rotated 90 deg. to bring the side now showing the drill bushings into correct relation with the spindles. The saddle is counterweighted so that the operator can readily raise it by the spoke wheel *B* on the right-hand column, and lock it in the raised position by a device controlled by the lever *C*. Power feed is provided for a travel of 13½ in. and has an automatic knockout when the adjustment stop *D* comes in contact with the tripping device *E*.

This illustration shows more clearly the dirt and chip protection device for the spindles than do the others, and this is further detailed in the sectional view, Fig. 6. Attached to the spindle is a cone *A* which comes down over the sleeve *B* surrounding the spindle *C*. The sleeve extends through the sloping cover *D* which is designed to throw off the chips without constant brushing by the operator. Below this cover are two plates *E* and *F* with connected dust pockets *G* cut in them. The plates fit tightly about the spindles and are bolted together on the spacing rim at their outer edges so as to make the dust pockets *G* practically air-tight. At the ends of the covering device will be seen hose connections *F*, Fig. 5, to one of which an air hose is connected and all dirt which collects in the dust space is blown out through the other opening. This protection has been found to insure the spindle bearings and gears against damage from the fine dirt and grit which ordinarily will work its way through the smallest openings.

Drilling machines of the inverted type built for convenience in handling the work can be shown by numerous examples which demonstrate the value of this design. A machine, Fig. 7, for drilling the rear-axle housing of a well-known automobile illustrates the advantage of having this part rest on its large end *A* while being drilled. A pressure screw at the top of the

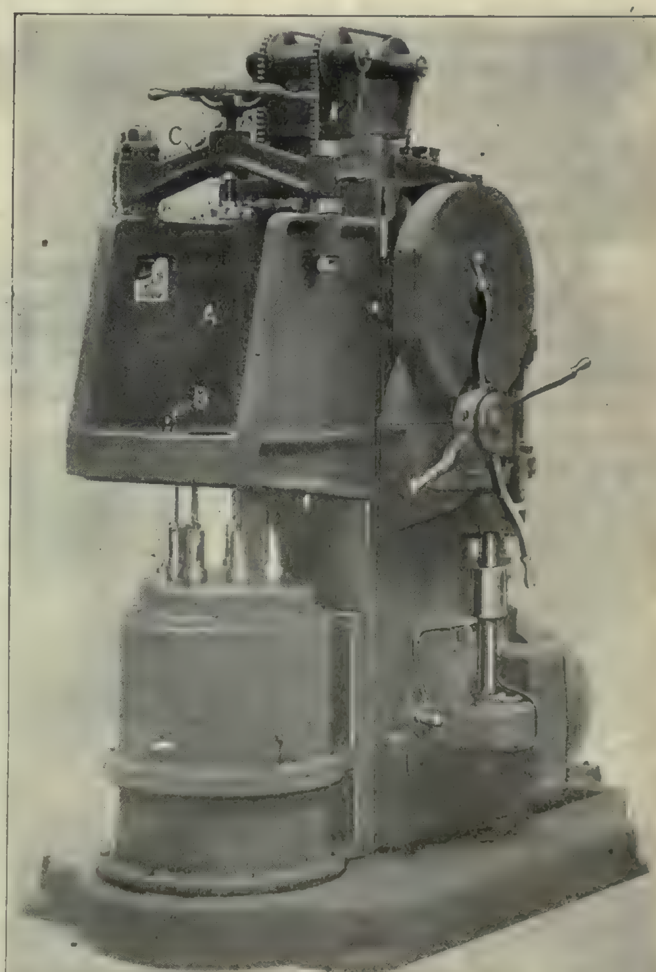


FIG. 9. MACHINE FOR INVERTED DRILLING OF AIR-BRAKE RESERVOIR CYLINDER

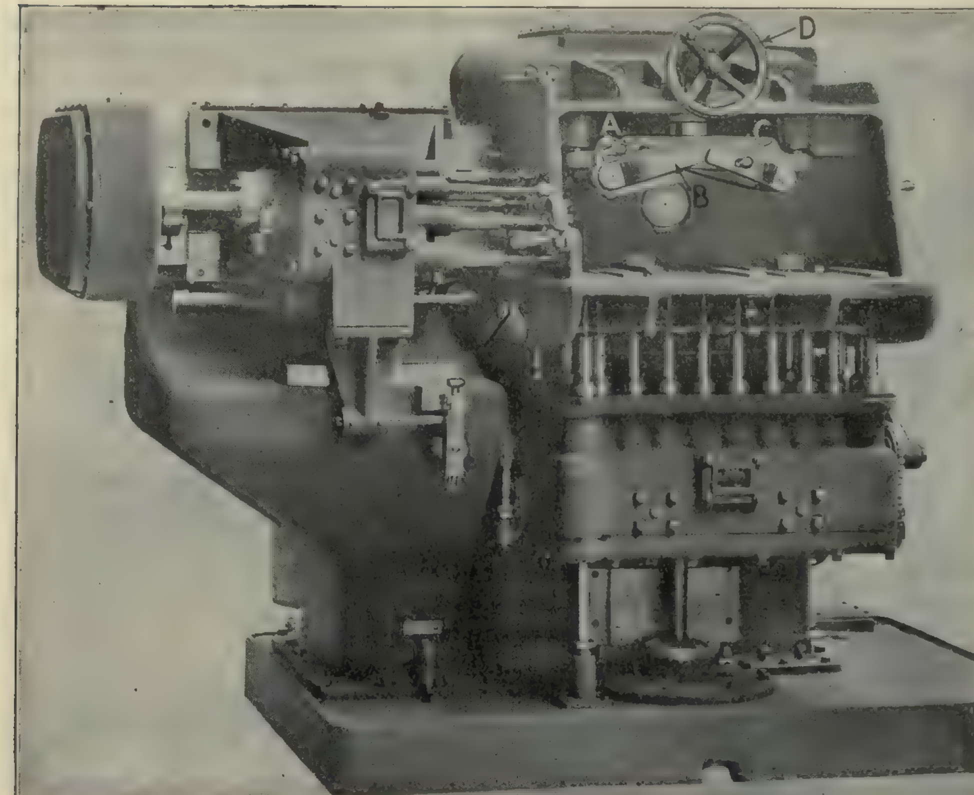


FIG. 10. TWO-WAY DRILLING MACHINE FOR CRANKCASE OF TRACTOR ENGINE

work carriage provides the only clamping necessary to hold the work firmly against the jig plate.

This same automobile has a steering rod with a flange on its upper end in which three holes are drilled and reamed by the machine shown in Fig. 8. This machine performs three separate functions and to do this it is provided with the jig *A* with trunnions at each end, about which it is revolved by releasing the locking lever *B*. There are nine spindles arranged in groups of three. The first spots for the drills, the second drills and the third reams the holes. While the jig head is feeding the three loaded sides to the tools the operator is loading the fourth side and he has only time to complete this while the machining is in progress and then revolves the jig 90 deg. and repeats the operation.

The machine illustrated in Fig. 9 shows from another viewpoint of the great convenience in handling which may be obtained by the inverted method. This was built for drilling the flanges of an air brake reservoir cylinder, that has an off-center lug on the opposite end from the flange to be drilled, and this together with its heavy weight made it very difficult to handle under an upright drill. It is dropped into the heavy frame *A*, with its machined flange resting on the jig plate and positioned by the pin *B*. The clamping yoke *C* is swung out of the way while placing the casting, and is then replaced and the screw turned down to clamp it.

The machine, Fig. 10, was designed for drilling the crankcase of a tractor engine. The parts are carried through the shop on a transveyor with their faces down and time is saved by not having to roll them over; while at the same time they can be jigged to greater advantage when resting on this machined surface. This is a two-way drilling machine and embodies many features which cannot be described here but the most

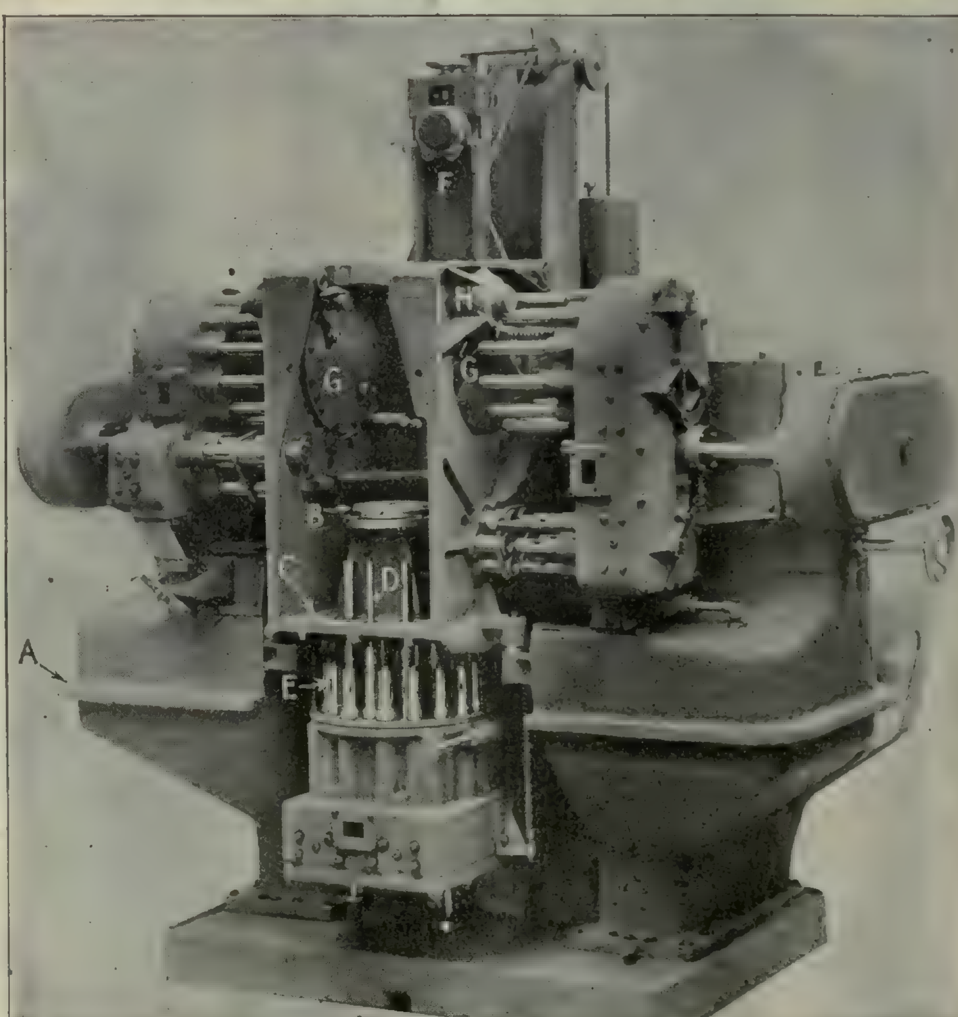


FIG. 11. THREE-WAY DRILLING MACHINE FOR TRACTOR AXLE HOUSING

radical difference between this and the preceding machines lies in the feed methods which are obtained by travel of the spindle heads toward the work. The clamping arrangement is unusual and yet simple in design. Releasing the trigger *A* permits the four interlocked arms *B* to fall into a perpendicular position resting on the flanges of the casting. They are fastened to a main head *C* and this is forced down with sufficient pressure by a screw operated by the handwheel *D*.

The size of the machine shown in Fig. 11 can be judged from the fact that the ledge *A* is the actual floor line, and all below this point is placed in a pit so as to lower the machine to a point where the operator can reach the working mechanism. This was built for drilling the transmission-housing castings of the Fordson tractor, which are conveyed through the shop standing on their open bell-shaped ends, and at this machine are lifted by a hoist and swung into the frame of the fixture.

When lowered into place, the casting goes over the centering plate *B* until its flanged end rests on the jig plate *C*. Both of these plates serve to guide drills to different sections of the casting, the plate *B* guiding drills carried in the long spindles *D* while plate *C* guides the drills carried in the short spindles *E*. The work is held in place by lowering the hinged plate *F* into a horizontal position. Another feature of this machine is the sliding jig plates *G* carried on large pins; these are forced into contact with the work when the side spindle heads advance and are pulled back when the pressure on the springs *H* is relieved by the withdrawal of the heads. This avoids interference of these heavy plates with the placing or removal of the work pieces.

Extracts From Chordal's Letters

In this letter Chordal tells of the progress in the practice of architecture in later years and how, when one material is substituted for another, the designs remain the same for some time. He also tells some things about interchangeable work and how certain implements of precision were made at the same cost as those of a lower grade. From this letter it is evident that Chordal anticipated the use of the present photostat many years in advance.

Mr. Editor:

* * * A column is a vertical support and it is a straight sort of an affair, no matter what it is made of, whether of iron, or wood, or stone, or brick, and an arch is an arch whether it be of cast iron, or of stone, or of brick, or of wood. Whether or not these things shall be made ornamental is a question of fancy. I believe it was Ruskin who said all architecture was the ornamentation of the building and that the architect was not concerned with its convenience or its adaptation to its purpose or to the methods of its construction. Our modern architect is truly the all-round man, if there is an all-round man, and at the very start he deals with convenience and adaptability to purpose, and with materials and method of construction, and, last of all, he deals with ornamentation of form or surface. In other words, he plans his structure and deals last with the question of how the eye will be affected.

* * * When a given art, appealing to the eye, has been for a lifetime dealing with a certain material, then if the art changes to a new material the old forms are very often adhered to. Take, for instance, a railway passenger car or sleeping car. These used to be of wood and certain features of their interior architecture were of a form enforced by wooden construction. Then the arts switched to the steel car, and when we enter a steel sleeper we want to knock on something to find out whether we are in a wooden or a steel car. Every detail we find to be strongly imitative of wood, indeed, the surfaces are imitative, and the wall of sheet steel appears as mahogany. The time will probably come, in the course of an age, when the interior of a steel passenger car will look as though it were made of metal and the interior of a wooden passenger car will look as though it were made of wood.

* * * In modern days, steel furniture is taking the place of wooden office furniture and, in making the change, the same lines are followed. If we see a steel office desk the chances are that it looks so much like a wooden desk that we can hardly tell the difference, and the question is, should there be any difference in form or in detail, understanding, of course, that there is a fundamental form based on utility, and that ornamentation is an entirely different matter. If you have an office safe built of steel it has a certain form and appearance. You use it for purposes of safety and it looks safe. Now, if you no longer have use for the safe as a safeguard but still desire it as a mere container and build it of wood, what is to be said if the wooden safe, so to call it, is built exactly along the lines of the metallic safe, even to the size and character of the hinges, and the dial and knob of the combination lock.

* * * The late war, and by the way, "late war" means something entirely different from what it meant many years ago, has developed certain lines of manufacturing which are interesting. Uncle Sam would want, say, a thousand cannon and he would parcel out the making of them to hundreds of different concerns, one establishment to make the guns, another the recoil mechanism of the guns, another the carriages, another the wheels for the carriages, another the sighting instruments, and so on through the entire list. When these different establishments delivered their individual products they had to fit in place on the products of other establishments. And here is where the system of well-studied tolerances and close inspection came into play.

Many of these contracts were let to manufacturing establishments who had or were willing to get the proper facilities but were totally unacquainted with the system of interchangeability, and now that the war is over it is believed that something good will be left from the Government-enforced system of inspection. In war work interchangeability is essential and it has gotten down in late years to a satisfactory point. I believe I am safe in saying that if all the rifles and all the field guns and all the wagons which we sent over to France should have been there dismantled and a mixed pile made of their separated elements, those elements could have been picked out at random and put together all right.

* * * Interchangeability is after all merely a case of well-studied tolerances and rigid inspection. Some years ago I remember seeing in the *American Machinist* a picture of a couple of square bars, about an inch square and four inches long, doweled together with two pins, one of these bars having two holes which had a sliding fit on the pins projecting from the other bar. Now, that pair of bars with its pins was a thing anybody could make by simply putting the two bars together and drilling the holes through the bars while they were together, and then making the pins to have a driving fit in one bar and a slipping fit in the other bar.

* * * But the point is this, the article illustrated in the *American Machinist* had its parts made in two different shops a thousand miles apart, and when they were brought together they fit each other. I believe this to have been the most readily acceptable example that I have ever come across illustrating the idea of interchangeability in machine manufacture. It was simple enough and complicated enough to set in motion the entire train of thought on the subject of interchangeability.

* * * In resuming my letters to you I ventured the thought that blueprints had been invented since my earlier series of letters ceased. I suggest, Mr. Editor, that you start a little research into this matter and let us know something about the early history of the blueprint.

* * * A business that I was once in, required that I send out lots of little drawings. At the start I would make a drawing and then have it photographed and would send out the photographs. Later, I adopted the plan of making the drawings in the form of tracings which I would send to the photographer and he would use the tracings as negatives to print the drawings from. The process was slow and expensive.

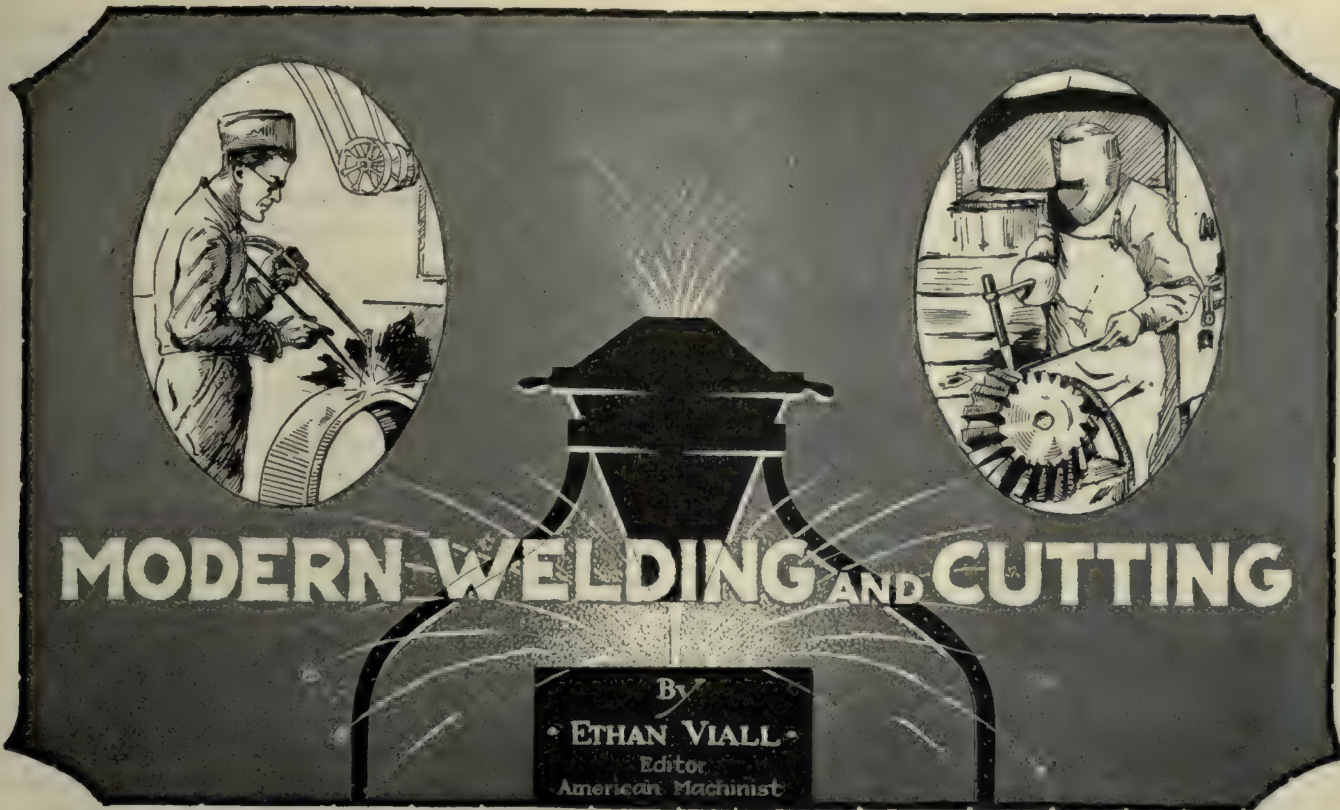
* * * As an illustration of how an ignorant inventor's mind works I can cite myself as an example along this line. It struck me that the ideal thing would be a photograph which could be made directly on sensitive paper. My main thought was the copying of documents, as in record books, and I went so far as to get a patent on a record book on whose leaves were pasted photographs of documents, the seal of the recorder's office being impressed partly on the book-leaf and partly on the photograph. This was on the idea that the photograph could be made directly on paper without bothering with the negative. Then I did something which I ought to have done in the first place. I consulted experts in photography and they quickly threw cold water on my scheme by informing me that you could not make a photograph directly on paper without a negative. I could not dispute these experts, though I could not see why a direct photograph could not be made on a sheet of sensitive paper as well as on a sensitive copper plate in daguerreotyping. This was many years ago and now we have the photostat, a machine on the camera order for use in the office or drawing room and it is a complete photographic outfit in itself, and can be run by a boy. In the machine are inclosed a roll of paper and certain accessories and there is a front tube looking down on a table-like support. You put your drawing on this table, and make the exposure, and turn the crank, and out comes the copy, needing only to be dried. I believe five minutes covers the process. If you write a letter to a man and would like to send him an illustrated page from some book, you lay the book open on the table of the photostat and, presto, in a few minutes you have a photographic copy of the page, full size or reduced, to send along with your letter. You have an inquiry from some one who wants a repair part for some machine, but his description is somewhat lame and leaves you more or less in the dark. You find two castings, either of which may be the thing he wants, and you lay them on the table of the photostat and in a few minutes you are able, in answering his letter, to inclose photographs enabling him to make his choice.

* * * Your associate, Mr. Hand, has been kind enough to say to me that some of the old readers of the *American Machinist* have an interest in Chordal and that he believes that this interest would justify some biographical notes which might prove interesting. I have studied over this matter somewhat and am inclined to start in on the subject, so you may reasonably expect in the near future to receive something along this line.

* * * Speaking of Mr. Hand reminds me that years ago he was a member of the firm of Richards, Hand & Taylor, of Philadelphia, manufacturers of gaging and measuring instruments. I remember visiting their shop at one time and watching their processes, and getting their price list. As I recollect it, they had three grades of accuracy in their gaging implements. An outside caliper, for instance, of a certain size, with a guaranteed accuracy of one five-thousandth of an inch, would be priced at so much; with a guaranteed accuracy of one ten-thousandth of an inch, the price would be a trifle higher, and with a guaranteed accuracy of one twenty-five-thousandth of an inch, the price would be a trifle still higher. I was talking with a manufacturer in a similar line and he ridiculed this price list saying that the cost would be many times higher for the high limit of accuracy than for the low limit. Now, while I said nothing to this manufacturer on the subject, I happened to know that the gages made by the Philadelphia concern all cost the same regardless of the degree of accuracy, it being simply a question of measuring everything with accuracy and laying them in three piles and putting the highest price on the pole of highest accuracy.

* * * And this reminds me, without any reason of connection, of the process of "sealing" followed by the manufacturers of weighing scales. If a scale maker builds, say, a platform scale, he tests its accuracy as a whole, and corrects for errors somewhere in the mechanism. Another plan is to "seal" each individual element before the parts are put together, the idea being that if each element is right the whole organization must be right.

Very respectfully, CHORDAL.



XVIII—Welding Various Metals and the Fluxes Used*

Before dealing directly with the use of fluxes, it is advisable to go back over some of the ground already covered. It must be borne in mind that in order for a welder to intelligently handle the work placed before him he must be able to immediately establish the identity of the metal, recognize its properties, have knowledge of its behavior under the welding flame, and know exactly what treatment to give it. This necessary knowledge cannot be acquired within a short time. It will result only from experience, careful observation, and close examination during welding.

(The last installment appeared on page 685, Vol. 51.)

THE first property to be considered in welding various metals is the melting point. Gas-torch welding is the joining together of two metal parts by fusion at the line of contact and in order to secure a perfect weld it is necessary that each part be melted, and the molten metal allowed to flow together and harden in this state of mixture.

The approximate melting points and other properties of the metals and alloys commonly welded are given in Table XXII, taken from "Oxwelding and Cutting."

When metallic bodies are subjected to an increase in temperature they expand, the rate of this expansion being closely known for each degree of rise in temperature. When the temperature is lowered a reverse action takes place, the bodies contract and the volume and linear dimensions decrease. This has been explained to some extent in a previous chapter, and examples given to show the effects. Each metal has its own coefficient of expansion, which varies materially for the different metals. As seen from the table given, of the metals most commonly welded aluminum expands the most, bronze and brass next, then copper, steel, and iron. Aluminum expands almost twice as much as iron or steel.

*For the author's forthcoming book, "Welding and Cutting."

Conductivity and Oxidation

The conductivity of a metal is its property of transmitting heat throughout its mass. This property is not the same for all metals, and varies widely. It is commonly called thermal conductivity.

It can be seen that if one metal conducts or transmits the heat from the torch flame more rapidly than another, it is necessary that allowance be made as to the method of handling the job, the size of the torch, and the nature of the preheating equipment used.

In welding metals of high thermal conductivity it is necessary to use oversize tips—as in the case of copper where the melting point is low and the conductivity high. However, too large a flame is bad, because the operator will not be able to correctly place the mass of molten metal. On sheet work the proper flame will melt the metal to a width about equal to the thickness of the sheet.

When welding heavy work the operator should be very careful not to blow a part of the molten metal on to colder portions as it will make a defective weld at that point (called an "adhesion"). If this should occur, the flame should be played over this chilled portion until it is in fusion with the molten metal.

Certain metals oxidize more rapidly than others. Oxidation is the reaction produced by the combination of oxygen with a metal. The weld may become oxidized by contact with the oxygen in the air and by the presence of excess oxygen in the welding flame. An oxide has none of the metallic properties of the metal from which it is formed. When present in a

weld it seriously weakens it and it is therefore very necessary that it be avoided as far as possible.

Some oxides are lighter than the metal itself, while others are heavier. Consequently, when a metal is reduced to a molten condition the oxide will either float on the surface of the liquid metal, remain suspended, or tend to sink toward the bottom.

The melting point of oxides is in some cases higher, and in others lower, than that of the original metals. This point must also be considered in attempting to eliminate oxide from a weld.

Some metals when molten also have the property of dissolving a portion of the oxide, the extent of this solution being dependent upon the metal itself. When this is the case the oxide is retained in solution until the metal hardens, in some cases separating and producing a weakened weld, in others being retained permanently.

Oxide may be dealt with in two ways. First, by taking means to prevent its formation, by the use of a neutral or reducing flame in the torch, or by the use of various cleaning fluxes; second, by eliminating the oxide after its formation with suitable fluxes, which either dissolve or float it off, or by mechanically removing it by the manipulation of the welding rod or a paddle made for this purpose.

The subject of oxidation is one of vital importance to the welder, one that he should study thoroughly in order to become familiar with all its forms. Oxidation is the cause of a great majority of defective welds.

There are also metals, that, when heated to the melting point, have the property of absorbing gases from the flame. When the metals cool, the gases are released. In a great many cases the release of the gases occurs at a time when the metal is not sufficiently fluid to allow them to pass to the air. Consequently, small bubbles or blowholes are incorporated in the weld.

TABLE XXII. PROPERTIES OF METALS COMMONLY WELDED

Metals	Weight Lb. Per Cu. In.	Tensile Strength Lb. Per Sq. In.	Coefficient of Linear Expansion Per Degree F	Specific Heat	Melting Point Degree F.	Relative Heat Conductivity Copper W1.00	Latent Heat of Fusion B.T.U's per Lb.
Cast	.0924	12000-14000	.0000123				
ALUMINUM				.2185	1215	.504	180
Drawn	.0967	25000-55000	.0000136				
Cast		18000-20000					
BRASS	Cu-60 Zn-40 .3036		00000957	.0939	1740	.204	
Drawn		40000-78000					
BRONZE	Cu-90 Sn-10 .3132	36000	.00000986		1650-1750	.735	
Cast		24000					
COPPER	.3186		.0000093	.09515	1982	1	77.9
Drawn		30000-60000					
White Cast		13000-22000			1922-2075		43.4
IRON	.2840			.1138		.152	124.2
Grey Cast		18000-29000	.00000556		2228-2786		59.4
WROUGHT IRON	.2779	50000-90000	.00000648	.1138	2732-2912	.156	
LEAD	.4108	1720-2050	.0000162	.0314	621	.076-083	9.66
NICKEL	.3179	54000	.0000071	.1086	2645 5	.14	122.4
Cast	.2479						
ZINC		5000-7000	.0000161	.0955	786	.303	40.6
Rolled	.2598						
Mild	.2834	55000	.0000063	.1165	.2687	.139	
STEEL							36
Hard		78000		.1175	.2370		

The Oxweld Co.

Then, too, in the welding of various metals the force of the torch flame causes the molten metal to flow back away from it. When the flame is withdrawn the molten metal returns—similar to the action of any other liquid. At such times the return of the molten metal may be so rapid that small quantities of the gases become entrapped and remain in the weld as blowholes. This is a very common occurrence in cast-iron welding.

In the case of the absorption of the gases by the hot and molten metal, the difficulties may be overcome by the use of proper protecting and cleaning fluxes and properly prepared welding rods.

In the case of the gases being entrapped by the molten metal, this may be overcome by "working out" the gas by means of the torch and welding rod.

Vaporization of Substances

In the manufacture of metals substances are combined in amounts which determine the behavior and characteristics of the metal. In iron and steel there is a certain amount of carbon, silicon, manganese, phosphorus, sulphur, etc. While these substances may be present in only very small quantities, yet their elimination, or presence in excess, may materially affect the mechanical properties of the metal.

The high temperature of the welding flame may cause these substances to burn out or to volatilize. They can burn or oxidize directly in the oxygen of the atmosphere, in excess oxygen in the welding flame, or by the reduction of the oxide of the metal formed in melting.

In the working of brasses, bronzes, or any alloy in which zinc is present, it is commonly observed that the zinc vaporizes and passes off as heavy white fumes in the form of zinc oxide. It can be seen that when this occurs the zinc content of the alloy is materially reduced, and consequently the resultant weld will not

have the same mechanical and chemical properties as the original metal. Special fluxes are provided to prevent this; also, welding rods can be obtained which will either prevent the vaporization of the volatile substance or will replace it.

Separation of Elements

Alloys are uniform mixtures of metals. The fusion of the different elements composing an alloy is carried out at a certain fixed temperature. In the welding of metals of different kinds, it has been noted that when some of these alloys have been heated to the high temperatures produced by the welding flame various substances separate or segregate and that it is impossible to secure a uniform weld.

This segregation occurs quite frequently under the torch flame and also occurs in the manufacture of the metal. Under these conditions the difficulty of welding some alloys can be readily seen.

Welding Various Metals

With the foregoing facts and suggestions in mind we will now take up the various metals most frequently welded, and give directions that will apply in their special cases. The composition of various fluxes will also be given, but it should be remembered that the different accessory concerns can supply far more satisfactory fluxes than can be made in small lots by the individual user, and the welder should, where possible, buy the fluxes needed and apply them according to directions. This also applies to welding rods which should be bought from reliable concerns for certain specified jobs. For emergency work, where the proper rods are not available scrap material or wire may be used, but it is not good practice. A first-class welder who cares for his work and his reputation will use rods of the proper chemical composition for the work he has to do. For this purpose he should buy his rods from firms of established reputation, who are not afraid to advertise their output.

Welding Aluminum

Aluminum parts to be welded may be divided into two classes—those made of drawn or rolled aluminum and those which are cast.

Rolled aluminum is usually 98 per cent. pure or better, the main impurities being silicon and iron. Aluminum as pure as this is seldom used for castings, since its strength is considerably less than that of various alloys. Zinc in amounts ranging from 5 to 25 per cent. but usually about 10 per cent., was often used in the past, but the alloy was so brittle just below solidification that a large number of castings were defective owing to shrinkage cracks. A copper alloy is now more commonly used, the copper content being less than 15 per cent., 7 per cent. probably being the favorite. This is not so strong at ordinary temperatures as the zinc alloy, but it does not have such a tendency to crack. This makes it much better for welding as well as for casting, especially on complicated work.

Aluminum oxidizes easily in the air, especially at high temperatures, and in the latter condition the oxide coating is quite thick. This oxide melts at a much higher temperature (5000 deg. F.) than aluminum (1215 deg. F.) and as the oxide is of greater specific gravity (heavier) than molten aluminum, it will sink down into the metal when welding unless it is removed in some way. As the oxide is very resistant to the action of any acid or alkali, even at a high temperature, any flux used must of necessity be drastic in action and if carelessly used, exceedingly injurious to the aluminum weld. On this account any flux should be used with caution and any surplus removed as soon as possible.

A flux is generally used in welding sheet aluminum where the puddling method cannot well be employed. More divergence must be allowed than for iron. Fluxes are usually composed of alkaline fluorides, chlorides or other combinations as shown in Table XXIII. However, these and other flux mixtures are only given for reference purposes, and it cannot be too strongly urged that all welders buy the fluxes used and follow directions in each case.

TABLE XXIII—FLUXES FOR WELDING ALUMINUM

	Formula Numbers						
	1	2	3	4	5	6	7*
Chemicals	%	%	%	%	%	%	%
Sodium Chloride	30.	....	12.5	16.	17.	6.5	30.
Potassium Chloride	45.	33.3	62.7	79.	83.	56.	45.
Lithium Chloride	15.	33.3	20.8	...	...	23.5	15.
Sodium Flouride	...	33.3	....	...	...	....	...
Potassium Flouride	7.	....	....	...	...	....	7.
Sodium Bisulphate	3.	....	....	...	...	....	...
Potassium Bisulphate	...	....	4.	...	...	....	3.
Sodium Sulphate	...	....	....	...	...	4.	...
Potassium Sulphate	...	....	....	5.	...	....	...
Aluminum Sodium Flouride	...	....	....	...	...	10.	...

*Recommended by the French Laboratories of the Autogenous Welding Association.

Where a flux is used in welding aluminum, the edges and adjacent surfaces should be well scraped and cleaned as the flux is only intended to eliminate the oxide and not grease and dirt. In welding heavy sheets the edges should be beveled and in light ones the welding will be aided by flanging the edges about $\frac{1}{16}$ in.

Aluminum castings are handled a little differently from sheets or plates. As previously mentioned castings are of different composition. Since the metal has a low melting point, high conductivity, and becomes rather fragile previous to fusion, preheating and cooling must be carried out very carefully. The average aluminum casting is somewhat complicated in its design, hence the necessity of skillfulness in carrying it through the preliminary heating period.

The use of a flux on aluminum castings has been abandoned by the majority of welders. In place of it they break down and remove the oxide by means of a paddle, which is also used to smooth off the surface of the weld after it is completed. In many cases it is an advantage when working on castings, not to bevel the edges.

In most cases aluminum articles should be preheated to some extent before welding. In certain cases the playing of the secondary flame on the object will be sufficient; in others a more thorough treatment is required, such as charcoal or coke. On the regular run of castings it is safest to preheat to about 500 or 600 deg. F., which on iron would correspond to a low red heat. In the case of a broken lug or piece of a flange, it is often really dangerous to preheat as it may cause the whole piece to collapse or distort. The beginner should also be very careful about shifting or turning a hot aluminum casting as it may get out of shape or crumble into pieces. Since the metal is so apt to crumble when hot it is advisable

for the beginner, and often the expert, to back up the parts. This may be done by molding a backing out of asbestos fiber 2 parts and plaster of paris 1 part, made into a thick paste with water. Have this mold about an inch thick and perfectly dry before setting in place. Fireclay may also be used in many cases to back up or support fragile parts. When the weld is completed the casting should be allowed to cool very slowly and evenly. A preheating furnace suitable for both preheating and slow cooling is shown in Figs. 199 and 200. This heater is made by the Geist Manufacturing Co., Atlantic City, N. J., and is known as the Wiederwax preheater. It has eight gas burners entering from each end and extending to the middle. This makes it possible to heat any section or all of the top, as desired. The top has parallel grate bars to support the work and the gas burners are buried in pieces of refractory, heat-retaining material, so that parts are heated with the use of a minimum amount of gas. After the welding is done, the work is placed in the oven underneath the heaters and slowly cooled.

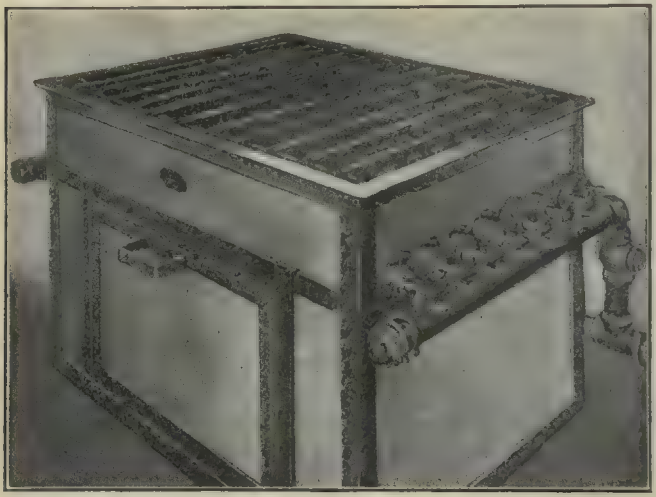


FIG. 199. THE WIEDERWAX PREHEATER

When using this heater or welding at any time, the work should be covered with asbestos sheet as much as possible. The iron puddling rod should not be allowed to get too hot or oxide of iron will be formed and scale off, making a defective weld.

Only a small amount of metal from the welding rod should be added at a time and this must be thoroughly stirred or "puddled" until a pool is formed that insures perfect fusion with the surrounding parts. Use the puddling rod to scrape off surplus metal while it is in a pasty condition. The beginner will find it a little difficult to manipulate the puddling and the welding rods alternately with the same hand but this becomes a habit with practice, and many do this by holding them between the fingers so that neither needs to be laid down. The property of conducting heat is greater in aluminum than in iron, but as the melting point is much lower, about the same size torch tip is used as for cast iron of corresponding thickness.

Filling a Large Hole

The *Journal of Acetylene Welding* says that when the filling of a large hole is required a chill of galvanized iron is provided, backing up the hole and welding against this when filling the hole with aluminum. Galvanized iron is preferable to any other material, such as tin or iron, since it peels away from the aluminum quite readily, and can therefore be easily removed after the weld has been completed. This is undoubtedly due to the zinc content of the galvanizing composition.

The chief value of the use of the chill is that it causes the filler to cool and harden quickly, thereby preventing it from contracting after the weld is finished. It also prevents the heat of the weld from spreading, which might cause the job to crack back.

The chill causes the added metal to cool almost as fast as it is connected to the edge of the break. After the weld has been finished and cooled, the chill can be removed by gently prying it away from the weld by means of a cold chisel.

Brass and Bronze

The composition of brasses and bronzes varies so widely that it is not good for a welder to use welding rods of the same composition for the general run of repair work. However, rods of Tobin bronze or manganese bronze are very satisfactory for all-round work. Where it is important to match the color of the weld with that of the surrounding metal it is necessary to use special rods of practically the same composition as the welded metal, and also to use extra care with the torch. This latter will be better understood when the welder knows that several of the alloys such as zinc, tin, etc., used with copper to make brass or bronze, volatilize easily and in so doing change the character of the metal. These metals should be prepared in the same way as any other. They must be so placed as to not move during the welding. Fireclay may be used to back up pieces in danger of collapse. The end of the flame cone should not touch the metal, but should be kept some distance above it. If a white smoke rises, or, as in the case of bronze, the metal bubbles, remove the flame, as it indicates that too much heat is being used and some of the elements are passing off in vapor. Do not breathe this vapor as it is poisonous. It is desirable to use a tip about the same size as for cast iron. A flux should be used though not too liberally. Calcined borax is good. Boracic acid is also good and, if used, may be applied by dipping the hot rod into the powder from time to time. The principal points to watch are not to heat too hot; do not move the parts until well cooled; do not use too much flux, and be sure to guard against caving in or distortion of the work by properly supporting it

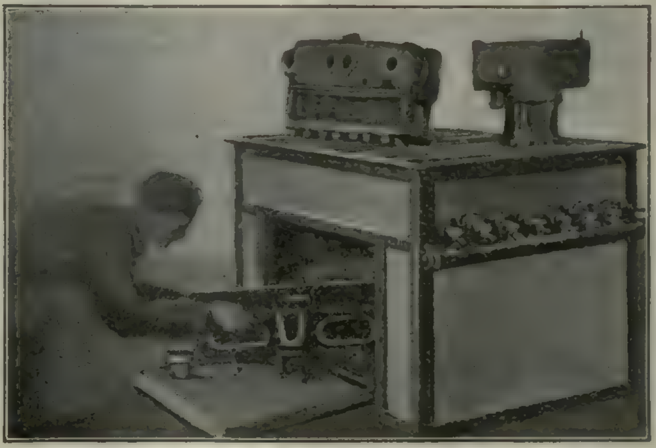


FIG. 200. SHOWING THE SLOW COOLING OVEN

previous to heating. If the metal is porous on cooling it is a sure sign that too high a heat was used.

Cast Iron

When cast iron is molten it oxidizes very rapidly. The oxide which begins to form at a bright red heat, melts at a temperature of 2400 to 2450 deg. F. Since the metal itself melts at a temperature several hundred degrees below this, it can be seen that the oxide will not be melted at the same time as the metal. In order to break the oxide down and allow the metal to flow together a flux must be used. A properly formulated flux will dissolve the oxide and float it to the surface, so that it may be removed by scraping the molten surface with the end of the welding rod. The welder should tap the end against something to free it from oxide before continuing to add it to the weld.

A good flux for use in welding cast iron may be made up of equal parts of carbonate of soda (washing soda) and bicarbonate of soda (baking soda). There is practically no advantage in using the pure chemicals in this case as the commercial product, which may be obtained at the grocery store, will do as well as any. The two sodas should be thoroughly mixed, however, which may be done by running them through an old coffee mill several times, or thoroughly shaking and sifting in a sieve. The flux is applied, as in most other cases, by dipping the hot welding rod into it.

Cast iron is quite fluid when melted. For this reason it offers considerable difficulty where vertical or overhead welding is attempted. Also its fluidity causes it to entrap gases, dirt, and oxide. These may be removed by proper manipulation of the torch and welding rod. As the molten iron can be forced ahead of the weld very easily, adhesion to the cold metal will result, if the welding is not watched carefully.

The silicon will volatilize to some extent in the molten metal and the lowering of the amount of this constituent will seriously increase the hardness of the metal. In order to compensate for this loss, a welding rod is used that contains from 2.75 per cent. to 3.5 per cent. silicon. The other substances such as sulphur, manganese, and phosphorus should be kept within rigid limits. The welding rod should be soundly cast, free from dirt, sand, scale, rust, etc.

The welding flame should always be neutral. The flame should be applied to the weld at such an angle that the metal will not be blown ahead. Inasmuch as the metal is quite fluid when molten, the welding is carried on in a series of overlapping "pools" or puddles. The welding rod is applied by placing it in these pools and playing the flame around it. The welding is aided by continually "working" the rod in the weld in order that blowholes, dirt, scale, etc., will be forced out.

The central jet of the flame should never impinge on the molten metal. It should be held $\frac{1}{8}$ in. to $\frac{3}{16}$ in. from it. Occasionally it is necessary to remove a blowhole, in which case the hole is burnt out with the flame and then the metal is worked over with the welding rod. The working over of a weld should be avoided unless it is absolutely necessary. If it is necessary to do this the welding rod should be used always, for otherwise a portion of the silicon will be lost.

When the weld is finished and it is still hot, the accumulation of scale, dirt, flux, etc., on the surface should be removed by scraping with a coarse file or other tool. This is a superficial coating that, when cold, is very hard.

As soft welds are nearly always desired, the casting should be cooled slowly and evenly. Where the work is complicated or of heavy section, it is by all means best to reheat it to a good red heat and then allow it to cool slowly. In some cases where charcoal has been used it is sufficient to allow the casting to cool in the preheating fire, without the additional reheating.

Cast Iron to Steel

To weld cast iron to steel, cast-iron rods must be used as the welding material. The steel must be heated to the melting point first, as cast iron melts at a lower temperature. A very little flux should be used.

Copper

Copper usually is produced in an almost pure homogeneous form. The impurities are present in small amounts and are not affected materially by fusion. Copper is a good conductor of heat, and is very tough, ductile, and malleable.

From these properties it would appear that it is easily welded. Unfortunately this is not true. There are few welders skilled in the handling of this metal.

Copper has two very pronounced properties under the welding flame. It absorbs gases very readily, notably carbon monoxide and hydrogen. These are released when the metal begins to solidify, with the result that they remain entrapped, producing a porous structure.

Copper oxidizes very rapidly when undergoing fusion. The molten metal has the property of dissolving the oxide thus formed. It will take up such large quantities of it that the mechanical properties of the weld will be affected. In addition to these two peculiarities the tensile strength of copper decreases rapidly as the temperature is raised, particularly from 500 deg. F. upward. The effect of temperature is so severe that at 900 deg. F. the tensile strength is only 40 per cent. of that at atmospheric temperatures.

Because of this weakening under heat, the strains resulting from contraction in the weld during cooling must be carefully dissipated, otherwise the metal in the weld or adjacent to it will fail.

A neutral flame should always be applied in welding this metal. If an excess of acetylene is used the products of combustion are richer in those gases which are easily absorbed. If an oxidizing flame is used, the weld becomes saturated with the oxide.

A larger sized torch tip than the melting point of copper indicates is used because of the high thermal conductivity. Where possible, auxiliary heating, such as air-gas flames and charcoal fires, should be employed. This is done not only from the standpoint of economy, but it also aids greatly in the success of the weld.

The torch flame should play on the weld in a vertical direction. The metal when molten is quite fluid, and for this reason if the torch were applied at an angle the metal would be blown ahead, producing adhesion. Also, by applying the torch vertically the molten metal is protected from the oxygen of the atmosphere by means of the enveloping flame.

Copper, if properly prepared and free from grease or dirt, does not need a flux.

The factor that contributes most to the successful welding of copper is the use of a properly formulated welding rod. Such a rod will overcome, to a great extent, both the absorption of gases and the solution of the oxide. It is not considered practical to remove the oxide in the weld by means of a flux, because it is dissolved in the metal. A welding rod is needed that has combined with it a reducing or deoxidizing agent. The reducing agent has a greater affinity for oxygen than copper, hence it combines with it and brings it to the surface in a fluid form. This material acts as a glaze or protecting coating for the molten metal beneath it, with the result that it tends to retard the absorpion of the gases.

Several materials, when added to a pure copper rod, have proved to be beneficial. The most prominent element at this time is phosphorus. It should be present in amounts not over 1.0 per cent.; otherwise the metal will be pasty and the weld will be weakened.

Newly welded copper has only the strength of cast copper, but after welding, the grain of the weld and the metal adjacent can be improved by hammering at a low heat.

Copper to Steel

If it is desired to weld copper to steel, heat the steel to a welding heat, then place the copper in contact. The metals will then fuse together. Take away the flame as soon as the copper flows properly. No flux is needed.

Lead

Lead can be readily welded. The process, however, is usually known as "lead burning." The gas torch provides a means of doing this work quickly and at a low cost. Skill in the manipulation of the torch is necessary, particularly on vertical seams. A light torch should be used. When welding sheets or plates, proceed as in lead burning by other processes.

The burned joint on a lead or block tin pipe line is not only a neat and permanent joint, but is all lead, and a block tin line is all block tin. The joints are fused together with the addition of enough metal of the same kind. If, for instance, a lead pipe line is to carry acid, the burned joints contain no solder which could be attacked by the acid.

In preparing lead pipe for welding the two pipe ends are scraped clean for about an inch back, and are tapered slightly at the edges. It is not necessary to drive one pipe into the other. The two ends are merely placed in contact and welded or "burned" with the addition of more lead to fill up the joint. No flux, no grease and no "wiping" of any kind is needed.

Malleable Iron

The manufacture of malleable iron has made enormous progress during the last few years, and while formerly malleable iron was really an unknown quantity and might contain different mixtures, from white iron to hard steel, in the same casting, a great uniformity is now obtainable by adherence to strictly scientific methods.

The Associated Manufacturers of Malleable Iron has set a standard of quality, to which all its members must adhere rigidly and castings procured from one of its members may be relied on to consist of a uniform and thoroughly high-class product.

While formerly the welding of malleable iron was considered almost impractical on account of the different structures in one and the same casting, it may now be welded with almost a certainty of success, if the casting was made in accordance with the rules of the association.

The break on malleable iron is prepared exactly the same as for any welding job, cleanliness in this instance being especially desirable, since dirt tends to weaken the weld considerably. Allowance should be made for the effects of expansion and contraction; malleable iron is less liable to break than cast iron, since it is ductile, but will be distorted unless such provisions are made. Use for flux the same powder used for brass—that is: borax or a purchased mixture.

As with cast iron, do not let the end of the cone touch the casting, but hold it just a little distance away. Watch the metal carefully and as soon as the metal begins to melt, add the filling rod, either Norway iron or malleable rod of the same grade as the casting.

However, not all malleable castings are of the high degree just described. They were originally white cast iron, very brittle and hard. By heat-treatment, the carbon content is changed, and instead of the brittle casting, it becomes ductile, fairly soft and changes to a darker color. Just how far into the body of the metal this change penetrates depends upon the size of the casting and the length of the heat-treatment, so that a malleable casting, as it is generally called, may be steel on the surface, a semi-steel part way through and white cast iron at the core.

Very small castings sometimes are steel all the way through and we may weld them without flux, using Norway iron or mild steel as the welding rod.

In nearly all cases, however, it will be found that the casting, if not made to association specifications, is composed of different metals—if the break is examined, we can tell this by the different colors. It is obvious that such a casting cannot be welded, since it would be extremely difficult to determine just where one metal left off and another began. The practice of using cast iron as a welding rod on malleable castings is not a good one, since the bond is very brittle and in all cases where strength is desired we would better use manganese or Tobin bronze—in this way securing a brazed joint instead of a welded one, of a different color than the casting but with the factor of strength a big one.

Watch the metal carefully and when the spot the flame is playing upon reaches a bright red heat, bring the bronze welding rod, which has previously picked up some borax, down upon this section, being careful that the cone does not come directly in contact with the bronze rod. Bronze melts at a lower temperature than malleable iron and with the iron at a bright red heat, and with plenty of flux used, it will be found that the bronze attaches itself to the iron. We must not, however *melt* any portion of the malleable iron and we must not play the cone directly on the iron or on the bronze.

Monel Met

Technically, monel metal is an alloy of nickel and copper, containing about 67 per cent. nickel, 28 per cent. copper, and 5 per cent. of other elements. This remaining 5 per cent. consists partly of iron from the original ore and partly of manganese, silicon, and carbon introduced in the process of refining. It contains no zinc or aluminum. The alloy can be machined, forged, soldered and welded, both electrically and by the gas torch. In the automobile industry it is used for float valves in

carburetors because it combines hardness with non-corrodibility. Borax or boracic acid may be used as a flux.

Nickel

Nickel melts at 2600 deg. F. and when melted has the property of absorbing large amounts of various gases, especially oxygen. The gases so absorbed remain when the metal cools, making it very porous. Nickel also has a great affinity for sulphur. It is often stated that nickel cannot be welded, but this is an error, although it is an extremely difficult metal to weld satisfactorily. Anodes used in nickel plating, may be fused together without flux as the blowholes do not affect the conductivity to any appreciable extent. However, where a weld is wanted free from blowholes, the nickel pieces should be laid on a heavy plate heated bright red or white, and the nickel heated to a bright white with the gas torch. The joint should then be carefully hammered with a light hammer. Previous to heating the nickel should be freed from grease or oil and scraped well back from the weld.

Steel

Steel welding on a commercial scale should never be attempted until after the operator has proved to his own satisfaction that the weld is strong by welding together mild steel plates of ⅛ to ¼ in., sawing them through the weld to make sure that the material is really bonded and testing them by bending back and forth in a vise.

Steel melts at 2500 to 2700 deg. F. When molten it is not extremely fluid. At dull red heat it begins to oxidize rapidly. The oxide, which melts at a temperature of several hundred degrees below that of the metal, remains at the surface and can be easily removed. A flux is not necessary, although some welders use a little borax. Close attention must be paid to the removal of the oxide, however, for its presence is very harmful. It is a common fault to have layers of oxide in the weld, which cause a laminated structure that weakens it.

Steel does not melt rapidly. It gradually comes to fusion, confined to small areas. Because of this, the weld is made up of small overlapping layers. The strength of the weld depends greatly on the thorough bonding of these layers to each other and to the beveled edges of the piece being welded. It is a common fault to force the metal ahead of the welding area and allow it to adhere to the cold sides of the beveled edges.

A welding rod of over 99-per cent. pure iron wire is commonly used. Occasionally a nickel-steel rod is used with good results on such work as crankshafts. A mild-steel rod is particularly satisfactory on steel castings.

Thickness of Steel	Diameter of Welding Rod
⅛ in.	1/16 in.
¼ in. to 3/16 in.	⅛ in.
¼ in. to ⅜ in.	3/16 in.
½ in. and up	¼ in.

Steel is very sensitive to the welding flame. An excess of acetylene tends to carbonize the metal; an excess of oxygen tends to oxidize. Therefore, a neutral flame should always be used and should be tested frequently in order that it be kept in proper adjustment.

Failures due to expansion and contraction are not numerous, because of the toughness and strength of the metal. If expansion and contraction are not properly taken care of, however, warping and buckling will surely take place, and internal strains will exist in the weld.

These can be avoided by properly setting up the work and with proper preheating methods.

The strength of a steel weld can be improved by mechanical treatment. Hammering is the most common method employed. After the welding has been completed, the entire weld should be heated to a bright red heat, and the hammering carried on at this temperature. If the hammering is done at a lower temperature, the weld will be weakened instead of strengthened.

The welder should always keep in mind that the higher the percentage of carbon in the steel the greater is the danger of burning the metal, with its consequent weakening effect.

Steel castings should be handled in a manner similar to cast iron. They may be preheated and prepared in the same way. Cast steel as a rule has a percentage of carbon between that in mild steel and grey cast iron. As a filler, good results will be obtained if cast bars of the same material are used. If not available, use vanadium steel or Norway iron filler.

While little work is done in welding high carbon or hard steel, the following instructions are given as a guide to the operator in case of necessity. Parts should be prepared for welding as for wrought iron or steel. Use a larger tip than for the same thickness of mild steel. For filling material where the parts are to be hardened, use ordinary drill rod. Drill rod is a hard steel which is used by tool manufacturers in the manufacture of drills, reamers, etc. Ordinary mild steel cannot be tempered and this is often necessary when high carbon or hard steel parts have to be welded. Employ cast-iron flux. Execute the weld very rapidly as there is a tendency for the metal to burn easily and also to decarbonize; that is, to burn out the carbon, leaving the metal in poor condition. A very slight excess of acetylene in the welding flame may be advantageous.

To weld high-speed steel to ordinary machine steel, the end of the high-speed steel to be welded must first be heavily coated with soft special iron. It can then be welded to ordinary machine steel without burning, but it takes an experienced welder to make a good weld of this kind.

Special Steels

There are many special or alloy steels used in the metal industry. The operator is often called upon to attempt welding on these. Many automobile and locomotive parts are made from special high-carbon steels, and often these castings or forgings undergo, during manufacture, special heat-treatments which are in many cases more or less of a secret process. It will be appreciated that welding with a high-temperature flame must necessarily counteract the effects that were produced by the heat-treatments, consequently, to make the part efficient it is essential that after welding, the piece be properly heat-treated by an operator skilled in such work. The services of such a man are rarely available, therefore, the results obtained when welding high-carbon alloy steels will be uncertain. Fortunately, however, many of the alloy steels used in practice are not high carbon and can be welded satisfactorily.

Manganese Steel (low carbon) is welded quite readily. The manganese acts as a deoxidizing agent; that is, it counteracts the effect of burning the metal. If possible, use a filling material of the same composition as the part welded. If this cannot be obtained use Norway iron.

Nickel Steel (low carbon) can be welded without difficulty in exactly the same way as mild steel, but nickel-steel filling rod must be used.

VANADIUM STEEL (low carbon)—This is probably the most commonly used steel alloy. Very fortunately it is extremely easy to weld, and flows much more readily than ordinary mild steel. Weld as mild steel, but use vanadium-steel filler.

CHROME STEEL is in the class of mild or low-carbon steel and can be welded readily. Weld as mild steel. Use a chrome-steel filler. Many chrome steels, however, are in the high-carbon or hard-steel class.

WROUGHT IRON may be easily welded without a flux though a little borax or other flux is sometimes advisable. The same general rules apply as for mild steel.

GALVANIZED IRON cannot be welded, since the iron is covered with, and to a greater or less extent impregnated with, a lower melting metal.

GERMAN SILVER, in many cases, is considered unweldable, due to its absorption of gases. For practically all commercial purposes, it may be bonded, using the same flux as for brass and a strip of German silver for the welding rod. Especial care must be given to expansion and contraction.

WHITE METAL CASTINGS used for die molded purposes usually are composed of aluminum, tin and zinc in varying proportions, but nearly always with the lower melting metals in the larger proportion. While the castings have a good deal the same appearance as aluminum, they are considerably heavier. They may be considered unweldable.

SILVER acts very similar to nickel and should be welded in the same way by heating and hammering. However, soldering usually answers all purposes.

GOLD welds very easily and the pure melting process is all that is needed.

Germany's Industry Recovering

SPECIAL CORRESPONDENCE

In a recent speech, the German secretary of state for trade and industry exhibited the fact that German export has *ad valorem* almost reached the pre-war average. The revival of export commenced last spring and has since then increased at a remarkable rate. This fact is not so much due to the initiative of the Germans themselves, who for the most part have shown no great indication of returning enterprise, as to the foreign buyers. The latter, attracted by the low rate of exchange, have appeared in ever-increasing numbers.

Export sales have been contracted to such an extent that the government, although keenly interested in the increase of export, has assumed strict control of all export with a view to bringing up the prices to the utmost limit permissible with regard to foreign competition. An agio (premium on the exchange of one currency for another) has been placed upon certain kinds of products, reaching as high as 70 per cent. of the home price in the case of machine tools. This procedure is of course not intended to prevent dumping in the interest of foreign competitive industries but simply to exhaust all the possibilities of the situation.

Still it can be said that every article turned out finds willing buyers from almost every country, and if the total of German export is not larger than it is now, it is not the fault of the buyers, nor of the manufacturers. The latter are doing their utmost to increase production, seeing that sales conditions are as favorable as they ever hoped they could be again. They are however sorely hampered by the labor conditions, especially the abolition of the piece rate, the inefficient supply of coal and other raw material.

The coal situation is however slowly improving and in the labor question the manufacturers are regaining confidence. The strike of the metal workers in Berlin is to all appearances the last effort of the radical labor movement. It is meant by both parties to be a criterion of the opposing forces and will no doubt be fought out to the bitter end. It is however the common belief that the employers have the upper hand, that the strike will lead to a settlement of the labor question and open the road to an enlarged activity of German industry.

All efforts are directed to increase the production. A reduction of wages will for a long time be out of the question. Even the predicted defeat of the workmen in the Berlin strike will not make a reduction of wages possible. The cost of production is high and still increasing. The whole German export and in fact the welfare of the industry rests at present on the foundation of the depreciation of German money. If the latter, by credit operations or other financial operations, was allowed to reach a more normal value, German industry would face a catastrophy. The figures in the accompanying table, taken from the machine-tool industry, will demonstrate this fact. These figures denote home market prices. For export an agio is added up to 70 per cent. of the home price, according to the dictates of foreign competition.

	Present German Price	Normal Dollar Equiv. 4.20 M. = $1	Present Dollar Equiv. 25M. = $1
Screw-cutting lathe:			
Medium quality, flat bed, 10 in. swing, 2-ft. bed	3,200 M.	$762	$128
12-in. swing, 3½-ft. bed	5,450 M.	1,295	218
Screw-cutting lathe:			
Good quality, flat bed, 16-in. swing, 3½-ft. bed	10,000 M.	2,380	400
20-in. swing	11,000 M.	2,619	440
Engine lathe.			
With lead screw and feed shaft, V-ways, cheap make, 18-in. x 3½-ft.	8,000 M.	1,904	320
Slotting machine:			
8-in. stroke	7,000 M.	1,667	$280
Shaping machine:			
16-in. stroke	6,000 M.	1,428	240
24-in. stroke	10,000 M.	2,381	400
Automatic screw-cutting lathe:			
¾-in. stock	12,000 M.	2,857	480
Milling machines.			
Plain No. 1 size 8 x 32-in. table	5,000 M.	1,190	200
Universal 12 x 48-in. table	12,000 M.	2,857	480
Turret lathe:			
1¾-in. spindle bore	7,000 M.	1,667	280
Planing machines, 36 in. x 8 ft	19,500 M	4,643	780
Bolt-cutting lathe:			
10 in. x 3½ ft	9,000 M.	2,142	360
Gear-cutting machine:			
Up to 20-in. diameter	25,000 M.	5,952	1,000
Up to 32-in. diameter	35,000 M.	8,303	1,400
Gear generating machine (Fellow's System):			
Up to 32-in. diameter	36,000 M.	8,571	1,440
Plain cylindrical grinding machine:			
16 in. x 3½ ft	12,000 M.	2,857	480

These figures show in comparison to pre-war prices an advance of between 600 to 800 per cent. In no other country have prices risen at the same rate. The export situation of German industry is therefore absolutely dependent on the rate of exchange. Germany's industry is making great strides toward recovery and if the present money situation is allowed to continue she will have an almost unique position on the foreign market. Existing conditions are not expected to last forever, and most people would rather see a better state of the exchange than an unduly inflated export, but there is no doubt that as long as the present conditions last the German industry will strive to utilize them to the fullest extent.

Machining Operations on Die Stocks

By J. V. HUNTER
Western Editor *American Machinist*

This article illustrates and describes the making of large die stocks of the kind that are used for the hand threading of pipe. The jigs used are designed to permit the greatest possible number of operations at one setting.

SOME of the methods used by the Reed Manufacturing Co., Erie, Penn., in manufacturing die stocks for pipe dies, are here shown.

The stocks are made from malleable-iron castings, one of which may be seen in Fig. 1. After the castings are cleaned the first operation is the blacking or japanning, which is done at this stage, so that after the machining operations are finished the machined surfaces, particularly the bearing spots for the dies, may remain clean and free from enamel.

When the japanning is done first it is a simple operation of dipping, while if made to follow machine operations it is necessary either to apply the enamel with a brush or to make an extra operation of scraping the machined surfaces, which operation usually costs more than the machining.

The surfaces *A* are milled with the casting in a horizontal position on the indexing fixture *B*. The narrow cutters *C* finish the die surface completely, passing the lugs *D* without interference, and at the same time the cutters *E* finish the top of lugs *F*. The fixture is capable of being revolved around a central pivot and locates the two cuts exactly 90 deg. apart.

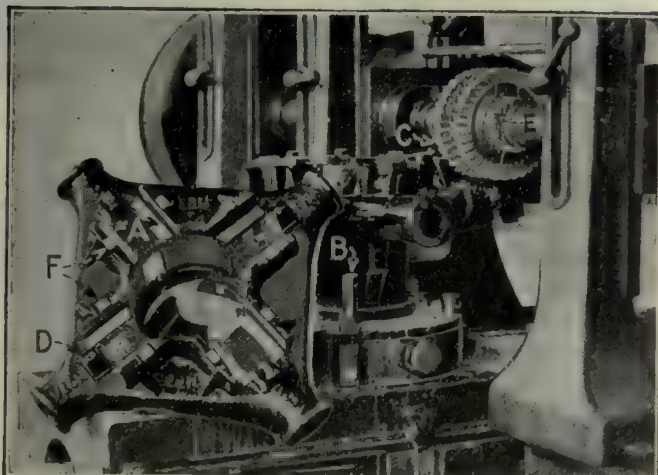


FIG. 1. MILLING THE CHANNEL ON LARGE STOCKS

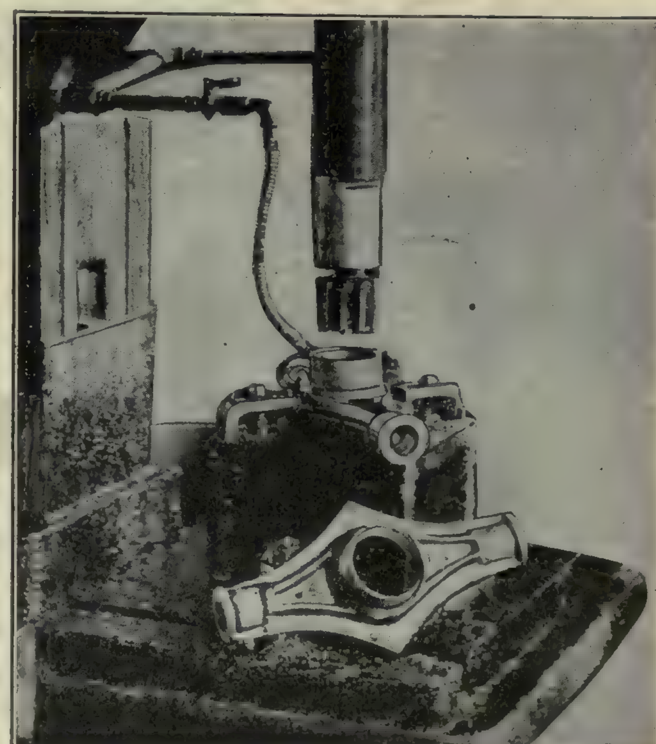


FIG. 3. TAPPING SMALL STOCK FOR SCREWED-IN GUIDE BUSHING

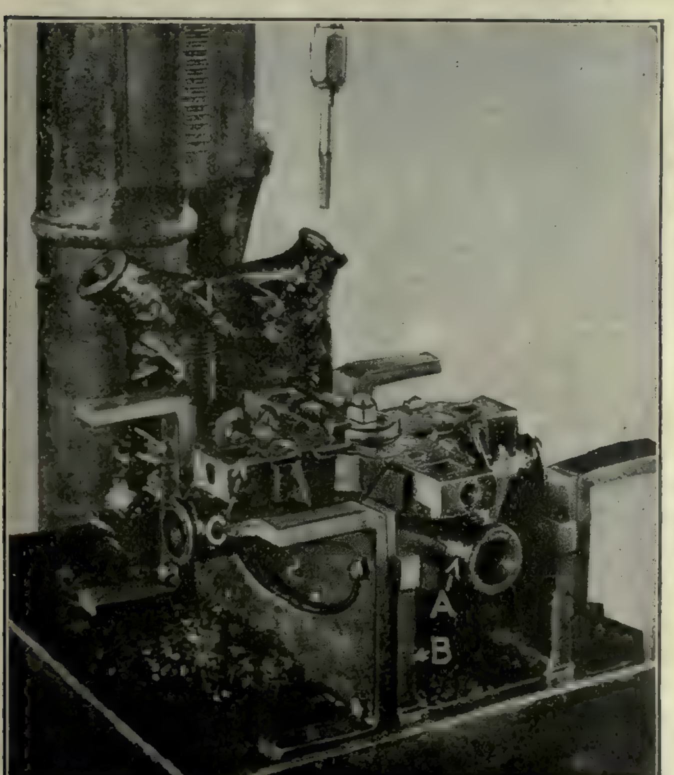


FIG. 2. DRILLING ALL SIDES OF STOCK AT ONE JIG SETTING

The next operation is drilling the sides, which is done in a jig at a single setting. The part *A*, Fig. 2, is clamped in the jig *B*, which has legs on all sides, so that it may stand in six different positions, and drilling operations are performed on five sides. A brace *C* fits into one of the slots which have just been milled to align the work. While in the position shown all holes are drilled and tapped on the face side. The four handle holes are drilled by standing the jig on the four respective sides and are later tapped in a similar manner.

Fig. 3 shows the tapping of one of the smaller sizes of stocks, for the screwed-in die bushing, the work being done on a Colburn vertical drilling machine. A gang drilling machine, Fig. 4, is used for finishing the

outside and reaming the inside of the pipe bushings, or "guides," as they are called by the trade. The hollow head with adjustable cutters for finishing the outside of the guide at the same time that the reamer is finishing the inside, is plainly shown in this illustration. To avoid having a lot of duplicate tools the machine is arranged so that the four spindles are used, each on a different size of guide bushing. The bushings have a groove cut midway of their length, as shown at *A*, Fig. 5, to give a hold for the thumb screw. This groove is cut by the device *B* mounted on the spindle of a vertical drilling machine. The body slips down over the bushing and the pressure forces out a small cutting tool which makes the groove. When the spindle is stopped the spring-operated lever *C* withdraws the tool from the work and permits the spindle to be raised.

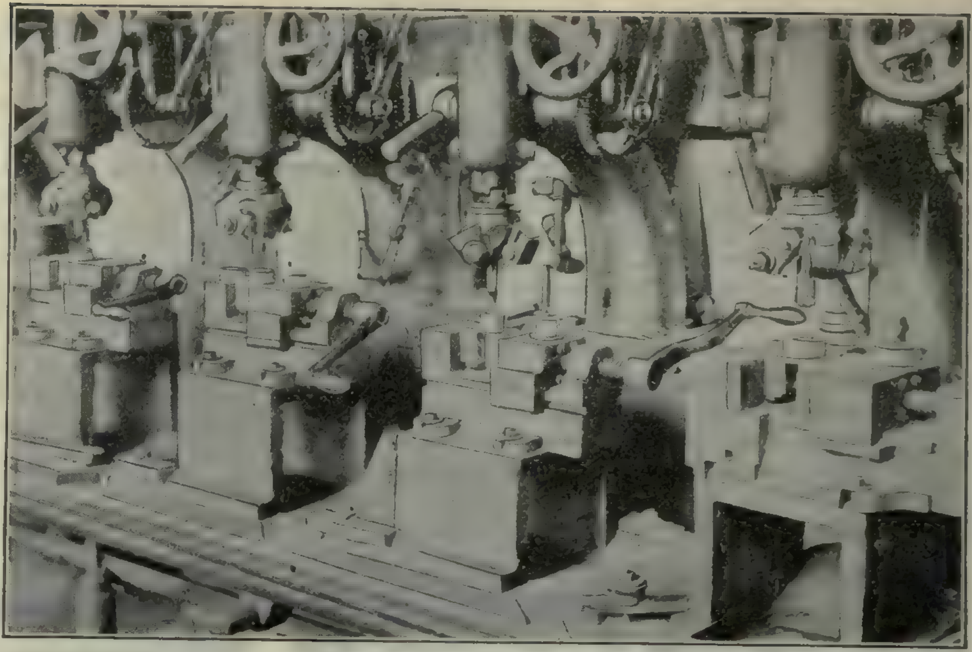


FIG. 4. FINISHING INSIDE AND OUTSIDE OF GUIDE BUSHINGS

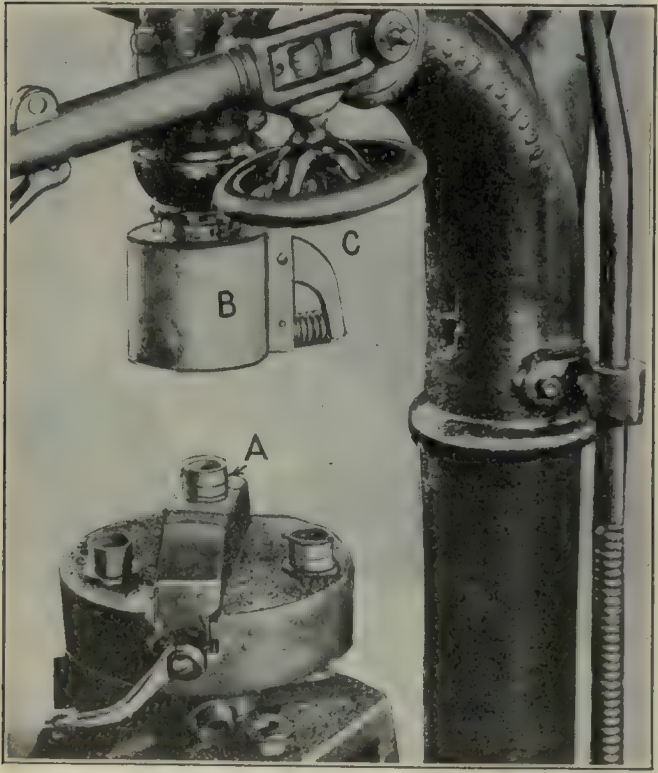


FIG. 5. DEVICE FOR TURNING GROOVE IN BUSHINGS

What's in a Name?

By L. D. Hayes

Professor of Machine Design, West Virginia University

One paragraph of the comment under the above heading, as made by Sandy Copeland and printed on page 816, Vol. 51 of *American Machinist*, is deserving, perhaps, of further attention. There is a great need for a clearer understanding concerning the misuse of the term "spiral gear." It is to be presumed that when this term was first applied to gears it was with no more definite intent than as a descriptive adjective and that this was at a time when no other gear of similar form made a finer distinction necessary.

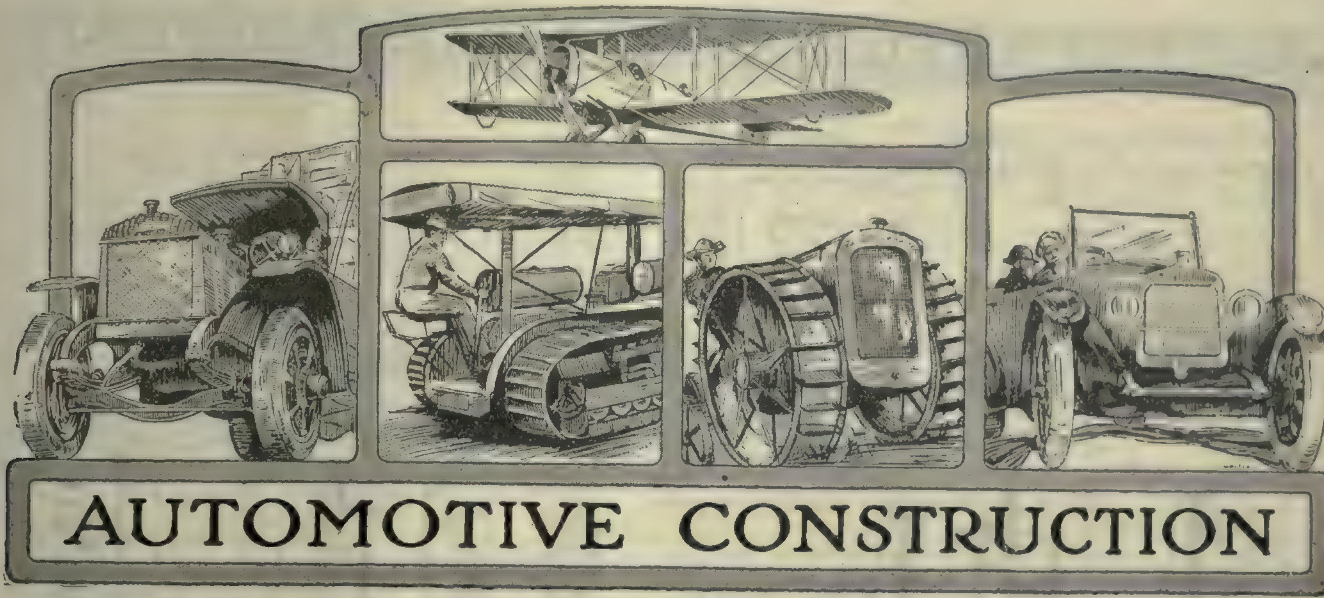
Unquestionably, the dictionaries sanction the use of the word "spiral" as a synonym for the noun "helix" or for the adjective "helical," even though not given as their preferred definition; but modern developments in gearing have made it almost imperative that there should be a more exact naming if endless confusion is to be avoided.

The confusion is greatly aggravated by the fact that a surprisingly large proportion of those using the term speak of a "spiral gear drive" as though no further explanation should be needed, no matter whether it is intended to apply to a pair of twisted, or herringbone, gears on parallel shafts or to a pair of helical gears on shafts which are neither intersecting nor parallel.

It cannot be emphasized too strongly that, even though a single twisted gear and a single helical gear may be identical in appearance and form, the methods of their operation and the theories of their design are wholly different. Only by the abandonment of the general and inaccurate term "spiral" and by the rigid use of the distinctive names "helical" and "twisted" can this confusion be eliminated.

It may be that Mr. Copeland is not quite accurate in saying of "the spiral gear—there 'haint no such animal' " as the writer has a distinct remembrance of a pair of gears, if they may be properly so called, in which the tooth of the driver extended in an Archimedean spiral slightly more than once around on the face of a rotating disk.

The cross-section of this spiral tooth was very similar to the common involute rack tooth profile. The mating gear was mounted on a shaft at right angles to that of the disk and the teeth were radial pins carrying rollers turned to an involute tooth profile. One revolution of the disk and spiral caused the gear to rotate one tooth. If this is not a spiral gear, what is it?



"Caterpillars" and Their Construction—III

By K. H. CONDIT
Associate Editor, *American Machinist*

The transmitting of upward of 120 hp. to a moving track going at a rate of three miles an hour over any sort of ground requires gearing and bearings not only rugged but accurate, and the controlling of such a mechanism presents problems with an individuality all their own. Steering automotive vehicles by means of the transmission is somewhat unusual. (Part II appeared in Jan. 1 issue.)

MANY an inexperienced automobile driver has involuntarily attempted to make his mount climb a tree, but the records show that in the vast majority of cases the tree had the better of the argument. It is a very different matter when a "Caterpillar" or a tank undertakes the same maneuver. The 120-hp. Holt "Caterpillar" can exert a drawbar pull of 15,000 lb. and naturally has a front-end push of about the same figure. Is it any wonder that stone walls and houses couldn't stop the tanks? As to trees, well, the sight of a Caterpillar mounting a good sturdy sapling is one to be remembered. If the sapling is very flexible the tractor ambles up to it, hesitates a moment as it hits the trunk and then begins to rise up on its hind legs, so to speak, until its weight bends the tree to the ground. Then it proceeds calmly along its recumbent adversary until it gets clear on the other side, when the tree, if it is limber enough, springs back to position somewhat the worse for wear. If it is not limber it is quite apt to lie flat at the first push and stay that way.

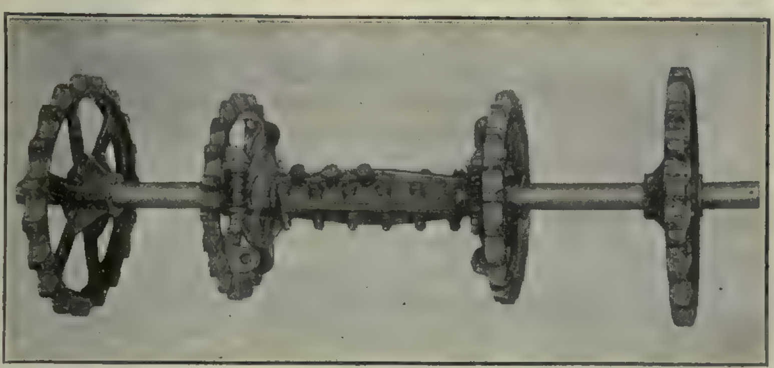


FIG. 17. MAIN DRIVE SHAFT

Although the maximum speed of the engine in the 120-hp. Holt is only 550 r.p.m., scarcely a quarter that of the average automobile motor, the maximum speed of the tractor itself is so much less than that of the car that a double reduction must be employed. The method of driving the chain track by a rear sprocket has been taken up in a previous article and it is now the intention to follow the transmission details up to the source of power.

Power is delivered to the track-driving sprocket through the main drive shaft or sprocket shaft shown assembled in Fig. 17. In this cut, the outer sprockets drive the track and are keyed to separate shafts joined by the long coupling shown which is used instead of a differential gear arrangement. The line drawing of this assembly in Fig. 18 gives a clearer idea of the coupling device. The ends of the two shafts are reduced to form collars which fit inside a bronze split bushing *A*, called the tension coupling. This prevents end play and the outer part of the coupling, called the center truss, provides the necessary aligning support. The center truss is made in two halves which bolt together. In Fig. 18 the left-hand part of the center truss is set up tightly on the left-hand drive shaft while the right-hand part is bored out enough to accommodate a cast-iron bushing in which the right-hand drive shaft is free to turn. The bushing is located by dowels to insure alignment of the grease-cup holes in poth parts.

Motion of the main drive shaft is produced through the first-motion chain, right and left chain drive sprockets and right and left spring drivers. These parts, except the chain, are shown in Fig. 19. It will be seen that the sprockets are free to turn on the shafts and impart their motion to the spring drivers through heavy coiled

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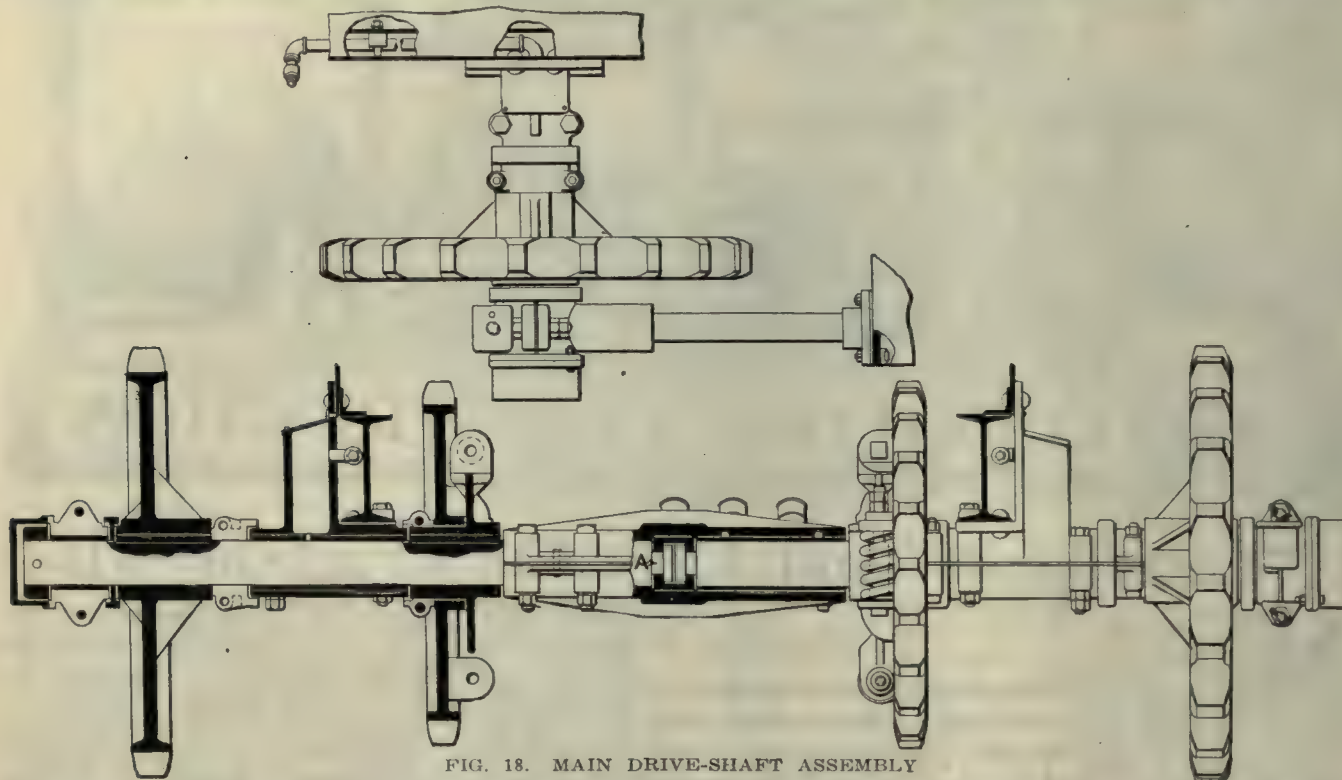

FIG. 18. MAIN DRIVE-SHAFT ASSEMBLY

springs for forward motion and through the bolts for reverse motion. Close adjustment of the bolt length is thus necessary. The spring drivers are a tight driving fit on taper keys. The shaft turns in four babbitt bearings of which more will be said in a later article.

The first-motion chains, one of which appears unlinked in Fig. 20, are driven by small sprockets with seven teeth. As there are 20 teeth on the chain drive sprockets the reduction at this point is practically three to one. The large wheel with bevel teeth on one side of it in Fig. 20 is the bevel gear and the plain wheel to the right of it is the friction wheel.

Inside of each of these wheels is a friction spider carrying two friction shoes which act as expanding clutches and permit either track to be driven independently. The result of releasing one of the frictions is of course to turn the tractor to that side. The need for a divided axle is obvious.

The details of the friction-shaft assembly are shown in Fig. 21, and Fig. 22 shows the friction spider and shoes removed. The shoes are faced with asbestos brake lining and prevented from shifting side-wise by the keys shown at *A* and *B*, Fig. 21. In Fig. 21 it will also be apparent that the two large friction wheels are rigidly attached to each other by the flanged coupling *C*, and that they turn with their shaft and the capstan pulley on the end of it, the small sprockets and friction spiders turning only when the friction shoes are engaged. These wheels are steel castings about 4 ft. in diameter and are bored and turned in a battery of Bullard Maxi-mills. The teeth on the bevel gears are cut in Gleason gear-shaping machines, two of which

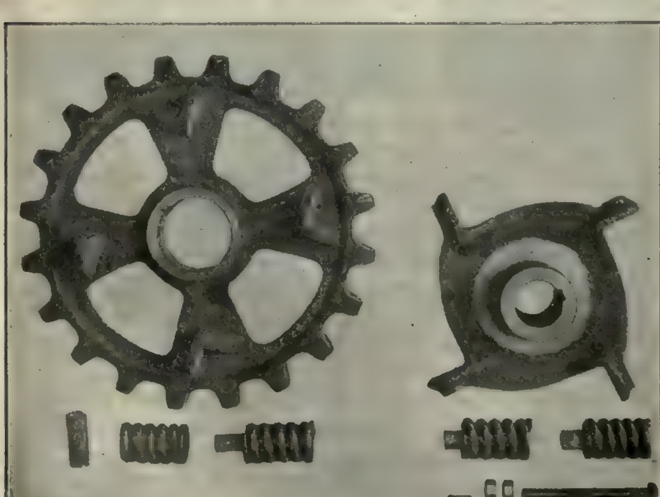

FIG. 19. SPROCKET AND SPRING DRIVER

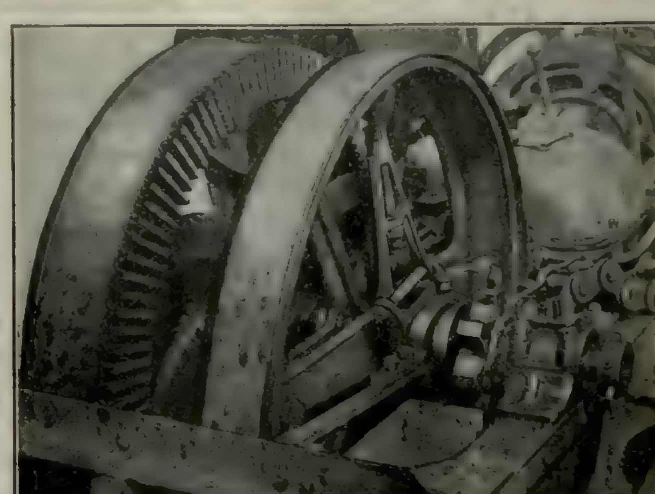

FIG. 20. FRICTIONS IN POSITION

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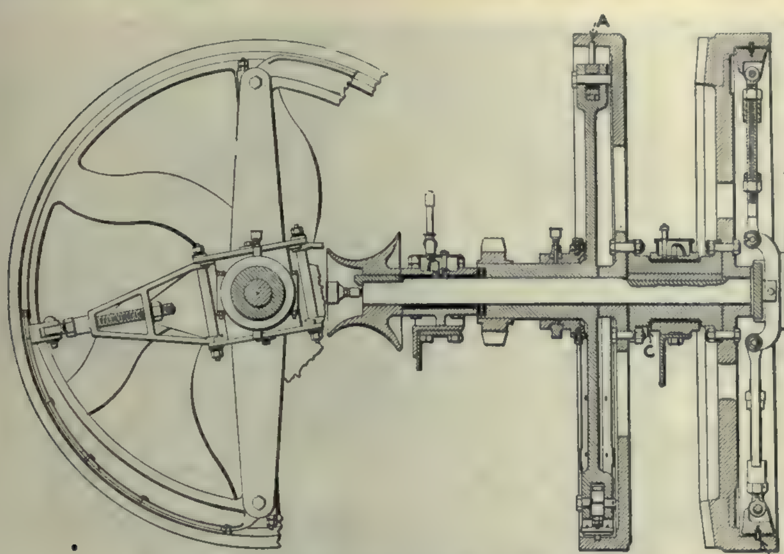


FIG. 21. FRICTION-SHAFT ASSEMBLY

are shown in Fig. 23. The average time for cutting the 106 teeth on one of these gears is 20 hours.

The 106-tooth bevel gear is driven by a 13-tooth pinion which is shown at *A*, Fig. 24. On the same shaft are two other gears, *B*, which is keyed on, and

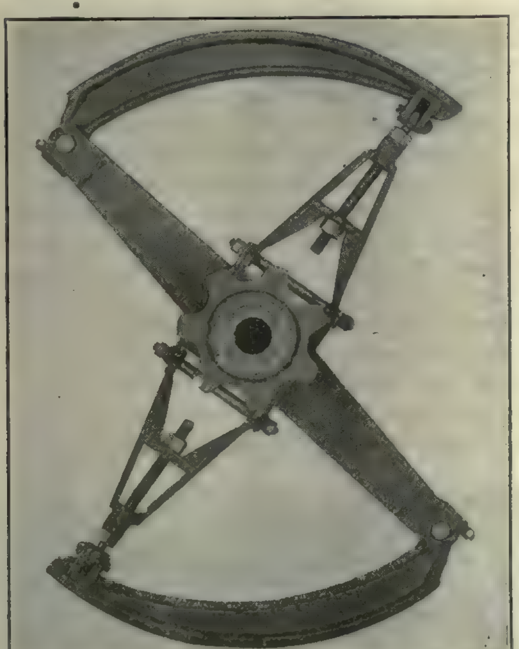


FIG. 22. FRICTION SPIDER AND SHOES

C which is bushed and free to rotate. The line assembly of the transmission given in Fig. 25 brings out these details somewhat better and shows the long tubular shaft integral with *B*. A jaw clutch *D* is mounted on two feather keys at the forward end of this shaft which ends at the face of the bevel gear *E*. Meshing with *C* and *E* is a bevel gear *F* keyed to the pulley shaft and performing two functions, that of acting as reverse idler and that of driving the power pulley on the outer end of its shaft. This pulley is used for driving all sorts of stationary farm machinery but is omitted from the army machines as shown in Fig. 25 where a shorter shaft is used and the end of the bearing is capped.

In front of *E* on the clutch shaft is a spur gear *G* which is keyed fast and drives the gear *H* on the countershaft. This gear is keyed on but the gear *J* on the other end of the countershaft is bushed and free. The jaw clutch *K* is carried on two feather keys.

With the engine running and the master clutch in, gears *C*, *E*, *F*, *G* and *H* are always in motion but not necessarily all working. Direct drive ahead at 2⅛ mi. per hr. is obtained by shifting *D* into mesh with *E*, thus locking the clutch shaft and the main transmission shaft together and furnishing a straight-line drive from the engine to the large bevel gear on the friction shaft. Reverse at the same speed is obtained by shifting *D* into mesh with *C*, thus locking *C* to the shaft on which it otherwise runs freely, and driving the main transmission shaft in the opposite direction from the clutch shaft through *C*, *E* and *F*. A high speed of 3 mi. per hr. can be obtained by leaving *D* out of mesh and meshing *K* with *J* in which case the drive will be through *G*, *H*, *J* and *B*.

The transmission gears are machined in Barber-Coleman gear-hobbing machines and hardened and heat-treated. The transmission cases are finished on an Ingersoll horizontal milling machine as shown in Figs. 26 and 27. They are held in special fixtures supplied by the Ingersoll Co. and enough fixtures are used to fill the table of the machine. Four of another type of

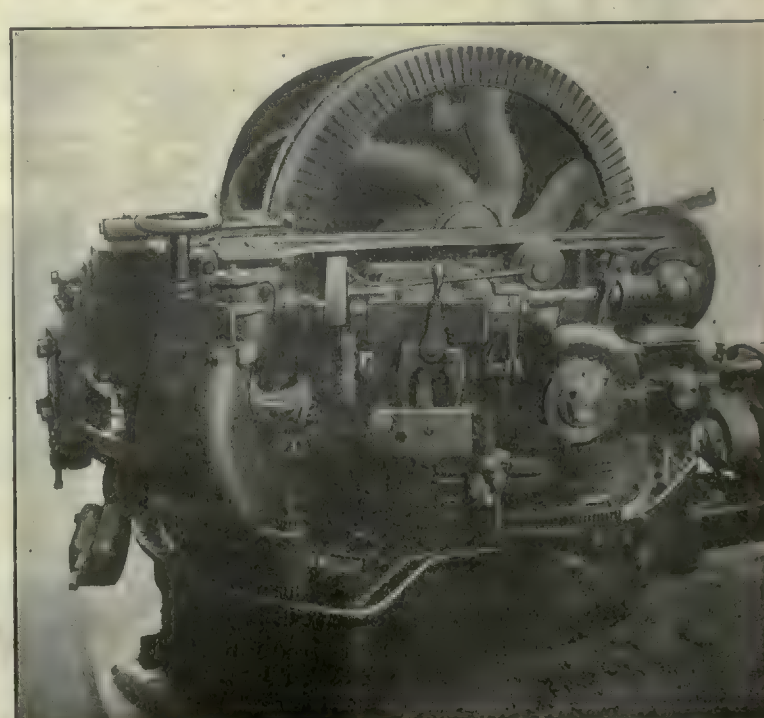


FIG. 23. MACHINING LARGE BEVEL GEAR

transmission cases can be set up at once. In this type the horizontal cutter spindles are also used instead of the vertical ones only, as illustrated. Special fixtures for this transmission case were also furnished by the Ingersoll people.

The motor is connected to the transmission by the master clutch shown in Fig. 28. The clutch is of the dry-disk type and is made up of two

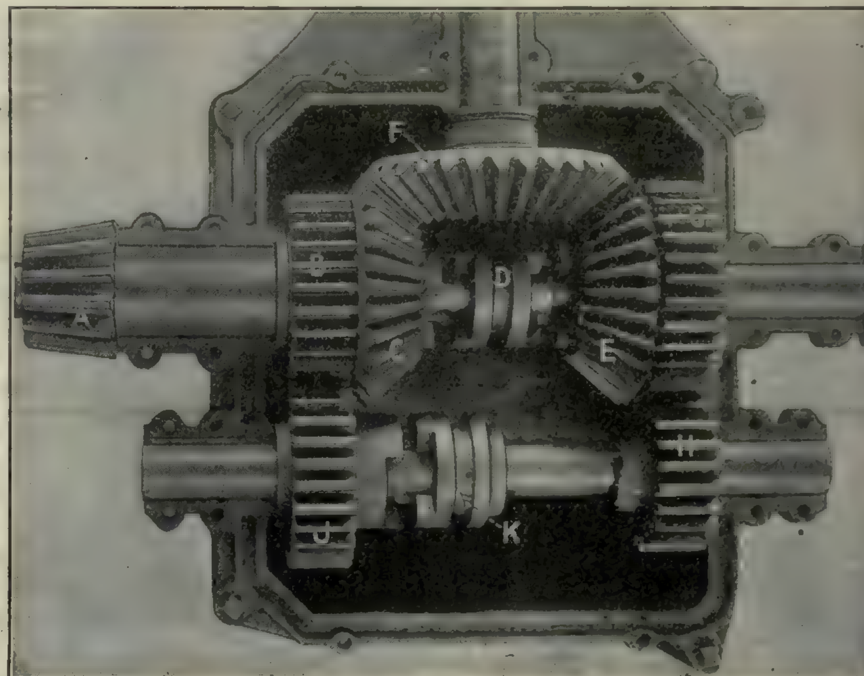


FIG. 24. TRANSMISSION IN NEUTRAL

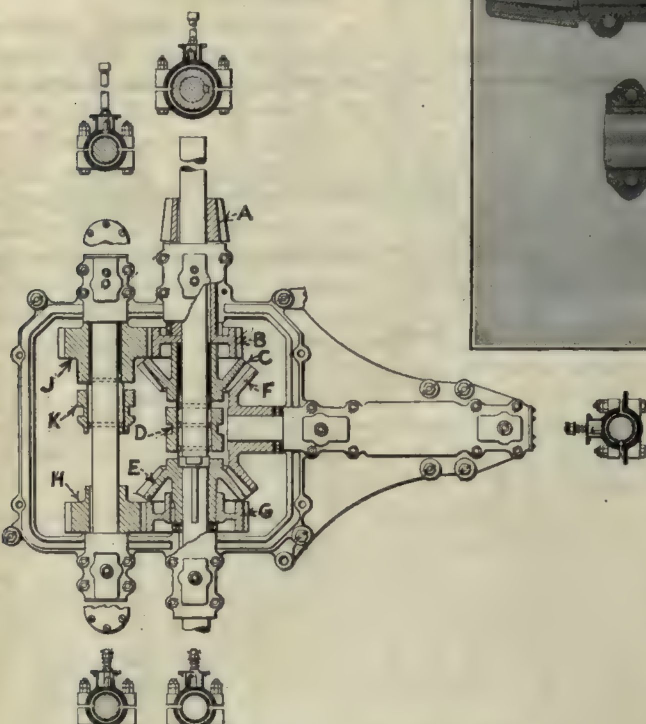
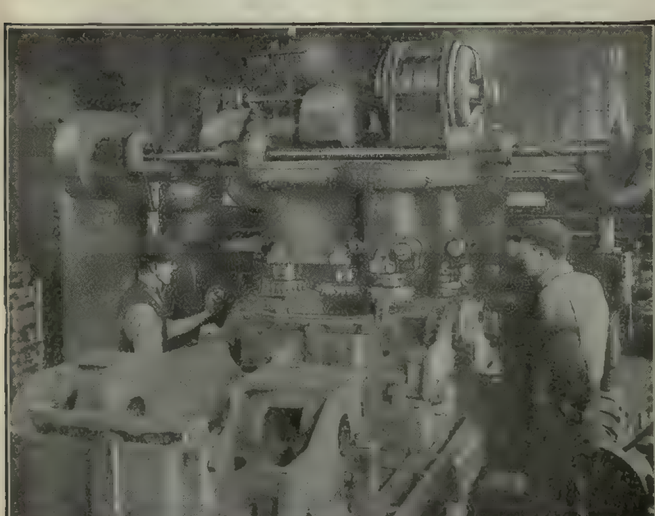


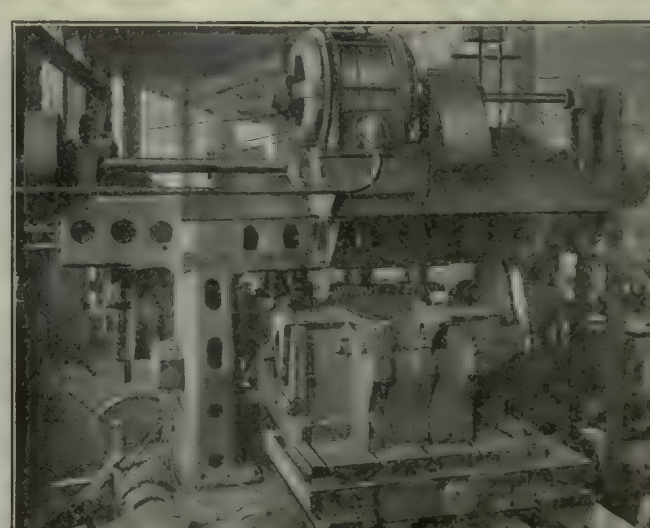
FIG. 25. TRANSMISSION ASSEMBLY

bronze and three cast-iron plates engaged through a linkage operating three dogs. Instead of the customary clutch foot-pedal with spring-operated releases, the control is by hand lever with positive action in both directions. Clutch-plate holes are drilled in a Harrington multiple-spindle drilling machine and most of the other machine operations on these parts are performed in Bullard vertical turret lathes.

The control arrangements of these big tractors look decidedly complicated to the layman as a separate lever is used to work each part instead of grouping the functions in one controller. This separation of controls might not work in a vehicle which traveled at high speeds but in these tortoise-gaited contrivances it answers very well.

As stated above one hand lever operates the clutch-shifting collar and permits the driver to fix his clutch in either "in" or "out" position. The master clutch is ordinarily used to start and stop the tractor, but in very bad going it is sometimes easier to get started by leaving the





FIGS. 26 AND 27. MILLING FIXTURES FOR GEAR CASES (FRONT AND REAR VIEWS)

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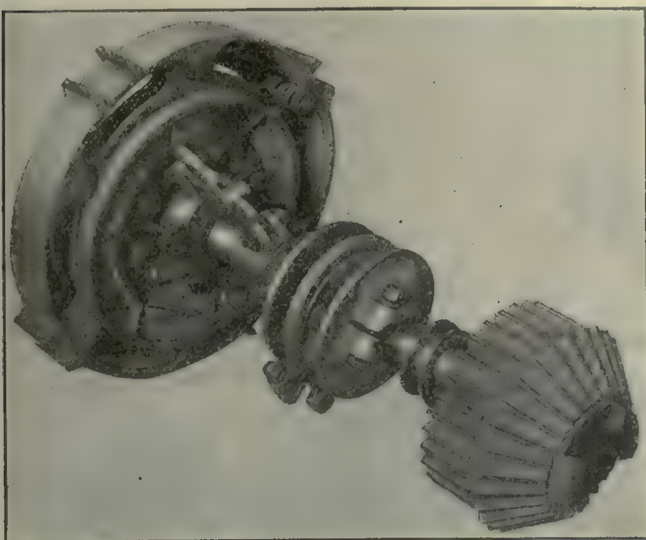

FIG. 28. MASTER CLUTCH ASSEMBLY

master clutch in and applying the power through the frictions previously described. This use of the transmitting units, while harder on the mechanism, increases the flywheel effect by adding the weight of the heavy friction wheels to the rotating mass and reduces the chances of stalling the engine. The frictions are controlled by separate levers so that either track can be driven independently to aid in turning the machine. Ordinary steering of the "75" and "120" is done by turning the front wheel by means of the steering wheel and column, but when the tractors get in bad places this method often becomes useless particularly if the front wheel leaves the ground as often happens when the surface is uneven or the pulling hard. Then the two friction levers are used to steer with and afford complete control.

In the smaller machines the front wheel is not used

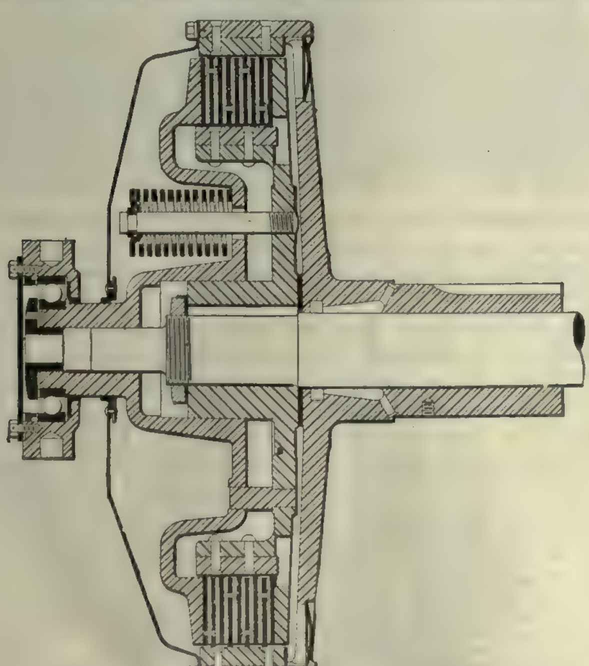

FIG. 29. STEERING CLUTCH OF 10-TON MODEL

and the rather clumsy-looking frictions are replaced by steering clutches like the one shown in Fig. 29. These clutches are connected to the steering column so that they can be released independently by a small movement of the control handle and allow the driver to turn one of these machines in its own length with ease. This quick turning ability and the absence of wheels make the smaller caterpillars look like some queer kind of animal instead of a man-made vehicle and this impression is heightened when one of them gets in very uneven ground and starts climbing around where no self-respecting wheeled contrivance would ever go—and come back.

The gears are shifted by means of a conventional shifting lever mounted on the transmission case cover which slides the dog clutches mentioned above. The remaining lever is equipped with a pawl and ratchet and works the single brake which is an asbestos-lined contracting band surrounding the plain friction wheel.

This all sounds rather complicated but it isn't so bad for the driver doesn't have to work anything with his feet and not more than two levers at any one time with his hands, wherein he has the advantage over the chauffeurs and organists.

The next article deals with the power plant of the 120-hp. tractor, one of the largest mobile gas engines built.

Machining and Testing a Large Transmission Case

By Fred H. Colvin

The transmission case of the Pierce-Arrow car presents a number of problems both in machining and inspection, as can be seen from an examination of the case itself as shown in Figs. 1 and 2. The work contains considerable boring and counterboring, all of which must be held within very close limits. This, as will be seen, involves drilling the small hole at *A* in line with the hole *B* Fig. 2, for which a special support is provided in the boring fixture at *A*, Fig. 3. This arm swings down inside the case and guides the drill

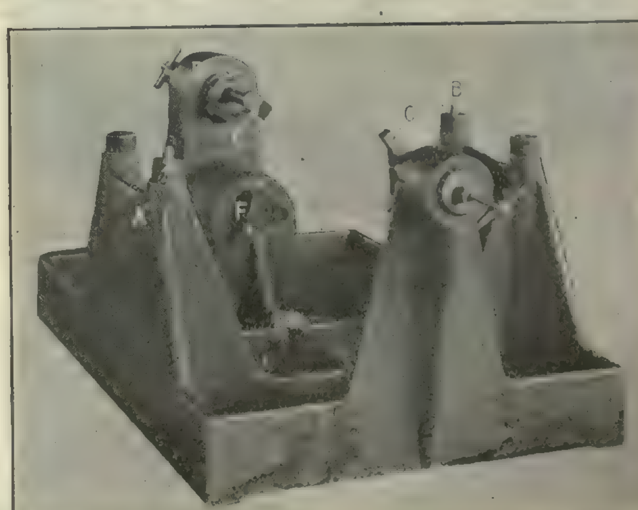

FIG. 4. THE FIXTURE FOR MEASURING COUNTER-BORED HOLES

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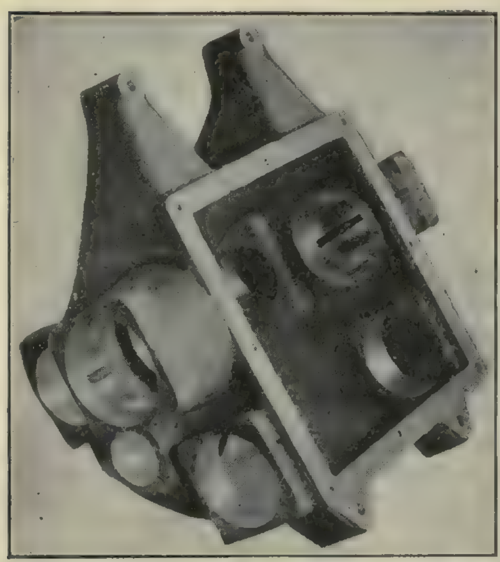

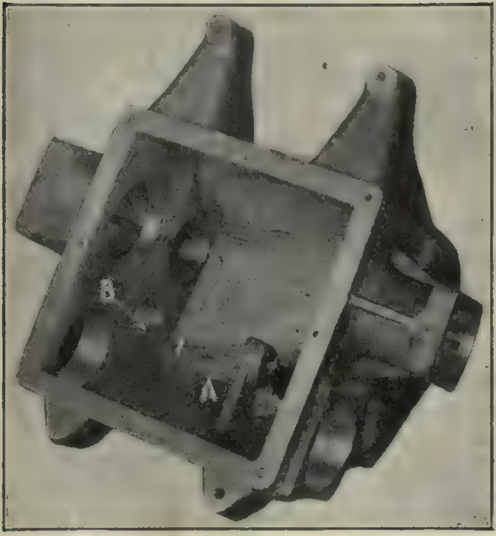

FIGS. 1, 2 AND 3. VIEWS OF TRANSMISSION CASE SHOWING PARTS TO BE MEASURED, AND HOW CASE IS BORED

which reaches in through the hole at *B*. The outer end of this hole is shown being faced by the bar *C*.

The fixture for testing the depth of the various counterbores is shown in Fig. 4, while Fig. 5 gives the essential details of this fixture and shows how the work is placed in it for inspection.

The transmission case is supported on the four uprights having two dowels *A* which must be within 0.002 in. of the same height and within 0.005 in. of the center line. When the case is placed in position, the depth of the various counterbores are measured by the plungers *C*, *D* and *F*, and the hook *E*, as can be seen in Fig. 5. The various measuring plungers are well supported also, and are easily used by means of the cross handles attached to the outer end in each case.

The measurements are determined by means of the

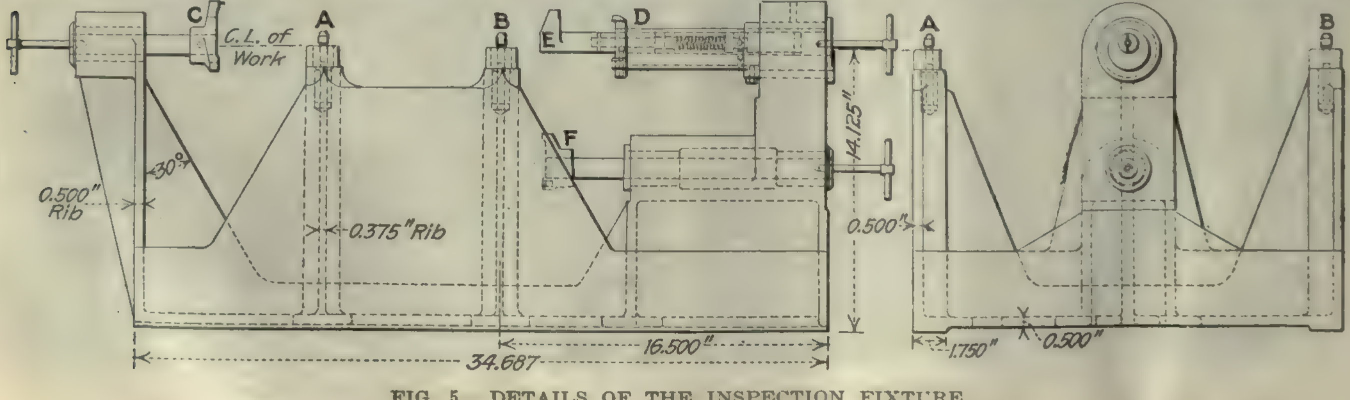

FIG. 5. DETAILS OF THE INSPECTION FIXTURE

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very common form of "steel" gage in which one-half of the end of the plunger is ground down the amount of the tolerance between the high and low limit. In the case of the measuring surfaces *D* and *E*, it will be noted that both the inner and outer shoulders must be measured, the tolerance being a thousandth plus or minus.

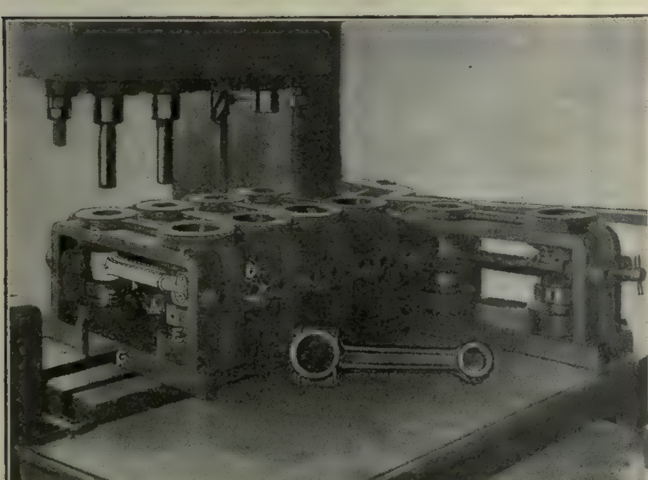
To accomplish this, the measuring plunger carries both the triangle *D* and the hook *E*, which are so located with regard to the center of the plunger that when swung down the point will clear the hole for insertion and removal. With the plunger pushed into place, the hook is then swung up into the position shown so that it not only gages the depth of the outer counterbore but also the distance between the two shoulders.

This makes a very substantial fixture and one which can be used easily and rapidly for work of this kind. It is the product of the tool designing department of the Pierce-Arrow Motor Car Co., Buffalo, N. Y.

Unusual Connecting-Rod Fixtures

By I. B. Rich

The Autocar Co. makes its connecting rods in the usual way, with the exception of a few operations. The rod itself is very substantial, as can be seen in the illustration, and the method of drilling the large and small



A METHOD OF USING SINGLE FIXTURES IN SEQUENCE

ends is somewhat unusual. Five connecting-rod fixtures are shown, four bunched together under the drilling spindle and the fifth removed to show how each one is handled independently of the rest. The rod *A* fits up against the under part of the bushings *B* and *C* while the screw *D* centers the rod by the two bosses and also clamps it before the drilling operation actually begins. The rod is held up against bushings *B* and *C* by means of the hollow jackscrews *E* and *F*.

A fixture with a rod in place is put under the right-hand spindle and the hole rough-drilled, this being the first operation. The fixture is then moved toward the left, and a second fixture put in its place under the first spindle. The rough-reaming of the first rod and the rough-drilling of the second rod takes place simultaneously during the next operation.

Then a third fixture is put in place and each of the others moved one position to the left. Here the first rod is finish-reamed, while the second is being rough-reamed and the third rough-drilled. In this way all the fixtures move down one place until they touch the stop *G*, which is the last position. After this the other end of the rod is bored the same way on an adjoining machine.

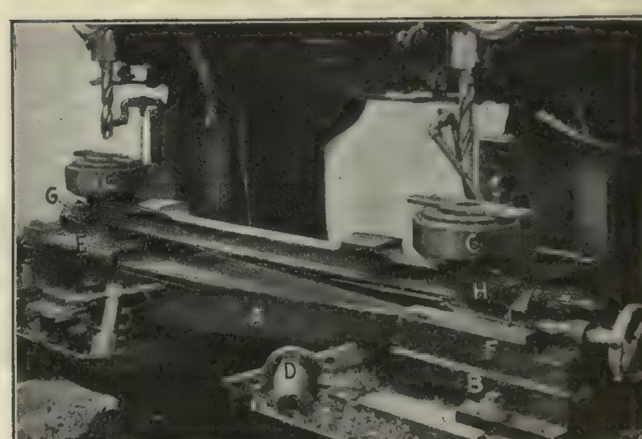
After the second end has been bored and reamed, the rods are removed and the empty fixture goes back to the starting point to receive another rod, which will then go through the same series of operations. These fixtures are easily handled, as they can be readily slid against the stop *G* after the end fixture is removed.

Drilling the Ends of Motor-Truck Axles

By Frank C. Hudson

The fixture used in drilling the ends of the front axle for a Pierce-Arrow truck is illustrated herewith. In this type of axle the yoke is made part of the steering knuckle, making the drilling of the axle an easier problem than when other designs are used. Two Colburn heavy-duty drilling machines are mounted side by side on a heavy bedplate with the spindle centers the proper distance apart. The drilling fixture consists primarily of the heavy bed plate *A* having one end bolted rigidly to the table of the machine at the left. The other end rests in the cradle *B* for convenience of construction.

The body of the fixture carries two heavy bushing supports, as can be seen at *CC*. These carry the drill



FIXTURE FOR DRILLING AXLE ENDS

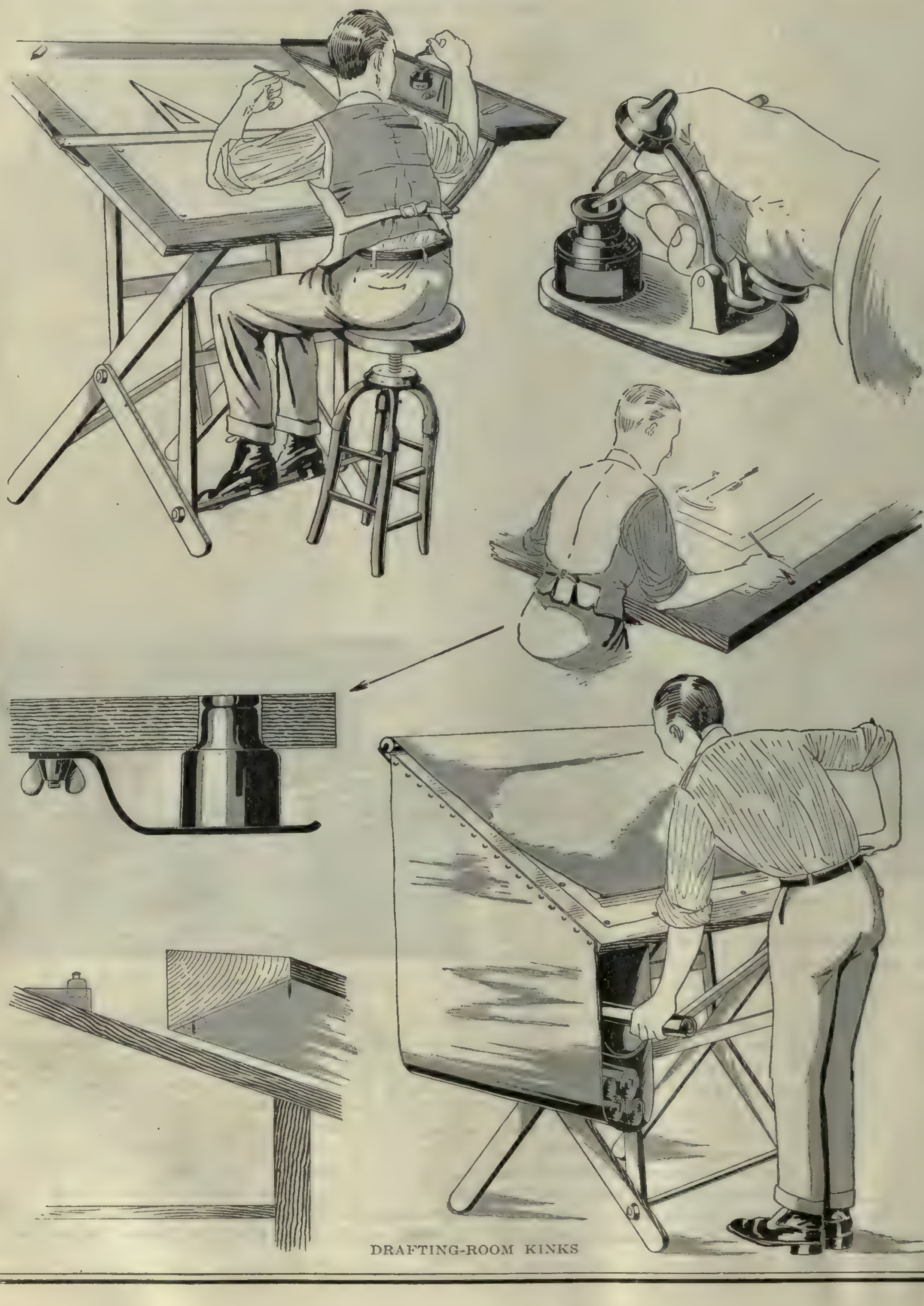
bushings or guides, which are removable, as seen at *D*, in order to allow for reaming at the same setting.

The clamping heads of the fixture *E* and *F* are both adjustable in order to compensate for permissible variations in axle forgings and to divide up any discrepancy instead of having it come all at one end.

The axle is located by two V-blocks *G* and *H*, the former being bolted to the block *C*, while the latter moves in a slide under control of the handle *I*. By this means the slide carrying the V-block can be readily moved so as to either clamp or release the end of the axle.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS

Contracts and Contractural Relations

(Part II—Continued)

By CHESLA C. SHERLOCK

WE HAVE already touched upon the matter of entering into contracts by mail. Insofar as they apply to acceptance of an offer by mail, there is not a great dispute among the courts as to the rules of law governing. It is agreed that a valid contract can be made by mail; that the offeror is deemed to be constantly repeating his offer until the offeree has had a reasonable time to reply to it and that unless the offeree avails himself of the opportunity to accept the offer within a reasonable time that he is deemed to have rejected the offer. When the offer provides that it shall be accepted by return mail, no acceptance is valid unless it is by return mail.

As in other instances, the offer stands, unless revoked before acceptance, for a reasonable time. Where it is limited, that limit is, of course, the measure of a "reasonable time."

The offeror has the right to revoke his offer at any time. The question naturally arises, where an offer has been accepted while a withdrawal is in the mails on the way to the offeree, which controls, the acceptance or the withdrawal?

When Acceptance by Mail Becomes Effective

Our courts have adopted the rule that acceptance by mail takes place as soon as the offeree has deposited his letter of acceptance in the post office and that unless the notice of withdrawal has reached him prior to this time, that he can hold the offeror to the terms of the contract. Unless the withdrawal of the offer reaches the offeree before he has mailed his acceptance, it has no more effect than if it had never been mailed.

It should be noted that it is immaterial whether the letter of acceptance ever reaches the offeror or not. All the offeree has to prove is the posting of the letter containing the acceptance. Much confusion and much litigation arises every year simply because business men suppose that it is necessary for the acceptance to reach the offeror to be binding upon him, or else are of the opinion that if acceptance takes place on the posting of the letter, that revocation also ought to be accomplished by the same method. It is impossible in this discussion to enter into all the complex situations which may arise in the acceptance of contracts. For that reason we are reducing to as short statements as possible the rules of law on each case and are refraining as much as possible from reference to the lengthy decisions contained in the reports. Where rules of law are practically uncontested, it is unnecessary to quote authorities.

Hence, while there are many situations which may arise in the case of offers and acceptance by mail, telegraph or telephone, we are passing them up. The general principles already mentioned apply in most cases.

Where contracts are agreed upon and the parties further agree to enter into a written contract, it is interesting to know whether the contract has already been made, or whether it is not completed until the matter has been reduced to writing and duly signed by the parties. This is a question which cannot be answered off hand, for its solution will depend largely upon the circumstances surrounding each case.

Where the contract has, to all intents and purposes, been entered into but is to be reduced to writing merely for the convenience of the parties, it is formed at the time the meeting of the minds of the parties occurred; if it is agreed to sign a contract in writing at some future time along certain lines agreed upon and it is evident from the action of the parties that they do not contemplate the contract as being yet in existence, then it does not arise until the written instrument is signed.

The Completion of the Contract

And one of the most important things in the whole law of contracts is to know just when the contract was completed. This is particularly valuable to business men, for oftentimes they imagine that valuable contracts have been completed when, in point of fact, they have not been completed at all and will not be until the parties get together at some future date. In the interval, the other party changes his mind, denies that he entered into a contract and our business man loses a valuable contract besides involving himself in expensive litigation.

Even though both parties may in fact agree to the matter, there is no contract where there has been a mutual mistake of fact as to what the subject matter of the contract was. Where the parties honestly believe that they are entering into a contract about machinery, for instance, when as a matter of fact they are entering into a contract about raw materials, there can be no valid contract because there was no meeting of the minds upon the matter.

A mistake of fact will not always avoid a contract even where it has been honest on the part of the parties. It must be a material fact, one going to the root of the whole agreement in order to have this effect, for the courts are not disposed to aid in the search for flaws to avoid a contract, and they would rather abide by the expressed terms of the written instrument, as evidence of the true intention of the parties, than to speculate on side issues. But where there has plainly been a mistake of fact material to the agreement, the contract will be set aside.

An example of this class of contracts may be given where there is a mistake of fact as to the existence of the subject matter of the contract. The parties may contract about a certain lot of second-hand machinery, but the machinery may even then be in the process of being destroyed by fire. In such case, there is no contract.

In the case of a unilateral mistake of fact, however, the contract is not avoided. Where one party makes a mistake, while the other party has acted in perfect good faith and innocence, the contract is not void, but in full force and effect on the part of the parties, except where it amounts to an injustice to the one making the error, according to the rule in some jurisdictions.

Since a meeting of the minds of the parties is essen-

tial to the validity of all contracts, the signing of a contract, in the belief that it is something else, renders the contract so signed null and void. There has been no meeting of the minds in agreement in this case. But where one, having the capacity to read and inform himself as to the subject matter of an instrument in which he is signing, where the contents have not been misrepresented to him, the courts are almost unanimous in saying that he cannot be relieved from liability for signing a contract without first taking the opportunity to discover what he was doing.

Oral Testimony

If it were possible for parties to a contract, when sued for nonperformance, to testify that they signed the contract but to add that it did not express their intention, or that it was something absolutely different from what they thought it was, it would destroy the value of all contracts. Thus, we have a rule of law which absolutely prohibits the introduction of oral testimony to vary the terms of a written instrument. And furthermore, the instrument itself is deemed to be the best evidence of what the agreement between the parties was.

This, of course, is subject to some modification in a court of equity, but we will consider that matter later in the discussion.

Mistakes of law, in the making of contracts, are not sufficient to permit a party to avoid his portion of the agreement. Generally, an instance is given where the facts are thoroughly understood but the party makes a mistake as to the legal effect of the agreement.

Contracts, in order to be enforced, must be definite or certain as to the terms. Unless the terms can be understood or ascertained by the courts, they will not attempt to enter into a puzzle-solving contest, but will declare the contract of no effect for want of certainty.

Contracts of Service

In Massachusetts, it has been said that a contract of service must be certain and definite as to the nature of the service to be performed, the place where and the person to whom it is to be rendered, and the compensation to be paid, or it will not be enforced.

It does not mean, however, that the courts will make no attempt to ascertain the intention of the parties merely because it is difficult to do so. In fact, if it is at all possible to do so, the courts will discover that intention and apply it, for they are becoming more and more anxious not to destroy contracts for mere uncertainty, if it is at all possible to preserve them.

There must be a valid consideration to every contract. This rule is so general as to need slight comment. The purpose of the rule is clearly to prevent the enforcement of gratuitous promises. It has been pointed out that if one receives such a promise and it is broken, that he is no worse off than before. But where a promise has been given, in consideration of a certain act or omission on the part of the other, there is something lost in case the promise is broken, and the courts are organized for the very purpose of preventing men taking advantage of others when it suits their convenience to do so.

Consideration is generally expressed in money terms as being the price paid to obtain the promise from the promissor. But it need not consist of money alone. It may, in cases of conveyances, be simply "love and affection," or it may amount to no expressed consideration in other similar agreements. It may consist of the doing of something which one is not legally bound to do. It does not, however, consist of performing a duty which one is required by law to perform. It may amount to a relinquishment of a right; or the performance of a moral obligation, or a forbearance to sue upon an obligation already owing. Consideration may consist of numberless items, almost, but the points named will cover practically the entire list of possibilities.

Of course, the consideration must be adequate and fairly well be worth the value of the promise given by the other party, although the courts will not attempt to set themselves up as judges of values. But where the consideration is plainly inadequate, a presumption of fraud arises which it is hard to overcome.

Where there is a want of consideration or a failure of consideration, the promissor has a right to show this in defense of his failure to perform his part of the agreement. Failure of consideration will not, however, affect a negotiable instrument in the hands of a bona fide holder for value, nor does it affect contracts under seal.

Mutuality in Contracts

We have already considered to some extent the necessity of mutuality in contracts in order to make them valid and enforceable. It is not necessary that mutuality extend to the point of making it possible for each party to sue one or the other as the case may be; but where mutuality refers to cases where there must be a promise on one side and a valid consideration on the other, there is no doubt before the authorities but what it must be present in every contract. One authority has said that it appears more to be another way of stating the rule that mutual promises are adequate considerations for each other.

So far in our discussion of the elements of business contracts, we have found that assent or agreement is probably the most important element.

This presupposes the existence of parties capable of entering into an agreement. It supposes that they are of sound mind and not physically or otherwise legally incapacitated from entering into an agreement.

Summary of Conditions

We found that the agreement must be certain and definite as to the subject matter, the parties, and the manner in which the promise is to be executed. We found that there must ordinarily be an offer and an acceptance of that offer, in order to evidence the assent of the parties to the agreement.

We found that the offer may limit the time or manner in which it is to be accepted and that in accepting it, the offeree had a reasonable time in which to signify his acceptance.

We found that as soon as the acceptance was posted in the mails that it constituted acceptance of the offer, provided notice of withdrawal had not reached the offeree prior to that time.

We found that there must be a consideration for every promise sufficient to become the subject matter of a contract. We found that this consideration may take the form of money, or a desire to show love and affection, or a forbearance to bring suit, or a number of other things entailing loss or gain. We also found

that where there is a failure of the consideration or a want of it, that in the majority of cases, the contract fails with the consideration.

In our next discussion we will take up the legality of contracts and their interpretation. This should be the most interesting and value of all to business men generally.

Industrial Brazil

By Ernest L. Little

Brazil, sometimes referred to as "the greatest storehouse" of raw materials in the world, has, during the four years of European war, passed through a period of industrial development that will lift her to a plane with the world's manufacturing nations. The demand on the part of the belligerent countries for foodstuffs and raw materials has stimulated agricultural and industrial production far in excess of pre-war years.

Brazilian factories have undergone a tremendous development and in the State of Sao Paulo alone, 323 new industrial enterprises have been established. This construction of new enterprises has had the favorable assistance of both the federal and state governments, special privileges having been granted to industries for the manufacture of caustic soda and to the iron, steel and coal-mining industries.

The most important expansion since the war has been the steady building up of the textile industry. Brazil, previous to the war, had become an important producer of raw cotton for export, but with the marked growth of this industry which now produces fully 75 per cent of the cloth consumption, the export of the raw material has materially decreased. This successful development of the textile industry offers an unusual opportunity for the manufacturers of textile machinery to market their products in Brazil.

In the shoemaking industry, there are several large factories in Sao Paulo and Rio de Janeiro, and with the further extension of the local tanneries which are now turning out leather in many grades equal in quality and lower in price than the imported product, it is stated that Brazil is being shod with Brazilian shoes.

There are also several large furniture factories turning out beautiful furniture made with the native hardwoods. There is a factory specializing in wicker furniture, which is becoming very popular.

Not only are cotton goods being produced, but the native hats are now worn, as are shirts, collars, underwear and hosiery.

A sudden business awakening has also taken place in metal-working industries. Brazilian farmers are now using agricultural machinery manufactured locally, especially rice-hulling and rice-cleaning machines and the various tools used on the coffee plantations. Sugar machinery, pumps and corn grinding machines are also included in the agricultural implement list. In Sao Paulo horseshoes, plumbing goods, chains, screws and nails, locks and wire netting are made to supply the home demand.

Brazil is also one of the richest countries of the world in iron ores, which are found in great quantities in several of the states. The ore is usually an oxide of iron and a large portion is stated to be 50 to 70 per cent pure iron. Some capital has been invested in this industry and there are several large works. It is merely a question of time before the ore deposits will be extensively worked.

The hoped-for discoveries of coal have not been made to any extent and consequently Brazilian industries cannot depend on native production for power. However, the mountainous nature of the country furnishes abundant water power, only a part of which has been utilized. The development of this source of power will assist in the solution of the power problem and will aid materially in the industrial expansion of the country.

This sudden awakening of industry in Brazil has provided a new market for American tools and machinery. Owing to the favorable attitude of the government and the financial success of these new industries, continuous growth is assured, thus providing a steady demand for machine equipment.

The method to be followed by the American manufacturer in marketing his machinery in Brazil depends upon his export policy. There are two general methods to be followed in export trade, indirect and direct. By indirect exporting, the manufacturer appoints a commission or export house in this country to act as his representative, accepting such business as his representative is able to develop and receiving payment for the merchandise in the United States.

The Direct Method of Exporting

The direct method is generally followed when a serious attempt is to be made for export trade. This consists of either securing a native house in Brazil to act as agent or by the establishment of a branch house.

The opportunity presented by the Brazilian market to the American manufacturer of machinery depends to a very great extent upon his ability to secure satisfactory and permanent connections with a Brazilian house. Such connections constitute, in fact, the important factor in the success or failure of any manufacturer who is endeavoring to enter this market.

The manufacturer, desiring to place his line of machinery with an agent in Brazil, must be certain that the house to which he intrusts his business is well represented in each of the commercial districts of the country. To secure adequate representation in Brazil it is necessary to grant the agency to a company that has commercial travelers or sub-agents who cover the entire republic. In the North are the cities of Para and Manaos—of considerable commercial importance. In the South the industrial centers are Rio de Janeiro and Sao Paulo. Since it takes about three weeks' journey to reach Manaos from Rio, it obviously is of vital importance to take this into consideration when granting the agency. If, however, it is not possible to obtain as an agent a company with facilities to cover the entire country, agencies should be given for each commercial district to separate companies.

The establishment of branch houses should depend upon the amount of business to be obtained. Owing to the expense that would be incurred in an undertaking of this character, careful consideration of the future possibilities of the market should be made before taking this step.

The question of credit in Brazil is not difficult providing the agent is of sufficient financial standing and responsibility. In order to clear merchandise through the Brazilian custom house it frequently takes from 30 to 60 days and to secure a large volume of business, credit will have to be extended for that period, usually for 60 to 90 days, as the importer desires to place the merchandise on display before payment.

When making shipments of machinery to Brazil great care should be taken to inclose direction sheets and repair lists in the Portuguese language. This direction sheet should contain a list of every part entering into the construction of the machine and if possible an illustration of each part. In case the machine is shipped knocked-down, instructions for assembling and installation for operation should be added.

The immediate opportunity offered by the industrial expansion of Brazil presents an unusually attractive market for American manufacturers of hardware and machine equipment to merchandise their products. By conforming with the requirements of the Brazilian market, together with the superiority of the American products, no difficulty will be experienced in competing with European manufacturers.

Lead Laps for Internal Lapping

By W. H. Sawtelle

While the lead lap is an old device for finishing holes requiring extreme accuracy and at the same time a smooth surface, the article by Hugo F. Pusep on page 712 of the *American Machinist* raises the question as to whether its many advantages are not being lost sight of. He advocates the "conventional type of lap—a split cylindrical brass or cast-iron bushing driven on a tapored arbor."

In the experience of the writer, much expense in first cost and valuable time in obtaining results have been saved by using laps made from lead. These are made by molding the lead on taper mandrels which have grooves milled on one side with a half-round cutter. Split iron coreboxes make ideal molds for this purpose when they can be obtained in standard sizes and molds of wood can be made quickly for emergency jobs.

The closed end of the mold is reamed to fit the large end of the mandrel which should have a suitable length left straight and finished to a standard size. The blacksmith's helper or a handy man should keep a number of these laps in stock in the tool crib, as obviously any number can be molded on one mandrel.

In turning the lap to size, use a round-nose tool and all the speed of which the lathe is capable. There is no danger of running it too fast. Allow enough freedom in fitting the lap to the work to charge in the abrasive; the lap will easily build up 0.002 to 0.004 in. when charged.

When turned to size the lap should have clearance grooves cut in it by running the lathe slowly, and traversing the tool quickly across the surface of the lap, allowing the tool to cut both ways and make helical grooves which serve to catch the loose emery and chips, thus preventing the lap from loading.

This type of lap with its diamond-shaped lands well charged with No. 90 emery becomes a real cutting tool, the only objection to which might be in the case of a concern working on a cost-plus basis; they might figure that not enough time would be consumed.

Rolling the lap in emery, slightly flattening it with a flat-faced hammer or splitting the whole length in order that the mandrel may be driven further in, are all methods of enlarging it which are available with this type of lap and each may be used according to requirements.

On the more particular class of work a mandrel as large as practical used in connection with the split lap, will be found by far the best as it can be kept to size and the whole length will cut. Small laps for jig bushings and similar work may be molded solid. A mold for several sizes can be made from two cast-iron plates planed and doweled together, the required sizes of holes being drilled nearly through on the parting line.

A good alloy for small laps is composed of ½ oz. bizmuth, 1 oz. antimony, 13 oz. tin, and 1½ oz. lead. This alloy is stiff enough to be held in chuck while being turned to size, and ductile enough to stand spreading with the hammer when just a little increase in size is needed.

Cast-iron and bronze bushings may be safely finished with lead laps and emery, obtaining a surface which, when used in connection with a hardened, ground and lapped spindle, is practically wear proof.

Having the opportunity to study the action of such bearings in actual service covering a period of more than 20 years, the writer is firmly convinced that no emery is left that will cause trouble. Some of these bearings have been in use all of this time and are still in excellent condition.

A Dozen Kinks for the Machine Shop

By A. R. Durant

I have found that:

Soft-steel arbors do not ruck up when driven into cast-iron or steel work if both arbor and hole are previously smeared with red lead.

Points of scribers and other small tools are easily hardened by heating to cherry red and plunging into a soft piece of soap.

Beeswax as a lubricant for a tail center is superior to oil, hard grease, red lead or chalk.

Large holes may be bored clear through sheet brass or steel with a twist drill by clamping a piece of hardwood board on either side and drilling through the whole.

Small dies, etc., can be tempered to a light straw color if heated to the point of just fusing wire solder before quenching.

In case of a stuck arbor or shaft, allow turpentine to penetrate thoroughly before attempting to drive out.

Minute cracks in hardened pieces are easily located if the work is oiled, wiped off and then chalked. The oil remaining in the cracks quickly shows up by soaking through the chalk.

Small left-hand or special taps for odd jobs are cheaply made by chasing a thread of the required pitch on a piece of drill rod in a lathe. The flutes are formed by filing the threaded portion three-cornered and the end is given a good taper for starting.

To do a good job of brazing, immerse, or thoroughly wet, the work in a saturated solution of borax and hot water. While heating, apply powdered borax freely.

When grinding in a lathe, a small pan or tray of water placed on the cross-slide and under the grinding wheel is most efficient for catching the sparks and emery dust.

In casehardening for colors, using cyanide, the work is often overheated. A bare red heat is sufficient for a good mottled appearance.

Heavy sheet brass may be quickly reduced to paper thickness—for thin gaskets, shims, etc.—by dipping repeatedly, for a few seconds, in nitric acid and then in water, until the correct thickness is obtained.

The Evolution of the Workshop—III

By H. H. Manchester

Of the discoveries and inventions which have had a marked influence on subsequent industrial development, the introduction of horseshoes, the invention of files and the organization of trade guilds are among the most prominent. The advent of these belongs to the Middle Ages. (Part II appeared in our Jan. 15, 1920, issue.)

After the Roman Empire was overrun by the barbarians, the old organization of industry, as it had been carried out by slaves and freed men, was broken up. Commerce between far distant countries, which had been common under Roman rule, came to an end, and each city and district was compelled to depend almost entirely upon its own resources for manufactured necessities.

In addition to this, the records of industry become almost negligible for several centuries, and it becomes a difficult matter to grasp the exact conditions of the period. In comparing the metalworkers' shop as it existed in Roman times with those of the later Middle Ages and early modern period, many changes will be seen. Even in the so-called Dark Ages important improvements had been made, but they can be assigned to no definite inventor or exact date. Practically all that can be done is to chronicle the first notice of their appearance.

The introduction of iron shoes for horses had a marked influence on the development of the workshop. The Greeks and Romans of the early Empire had occasionally used, for horses and asses, sandals which were tied on the feet. However, during the last centuries of the Empire, shoes that were nailed on were introduced; evidence of this having been found, to some extent, in the later Roman remains. Their use greatly increased the demand for workers in iron and made smithies far more common than before.

FIG. 12. ANGLO-SAXON FORGE SHOP ABOUT 900 A.D.

The pictures of the so-called Dark Ages that represent workshops may be counted upon one's fingers. Two very crude wood carvings in the church at Hillestad show what is apparently the working of soft metal. However, an Anglo-Saxon picture, Fig. 12, of perhaps the 9th century illustrates two smiths working at a furnace. It is to be noted that the tongs have become round and the hammer long and slender. The old Norse description of Wayland, the smith, describes how in making the charmed sword he improved its temper by filing it into pieces and reforging it, and mentions the furnace, forge, hammer, files and other tools common to Roman times.

Probably the best idea of the workshop of the 11th century is to be gained from the "Diversarium Artium Schedula" (Schedule of the Various Arts) of Theophilus. He describes how the workshop should be divided into different parts to correspond to the work in different metals, for it must be remembered that the smiths still worked in more than one material. He gives simple instructions concerning

FIG. 13. AN ANGLO-SAXON SMITH OF THE 13TH CENTURY

the work bench, furnace, bellows, handles, tongs, hammers and files. The bellows were still of the hand variety; the files were flat, three cornered, round and hollow. He also notes the tools required for hollowing, scraping, engraving, cutting and key-making, and the simple hand methods employed in these operations.

Wire Drawing

The first account of wire drawing was also made by Theophilus. The method described by him, which was used by St. Eligius in the first half of the 7th century, consisted of drawing the wire through holes of various sizes in a steel plate by main strength, aided only by a pair of pinchers. The holes are graduated in size so that the wire could be made a little smaller with each drawing.

Another interesting device described by Theophilus, was used in beating out beads of soft metal. It consisted of two plates, fitted one over the other, with hollows in them corresponding to the size of the bead. The metal to be formed was placed in the hollows, and the plates pounded with a horn mallet. This was essentially the forerunner of die-stamping, though, of course, single dies for the stamping of coins had been used for many centuries. Theophilus also treated of chasing, engraving, repoussé work, studding, soldering, niello, and casting.

During all of the centuries which are often somewhat opprobriously termed the Dark Ages, it must be realized that they were dark for Europe only. For the Mohammedan world of Asia Minor and North Africa, on the contrary, they mark an age of great progress. This development held good in metal work as well as in other fields. Greece and Rome had remained users of bronze, using steel only for sharp-edged weapons and tools. The Arabs adopted the Wootz steel, which was already made in India, and from it fashioned not only the famous blades of Damascus and Toledo, but defensive armor which no bolt from the crossbow could pierce. There are many specimens of Arabic metal work in existence, but unfortunately the Mohammedan religion forbade its followers from depicting the human form, and for this reason we have no Arabic figures of workshops or any showing the methods used by the scimitar maker.

FIG. 14. LATHE OF 13TH CENTURY, FROM A WINDOW IN THE CATHEDRAL AT CHARTRES, FRANCE

FIG. 15. GIOTTO'S BAS-RELIEF OF A SMITH IN THE CAMPANILE AT FLORENCE, ITALY

The crusades, which began in 1096, increased the intercourse between western Europe and the Greek Empire at Constantinople and the Arabs. These wars spread the knowledge of many things throughout Europe and forced the Western knights to adopt the better steel of their foes for weapons and armor. At the same time the demand in Europe for the work of armorers and farriers greatly increased, and from this time on the pictures and other records concerning the metal industries become more common.

In olden Greece and Rome, as has been already mentioned, the work was done by slaves and freed slaves. After the fall of the Roman Empire, slavery continued to some extent, but there grew up, especially under the feudal system, the institution of serfdom under which the workman was bound to the lord and to the domain. During the crusades, however, the development of industry in the cities gave rise to skilled craftsmen, who partly for mutual advantage and protection, and partly

to buy off the services due from themselves and the towns to the overlord, formed associations or guilds. These differed widely from any present association. The guild included both the masters and workmen in a trade. It had no connection with any similar industry in another city, but in many places took part with the other guilds in the government of the town, and in some notable cities, such as Florence, the guilds were in fact the only governing agency. Each guild had a monopoly of the manufacture and trade in its own line in the city, and in return owed certain duties to the city.

Each master workman or shop owner might have under him both apprentices and journeymen. The apprentice was usually bound to him when a boy, and was required to spend at least seven years before he completed his apprenticeship, during which time he received board and clothing and a few dollars a year as wages. After his apprenticeship he became a journeyman for three years or longer. During this time he received the wages prevalent in the craft, and was permitted or expected to journey to different cities in order to learn new methods of the trade. Before becoming a master he was expected to prove his efficiency by producing a so-called masterpiece, and to pay a considerable sum into the treasury of the guild. While conditions under the guild were far better than under the slave system of the classic period, they were still far from ideal. The journeyman shop worker of 1300 worked from dawn until dark, and for this received about 40 cents a week for a six-day week.

There are several 13th century illustrations of workshops or parts of workshops which are very interesting, although only a few of them illustrate any advance from the classic period. An English blacksmith of the 13th century who was pictured in Strutt's book on "English Dress" is using only the hammer and tongs. A reproduction of this picture is shown in Fig. 13. Further evidence of the kinds of tools used is shown in another illustration found in the "Weltchronik" of Rudolf von Ems about 1254. Here again only the hammers and tongs are used. One of the windows in the Cathedral of Chartres, however, is a good picture of a farrier shoeing a horse, which is probably the oldest extant representation of this operation.

One of the unsolved problems in the history of technology is the date and manner of the introduction of the various machines which we find in use at the beginning of the Modern Age. One of these machines was the lathe. The Romans probably had no machine tools which could be properly designated under this name, although they had a method of using a bow to turn a drill placed horizontally. Philo of Byzantium mentioned that a cylinder for a pump could be bored out in this way, and there is a broken sketch of such an arrangement on a tomb of the Empire period. Moreover, Oribasius about 362 A. D. suggested that one might cut screws by using a bow to turn the work. Thus, it can be seen that something approximating the lathe was in contemplation, although it will be noted that the work was still to be turned by one hand while the tool was held by the other.

For this reason one of the windows in the Cathedral at Chartres, Fig. 14, is of the highest historic importance. It represents a workman who is unquestionably turning a lathe by means of a treadle and holding a tool against the material with his hands. The machine and operation are both of the simplest sort, and were probably applied only to wood, or if to metal at all, only to the softer varieties. The picture is probably the oldest illustration of a lathe run by foot power, and as such is well worthy of reproduction.

In other fields we discover that at this time attempts were being made to develop some sort of machine to take the place of slave labor. While these do not apply to the machine shop, it should be noted that one Villard de Honnecourt devised a saw, the running of which was assisted by the spring of a bent sapling, and also a saw so arranged as to cut piles under water. At the end of the 13th century the Arabs were using the water-wheel to furnish power for the crushing of sugar cane, but the extension of this power to other lines did not come until later. An illustration, Fig. 15, of the metal workshop is found in one of the panels, by Giotto, in the Campanile at Florence. While this is supposed to represent Tubal Cain, it is like all other examples of medieval art representing the conditions existing at the time of the artist. An interesting picture of a workshop is that shown in a manuscript which dates from the beginning of the 13th century, and is now found in the British museum. As reproduced in Fig. 16 it depicts a style of forge with a canopy top and, which is more important, it shows the application of the lever to the bellows. In the picture it is apparently being worked by a man behind the forge.

FIG. 16. WOMEN AT A FORGE IN ENGLAND, ABOUT 1338 A.D.

Another very strange peculiarity in the picture is that the workers forging the iron are women, which

FIG. 17. THE SHOP OF EARLY ENGLISH TOOLMAKERS

suggests that the entrance of women into the shops during the recent war was not an unknown innovation.

Another interesting picture of this period is shown in Fig. 17. This shows the shop of an English toolmaker and portrays, without a doubt, the forging and cutting of files. It will be noted that the file cutter's hammers and methods of cutting the files do not differ to any great extent from those employed today. After the 14th century, however, the development of the workshop took place more rapidly, which together with the 15th century will be covered in a subsequent article.

More Advice to Inventors

By E. H. Michaelis
Consulting Mechanical Engineer

Many of my clients ask me this question: "Shall I first make an application for a patent to protect my invention or shall I go ahead and make a working model of it?" I always advise them to protect their idea first and then go ahead with experimental work. It often takes a lot of time and work to develop an invention far enough to be of real practical use, and it is always possible that somebody else may have the same idea and get ahead of you. Your patent, if drawn right, will protect your invention even if you change your construction in the course of reducing your idea to practice.

The reduction to practice can be done either by making drawings and developing the invention on paper or by starting to build a model and changing this model around until it meets with your approval or has to be thrown away and a new one started.

Many inventors are under the impression that it is necessary to have a model in order to apply for a patent. If they would write to the Commissioner of Patents, Washington, D. C., for a booklet issued by the U. S. Patent Office entitled "Rules of Practice in the U. S. Patent Office" and furnished free of charge on application, they would find that only drawings are needed and that the Patent Office will ask for a model only in case the examiner deems one necessary to demonstrate the practicability of the invention, or if the invention is so complicated that it is necessary to have a model to understand it. All the inventor needs before making application for letters patent is either a rough sketch or a crude model and the ability to describe his invention to his attorney so that the latter can work out the application intelligently.

Now to come back to the question as to which is the better way to do your experimental work—on paper or in the shop by building a model. The answer depends on circumstances. If the inventor has mechanical ability, knows pretty well what he wants to build and has the facilities, it is possibly better to build a model and try it out. If it does not work, it will be easy to find what has to be changed in order to get the right results. But this way has quite a few drawbacks, especially if the inventor can not do his own work and can only spend a part of his time in the shop where his work is done. He has then to tell the man in charge what he wants and must depend on him to have the work done right. When things go wrong he will have to pay for the time at $1.25 an hour, and also for the material used and which has to be thrown away. In many cases it will be necessary to have patterns made and pattern work runs into money, as anybody who ever paid for it will tell you. If things in the shop do not work out right, the patterns will either have to be changed or new ones made.

Nobody would try to build a barn without making a layout from which to get the necessary list of material, length and sizes of uprights, sleepers, etc., but many will try to build a new mechanical device without layout or specification for the simple reason that they feel it costs too much to have a set of drawings made. If they would look a little deeper into this matter they would find that money spent for experimental work on paper does save money for the inventor.

If the inventor will employ a competent engineer to do his work, he will have nothing to pay for but the time spent on his work which at present rates is usually $1.50 per hour. Changes which in the shop would mean a lot of money for material which could not be used again for new patterns can be made on the drawings with the help of an eraser, or if the changes should be very radical, all the material wasted would be some paper which would cost very little.

After the drawings are finished to the satisfaction of the inventor it will be easy to get competitive prices on the patterns, the castings from the patterns and on the machine work, while without the drawings it will be found impossible to get the work done on any other basis than the hourly price.

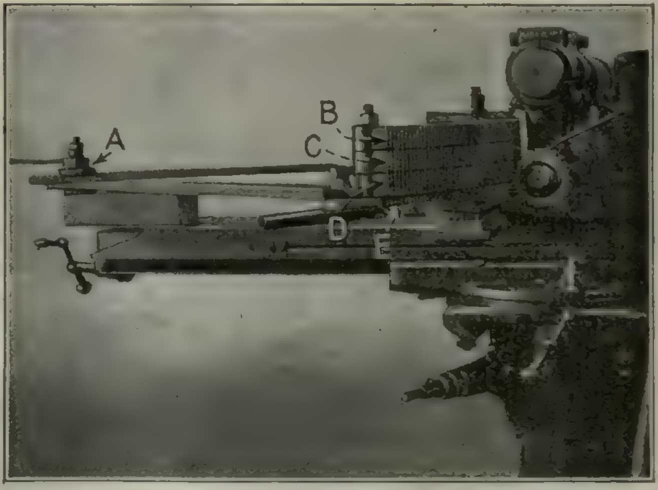
Notching Locomotive Quadrants

By John Martin

Notches for controlling the link positions on locomotives must be so spaced that the valves will cut off at a certain part of the stroke when the lever latch is dropped into any particular notch.

The illustration shows a device, for indexing quadrants for notching, in use in the Chicago shops of the Chicago and Northwestern R.R.

Three quadrants to be cut and a master quadrant for spacing are held in a bar-iron frame pivoted on the milling-machine table at *A*. Three quadrants, *B*, *C* and *D*, are notched at the same setting, the positions of the notches being located by the master quadrant *E*



NOTCHING LOCOMOTIVE QUADRANTS

which is locked in position by a locking pin on the milling-machine table, but not visible in the illustration. Spacing is done while the work is lowered so as to clear the milling cutter, and the notches are cut by elevating the milling-machine knee.

ARMY ORDNANCE NEWS

The Manufacture of Artillery Range Finders—II

BY GEORGE H. THOMAS

In this article, which is the second of the series, the tools, jigs, fixtures and manufacturing methods as employed by the leading French and American range-finder manufacturers are compared.

(Part I appeared on page 1045, Vol. 51.)

MOST of the devices and methods employed in the manufacture of range finders and gun sights are the result of considerable study and experiment. It is rare that we have an opportunity to compare the foreign and domestic manufacturing methods as employed in similar lines and in this respect the practice of the leading French manufacturers and that of Slocum, Avram & Slocum are presented. Many of the devices employed were improvised under adverse and rush conditions to equal foreign production on established lines.

The French quadrant sight is distinctly an instrument of precision and up to a certain point it can be built on an interchangeable-part basis as will be shown later on. It will be seen from the drawing of the body, Fig. 8, that the part is very irregular in shape and its

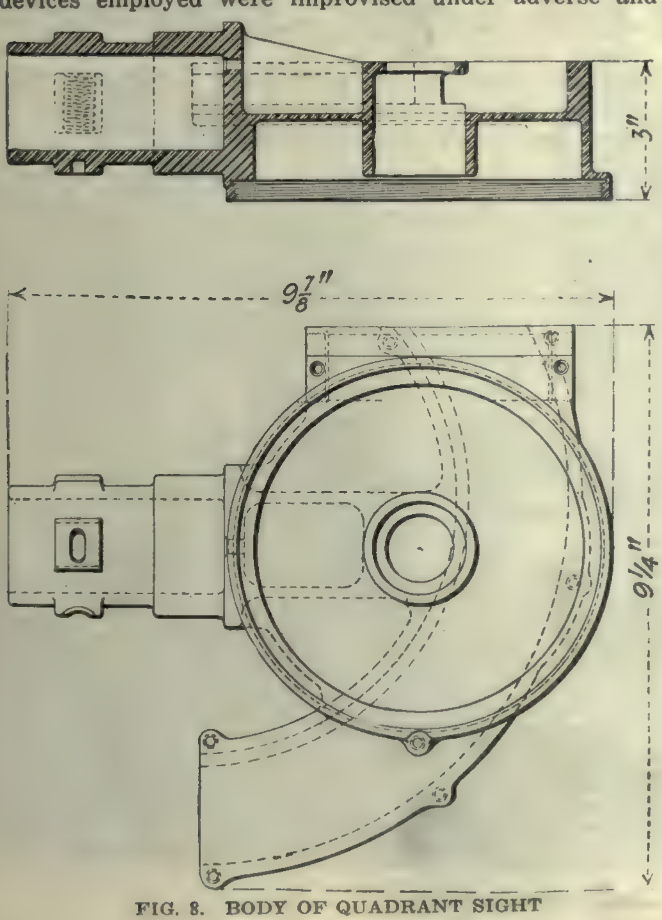


FIG. 8. BODY OF QUADRANT SIGHT

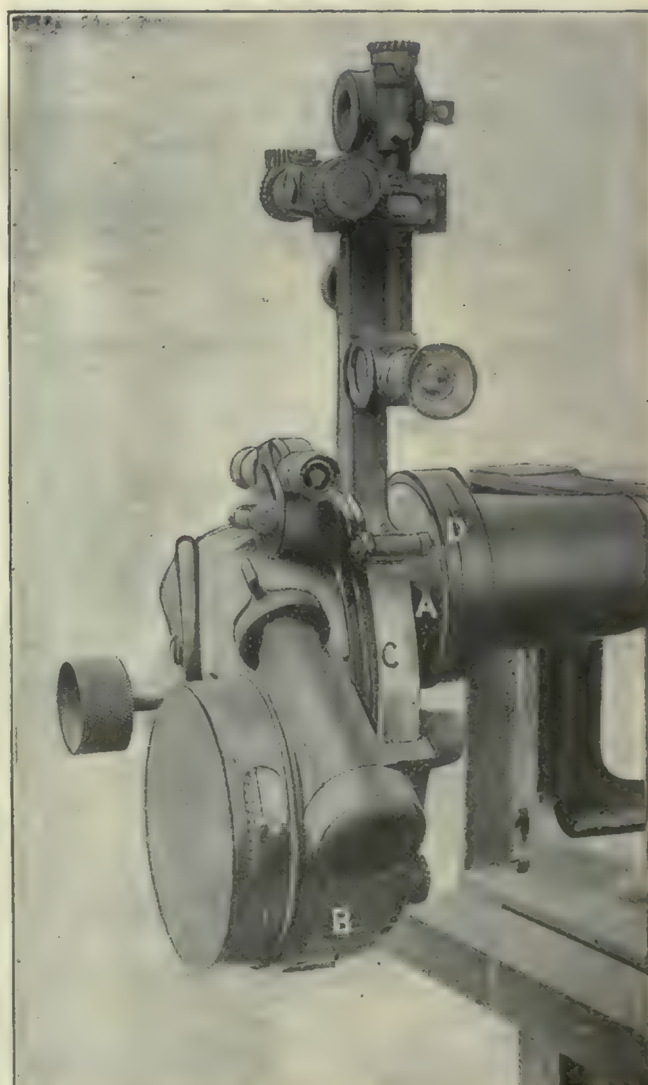


FIG. 9. AMERICAN MODEL OF PANORAMIC SIGHT

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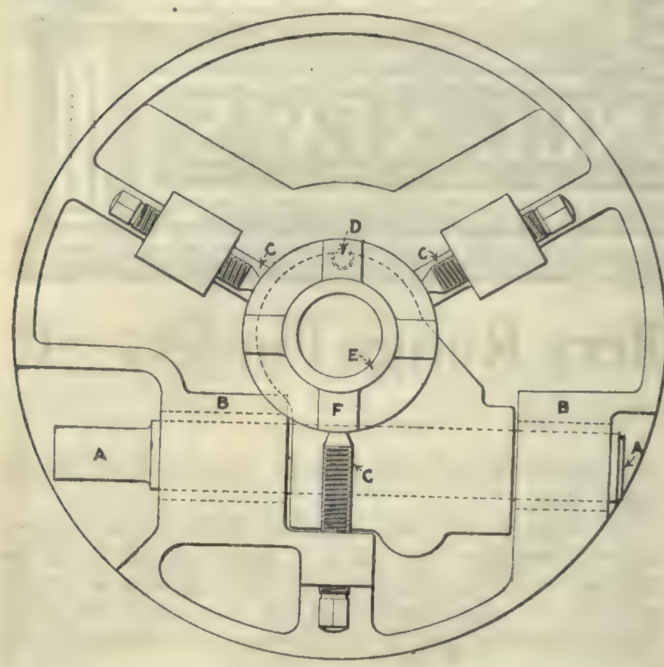
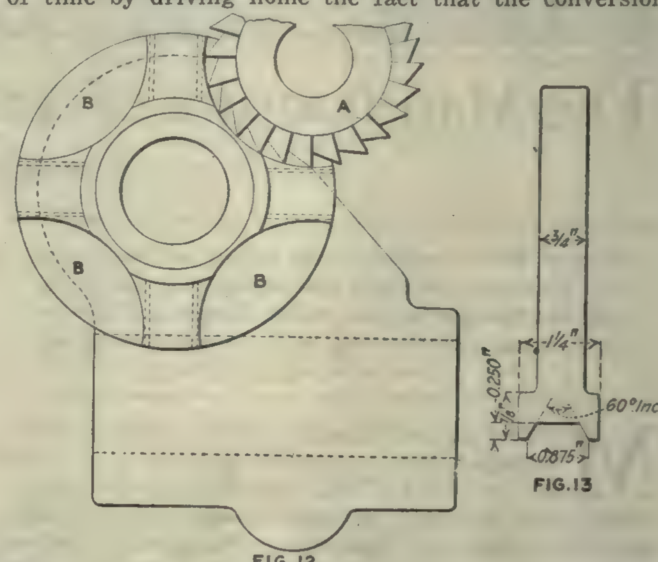


FIG. 10. SCHEMATIC DRAWINGS OF THE HOODED LATHE CHUCK USED IN MACHINING GUN-SIGHT BRACKET

contours are multiplied in endless variety; ideal work for profiling machines, but the French practice in manufacture has not reached the stage that departs from the chalked-surface layout method, scribed diagrammatic lines and skilled operators to follow them. The possibilities of jigs and fixtures are not developed in any direction. Their product is the result of skill in many instances—skill at the expense of time and the use of special devices.

Time being the essence of all things, American preparation for the quantity production of this apparatus did two things that spelled dispatch: First, they engaged an expert to analyze European methods of manufacture, labor conditions and costs, to formulate a tool program of magnitude and efficiency. Second, a body of trained engineers was gathered together to study the operations in production and conduct a schooling system for the draftsmen in performing their calculations directly in the metric system, thereby saving a great deal of time by driving home the fact that the conversion



FIGS. 12 AND 13. SHOWING THE METHOD OF ROUGH-MILLING TENONS ON BRACKET MEMBER AND THE FORMING TOOL FOR FINISHING THE TENONS

of final results into inches was a safer and shorter cut than to convert every fraction. This schooling system was not limited to draftsmen alone but was extended to many others in touch with ordnance material and the functions of range-finding apparatus.

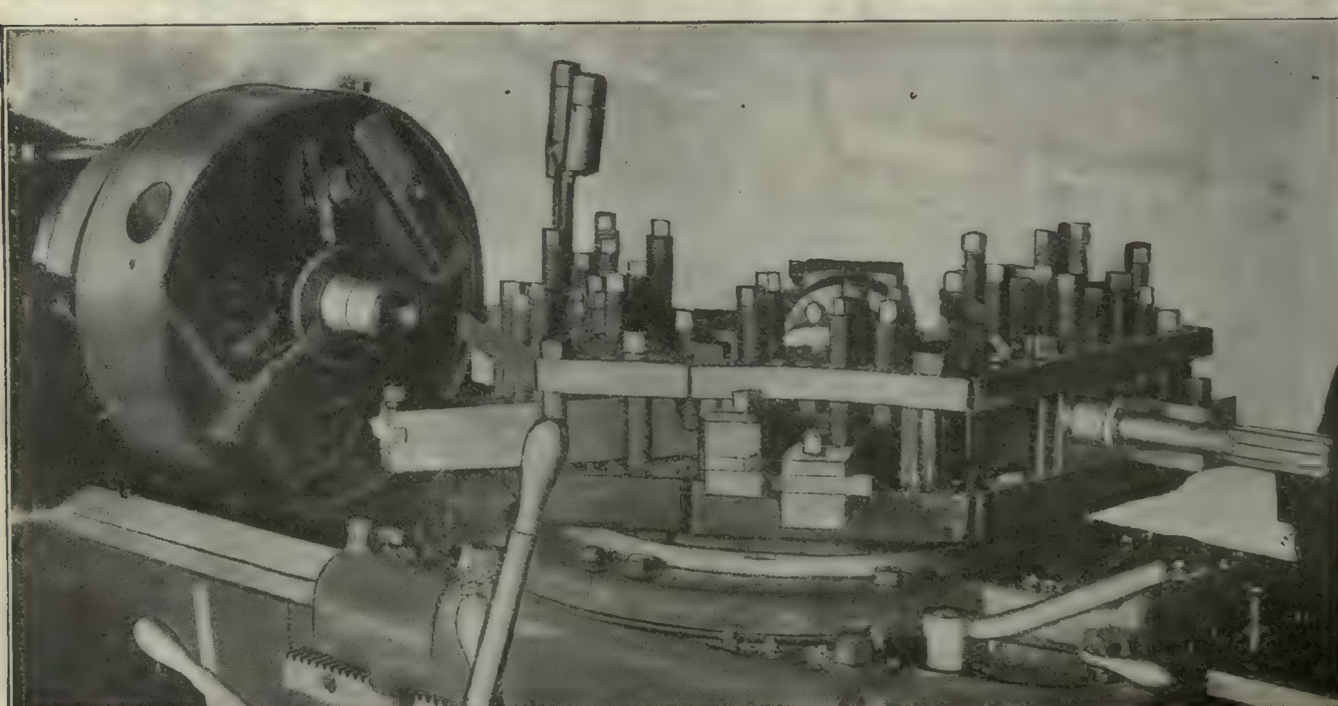


FIG. 11. A HOODED LATHE CHUCK IN USE

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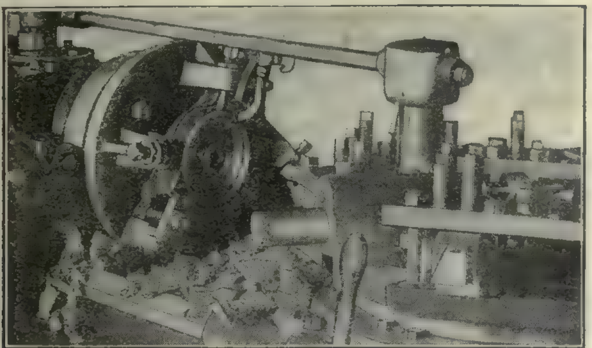

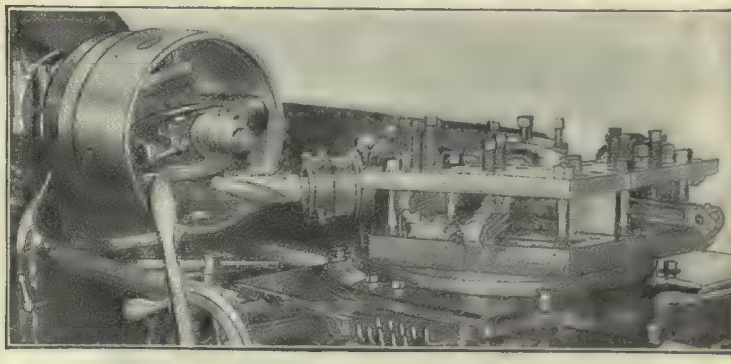

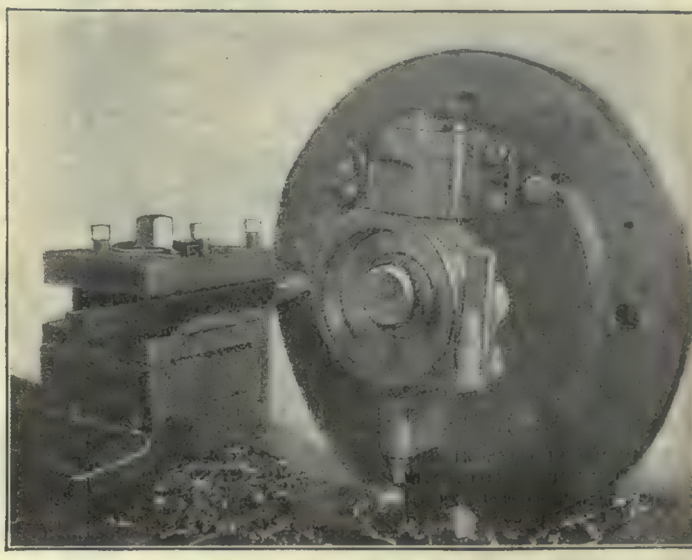

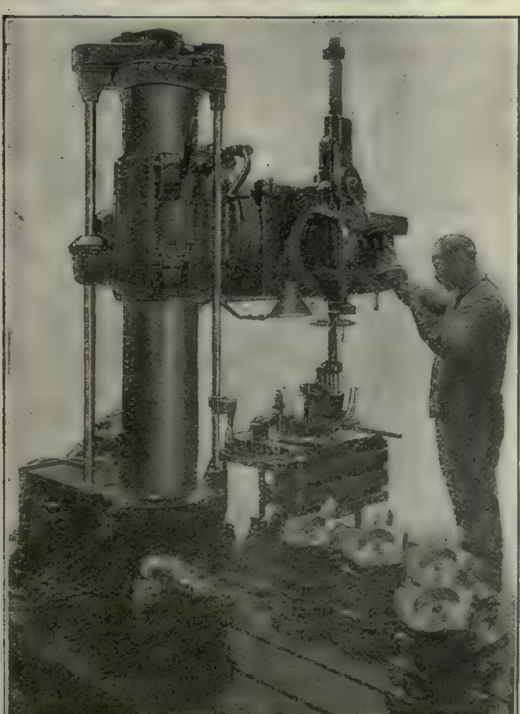

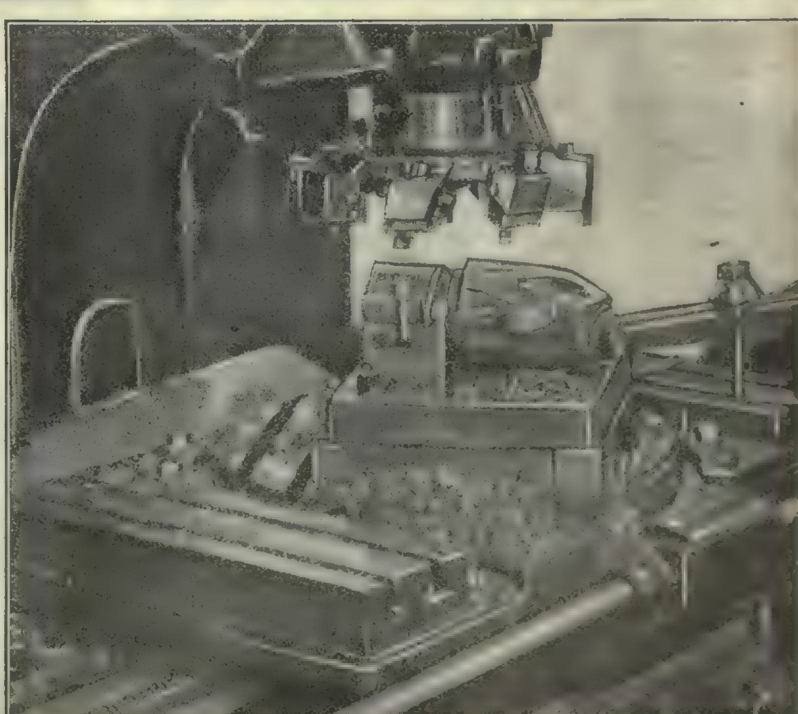

FIGS. 15 TO 20. VARIOUS MACHINING OPERATIONS

Figs. 15 and 16—Typical American methods of machining the body member. Fig. 17—The French method of turning between centers the shank of the body member. Fig. 18—The French method of turning the box side of the body member. Fig. 19—Boring the wormshaft hole of the body member as employed by both French and American manufacturers. Fig. 20—Typical French method of milling the channel section of the body member.

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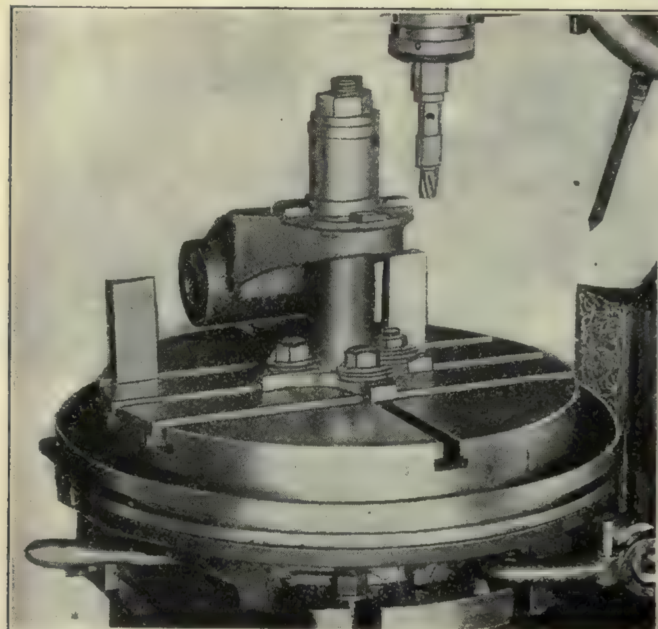

FIG. 14. THE FRENCH METHOD FOR FINISHING THE TENONS ON THE BRACKET MEMBER

An idea of the manifold details of the quadrant gun sight is shown in Fig. 9 and it is obvious that the tools, jigs and fixtures used in its manufacture are somewhat complicated. The three principal parts are the bracket *A*, the body *B*, and the sector *C*. Four tenons *D* appear on the flange of the bracket *A*, and are the means of adaptation to the gun cradle. The tenons are machined first and are used as locating points for all subsequent operations.

A feature worthy of note is the protection afforded the operators by the hooded construction of the lathe chucks, Fig. 10, a feature which is lacking in the tools employed by the French. The bracket forging is mounted on the mandrel *A* which is supported by the bosses *B*, the bosses being a part of the chuck casting. The forging is then lined up and held in place by the screws *C*. The thrust of the tool is taken up by the stop screw *D*. By chucking the part in this manner the shank *E* and tenons *F* of the bracket are machined first. Fig. 11 shows this chuck in use. The unique turret toolholder makes it possible to set up several tools in different positions for multi-operations.

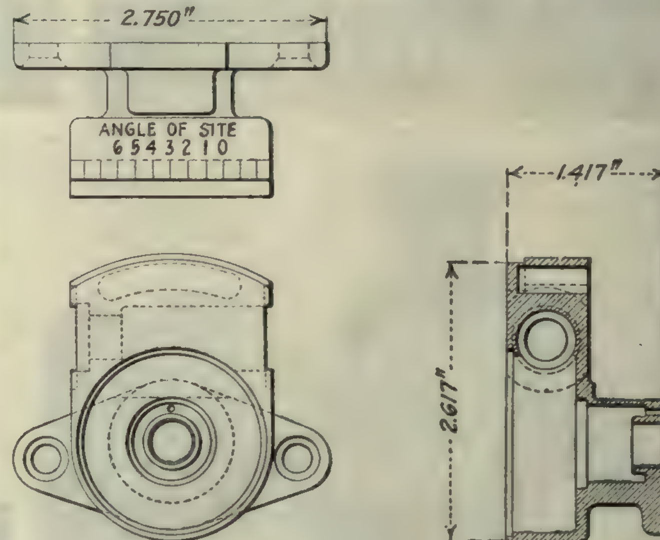

FIG. 22. DETAILS OF THE ANGLE OF SITE WORM HOUSING

The machining of the tenons on the flange *D*, Fig. 9, employs a four-position milling fixture. The work is arranged vertically in the fixture and the operation imposes only two steps in the formation of the tenons. The fixture is set up in a vertical milling machine and in the first step a milling cutter *A* roughs the flange *B* as shown in Fig. 12. The part is then set up in a similar index fixture in a shaping machine and the tenons machined to gage. The tool employed is shown in Fig. 13.

The French employ a rotating table and plane radially between the tenons, after which the latter are milled to gage on a vertical milling machine as shown in Fig. 14.

The French adhered to the layout method of scribing on whitened surfaces and depending on skilled operators to follow the lines in preference to or for lack of profiling facilities. There were, however, profiling machines on the premises, American machinery being much in evidence.

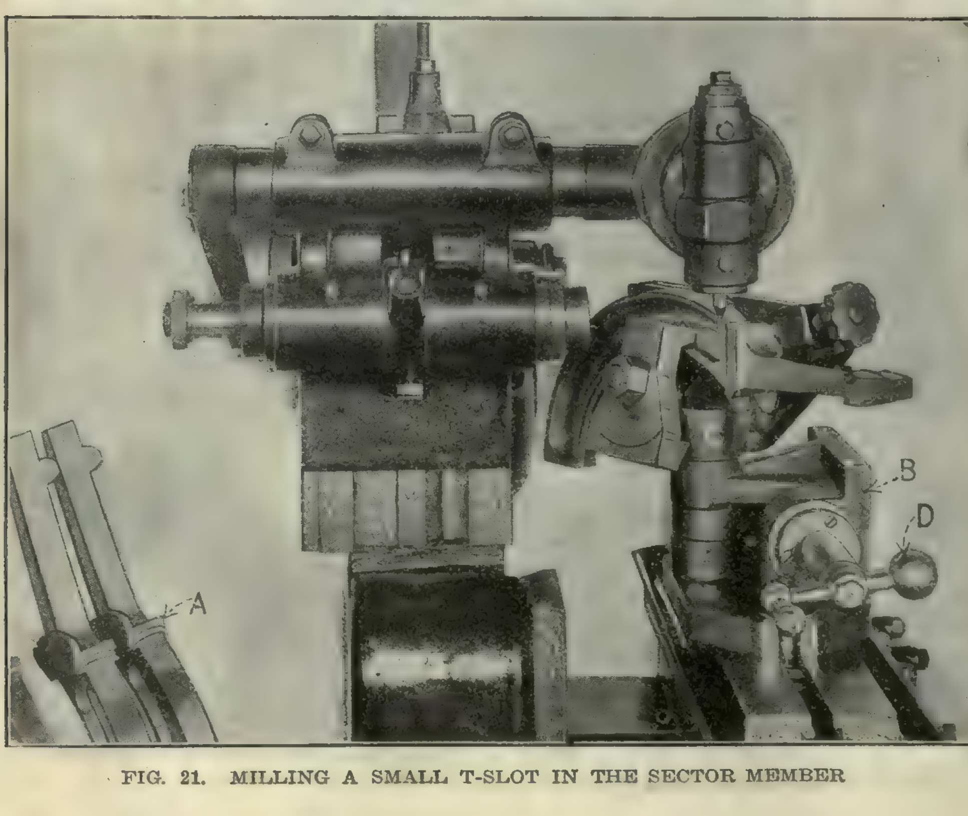

FIG. 21. MILLING A SMALL T-SLOT IN THE SECTOR MEMBER

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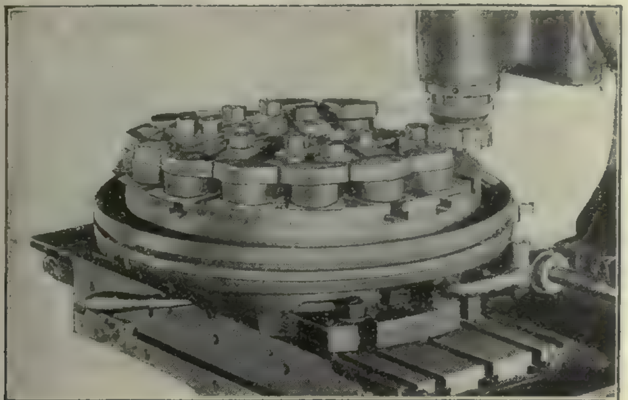


FIGS. 23 AND 24. MULTIPLE MILLING OPERATIONS ON THE ANGLE OF SITE WORM HOUSING

That the French did not make use of the jigs and fixtures is shown in the following comparison of the French and American sequences of operations employed in machining the body of the quadrant sight, Fig. 8.

FRENCH METHOD

1. Whiten with chalk.
2. Layout contours.
3. Drill lathe center holes in shank.
4. Turn shank between centers; engine lathe.
5. Bore the open side of box; engine lathe.
6. Drill the wormshaft hole tangent to the box recess; radial drilling machine.
7. Layout contours on channel side.
8. Mill the indent surfaces and rough-mill to the diagram for the contours; vertical milling machine.
9. Rough-mill the channel; heavy-duty vertical milling machine.
10. Finish-turn the channel; engine lathe.
11. Bore shank; drilling machine.
12. Finish-turn shank; engine lathe.
13. Finish-end-mill the contours in vertical milling machine.

AMERICAN METHOD

1. Turn, bore, face and thread the box side complete; turret lathe.
2. Turn, bore, and face the shank complete; turret lathe.
3. Face the channel side and rough the channel shape; turret lathe.
4. Drill the wormshaft hole tangent to the large box recess; radial drilling machine.
5. Profile horizontal steps and contours on the box side; profiling machine.
6. Profile the indents and the contours on the channel side; profiling machine.
7. Finish-turn channel, engine lathe.

Aside from the foregoing are minor operations which are more dependent on shop expedients than on sequence; however, the brevity of the American method as compared with the French is due purely to a careful analysis of sequence and tools.

Some of the more noticeable differences in methods are brought out in Figs. 16 and 17, and Figs. 15 and 18. Note the design of the lathe tool in Fig. 18, which permits the work to turn away from the operator.

The French method of performing Op. 6, shown in Fig. 19, was adapted in this country to an American-built machine.

The French practice shown in Fig. 20 is excellent. The multiple tool is designed to swing the complete circle of the channel shape, and the time required to mill the groove, ready for finishing on an engine lathe, is but a few minutes including setting and clamping. The machine used is a heavy-duty vertical milling machine of French design and manufacture.

The milling of the small intricate curved T-slot *A*, Fig. 21, is interesting. The radius of this detail is 1.850 in. to the center of the groove. The fixture consists of a brace bracket *B* which is attached to the table of the machine and has a vertical shaft *C* whose axis is the center of the radius about which the work swivels. The work is swiveled by means of the handle *D* which actuates a wormshaft engaged with the vertical shaft *C*. Two tools are employed, one a straight end-mill fed to the required depth followed by the second T-cutter for the under cut.

Typical multiple milling operations of the angle of site, Fig. 22, are shown in Figs. 23 and 24.

In the partial assembly shown in Fig. 25, the angle of site is mounted on the sector which is extended from the channel in the body. The shank of the body member is within the bracket and the box side of the body is exposed to reveal the actuating worm of the dis-

FIG. 25. ASSEMBLING THE QUADRANT SIGHT

mantled drum. The pinion of the drum engages the back teeth of the sector shown through the exposed bore. This worm acts as a lock and a means of precise adjustment of the scale drum and is mounted in eccentric bearings which can be thrown out of mesh, thereby permitting a rapid approximate setting of the drum scale.

Fixture for Milling Clutch Rings

By M. J. Schmitt

The illustrations show a special holding and indexing fixture which was made by Kearney & Trecker Co., Milwaukee, Wis., for straddle-milling the three lugs of clutch rings, one of which the operator is holding

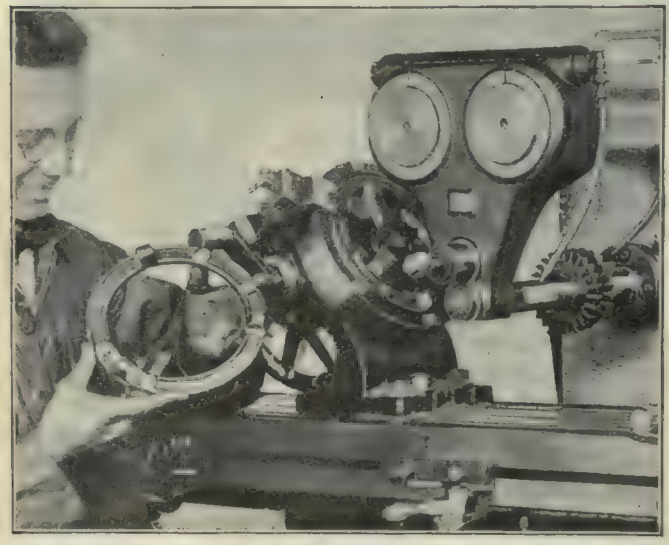


FIG. 1. FIXTURE FOR MILLING CLUTCH RINGS

in his hand in Fig. 1. The rings are of malleable iron, and must be milled with a tolerance of 0.001 in.

The fixture is provided with a hardened-steel plate *A*, Fig. 2, into which the clutch ring fits, and this is attached to a cast-iron body *B*, arranged to be revolved

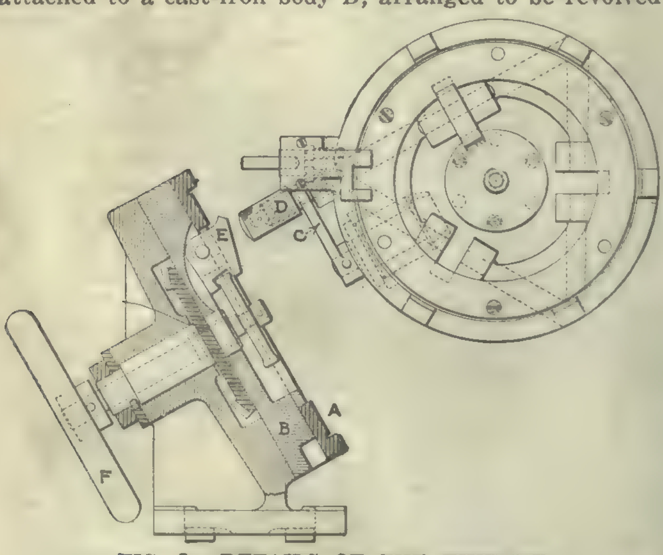


FIG. 2. DETAILS OF THE FIXTURE

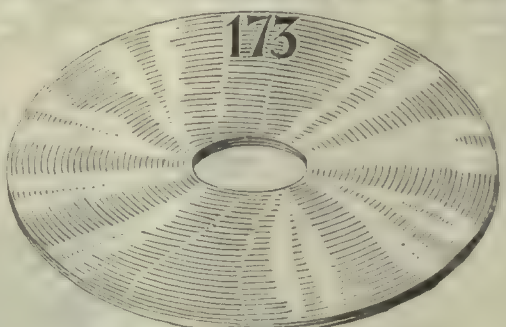
by means of a bevel gear and pinion, operated by the indexing crank *C*. The ratio of the gears is such that one revolution of the pinion turns the plate one-third of a revolution, or equal to the distance between the centers of the lugs on the clutch ring. Attached to the handle end of the indexing lever is a plunger *D* which fits into a hole at the top of the fixture, and both handle and hole perform the same duties as the handle and holes on an index plate of an ordinary dividing head. Arranged around the inside edge of the steel plate *A* are three clamps *E* which are operated by the handwheel *F* at the rear of the fixture. One revolution of the handwheel is sufficient to clamp the ring firmly in place. To locate the rings properly with relation to the cutters, a gage is located at the top and front of the fixture. The opening in the gage is just large enough to fit over one of the lugs in the rough casting and when in place the lug at the bottom of the ring is in position to be milled. When the ring has been properly set by the gage, the clamps are drawn down by the handwheel, locking it into place. The gage can then be withdrawn, allowing the holding plate to revolve as desired, and is held away from the work by a ball and spring arrangement directly behind it.

When milling, the table of the machine is fed by hand, bringing the work into the cutters, and a positive table stop prevents it from going in too far. After reaching this stop, the table is returned by hand, and the fixture indexed into the second position, this operation being repeated until the three lugs have been machined. The work may be removed by releasing the clamps by the handwheel *F*, and a fresh casting placed on the fixture. With this fixture the floor to floor time on each piece was reduced to 33 sec., cutting the old milling time approximately in half.

A Metal Disk Identifies the Producer

By Peter F. O'Shea

In the tap-making department of the Greenfield Tap and Die Corp. a sheet-iron disk is tossed into a pailful of product to identify the man who did the work. The disk is galvanized iron, 3 x $\frac{1}{32}$ in., and has a $\frac{3}{4}$-in. hole punched in the center so that it may be hung on a nail. Each disk has the number of a workman stamped into one surface in figures $\frac{3}{8}$ in. high. When the pan or pail of product goes to the inspection bench,



ONE OF THE METAL DISKS

the galvanized-iron disk in it tells which man is to be credited with the output or held responsible for spoiled work.

Each man is furnished with a dozen disks, all bearing his own payroll number. When a machine operator is ready to send a batch of product for inspection, it is much simpler and quicker for him to toss one of his disks into the pail than to stop and write his name on a paper card, which might become soiled or illegible.

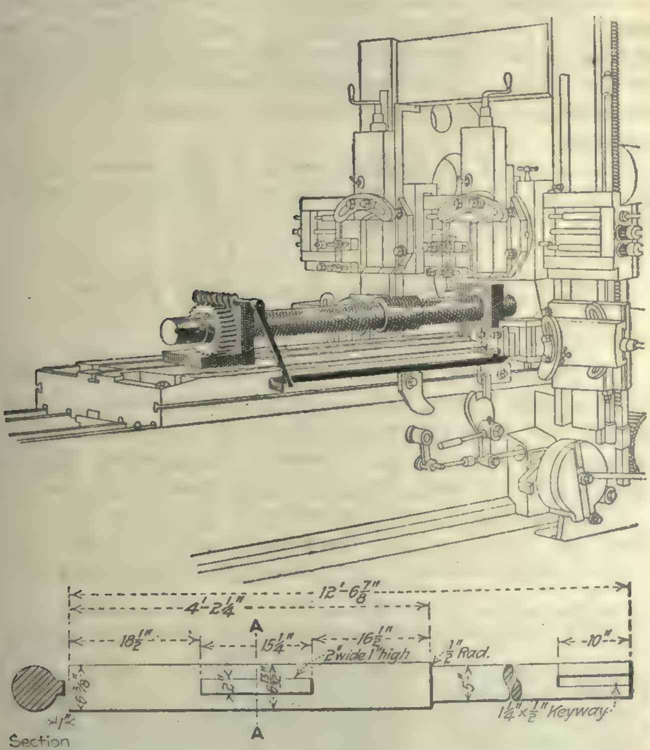
As fast as the product is inspected, the inspector hangs the disks on nails along his bench, and later distributes them to the men for use again.

A Homemade Circular Planing Rig

By F. F. Wolfe

The illustration shows a rig which was devised for planing that part of a large driving shaft which had a raised key made integral with the shaft. The shaft was $6\frac{13}{32}$ in. in diameter at the place where the key was, while the key itself was 2 in. wide, 1 in. high and $15\frac{1}{4}$ in. long.

Two brackets that had previously been used for a boring job on a Corliss engine happened to be on hand.



IMPROVISED RIG FOR CIRCULAR PLANING

These were fitted to the bed of a planing machine and the bore enlarged to make a close running fit on the shaft.

A wormwheel was fastened to the shaft by setscrews, its hub bearing against one of the brackets to take the thrust of the planing cut. Bearings for the worm-shaft were bolted to the bracket, and a rachet, with lever and pawl, placed on the outer end of the worm-shaft.

The planing machine was equipped with side heads and into one of these a bent bar was clamped in such a position that it would strike the pawl lever at the end of each stroke. By raising or lowering this head the feed of the work could be adjusted to suit the cutting conditions.

The rigging up of the device, including necessary alterations of parts used, and the planing of the shaft to a neat sliding fit in the hub of a large gear, occupied 12 hours.

Rejuvenating Obsolete Machine Tools

By E. A. Dixie

One is often at a loss to know what to do with machine tools which have become obsolete. In practically every shop there are lathes and other machine tools which because of their lightness have no place in the machine shop in these days of high-speed steels and intensive production.

The illustration shows an old Springfield Tool Co. lathe built 63 years ago. Originally, it was about 18 in. swing and no doubt as judged by the production of its contemporaries it was a satisfactory tool. At the time when it was decided to discard it, its scrap value was about $\frac{1}{2}$c. a pound. Although far too light for metal turning, the boss patternmaker was in need of a pattern lathe that would swing fairly heavy wooden patterns 30 in. in diameter between centers and above

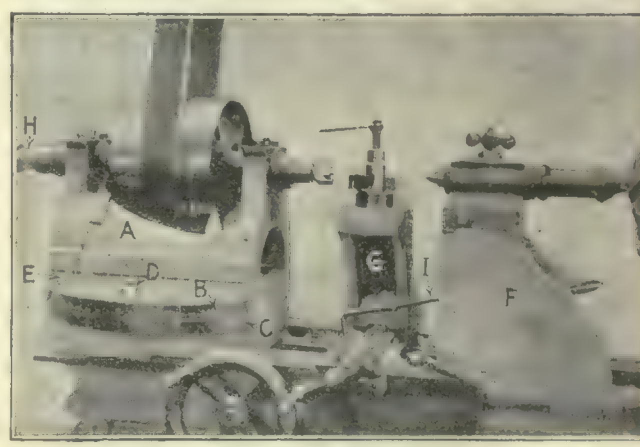


FIG. 1. THE OLD ENGINE LATHE NOW A PATTERN LATHE

this diameter on a faceplate at the rear of the headstock. So instead of scrapping the lathe it was turned over to the pattern department for alterations and installation.

The head *A* was mounted on a base *B* which in turn pivots on a sub-base *C* secured to the bed of the lathe. A central bolt passes through *B* and *C*. The sub-base *C* has a circular T-slot to accommodate the heads of the bolts *D* which clamp *B* and *C* together. It will be noted that a circular flange extends horizontally from *B* and

also from *C*. The flange of *B* is graduated up to 45 deg. on each side of the center. A center line on *C* assists in setting *B*. To assure that the head can be always set back to turn parallel a taper pin is fitted through *B* and *C* at *E*. It will be noted that this taper pin is chained to the lathe head so that there is no danger of losing it.

The tail center has been raised on the base *F* and the toolpost raised by the casting *G*. The original spindle of the headstock was replaced by the one shown. This has a right-hand thread on the front end and a left-hand thread on the rear end. While it is not in use the left-hand thread is protected by the small flanged collar shown at *H*. This flanged collar serves a double purpose, as a protector for the thread and also as a pulley for driving a band-saw sharpening machine located nearby.

The swiveling head is very handy for pattern work. Take for instance a job that recently went through the shop. This was a cone approximately 22 in. in diameter, 12 in. deep and had walls $\frac{5}{16}$ in. in diameter. For certain reasons it was advisable to have a separate core and not make the pattern so that it would leave its own core. The headstock was swiveled five degrees, the taper of the cone, and the outside of the pattern turned; with the same setting the corebox was bored, insuring practically exact parallelism of the inside and outside of the finished casting.

The graduated-head feature often works in well in connection with the other tools in the pattern shop, for instance: Where tapered segmental cores are used in producing a casting the pattern can be turned on the lathe, setting the swivel at say 10 deg. Owing to lack of balance it is seldom advisable to turn segments of circles or segmental coreboxes so these are usually cut out on the bandsaw. Ten degrees on the bandsaw give the same results as 10 deg. on the lathe so the two can be made to work together very nicely. At *I* is shown a little afterthought of the patternmaker. We all know about moving the tailstock away from the headstock by racking the carriage against it but the little hook shown connects the tailstock with the carriage and permits the tailstock to be racked toward the headstock.

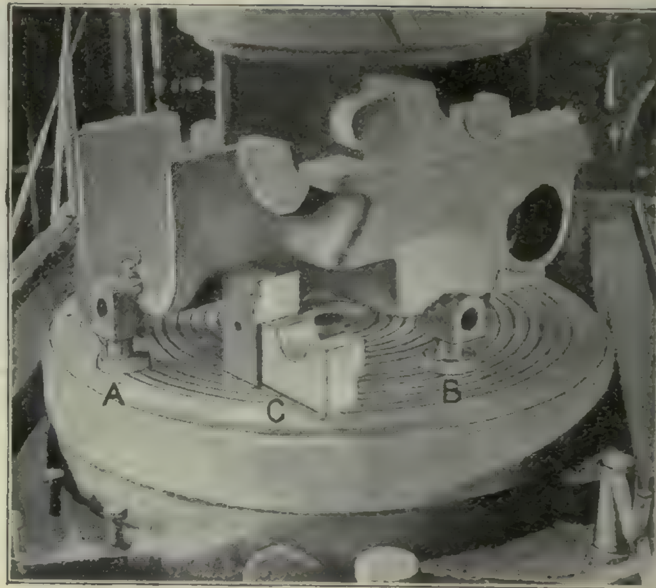
Holding Irregular Pieces on the Magnetic Chuck

Special Correspondence

The use of the magnetic chuck has increased beyond all expectations, but for the most part has been confined to the holding of objects which presented flat surfaces to the magnetic face of the chuck. The illustration shows a novel method of utilizing the magnetic chuck on work for which it has heretofore been considered necessary to provide special holding fixtures.

The work shown is half of a gear box and, instead of having a special holding fixture, it is supported on three special jacks, two of which are shown at *A* and *B*. The jack *A* is made with an opening on the side which fits over the edge of the casting and has a thumbscrew by which it can be clamped to it. The other jack is provided with a lip on which the casting rests, and the third jack is of a similar nature.

All of the jacks have a flat round base, 3 in. in diameter, and are held magnetically to the chuck, as well as conducting the magnetism to the work itself.



HOLDING IRREGULAR WORK MAGNETICALLY

These both support and hold the casting, and, as an aid in driving it against the cut of the grinding wheel, the steel blocks *C* are also placed on the chuck. Presenting a considerable magnetic surface, they serve as substantial stops to prevent the turning of the work on the chuck. The size of the work can be readily determined from the fact that the table is 26½ in. in diameter.

This method of holding work is the present practice of the Blanchard Machine Co., Cambridge, Mass., with its grinding machines.

A Gang Punch for Lead Plates

By Frank A. Stanley

The illustration, Fig. 1, shows a press outfit made for piercing lead plates for use in connection with battery work. The lead plates are about $\frac{3}{16}$ in. thick and approximately 16 x 20 in. in area. The punches number 368 all told and are arranged in 39 rows of 12 each.

The purpose of these punches is to pierce the lead sheet but not to cut out the metal completely and leave a clean sharp corner; but, rather, to throw up a burr

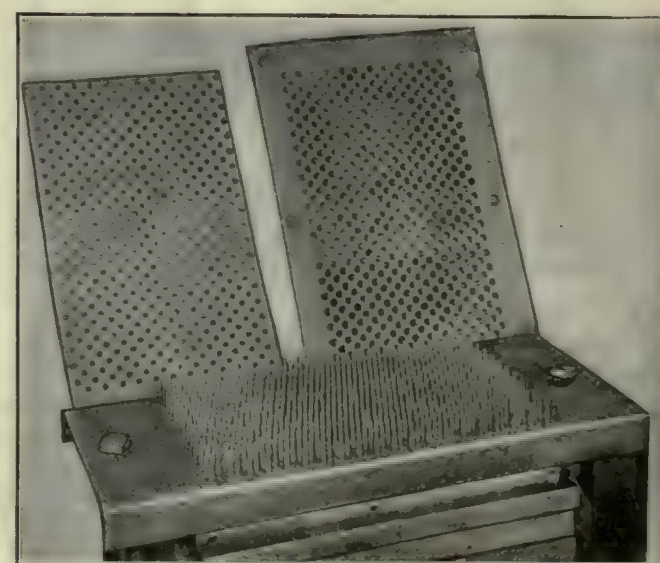


FIG. 1. THE GANG PUNCH AND THE WORK

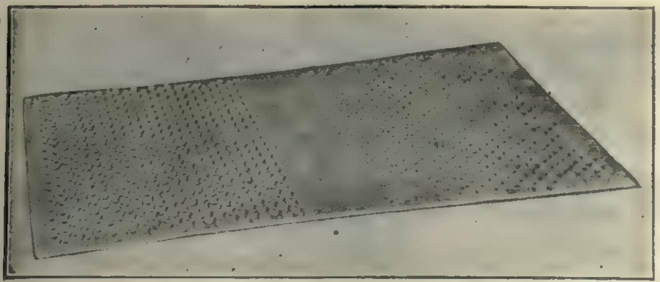
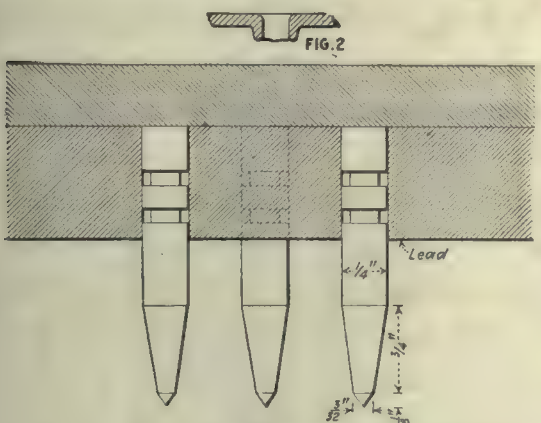


FIG. 3. HOW THE METAL IS THROWN UP ON THE UNDER SIDE OF THE PLATE

or fin on the under side of the plate just as a tapered center punch would leave a piece of sheet metal if driven through, the action being to indent the metal and then upon breaking through to form a shallow wall around the hole as in Fig. 2. This leaves the maximum area of metal upon the surface of the plate. The effect is illustrated by Fig. 3, which shows the under side of the plate as it comes from the press.



FIGS. 2 AND 4. FORM OF HOLE PIERCED AND A SECTION SHOWING METHOD OF HOLDING PUNCHES

A section showing the method of carrying the individual punches is represented in Fig. 4. These punches are made of drill rod ½ in. in diameter and the lower ends are tapered for a distance of ¾ in. from the body size down to $\frac{3}{32}$ in. They are then brought to sharp points which resemble closely the proportions of a regular center punch.

In making up the punch holder for this job the punches were set upright in a locating plate and lead

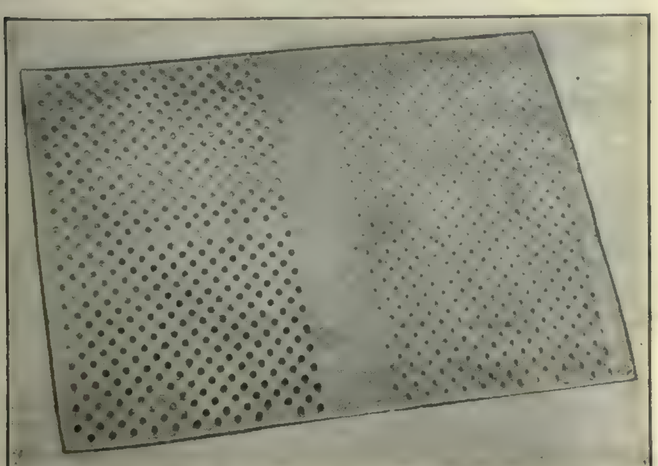


FIG. 5. SHOWING EFFECT PRODUCED BY DIFFERENT METHODS OF PUNCHING

was then poured into the surrounding form to inclose all of the punches and hold them securely by means of the anchor grooves, two of which are shown as cut around the body of each punch. The punches project from the face of the lead holder about 1½ inches.

This gang punch was originally tried out under a heavy drop and curiously enough, at least upon first thought, the punches could not be forced through the lead plate sufficiently to give the desired size of hole. The effect under this method is indicated by the small holes shown at the right-hand side of the double sheet, Fig. 5. When the work was transferred to a heavy punching machine there was no difficulty in forcing the punches through the desired amount and producing holes of the required diameter as shown in the left-hand side of the sheet.

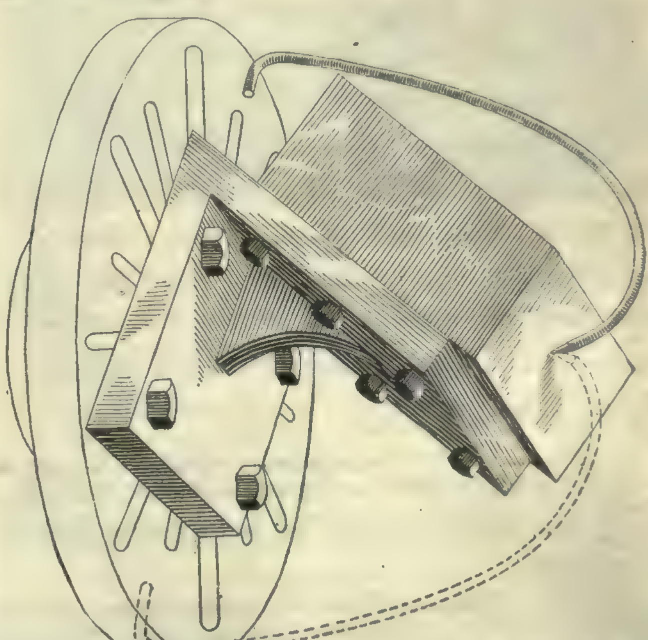
When we consider the total area acted upon by the 368 punches and also allow for the wedging action of the tapered ends, which would cause the metal to be compressed in all directions before the points of the punches could break through, it would appear that the very rapid blow applied under the drop did not permit of sufficient time for the metal to flow and as a consequence the force of the blow was absorbed and the punch brought to rest before the desired work had been accomplished. Under the relatively slow action of the punching machine, however, the flow of the metal took place naturally and the punches were forced through to the desired point without difficulty.

This press work was handled at the shop of the Gilro Machine Co., Oakland, California.

Locating a Job on the Lathe Faceplate

By Gustave A. Remacle

It sometimes happens that work to be bored on a lathe is of such shape that it is desirable to remove the faceplate from the lathe in order to clamp the job in place. In such cases the work may be located to nearly its proper position by bending a piece of rod as shown in the sketch and swinging it around to different points. I get the best results by bending the rod so that the end rests upon the face of the plate near its periphery.



LOCATING WORK ON FACEPLATE

A *Complete* Condensed Clipping Index of Equipment

IN our issue of July 26, 1917, we printed the first page of our Condensed Clipping Index of Equipment. This and subsequent pages attracted widespread favorable comment.

The cuts and data put on the index cards are condensed from the more complete descriptions previously appearing in our Shop Equipment News section.

Purchasing agents, factory managers, superintendents and others who wish to have descriptions of the latest mechanical productions readily available for quick reference, keep these cards on file and up to date.

Only equipment that has not been on the open market over six months is eligible for space in our Shop Equipment News section and, consequently, in the Clipping Index. For this reason, no complete card index can be made of the entire line of any one manufacturer, unless such equipment is described as it is first put on the market. This naturally excludes all equipment put on the market more than a few weeks previous to our first index page.

Many executives and purchasing agents, as well as manufacturers of equipment, have asked us to place entire lines of machinery in condensed descriptive form on our index cards. Space will not allow this.

However, we have a suggestion to make to manufacturers of equipment when they make up their catalogs and bulletins. It is this: Follow our plan and place a cut and specifications for each piece of equipment in card form, on the back pages of the catalog or bulletin containing the more detailed description. Put this information in easily detachable form either for the standard 3 x 5 filing card, or the 2⅜ x 3½ size which we use, and which, when pasted on a standard card, leaves room for prices or other notes to be penciled in.

In order to encourage the making and use of index cards of this kind, any manufacturer of shop equipment, may use, free of charge, our patented form of Condensed Clipping Index in his bulletins or catalogs.

Think this over, Mr. Manufacturer, and Mr. Sales Manager.

Isn't it worth while ?

Ethan Viall

Editor

SHOP EQUIPMENT NEWS

–Edited By–
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS · A weekly review of modern designs and equipment

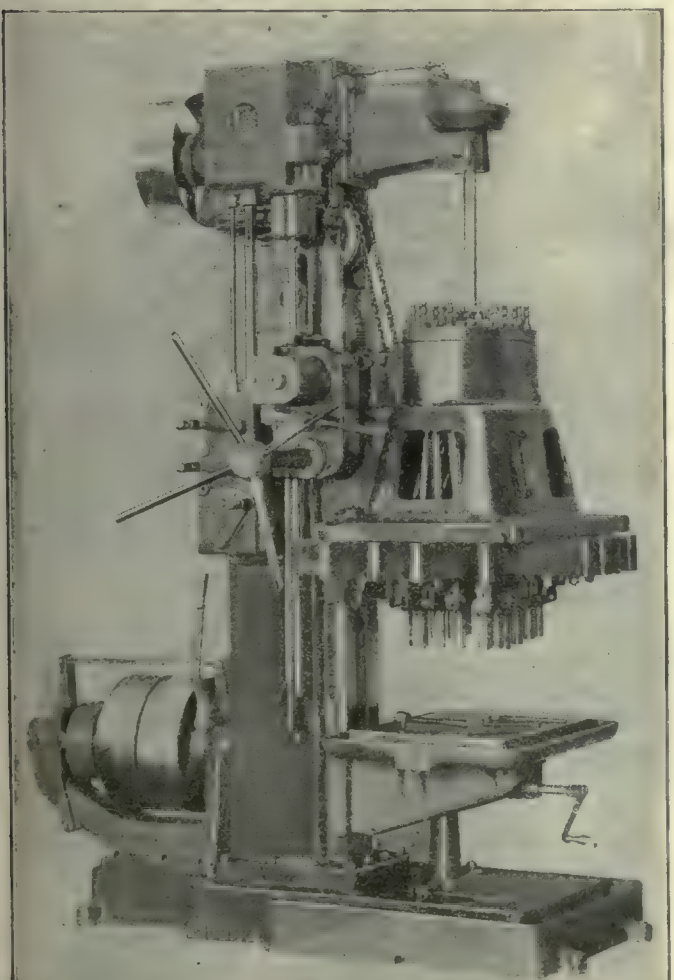
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX A continuous record of modern designs and equipment

Fox Multiple-Spindle Drilling Machine

The Fox Machine Co., 1804 West Ganson St., Jackson, Mich., has added to its line a multiple-spindle drilling machine known as its No. D-22, as illustrated.

The base is provided with T-slots, has a broad and deep oil channel and provision for straining the oil or cutting compound before entering the reservoir. The column is of box section and accommodates the gear box at the top, the counterbalance weight on the inside and the oil pump and tank on the right side. The drive is of the constant-speed type and power is delivered to the head of the machine through a disk clutch and belt. The gear box contains all shafts and gears necessary for the three changes of fast and slow spindle-speeds. For the feed, power is taken from a variable-speed shaft through two sets of cone gears and through a worm and gear on the vertical feed shaft. All gears are inclosed and lubricated, and the thrust of all shafts is taken by ball bearings. The oil pump distributes oil to the gears on top of the machine.



FOX MULTIPLE-SPINDLE DRILLING MACHINE

Specifications: Head travel, 24 in.; drilling area, 12 x 18 in. rectangular, or 16 in. round; center of head to face of column, 14 in.; work surface of table, 18 x 24 in.; table to base, maximum 29 in., minimum 10 in.; height to top of frame, 99 in.; height to top of drive shaft, 120 in.; maximum number of spindles, 1 speed 24, 2 speeds 16; pulley, 16 x $5\frac{1}{4}$ in.; speed, 450 r.p.m.; hp., 5; floor space, 46 x 75 in.; weight, net 5,000 lb., crated 5,500 lb.; will drill eight $\frac{3}{4}$-in. or twenty-four $\frac{3}{8}$-in. holes at speed of 70 ft. per minute and feed of 0.0045 in. per revolution in cast iron.

The saddle has a long bearing on the column, is separate from the head to which it is bolted and is gibbed to the column. The spindle-bearing adjusting-arm is claimed to be firm, to hold the spindles perpendicular with the least possible deflection under heavy duty and to be easily adjusted. The universal joints are driven by keys and are easily removable. The machine can be driven either by motor or belt.

Improved Spindle Construction for Badger Grinding Machines

The Badger Tool Co., Beloit, Wis., has adapted a ball-bearing spindle mounting, illustrated herewith, for its grinding machines. This type of construction uses one radial bearing in each housing, together with an

BADGER BALL-BEARING-SPINDLE CONSTRUCTION

additional double row of ball-thrust bearings in the left-hand housing. To aid in obtaining a more perfect mounting the bearings are fitted into individual housings which are detachable from the main body of the machine. Consequently, these are relatively small castings and it is possible to maintain a better grade of workmanship when fitting in the bearings.

The ends of the Badger spindles are turned and ground to an accurate taper and the wheel collars are drawn up on the taper by means of a locking nut. Solid renewable felt rings are placed in all end caps and are held by the removable end plates shown. A special grease filler cap is provided to prevent dirt and grit from entering the bearings.

Champion All-In-One Furnace

The portable furnace illustrated is built as a unit by the Champion Kerosene Burner Co., Kenton, Ohio. It was designed to meet the requirements of the structural steel fabricator and is suitable for outside work as well as inside. It is further recommended by the makers for heat-treating and general forge work. Being entirely self-contained it can be moved about at will even when in operation. The heat is generated by a

CHAMPION TYPE "A" ALL-IN-ONE FURNACE

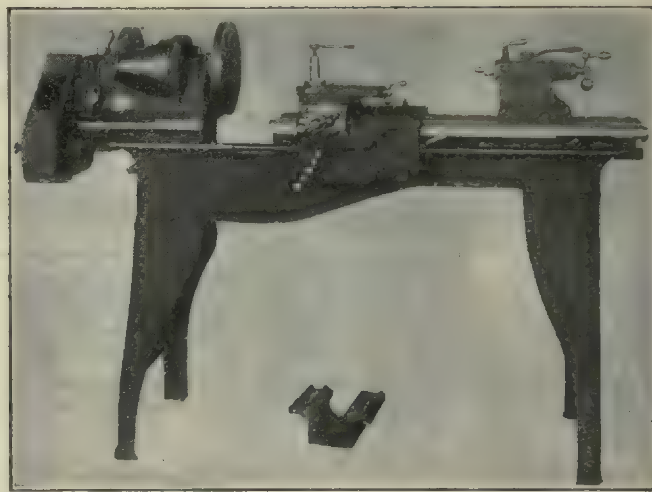
kerosene burner that is said to produce a temperature of 2,500 to 3,000 deg. F. in five minutes' time. The nature of the flame is such that there is a minimum of oxidization smoke and odor. Several types are made to suit various conditions under which they are to be used. For close quarters inside, a small model with a cylindrical firebox is furnished.

Star Gap Lathes

The Seneca Falls Manufacturing Co., Inc., Seneca Falls, N. Y., has brought out two sizes of gap lathes—one with an 11 and 18 in. swing and the other with a 13 and 21 in. swing. The former is shown in the illustration.

The beds are of the box-section type, thoroughly braced by cross-webs and made very heavy through the gap sections to insure stiffness. Bridge pieces are furnished to close up the gaps when the extra swing of the gaps is not needed. Beds are made 5, 6, 7, 8 and 10 ft. long.

The crossfeed screws are supplied with micrometer collars graduated in thousandths of an inch. The



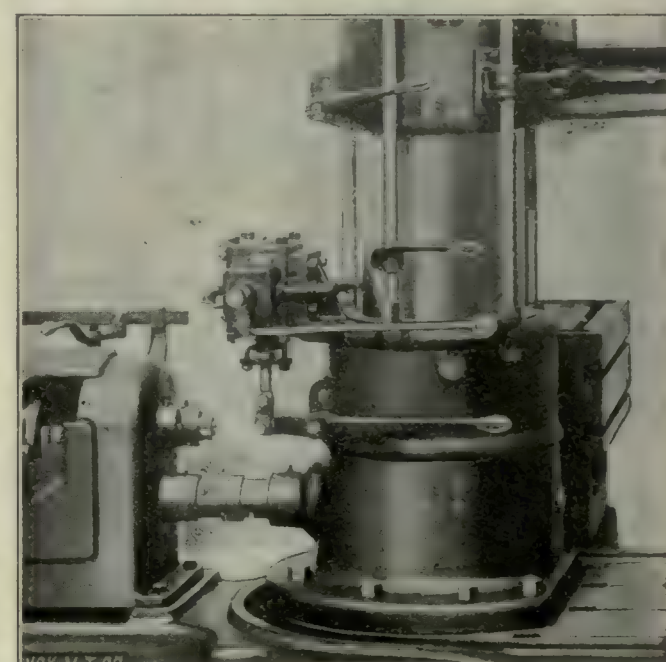
11 AND 18 IN. SWING STAR GAP LATHE

aprons have safety devices, so that longitudinal feeds and split nuts cannot be engaged at the same time. All standard threads, from 3 to 72, can be cut, including 11½ and 27 pipe threads. The lathes can be equipped with transposing gears or metric pitch lead screws for cutting metric threads.

The extra attachments that can be furnished include raising blocks, quick-change gears, taper attachment, motor drive, draw-in chuck, milling and gear-cutting attachment, etc. Weights: 11 and 18 in. swing gap lathe with 6-ft. bed, 880 lb.; 13 and 21 in., with 6-ft. bed, 1,390 pounds.

Fosdick Arm-Clamping Device for Radial Drilling Machines

The Fosdick Machine Tool Co., Cincinnati, Ohio, is equipping its radial drilling machines with a combination clamping device that operates either by compressed air or by hand. It is attached near the base of the column and as may be seen from the illustration has



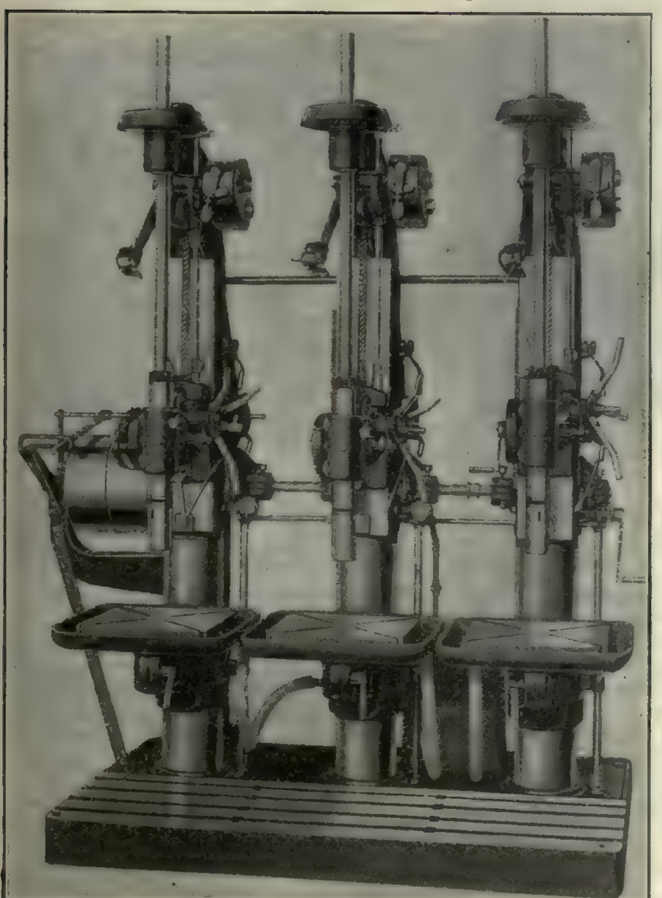
FOSDICK ARM-CLAMPING DEVICE FOR RADIAL DRILLING MACHINES

no connection with the spindle head. The appliance being located directly at the point of clamping simplifies the arrangement. It is intended for low pressure, the relief valves being set for 45 lb., though it is said to operate without shock or jar at pressures of 150 lb. or more owing to the air cushion that is provided at each end of the cylinder. The valve is of the flat disk type and has six ports which gradually admit or discharge the air. The valve is controlled mechanically by a horizontal shifting rod that extends the full length of the radial arm and is accordingly within easy reach of the operator at all times. If the supply of compressed air should fail the clamp may be operated by hand in the usual manner.

Barnes All-Geared 26-In. Gang-Drilling Machine With Sliding Heads

The Barnes Drill Co., 814-830 Chestnut St., Rockford, Ill., has placed on the market a 26-in. all-geared gang-drilling machine with sliding heads as shown in the illustration.

The heads are counterweighted and are gibbed to the column faces. They can be raised or lowered by means of the usual racks and pinions and may be held at any point by quick-acting clamps. Adjustable stops are provided so that the heads can be repeatedly located at the same place. This machine can be furnished with either round or square tables and automatic reversing mechanisms for use in tapping.



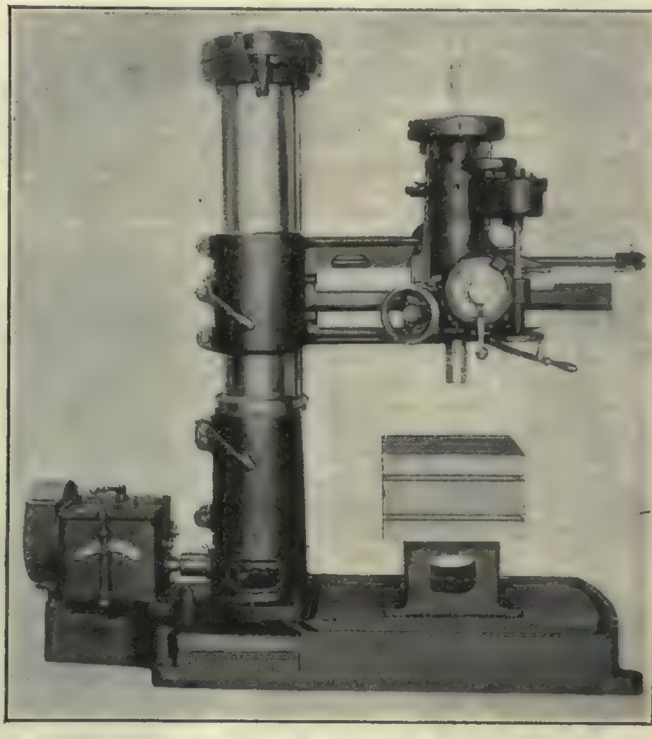
BARNES ALL-GEARED 26-IN. GANG-DRILLING MACHINE WITH SLIDING HEADS

Specifications: Capacity, 2 in. hole; distance, center to center of spindles, 24 in.; face of column to center of table, 12 in.; diameter of spindles, 1 13/16 in.; hole in spindle, No. 4 Morse taper; distance, spindle to table, maximum, 40 in.; spindle to base, maximum 53½ in., minimum 18½ in.; vertical travel; spindle, 14 in.; head, 23 in.; table, 20 in.; square table, 18 x 18 in.; round table, 23 in. in diameter; speeds, eight, 23 to 230 r.p.m.; feeds, eight, 0.005 to 0.075 in per rev.; all speeds and feeds independent of each other; floor space, 49 x 70 in.; speed of tight and loose pulleys, 325 r.p.m.; weight, net, 6,330 lb.; crated, 6,670 lb.

Morris Radial Drilling Machine

The Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio, has brought out a re-designed radial drill which is illustrated herewith.

The changes embody the following: Inclosed type of head, back bracket and tapping attachment gears fully inclosed, dial depth gage on head, changes in head traversing device, gears in column cap do not revolve except when arm is being raised or lowered, base is deeper and heavier with oil channel completely around it ways on arm widened and some changes in gear bracket on back.



MORRIS RADIAL DRILLING MACHINE

Specifications: Distance spindle to base (maximum, 52⅝ in.; minimum, 16¼ in.); maximum distance spindle to table, 31⅜ in.; spindle traverse, 12 in.; taper hole in spindle, Morse No. 4; spindle speeds (cone drive, 20 to 400; speed-box drive, 18 to 400); work surface of table, 18 x 18 in.; work surface of base (with 2½-ft. arm, 30 x 35 in.; with 3-ft. arm, 30 x 41 in.; with 3½-ft. arm, 30 x 47 in.); weight, crated (with 2½-ft. arm, 4,000 lb.; with 3-ft. arm, 4,425 lb.; with 3½-ft. arm, 5,165 lb.)

This machine can be furnished with either a 2½-, 3- or 3½-ft. arm.

"Velco" Push Keyway Cutters Erratum

In the article entitled "Velco Push Keyway Cutters," on page 800, Vol. 51, the address of the maker, the V. E. La Pointe Manufacturing Co., was incorrectly given. It should have been Manchester, Conn., and we request all our readers who intend keeping their copies for reference to make this change.

Sparks from the World's

By E. C. Porter

Y. M. C. A. Schools File Applications for Machine Tools

Distribution of machine tools to Young Men's Christian Association schools, which have made application to the Director of Sales of the War Department for equipment under the Caldwell Act, will be conducted by the international supervisor of technical education of the association, according to a plan approved by the Director of Sales, Jan. 16.

Thirty-five Y. M. C. A. schools, comprising in the neighborhood of 44,000 students, have already filed application with the machine-tool section and other bureaus of the War Department for machine tools.

The office of the Director of Sales, through the machine-tool section, has sent out 1,000 purchasing coupons to various educational institutions, entitling them to call upon the various district offices of the several bureaus for the machine tools desired. A coupon is issued for each machine tool asked for by a school.

War Department Issues Bulletin Listing 4,000 Different Machine Tools

A revised and corrected list of surplus machine tools held by the various bureaus of the War Department, containing about 4,000 different machine tools valued at approximately $10,000,000, has just been issued by the Director of Sales.

This bulletin contains a complete description of every item listed, giving the make, size, capacity, condition, location and other important information of each tool. Only in the case of new tools, that is, where the condition is 100 per cent, is the selling price given. The bulletin as a whole contains the most comprehensive list of machine tools yet issued by the War Department.

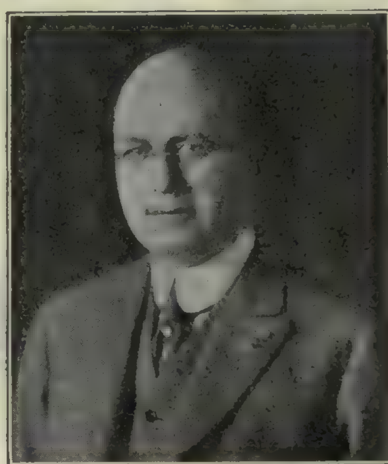
While the descriptions contained in the bulletin are based on the best information obtainable, the Government does not guarantee the accuracy of such descriptions or warrant the condition and fitness of the machine tools or their suitability for the use intended to be made of them.

As a special feature, the bulletin contains instructions to educational institutions contemplating the acquisition of surplus machine tools under the Caldwell Act.

In view of the limited number of machine tools suitable for the use of educational institutions, schools desiring to acquire equipment under the act are urged to consummate their purchase within the time limit provided by the rules governing the distribution of machine tools to educational institutions.

Westinghouse Air Brake Company Organizes Export Department

In order to provide better facilities for handling its export business and for the development of its foreign trade the Westinghouse Air Brake Co. has organized an export department with headquarters in the Westinghouse Building, Pittsburgh, Pa.



E. A. CRAIG

The new department began operation on Jan. 11, 1920, and is in charge of E. A. Craig, export manager.

Mr. Craig has been associated with the Westinghouse Air Brake Co. for thirty-two years. In 1905 he was appointed auditor and assistant secretary and in 1906 he was made Southwestern manager of the company.

This new export department will be represented in the New York office by W. G. Kaylor and in South America by R. M. Oates.

Machinery Club of Chicago Increases Space

The Machinery Club of Chicago has been able to acquire more space on the same floor of the building which they now occupy and this is being rapidly fitted up for the purposes of the club. The change will give the Machinery Club approximately 3,200 sq.ft. of additional floor space which will be used largely for recreation purposes.

Meeting of Engineers' Society of Milwaukee

The regular monthly meeting of the Engineers' Society of Milwaukee was held under the auspices of the Milwaukee section of the American Society of Mechanical Engineers on Wednesday evening, Jan. 14, 1920, in the assembly room of the Athletic Club. The society was addressed by Max Rotter, consulting engineer for the Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo. He gave an illustrated talk on "Diesel Engines with Particular Reference to Recent Two-Cycle Engines." Mr. Rotter was for a number of years consulting engineer for the Allis-Chalmers Manufacturing Co.

Bessarabia Calls for American Plows

According to a report just received by the National Foreign Trade Council from the director of industry and commerce of Bessarabia, there is a widespread demand in that market for American agricultural machinery. It is estimated that over 30,000 plows are needed at once. Very high prices are also being paid for spades, shovels, rakes, sickles, scythes, forks, weeders and winnowing machines.

On account of the lack of overseas transportation, this country has been unable to export any of its produce and to import the manufactured goods which are so urgently needed. With the establishment of direct lines from the United States to the Near East, American exporters will find it worth while to make a careful study of this market.

There is a great shortage of rolling stock for the railroads. Of 310 locomotives which Bessarabia possesses, only seventy-four can be utilized. Only half of the 3,000 freight cars are fit for service.

Janette Manufacturing Company Moves Into New Building

The Janette Manufacturing Co. has moved into its new factory building at 556-558 West Monroe St., Chicago, Ill. This is a seven-story and basement building, comprising a floor space of 60,000 sq.ft. The main floor will be used for offices and shipping department; the second floor for engineering and drafting room, and restaurant; and the five top floors will be used for manufacturing electric motors and generators.

Industrial Forge

News Editor

One Million Pounds of Tool Steel Offered for Sale

Approximately 1,000,000 lb. of tool steel are being offered for sale by the surplus property division, Office of the Quartermaster General of the Army, bids for which will close Feb. 17, 1920.

Included in this quantity are the following items located at Baltimore, Md.: 89,600 lb. of flat bars, 17 ft. long; 170,210 lb. of square, 18-ft. bars; and 274,655 lb. of hexagonal bars. More than 225,000 lb. of annealed round bars, ⅝ in. in diameter, are also being offered for sale in the same lot.

In addition, smaller lots of high-speed steel, manufactured by E. T. Ward & Sons, Raeburn, Pa., mostly 18 per cent tungsten, will be submitted for sale under sealed proposals. Bids may be submitted for any quantity above one bar to any of the district zone supply offices.

Full information regarding the material, places of inspection, conditions regulating purchases and specifications may be obtained from the surplus property division, Office of the Quartermaster General of the Army, Washington, D. C.

Would Transfer Surplus Machine Tools to Vocational Education Board

Representative Kahn, chairman of the Committee on Military Affairs of the House, has introduced a bill providing for the transfer to the Federal Board for Vocational Education "such machines, appliances, tools and equipment pertaining to the military establishment that may be found surplus and no longer required for military purposes and which the chairman of the Board for Vocational Education shall certify to be needed for the purpose of providing vocational rehabilitation for discharged disabled soldiers, sailors and marines." The transfer is left to the discretion of the Secretary of War.

Canada Gets Large Order from Belgium for Railway Equipment

An order for ten million dollars worth of railway equipment has been received by Canada from Belgium. This order is subject to arrangement of credit facilities under the new plan of specific accommodation to be granted by the Canadian Government where needed.

The order, which comes from the Belgian Minister of War to the Canadian Trade Commission, is for fifteen locomotives and three thousand cars. It is expected to be distributed among Montreal Locomotive Works, Kingston Locomotive Works, National Steel Car Company, Canadian Allis-Chalmers and other concerns which have been negotiating with the Belgian authorities for some time.

Erwin Frudden Appointed Chief Engineer Hart-Parr Company

Erwin Frudden has been appointed chief engineer of the Hart-Parr Co., Charles City, Iowa. Before accepting this position, Mr. Fudden was the chief engineer of the Buda Motor Co. at

ERWIN FRUDDEN

Harvey, Illinois. He was formerly in charge of engineering and production at the Parrott Tractor Co. During the war Mr. Frudden was a captain in charge of production of all automobile equipment for the Army in the New York zone.

Meeting of Engineers' Club of Cincinnati

"The Evolution of Automotive Electrical Ignition" was the subject of a talk by R. C. Fryer, superintendent of the garage of the Union Gas and Electric Co., before the Engineers' Club of Cincinnati on Thursday, Jan. 15.

School Requisition for 2,000 Machine Tools

Army reconstruction schools, which have undertaken the task of instructing disabled soldiers and sailors along technical lines, have requisitioned the Director of Sales of the War Department for 2,000 machine tools, available for educational purposes under the Caldwell Act.

Railroad Legislation Pending Before Congress

At the annual dinner of the Chamber of Commerce of Buffalo on Jan. 15, 1920, Thomas De Witt Cuyler, chairman of the Association of Railway Executives, discussed the railroad legislation pending before Congress. We present an abstract of his remarks to indicate the attitude of the professional railroad men of the country on a very important matter.

For two years now, the Government has operated the roads. When they were taken over, the general belief was that the great question to be settled was whether they would return to private ownership or remain forever in the possession of the Government. That question now is not a pressing one. Government operation for the two years has convinced the country in every quarter that public ownership is not desirable and that the roads should and can be operated by their owners.

The question, therefore, is how shall they be returned. Shall they be returned under the laws that existed prior to their taking over by the Government or shall such legislation be enacted as will enable the owners to operate their properties for the benefit of the public and their own profit? In other words, are the laws to be broad and strong enough to maintain the roads, provide the cost of operation, necessary additions and betterments, a fair return on the capital invested and a system of credit in the future that will provide for betterments and extensions that will be required incessantly for all time to come?

Any measure of legislation that falls short of this will be inadequate and will tend ultimately to government ownership.

To meet this situation arising from the return of the railroads on March 1st, two bills have been introduced into Congress; one in the House of Representatives known as the Esch bill; and the other in the Senate known as the Cummins bill.

The Esch bill proceeds generally on the theory that the Interstate Commerce Commission, whatever its shortcomings have been in the past, shall be the arbiter of the fate of the railroads in the future. They shall be the rate-makers, and in fact, the absolute controlling body over the railroads. But there is no adequate rule of rate-making provided in the Esch bill to guide the Interstate Commerce Commission, and so we are left to

its judgment and discretion solely as to just what the railroads need. Nor is there any adequate provision for dealing with labor. The bill in point of fact while proceeding on the sound principle that a Government guarantee should not go with private ownership, does not, in lieu of such guarantee, provide any proper rule of rate making. If, therefore, the Esch bill is not improved—and I am free to say that it can be improved upon the foundations laid down by the Committee—it would soon bring us to the same condition, as to credit and the inability of the railroads financially to protect themselves, that existed just before the war began.

On the other hand, the Cummins bill practically provides for a guarantee, but not an adequate one. The provision is that the roads shall receive not more than $5\frac{1}{2}$ per cent return on their property investment and an additional one-half per cent for additions and betterments, and then proceeds to provide that all net earnings over 6 per cent shall be divided in certain proportions among the roads not earning this excess amount and the Government.

In other words, for the first time, so far as I am aware, in our country, the socialistic doctrine is introduced, that those who make their earnings under the law and as a result of the law by wise and proper management, shall surrender a portion of these earnings for the benefit of those who have been less fortunate. It is hard to see how such a provision can be enacted constitutionally, but even assuming that such a provision would be lawful, many of us feel that it violates the sound economic laws upon which this country was built and has prospered. If you once start the principle that the roads must give up a certain portion of their earnings for the benefit of others, the doctrine, socialistic in the extreme, will spread to other industries.

If the roads are to be deprived of reasons for initiative and the incentive to make the very best earnings they can, their enterprise will be stifled and the roads will not be maintained and improved in a manner adequate for their proper operation.

Nor could railroad credit be established on such a basis—at least so far as stock investment is concerned. What investor would buy railroad stocks with knowledge that their dividends are limited, and more than that, jeopardized by the possible inability of the roads to maintain and improve their properties? And where would be the incentive for the development of the country, a considerable portion of which is still in its infancy? New lines would rarely be built.

There are other features of the Cummins bill that are wise and beneficial. The provision as to a Transportation Board, made up of high-class men, whose duty shall be to study the transportation system of the country and recommend to the Interstate Commerce Commission what a proper rate would be in order to maintain the roads as they should be maintained, is a wise one. The provisions as to strikes, while extremely drastic, lay the foundation for some law whereby strikes will be curtailed and arbitration insisted upon.

The proposals of the Railway Executives proceed on the assumption that the American people want the railroad companies to be private enterprises under Government control.

They provide for a Board of Transportation largely similar to the provision in the Cummins bill, but with greater powers.

They make the Interstate Commerce Commission a judicial body and take away to a considerable extent its administrative functions.

They provide that intra-state rates shall be subordinate to and not in conflict with the interstate rates.

They provide that it is the duty of the Board of Transportation to see to it and certify to the Interstate Commerce Commission that the return received by the railroads shall be adequate to meet their operating expenses, including the cost of labor, material and supplies, interest and dividends on present capitalization and indebtedness and credit for future borrowing to meet the needs of the roads as to improvements and extension.

An address has recently been delivered by the present Director General of Railroads before the Bar Association of New York, in which he proposes that all the roads of the country shall be consolidated into a few great systems and that Government control shall continue until this is accomplished. I cannot believe that such a consolidation over night would be either wise or beneficial.

The consensus of opinion of the railroad men of the country is that actual or potential competition between strong, well-balanced railroad systems spells progress and efficiency. The consolidation of lesser lines needed to fill out or to create these great systems should certainly be permitted, under Government approval, but it is a grave question if the country would be well served by a few great systems, the operation of which would tend to stifle enterprise and become perfunctory in its nature.

You may by improvident legislation destroy securities and the financial interests of the roads, but you cannot destroy the railroads without destroying the country. This transportation system is its most vital interest and it should be adequate and capable of enlargement whenever the demands of the country require it. Therefore, it is to that vision that I desire to direct your thought. It is your fight as much and more than the fight of the owners of railroad securities, and if you are to prosper in your business, if your country is to grow, you must see to it that transportation is provided.

A Gasfitter's Invention for Armless Men

GEORGE THOMAS, gasfitter of Edinborough Co., England, recently gave a demonstration of an appliance which he has invented for the use of armless men. It is reported that this machine, which is worked by the feet, can do anything a man can do with two arms. Mr. Thomas, the inventor, is shown seated in the accompanying illustration, demonstrating how the machine can be used for writing.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, JAN. 2, 1920.

Writing during the lull which occurs at the opening of the year, one cannot help being struck by the different commercial conditions which prevail in Great Britain as compared with the pre-war period, and more particularly with the earlier section of the war period itself. Formerly, it was the seller that competed for the favor of the buyer; now, on the contrary, owing largely doubtless to the recognized shortage of supplies, buyers are competing one with another, and the natural tendency is for prices to rise.

Another unusual feature is that, to support demands for increased wages, workmen are now tending to criticize those in charge of industry on the ground that they are not sufficiently alert in the use of improved means and methods of production and transport. Certain workers, the miners for instance, have in fact burned their boats as regards opposition to the introduction of machinery. The whole of Great Britain looks forward to a year of prosperity, as measured at least by receipt of orders at high prices. Many materials are scarce and dear and such actions as the impending increase by the government in railway freight charges must tend to limit trade. But apart from labor troubles, one of the main handicaps likely to be experienced is the relative shortage of machinery for production. Workers, too, are pressing, for the reasons hinted at, for more efficient methods of distribution of goods, and a public inquiry is to be held into the economic effect of the 16s. standard daily wage demanded for the dock and riverside workers. The inquiry will probably be held as the result of the industrial courts act which was passed at the last session of parliament and, at any rate if the workpeople can have their way, the scope of the inquiry will be wide.

No one has yet estimated closely the effect of the change in railway rates on selling prices, but it is very generally intimated that the ultimate increase will be considerably more than that due to the raised rates. The figure of £1 a ton has been mentioned in connection with pig iron, but this has rather reference to increased charges for coke. In Birmingham it has been reported that certain steel billets from America are being offered considerably below the charges of Welsh makers. To illustrate the advance in prices, it may be mentioned that in the Glasgow district plates for ships and boilers are at between three and four times the pre-war prices, with no present hope of reduction.

The ease with which orders can be obtained for the home market has led to the danger that the importance of foreign trade for the prosperity of Great Britain may be overlooked in the desire for easy profits. The Department of Overseas Trade is therefore pressing forward commercial exhibitions of goods suited to given markets, these exhibitions being moved from place to place, outside Great Britain, of course, in order to keep merchants and others in exhibition districts well educated as to British products. In addition, it is proposed that showrooms to exhibit British manufactures shall be opened in some twenty or thirty of the chief cities of the European continent, exhibitions of goods being arranged in rotation; that is, the class of exhibit shown would not be permanent for any particular place. A great war exhibition will be held in the Crystal Palace in May next, where some 50,000 sq.ft. of space will be devoted to engineering and electrical objects, and further, a special oil exhibition will be organized. Previous to this, however, a British industries fair will be held in the same place, and similar fairs in Birmingham and Glasgow, and the occasion will be taken to see how far the idea of peripatetic exhibitions and estabished continental showrooms is likely to be supported. The department concerned will work, if necessary, in conjunction with organizations already in existence to further British export. The Federation of British Industries is particularly mentioned. This federation has now taken over the British-China trade bureau. The latter has an organization throughout south China and, it is asserted, "exercises a controlling influence over nearly 100 newspapers published in the vernacular." Free of charge, it introduces British manufacturers to merchants in China.

Announcement is made that a census of production will be taken in Great Britain in 1921. It will not be all-embracing, but the engineering trades are of course included. Concerns employing, on an average, not more than five persons, exclusive of officers of the company or members of the firm, will not have to make returns, but must make signed declarations as regards the average number of persons employed during 1920.

To deal with the handicap of unemployment, the government proposes to extend the national unemployment insurance scheme so that it will cover almost every employed person between the ages of sixteen and seventy. The wage limit has not yet been stated, but the contributions will be at an equal rate for employer and employed — 3d. for each man and 2½d. for each woman, with one-third of the combined contribution, that is, 2d. in the case of each man, payable by the state.

Reference has been made in these columns to the inquiry instituted by the British Engineering Standards Association on limits and it will be recalled that the committee concerned was unable to make a definite recommendation, though it was clear that the hole rather than the shaft should

To Technical Educators of the Country

OHIO and Michigan schools are leading in the filing of the questionnaires requisite to the securing of machine tools under the Caldwell Bill. Consequently, they will be in a position to obtain first choice from the available supply.

If you have not received your questionnaire write at once to the Director of Sales, Munitions Building, Washington, D. C., and ask for it. If you have received it and have not returned it, do so at once. We urge this action because there seems to be a strong possibility that the supply may not be large enough to go round.

* * *

The *American Machinist* has put up a strong fight to make these tools available for you and now that success has crowned our efforts we want the distribution to be as widespread as possible.. A copy of the questionnaire and letter of instructions from the Director of Sales appeared in our issue of Jan. 1.

* * *

If you are loaded up with worn-out tools why not sell them for what you can get in the second-hand market, where prices are now high, and apply the receipts on the 15 per cent purchase price of the new and up-to-date tools of the War Department? Here is a golden opportunity to exchange old tools for new without spending any of the cash in your limited equipment funds.

The Director has just issued a bulletin describing 4,000 tools. Ask for a copy when you write him. Once again, don't delay if you want your share of this valuable equipment! Remember the early bird!

in the general opinion be the basis. It was known that about the same time the German engineering industry had been investigating the same subject, though with what result was not clear in Great Britain. The editor of the European edition of this journal therefore wrote to the Verein Deutsche Ingenieure, Berlin, and in reply heard that, to translate: "In German industry, so far, the following final resolutions have been adopted: (1) The temperature of reference is 20 deg. Celsius. (2) The zero line is the limit line; that is, the nominal dimension for the shaft is the maximum dimension of the same from which deviations are only allowed downward. For the bore the nominal dimension is the smallest dimension of bore. Deviations are only permissible upward." What was, however, astonishing was the further suggestion that in all probability it is the standard shaft that will be adopted, supplemented by the statement that "those that were hitherto partisans of the standard bore in German industry incline more and more to the view that the standard shaft is the right one."

Trade Currents From New York, Cleveland, and Chicago

New York Letter

An otherwise eventless week in the local machine-tool field is relieved by the announcement of several expected price increases, a heavy demand for small woodworking machinery, and considerable improvement in deliveries.

Certain makes of planing machines were advanced 15 per cent, milling machines soared to 10 per cent above last quotations, boring-mills were increased 20 per cent and those "in the know" say the "end is not yet."

Deliveries are improving. A representative firm offers spot delivery on No. 2 milling machines, thirty to forty-five days on No. 1 milling machines and two to three weeks on standard cutting machines. Other firms make very favorable delivery dates, so, based on current reports, there should be an improvement in deliveries shortly.

Small, motor-driven machines of all types are leading in inquiries among local dealers. One of the larger houses issued a recent catalog supplement featuring fractional horsepower motor grinding and buffing machines and the like, and reports that the sales of this class of equipment are reaching record proportions.

Small group orders, and singles still dominate sales. There is, however, an air of expectancy based on recent industrial events, that the next few weeks will see some unusually heavy unit purchases. A recent order to the Submarine Boat Co. for thirty-two ships of 5,500 tons each may reasonably result in a large list of machine tools.

The building trades are again active after three years of "innocuous desuetude," and with $150,000,000 worth of construction in sight, the machine-tool trade obviously will benefit from the mechanical auxiliary end.

Change-overs from coal to fuel oil by the larger fuel consumers in New York City are now permitted by the authorities. The Singer Building, and the Hotel Astor are converting their coal burning plants. With the thousands of change-overs that will certainly follow this pioneering of the buildings mentioned, a vast industry in fuel-oil burners and their auxiliaries will pay handsome tribute to local machine-tool dealers.

Pneumatic tools are going strong, particularly in export trade. For the month of November, air compressors valued at $125,634 went overseas; and a steady stream of attendant tools is following.

Exports of machine tools from this port in November, most of them bought locally, reached the substantial mark of $2,925,708. Of this amount, $404,390 went for lathes. Other machine tools brought $660,966. For metal-working machinery, exclusive of, but allied with, machine tools proper, $1,860,352 was received. This was November, 1919, and there has been a substantial increase in the export trade since then.

Little change is noted in the used-machine-tool situation. There is a tendency among dealers to buy shops as a unit, rather than individual machines. The demand for all lines is steady, with a substantial volume of business evident.

The Watervliet Arsenal is in the New York market with used equipment. The standard machines sell readily at good prices, but specials are sluggish.

The general tone of the machine-tool market is good. Many concerns are sold out on their factory allotments, and are forced to refuse im-

Domestic Exports of Metal-Working Machinery from the United States by Countries During November, 1919

Countries	491 Lathes	492 Other Machine Tools	493 Sharpening and Grinding Machines	495 All Other
Belgium	129,837	8,305	6,924	69,351
Denmark	7,033	9,080	1,064	28,632
Finland				14,955
France	36,830	143,968	112,555	1,021,842
Gibraltar				4,000
Greece		1,073		72
Italy	945	53,772	17,500	42,096
Netherlands	13,862	11,808		20,639
Norway	717	1,062	1,846	5,502
Portugal				2,555
Spain	38,056	11,131	3,548	11,995
Sweden	19,421	2,212	9,974	24,827
Switzerland	125	324	706	2,450
Turkey in Europe	441			
England	112,499	414,043	163,396	550,841
Scotland		403		2,815
Ireland		1,336		
Canada	61,118	196,592	88,125	210,240
Costa Rica	1,665			70
Guatemala		56	138	569
Honduras				88
Nicaragua		450		183
Panama		335		
Salvador		74		
Mexico	4,666	8,716	419	22,066
Newfoundland and Labrador		221		
Jamaica	1,581	138		625
Trinidad and Tabago	48	291	6	
Other British West Indies	903			
Cuba	16,276	49,274	400	24,567
Danish West Indies		64		
French West Indies	1,164	42		
Haiti			100	37
Dominican Republic	842	57		486
Argentina	5,504	11,685	5,857	18,711
Bolivia		22		
Brazil	4 808	7,583	1,234	4,381
Chile	700	2,790	583	75,206
Colombia		833	295	576
Ecuador		148		
British Guiana	242			
Dutch Guiana			58	
French Guiana		30	180	
Peru	2,754	2,393	18	11,009
Uruguay	3,175	1,199		657
Venezuela	6,900		142	300
China	3,585	2,081	520	11,592
British India	3,443	5,121	255	8,223
Straits Settlements		4,319		
Dutch East Indies	16,804	1,311	2,125	12,740
Hongkong		40		3,890
Japan	21,404	31,075	12,182	190,342
Russia in Asia		586		4,456
Australia	1,776	9,146	2,326	9,457
New Zealand	8,683	1,960	504	2,776
French Oceania				17
Phillippine Islands	10,616	8,106	764	16,027
Belgian Kongo				1,382
British West Africa	960			
British South Africa	8,418	1,289	5,235	16,453
French Africa				1,669
Portugese Africa				1,354
Total	647,801	1,006,544	438,979	2,452,721

mediate business. Credits shape up well, and sales are more a matter of order taking than effort at present.

Cleveland Letter

The first month of the new year finds almost weekly improvement in the machinery market of the Cleveland and northern Ohio districts. There is a marked increase in inquiries followed by orders, and likewise caution among those interests toward whom the machinery trade has been looking as probable large buyers.

Considerable stress has been laid by the automobile industry and those interests allied with it on the tremendous output that was scheduled for 1920. These assertions still are forthcoming and the machine-tool trade is ready to cope with the demand when it materializes.

While the machinery business is good, because of a large volume of business, orders are comparatively small, and generally range from five or six machines down to ones and twos. Inquiries are being made by the General Electric Company, but just how extensive the requirements are to be for this concern is not yet announced. Meanwhile, general manufacturing firms continue to be the principal buyers of equipment in this market.

It is believed among some machinery interests in this locality that, while it is unusual to do so, automobile producers, at least some of the local car builders, may base their immediate future activities upon the amount of prospective business that will have developed out of the Cleveland Automobile Show, being held here during the week of Jan. 19. It is claimed by many salesmen at the show that a larger number of actual orders for new cars have been booked at this show than during any previous similar exhibition. If this is true, machinery interests believe increased production of cars will start immediately, and that the requirements for equipment will be in proportion.

Machinery producers in this district and others which have representatives and retail establishments in Cleveland, all report slow deliveries. In some instances representatives find the demand for immediate delivery so keen that plant managers are willing to take machines from the floor. This will be done in some instances where it is found delivery cannot be made from the factories in less than thirty days.

Considerable interest is manifested by machine-tool men here in the announcement that the Overland automobile interests plan to establish a plant in England for the purpose of producing 25,000 cars a year there. The production will be by Willys-Overland-Crossley Company. E. B. Jackson, vice president of the Overland, has recently returned from England where an arrangement was made to co-operate with the Crossley Motor Works. At the start, it is explained, American foremen and American parts will enter into the English production. The project is admittedly too incipient to foretell what, if any, American-made machinery will be required for this enterprise.

Chicago Letter

The third week in January opens with dealers reporting excellent business. One concern considers this the busiest week in its history, but other sales offices notice a very slight let-up from the high pressure maintained during the past three months. Deliveries are getting worse rather than better, and back orders are piling higher every day. Several dealers state that new orders booked so far in January exceed deliveries by 30 per cent. This proportion is even higher in some lines.

Prices of heavy equipment advanced last week. Practically all makes of planing machines and turret lathes were advanced 12½ per cent. Boring mills went up 10 per cent. Every item in the machinery line is now either as high or higher than during the price peak reached in 1918. The Government is also taking advantage of the demand, and tools being sold from the Quartermaster's Store here have also been marked up from 80 per cent of full list, for new, to 90 per cent.

This Government tool sale which has been carried on at the old Symington Corporation plant for some months is still in progress. The immense floor remains well covered, but no shaping, milling, planing machines nor radial drills are left. Callers are numerous but, as the items most in demand are all sold, actual sales are not nearly as heavy as they were in October and November. When it is considered that the sale prices are based on present list prices of similar tools, and that these current lists are all equal to or higher than those in effect at the time the Army purchased the machines, it will be seen that a very good price is being obtained.

The Studebaker Corporation continues in the market for various classes of tools and the Worthington Pump Company is buying quite heavily. As an evidence of activity in the automobile industry, it was reported, after the January meeting of the board of directors of the Buick Motor Company, in Flint, Mich., that the company would immediately proceed with the expenditure of over seven million dollars on additional plant equipment at Flint, to include nine new buildings and three additions, and of three million dollars on an assembly plant in St. Louis, Mo. All the motor-car builders are constantly in the market for a wide variety of tools.

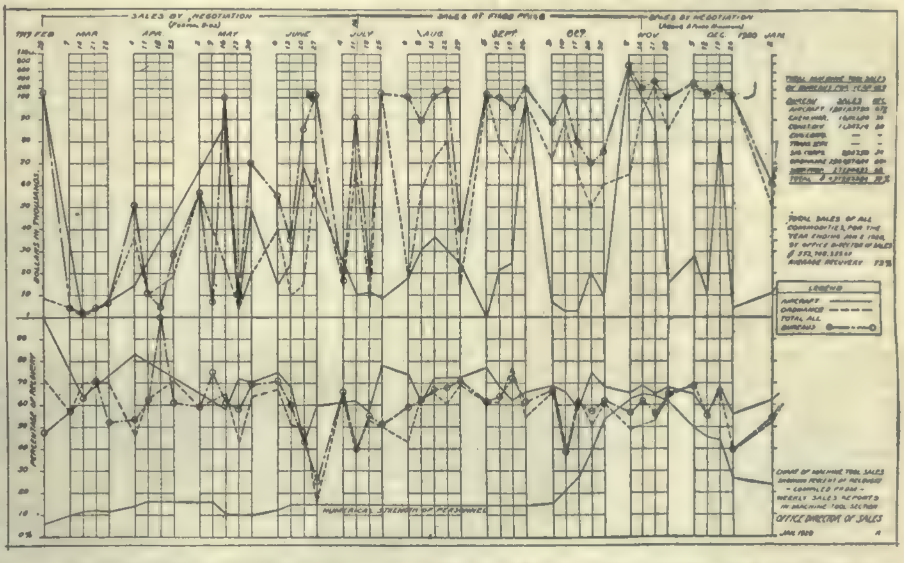


CHART OF MACHINE TOOL SALES SHOWING PER CENT OF RECOVERY

The Kewanee Boiler Co. announced its intention of erecting a $500,000 warehouse and salesroom on the west side. A contract was let for the construction of a fifteen-story building by the Chicago *Tribune;* which will occupy a portion of the building for its own plant, and rent the remainder for light manufacturing.

Control of German Export Trade

FROM OUR GERMAN CORRESPONDENT

In order to prevent German firms from selling their export goods below market prices, a governmental decree related to the control of German export trade will be promulgated shortly. This decree will empower the federal minister of economics to prohibit the export of German goods by granting full authority to the federal commissioner for export and import, or any other competent board, to use his own discretion with regard to export permits.

With a view of accelerating the working of the official machinery and eliminating red tape, extensive changes in the administration are contemplated. The federal commissioner will be authorized to vest the various foreign trade boards or other bodies with far-reaching power; besides, the existing "Central Bureaux for Export Permits" will be superseded by foreign trade boards.

In granting export and import permits certain conditions will be stipulated as, for instance, re-export of imported goods, minimum prices or certain modes of payment for export goods, etc. Fees will be charged to cover the expenses the state incurs in administrating the foreign trade control; the foreign trade boards will likewise be entitled to charge certain fees for their operation.

Another stipulation in granting export permits will be that a certain amount of the surplus profits realized by the exporters, due to the required minimum prices, will have to be handed over to the state. This amount will vary according to the industrial districts and will be spent for industrial welfare work. The penalties for exporting prohibited goods will be made even more severe and any contravention of the conditions under which the export permit was granted will also be punishable. For both offenses a penalty of at least one month in prison will be inflicted unless a still more severe punishment is provided by the existing penal code. Besides, a fine of at least three times the value of the goods in question will be imposed. A contravention of the decree caused by negligence will also be punishable and all goods handled in illicit trade are liable to seizure by the government with the owner forfeiting all claims as regards compensation.

National Copper and Smelting Co. Leases a Plant

The National Copper and Smelting Co. leased part of the property of the Babin-Sill Co., Euclid Ave., Cincinnati, Ohio, for the purpose of manufacturing small seamless copper and brass tubing. The company already has a plant in Detroit, according to F. G. Carpenter, Illuminating Building. Henry Osborn, president of the American Multigraph Co. and president of the Cleveland Brass and Copper Mills, Inc., is a director in the National concern.

Prospective Railway and Machinery Purchases in Russia

Announcement is made of the formation of the buying committee of the Economic and Technical Association of the liberated Provinces of Russia, with offices at 116 Bolshaya Sandovaya St., Rostov-on-Don, Russia. The British vice-consul at the above place reports that this is an organization composed of several of the railway companies, government and industrial agencies and other establishments which is combined with a capital of 50,000,000 roubles. The purpose of the association is to purchase various kinds of machinery and railway supplies and other goods required by the individual members of the organization. Reports state that some of the backers of the proposition are very influential and the combination is looked upon as being a good omen for the future trade possibilities in South Russia.

New Plant of the Conradson Machine Tool Co.

The Conradson Machine Tool Co., Green Bay, Wis., has recently occupied its new machine-tool plant shown in the accompanying illustration. The construction of this plant was started in the spring of 1918. The articles of incorporation recently filed for this company show C. M. Conradson as president. Mr. Conradson is well known in the machine-tool field and has lately been engaged in general consulting work in tool design.

NEW PLANT OF CONRADSON MACHINE TOOL COMPANY

This new plant is located on a site of twelve acres on the outskirts of Green Bay, and consists of a machine shop, a main erecting bay, a power house, a heating plant, and an office building. The equipment has been installed and production is under way. The machine-shop equipment is modern and consists chiefly of individual motor-driven machine tools, all of well-known makes.

Joseph T. Ryerson & Sons, the selling representatives, will market the plain and universal milling machines, selective head lathes, planing machines and radial drilling machines which will be built at this new plant under the trade name of "Ryerson-Conradson."

British War-Time Plants Take Up New Lines of Manufacture

Advices just received from London indicate how various British industrial firms are turning their war-time plant extensions into new lines of manufacturing, particularly in the construction of locomotives and railway equipment. One of the largest ship and armament building companies in Great Britain has converted an extensive shell plant into locomotive shops intended to be the largest and most modern shops in the British Empire.

The conversion of this plant, which had manufactured 14,500,000 shells during the war, and the production of its first main line locomotive were accomplished within a year from the Armistice.

The same company has acquired a plant for automobile manufacture on a large scale, has transformed one of its gun and gun-carriage shops into marine-engine works, turned another war-material shop into an iron foundry, diverted gun forges to the production of marine shafting, altered armor-plate mills to manufacture ship and locomotive plates, rearranged its shipyards so that their greatest output is now merchant instead of war craft, acquired an electrical works for building its own power machinery, and also expanding in the construction of pumping engines, cranes, dock gates and similar output. Another large British concern, formerly identified especially with the manufacture of harvesting machinery, has converted a munition works into a plant for the production on a very large scale of railway cars.

This same company recently received an order for Pullman cars from one of the leading British railway companies, whose equipment did not include this character of rolling stock. These new Pullmans are to be superior to any other railway vehicles now in service in the United Kingdom. Orders are also in hand for some 4,400 all-steel covered freight cars for the Indian State Railways, and various types of freight equipment for several British railways.

A Sheffield concern, which during the war had been manufacturing engine parts for airplanes, is now extensively engaged in the output of light-gage locomotives and model locomotives and steam engines.

Machinery Parts Needed in Brazil

One of the greatest drawbacks of industrial development in Brazil has been the difficulty of obtaining spare machinery parts. Machinery in many cases has been worked until worn out and useless, or after long waiting spare parts have locally been supplied, rarely with successful results, and the output of manufactured goods has suffered alike in quality and volume.

What is true of Brazil is more or less true of all parts of South America in which industrialism has made progress during the past few years. One of the chief needs of these countries is some system by which spare parts

(*Continued on Page* 268b)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

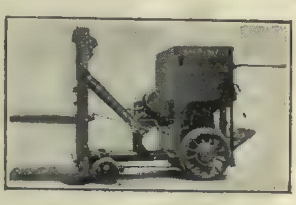
Milling Machine, Universal.
Alma Machine Wks., Liversedge, Eng.
"American Machinist" (Eng. Edition), Nov. 15, 1919.

Has 18 spindle speeds; Morse taper No. 5; 3-step cone, 13 in. to 16 in. in diameter; belt, 4 in. wide; table, 60 x 12 in.; working surface, 54 x 12 in.; is mounted on swivel slide and locked by three bolts; power feed acts with table swiveled 45 deg. to either side; range, 36 x 11 x 21 in.; feed changes by gear box; floor space, 9 ft. 4 in. x 7 ft.; net weight, 7400 lb.

Indicator, Liquid, Micrometer.
T. S. Booth & Co., Manchester Road, Castleson, Eng.
"American Machinist" (Eng. Edition), Nov. 15, 1919.

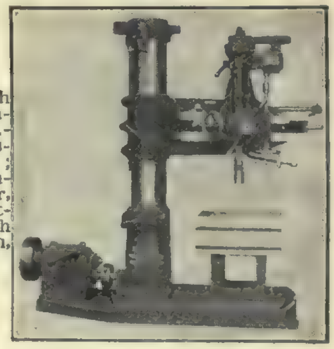
Works on the principle of displacement of a liquid by the spindle. When liquid rises in tube the air will pass through the valve at top. Should indicator be inverted, or liquid rise to top of tube, valve will automatically close and prevent liquid escaping. Two or more readings can be had by the same indicator. Graduations on the tubes shown read 1 in. movement for 0.001 in. which makes it possible to read to 0.000025 in., and the tube in the indicator reads $\frac{5}{16}$ in. movement for 0.001 in. Changing tubes is only a matter of seconds.

Truck, Tiering.
Elwell-Parker Electric Co., Cleveland, Ohio.
"American Machinist," Nov. 6, 1919.



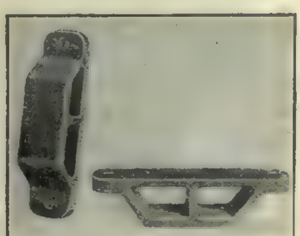
Truck is driven by an electric motor from storage batteries; drive is by worm gearing. Hoist is operated by a separate inclosed-motor, direct-connected to hoisting drum. Platform uprights provided with rollers, guided by upright channel irons. Limit switch stops the elevator at extremes of travel. Wheel base is short; all four wheels used for steering. All the wheels have rubber tires. Specifications: Speeds: 3 in either direction, 375 to 525 ft. per minute; load capacity, 1000 lb.; minimum distance, platform to floor, $2\frac{1}{2}$ in.; lifting height, 5 to 6 ft.

Drilling Machine, Radial, Simplex.
Dreses Machine Tool Co., Cincinnati, Ohio.
"American Machinist," Nov. 6, 1919.



These machines are built with $2\frac{1}{2}$- and 3-ft. arms, and the principle dimensions of the $2\frac{1}{2}$-ft.-arm machine are: Maximum distance from base to spindle, 51 in.; traverse of spindle, 11 in.; diameter of column, 9 in.; feeds, four, 0.007 to 0.018 in.; speeds, eighteen, 83 to 575 r.p.m.; weight, with $2\frac{1}{2}$-ft. arm, 3100 lb.; 3-ft. arm, 3400 lb.

Feet for Transveyor Skids.
Cowan Truck Co., Holyoke, Mass.
"American Machinist," Nov. 6, 1919.



The feet are made of cast iron, with broad surface to floor. Two bolt holes are provided to fasten to skid; it is claimed that their use will double life of skids.

Heater, Electric Rivet.
General Electric Co., Schenectady, N. Y.
"American Machinist," Nov. 6, 1919.

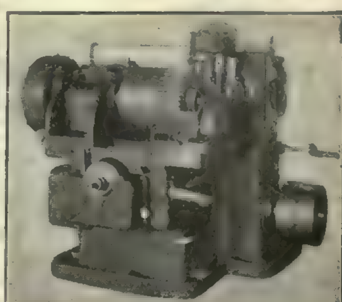
Transformer mounted on angle-iron legs; can be fitted with wheels; two copper bars fitted with heavy air-cooled electrodes of cast copper and underneath these a copper block act both as support and an electric connection for two rivets in series. Sizes of heaters are 5-kw. for rivets up to $\frac{1}{2}$-in. diameter and 15-kw. for rivets up to $\frac{7}{8}$-in. The 15-kw. in actual test heated 500 $\frac{1}{2}$ x $1\frac{1}{4}$-in. rivets in one hour.

Re-turning Tool, Crankpin.
Sawyer-Weber Tool Manufacturing Co., 350 South Alameda St., Los Angeles, Calif.
"American Machinist," Nov. 6, 1919.

Different form cutters are furnished to suit the lengths of crankpins to be re-turned.

This tool is made in four sizes as follows: No. 1, for pins $1\frac{1}{8}$ to 3 in. in diameter by $1\frac{1}{2}$ to 3 in. long; No. 2, for pins $1\frac{1}{2}$ to 3 in. in diameter by 2 to 4 in. long; No. 3, for pins $1\frac{7}{8}$ to 4 in. in diameter by $2\frac{3}{4}$ to 5 in. long, and No. 4, for pins 3 to 6 in. in diameter by $3\frac{1}{2}$ to 7 in. long.

Gear-Generating Machine.
Donaldson & Fisher Manufacturing Co., Chicago, Ill.
"American Machinist," Nov. 6, 1919.



Will cut straight and helical gears, worms, wormwheels and will spline shafts. Headstock and tailstock mounted on heavy table; provision made by cross-slide, for moving them to or from hob for adjusting depth of cut. Crossfeed has micrometer dial reading to 0.005 in. Adjustable stops provided so that settings can be repeated. Table can be locked. Specifications: Capacity, gears 14 in. in diameter by 14 in. wide (or wider if so ordered); will cut cast-iron gears up to three diametral pitch; steel gears up to four diametral pitch; pulley, 14 x $3\frac{1}{2}$ in.; speed, 350 r.p.m.; floor space, 54 x 67 in.; weight, 5500 pounds.

Clip, paste on 3 x 5-in. cards and file as desired

can be obtained for replacing those worn out with as little delay as possible. A prominent industrialist of Sao Paulo urges that stocks of spare parts be maintained at Rio de Janciro. To some extent that is done already, but the stocks are not sufficiently large nor of wide enough variety to insure the customer of having his order filled from stock.

Several Hundred Tons of Machine Tools in the "Powhatan" Cargo

Delay in the transportation of between 400 and 500 tons of machine tools, purchased by Belgium from the War Department, was caused when the Army transport "Powhatan," which included in her cargo part of the Belgian consignment of machine tools, sprung a leak 700 miles east of New York.

Officials in Washington in charge of the transaction with Belgium believe that no damage was done to the machine tools, although the accident will considerably delay their arrival in Belgium.

Another shipment of the Belgian order of machine tools is expected to be made within the near future. A vessel is now being loaded in New York Harbor which will carry 2,000 additional tons of the order.

American Society of Civil Engineers Elects Officers

At the sixty-seventh annual convention of the American Society of Civil Engineers, which was held at the Engineering Societies' Building, 29 West Thirty-Ninth Street, New York, last week, Arthur Powell Davis, chief engineer of the United States Reclamation Service, was elected president for the year. New vice presidents elected were Robert A. Cummings, of Pittsburgh, and Francis Lee Stuart, of New York. Arthur Smith Tuttle, of New York, was re-elected treasurer.

New directors chosen include Carlton Greene and C. W. Hudson, of New York; John A. O'Connor, of Albany; J. C. Hoyt, of Washington; Anson Marston, of Ames, Iowa, and David C. Henry, of Portland, Ore. The annual convention will be held in Houston, Tex., in October.

A feature of the annual report was the honor roll of the society, which showed 1,823 members in the service of one or the other of the Allied armies during the war.

A Demand for American Machinery in Foreign Countries

Machinery manufacturers report a continued demand from foreign customers for American machinery. In addition to large shipments of both light and heavy industrial machinery to the Far East, there is a good demand from South America and the West Indies. South Americans are buying agricultural and mining machinery as well as equipment for large industrial enterprises. The orders from the West Indies are mostly for sugar-mill equipment, a large portion of which is new business. Greece and other southern European countries are placing orders for small marine engines and light agricultural machinery. Australian and South African machinery buyers are active. Both countries are advancing in industrial lines and are in need of much equipment.

Short News Notes

It is reported that the General Motors Co., Flint, Mich., will build a half million dollar drop forge plant at Lansing, Mich.

* * *

The Cincinnati Milling Machine Co., Cincinnati, Ohio, has announced an increase of 10 per cent on milling machines from No. 2 up.

* * *

The Bullard Machine Tool Co., Bridgeport, Conn., increased the price of boring mills 20 per cent. This is the first raise in price since Oct., 1918.

* * *

The H. H. Franklin Manufacturing Co., Syracuse, N. Y., which is largely increasing its plant, is in the market for $200,000 worth of machine tools.

Changes in Personnel of Westinghouse Air Brake Co.

J. R. Ellicott, manager of the Eastern district, has retired after a long service with the Westinghouse Air Brake Co. He will, however, act with the officers of the company in a consulting capacity. Mr. Ellicott will be succeeded by C. R. Ellicott. C. H. Beck, heretofore special representative of the Safety Car Devices Co., succeeds C. R. Ellicott as assistant Eastern manager, with headquarters in New York City.

With the promotion of E. A. Craig to the position of export manager, with headquarters in the Westinghouse Building, Pittsburgh, Robert Burgess, representative at Atlanta, becomes Southeastern manager, with headquarters in the Munsey Building, Washington, D. C.

A. K. Hohmyer, a representative of the company attached to the Chicago office, is promoted to the position of assistant Western manager.

J. B. Wright, assistant Southeastern manager, is made assistant district manager at Pittsburgh.

W. G. Kaylor, representative in the Eastern district, is appointed representative of the export department, with headquarters in New York City.

F. H. Parke, resident engineer, Southeastern district, is appointed general engineer with headquarters in the Westinghouse Building, Pittsburgh.

T. W. Newburn, assistant resident engineer, Southeastern district, becomes district engineer, Southeastern district, headquarters, Munsey Building, Washington, D. C.

J. C. McCune, special engineer, Wilmerding, is appointed assistant to district engineer, Eastern district, headquarters, 165 Broadway, New York City.

J. H. Woods of the commercial-engineering department, Wilmerding, is appointed engineer, export department, with headquarters in the Westinghouse Building, Pittsburgh.

Business Items

The Wittemann-Lewis Aircraft Co., Inc., Newark, N. J., has changed its address to Hasbrouck Heights, N. J.

The Grinnell Co., Inc., Providence, R. I., on Jan. 1, took over the sales force and contracting business of the General Fire Extinguisher Co.

The T. A. Willson & Co., Inc., Reading, Pa., has changed its name to the Willson Goggles, Inc. The ownership and personnel of the corporation remains the same.

The Cleveland Drop Forge Co., Cleveland, Ohio, has been chartered with a capital of $750,000 to operate a drop-forging plant. The incorporators are I. W. Sharp, H. S. Brady, S. C. Smith, H. P. Baker and A. Cullen.

The Victor Saw Works held its annual salesmen's convention at Springfield, Mass., on Jan. 2 and 3, 1920. The activities of the past year were reported and analyzed as were plans under consideration for the future.

The Gandy Belting Co., 726-40 West Pratt St., Baltimore, Md., will establish a branch at 549 Washington St., Chicago, Ill. Fielder I. Schillinberg, Jr., who has been in charge at the company's New York office, has been transferred to Chicago, where he will be manager of the new branch.

The Barnum-Richardson Co., Lime Rock, Conn., manufacturer of iron, has been purchased by Eugene E. Anderson, Sharon, Pa., who is representing a syndicate. The company has iron mines located in New York and Connecticut, the product of which has been largely used in the manufacture of car wheels.

The Cramp Manufacturing Co., 910 West Van Buren St., Chicago, Ill., has been capitalized for $50,000 to engage in the manufacture of precision tools. The incorporators are E. Brust, Paul Schmidt, C. Nebeser and J. Wright, all of whom have been identified with various small-tool manufacturing concerns.

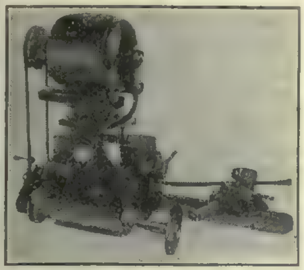
John M. Howitt has opened a machinery business at 12 West Second St., Dayton, Ohio, and will carry a stock of machinery manufactured by the following firms: S. A. Potter Machine and Tool Co., bench plates; Greaves Klusman, engine lathes; John Steptoe Co., shaping and milling machines; Hoefer & Co., drilling machines and multiple spindle heads; Hannifin Manufacturing Co., air chucks; Kelly Reamer Co., reamers.

(*Continued on Page 268d*)

Condensed-Clipping Index of Equipment

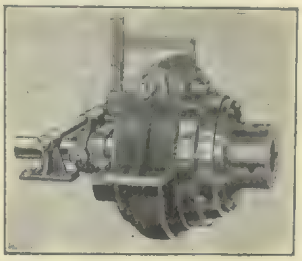
Patented Aug. 20, 1918

Grinding Machine, Portable Universal
Lafayette Tool and Equipment Co., 21 South 12th St., Phila. Pa.
"American Machinist," Nov. 13-20, 1919



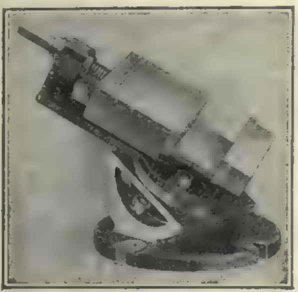
Adaptable to a wide range of light work; particularly recommended by the makers for threaded work—internal or external. Is said to grind to within 0.0001 in. all types of gages, taps and dies, reamers, cutters, etc. Can be used as a bench machine or in conjunction with a lathe or other machine tools. Is capable of grinding holes as small as ⅜ in. in diameter by 8 in. in length; is convenient for grinding milling cutters while in position. Button dies may be ground, teeth and flutes, at one setting. Possible to obtain any angle desired as machine is adjustable horizontally 3½ in., vertically 2½ in. and angularly to 20 deg.; adjustments regulated by micrometer readings graduted to 0.001 inch.

Reversing Gear
Snow & Petrelli Manufacturing Co., New Haven, Conn.
"American Machinist," Nov. 13-20, 1919



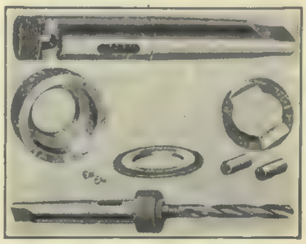
The gear is built in four sizes, with capacities ranging from 9 to 52 hp., according to size. Employs the internal gear principle, using the three-point contact system, but eliminating the central spur gear; has a balanced design. The ratio of reverse speed amounts to about 85 per cent. of the motor speed. Brake band is free to grip evenly and is supported by a bracket which surrounds the brake; being suspended, does not drag on the drum when not in use. Gear designed for shafts with diameters from 2½ to 5 in., and the weights of the four sizes are 190, 566, 950 and 1,900 lb., respectively.

Vise, Universal
New Britain Tool and Manufacturing Co., New Britain, Conn.
"American Machinist," Nov. 13-20, 1919



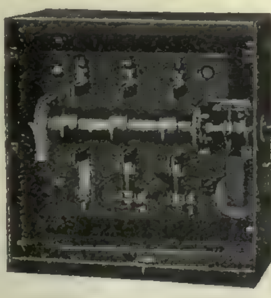
For use in milling and drilling machines, and in laying out work; it combines in one tool means of obtaining any angle. Is graduated and may be tilted to any angle from vertical to 10 deg. below horizontal. A circular boss cast upon the upper surface of the tilting member is graduated and receives the base of the vise which may be turned to any desired position. Any angle within the complete circle may be obtained in the horizontal plane, and this movement combined with available angles in the vertical plane enables the user to set his work in any position without tilting plates, angle plates, or straps and bolts. The jaws are removable, and are hardened and ground. They are 1½ by 5½ in. in size, and the complete tool weighs 55 pounds.

Holder, Drill, Improved
Roberts Manufacturing Co., 152-6 Brewery St., New Haven, Conn.
"American Machinist," Nov. 13-20, 1919



To lock the drill in place, the knurled collar is turned by hand. The loose collar, inside, is thus forced up by the screw and acts as a cam, forcing the two hardened rolls into recesses ground in the drill, holding it securely gripped and preventing it from twisting or dropping out, and incidentally preventing injury to the drill or holder.

Switch, Safety Motor Starting
Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.
"American Machinist," Nov. 13-20, 1919

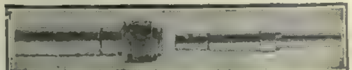


Type WK-100 provides protection to both operator and motor; is designed for connecting single or polyphase alternating-current motors of from 1 to 20 hp., 250 and 550 volts, directly to the line without the use of auto-transformers or resistance. All mechanism with exception of operating handle inclosed in a steel box. The protective devices are easily accessible on opening a door in the cover, but this door can not be opened except when the switch is in the "off" position.

Rolls, Bending, Heavy-Duty
Wickes Bros., Saginaw, Mich.
"American Machinist," Nov. 13-20, 1919

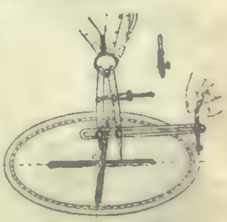
The bed is built of 24-in. I-beams and the housings are semi-steel castings. The housing at the right is hinged so that it can be opened to permit the removal of tightly rolled plates. Power is furnished by a 150-hp. motor mounted on the bed. All driving gears are steel. Distance between housings, 32 ft. 2 in.; capacity, 1-in. plate; diameter of top roll, 30 in.; diameter of bottom rolls, 20 in.; motor, 150 hp.; weight, 270,000 pounds.

Holder, Easy Lock for Reamers and Cutters
S. & C. Manufacturing Co., Detroit, Mich.
"American Machinist," Nov. 13-20, 1919



This quick-acting holder for reamers and cutters is designed to hold such tools securely or release them quickly through hand manipulation only, and without the use of hammers, wrenches or other mechanical means. Has a variety of uses, such as holding interchangeable counterbores, tapered bridge reamers or floating shell reamers. In the latter case a separate shank is required in connection with the easy-lock holder. The holder is made in four sizes to accommodate ten different sizes of shanks which will handle the entire line of standard shell reamers.

Ellipsograph
Daniel C. Reid, 2717 North Crosky St., Philadelphia, Pa.
"American Machinist," Nov. 13-20, 1919



The instrument is provided with pen and pencil parts and by detaching the slotted bar it can be used as an ordinary spring divider. It is claimed that by its use all kinds of ellipses with major axes of from 1½ to 12 in. can be drawn in one operation; also that it can be used for drawing circles up to 12 in. in diameter.

Clip, paste on 3 x 5-in. cards and file as desired

The Millholland Machine Co., Indianapolis, Ind., announces the appointment of the E. A. Kinsey Co., Cincinnati, Ohio, as agent for the Milholland turret lathes and screw machines for southern Ohio, Kentucky, Tennessee, western West Virginia and the greater part of the State of Indiana.

The International Oxygen Co., with main offices at Newark, N. J., is establishing a new branch plant at Toledo, Ohio, to furnish oxygen and hydrogen for all purposes to manufacturers and industries in that industrial section using either one or both of these gases in their processes. The capacity of the plant will be 3,000,000 cu.ft. of gas per month.

The Lombard Iron Works, Augusta, Ga., which during the machinist strike disposed of a great amount of its machinery, is reorganizing its machine shop and is purchasing lathes, drilling machines and other equipment. Previous to the strike this firm employed 300 machinists, but at present only about sixty are employed. John S. Van Pelt is the master mechanic.

Don F. Kennedy, manufacturers' agent, 1257 David Whitney Building, Detroit, who has handled the account of the Hammond Steel Co., Inc., for the past four years as district sales manager, announces the discontinuance of this line. He will, however, continue in the tool and alloy steel business. Mr. Kennedy has taken on the sales of the products of the Towmotor Co., Cleveland, manufacturer of gasoline industrial tractors for mill and factory use, for Michigan and the city of Toledo.

The National Steel Products Co., Dayton, Ohio, has been incorporated for the purpose of taking over the combined plants and assets of the National Vacuum Machinery Co., and the Crown Hardware Manufacturing Co. The company will specialize in the manufacture of the "Ream" universal joint, steel specialties, tools and dies. It will also continue the manufacture of Crown plating machinery and accessories. The officers of the company are: J. G. Petosky, president; T. M. Heister, vice president and general manager; Jos. G. Lehman, secretary and treasurer.

Personals

H. W. JACKSON has been promoted to factory manager of the S.K.F. Industries, New York City.

C. M. ROBERTSON has been elected vice president of the Dale-Brewster Machinery Co. Mr. Robertson was the Chicago manager for this company.

M. L. HUTCHINSON has been made assistant to A. H. RAINEY in the sales department of the Graton & Knight Manufacturing Co., Worcester, Mass., manufacturer of leather belting, etc.

H. C. BARNES has joined the Allegheny Gear Works, Pittsburgh, Pa., as superintendent of laboratory and metallurgical work.

LAWRENCE A. MILLER, formerly of the Ward & Hill Co., 1 Madison Ave., New York, has become associated as sales manager with the Badger Tool Co., Beloit, Wis.

IRVING H. JONES has become associated with the machinery department of the Joseph T. Ryerson & Sons and will be engaged in sales engineering work in machine-tool equipment.

SAMUEL R. DODGE, formerly chief tool designer for the Locomobile Co., has resigned to become associated with the E. A. Harper Tool and Supply Co., 30 Church St., New York City, as its Connecticut representative.

J. P. GREGG and CARLISLE ELLIS, of the Hart-Parr Co., Charles City, Iowa, have sailed for Europe where they will remain for six months to look after the interests of the Hart-Parr tractors. Mr. Gregg is attorney for the company.

THOMAS J. SCOTT, for many years plant superintendent of the Alvey-Ferguson Co., Cincinnati, Ohio, has resigned to assume the general management of the Scott-Spencer Automatic Tool Inc., of which he is president.

E. W. BERNARD, formerly of Providence, R. I. and for a number of years connected with the Hess-Bright Manufacturing Co., Philadelphia, Pa., has been made assistant to the general factory manager of the S.K.F. Industries, New York City.

FREDERICK H. PAYNE has succeeded Frank O. Wells as president of the Greenfield Tap and Die Corporation, Greenfield, Mass. Mr. Wells has disposed of his interests but will remain with the company in an advisory capacity.

HERBERT L. TENNEY has been appointed chief engineer for the Carlyle Johnson Machine Co., Manchester, Conn., to succeed J. H. ROBERTS who has accepted a position with the sales force. Mr. Tenney has been engineer for this concern for the past year.

I. F. BAKER of the Westinghouse Electric International Co., who has been located in the New York office of that company for the past two years, is now on his way to Tokio, Japan, where he will act as a special representative of the Westinghouse International Company.

WILLIAM S. STUBBS, formerly sales manager, and C. K. OLBERG, formerly vice president and secretary, are no longer connected with the International Metal Manufacturing Co., Philadelphia, Pa. JOHN A. CALL, president, has assumed the general sales management, and C. W. WYLAM, the production management.

J. GEO. LEYNER has resigned as president of the J. Geo. Lyner Engineering Works Co., Littleton, Col. Mr. Leyner resigned in order to devote all his time to the Leyner Tractor and Manufacturing Co., organized for the manufacture and sales of the Linapede tractor, which he has recently perfected. The office of the company is located at 212 Tramway Building, Denver, Col.

ELLIOTT A. ALLEN, for eight years sales engineer for the S.K.F. Ball Bearing Co. and recently district manager for this company, has organized the Allen Spindle Corporation and will manufacture ball-bearing textile spindles. This corporation has leased a plant and has installed additional machinery. The headquarters of the corporation are located in the Little Building, Boylston St., Boston, Mass.

Obituary

DANIEL F. VILES, president of the Waltham Screw Co., Waltham, Mass., died at his home in Waltham, on Dec. 24, after a brief illness.

W. H. H. WOOSTER, president of the Seymour Manufacturing Co., Seymour, Conn., died last week at the St. Raphael's Hospital, New Haven, Conn., after a short illness. Mr. Wooster served as State Senator in 1905-6.

WALDEMAR GIERTSEN, president and owner of the Chicago Machinery Exchange, died at his home in Chicago, Jan. 12, 1920, after a long illness. In addition to his business activities, Mr. Giertsen was a member of the Illinois Athletic, Hamilton, Columbia Yacht, Evanston Golf, and Chicago Norwegian Clubs.

Forthcoming Meetings

The American Institute of Mining and Metallurgical Engineers will hold its annual meeting in New York City, Feb. 16 to 19 inclusive.

The First Annual Convention of the A. S. M. I. and the Mechanical Inspection Equipment Exhibition will be held at the Hotel Astor, New York, Feb. 2 to 6 inclusive.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Second Annual Aëronautical Exposition of the Manufacturers Aircraft Association, Inc., will be held at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, on Mar. 6-13, 1920. S. S. Bradley, 401 Fifth Ave., New York City, is the general manager.

February 5, 1920 American Machinist Vol. 52, No. 6

Machining Cylinders for the Fordson Tractor

By Fred H. Colvin
EDITOR
AMERICAN MACHINIST

Although many of the methods employed in building the Fordson motor are similar to those developed by the Ford Motor Co., there are numerous differences, as will be seen by following the various operations. This is a heavier motor in every way, and special machines have been devised for it. The two types of continuous milling machines shown in this article by illustrations are particularly interesting.

WE ARE apt to look upon the tractor as a crude machine, and, realizing that it rarely moves over 8 miles an hour, we fail to appreciate the strenuous service to which the motor is subjected. The average automobile motor is working at a comparatively small percentage of its maximum power a large proportion of the time. It is only when we come to a long, hard grade, or strike a long stretch of bad road, that it is subjected to heavy duty for any length of time.

Strange as it may seem, the tractor motor and the airplane motor may perhaps be best compared for continuous service at high power, the great difference being that it is permissible to use all the weight necessary in the tractor motor, while this is not the case with motors for aircraft work. Tests of standard automobile motors by builders of farm tractors have shown conclusively that while they do admirable work in the automobile, they are entirely unsuited for the continuous heavy duty of the tractor. Another serious factor is the constant presence of dust and dirt, which filter into the carburetor and to the bearings in spite of all the precautions which can be taken to prevent it.

A direct comparison of this difference may be had in the case of the Fordson tractor, which will be found to be much heavier in every way than the well-known Ford motor.

There are 54 operations on this cylinder, so that only the main operations which differ, more or less, from those of the Ford motor, or which involve the use of special machinery or fixtures, are illustrated in this article.

The operations begin with the milling of four locat-

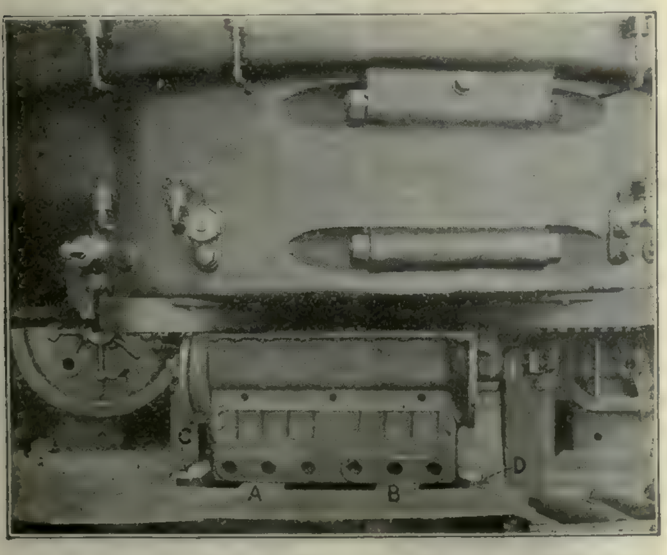


FIG. 2. FACING THE BOTTOM FLANGE ON CONTINUOUS MILLING MACHINE

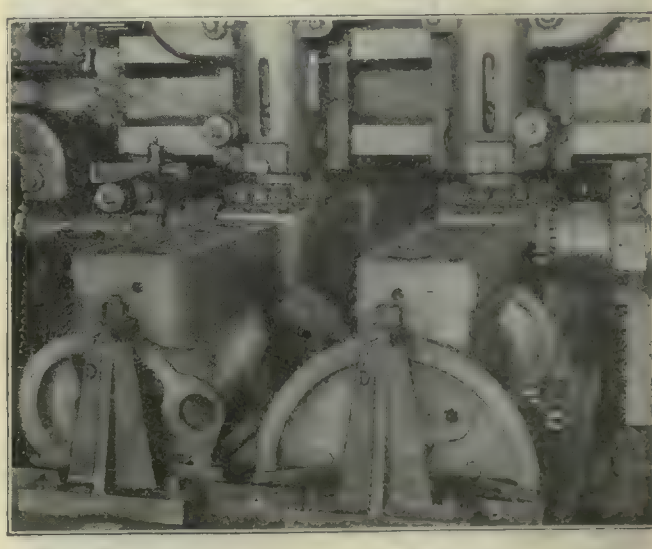


FIG. 3. MILLING TOP AND SIDES ON A LARGE CONTINUOUS MILLING MACHINE

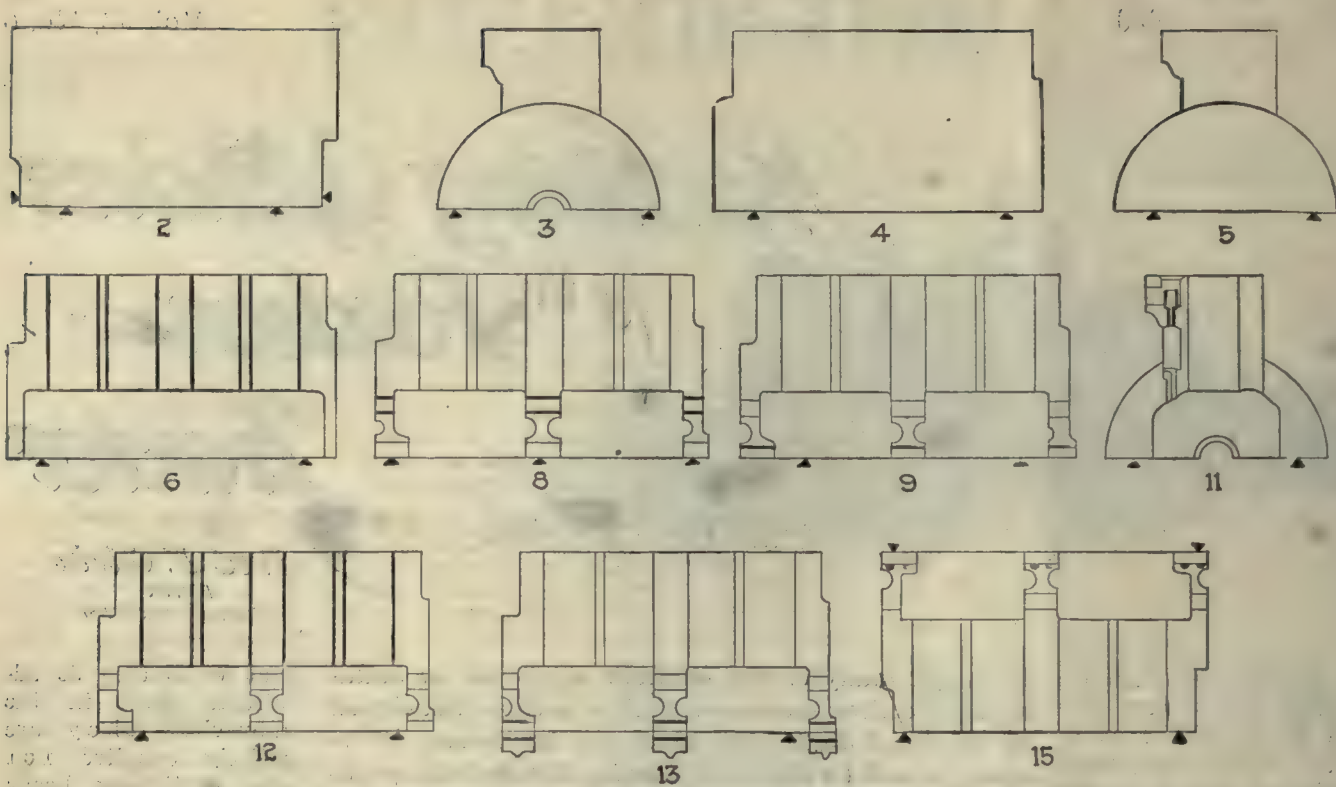


FIG. 1. TRANSFORMATION SHEET SHOWING PRINCIPAL OPERATIONS

ing spots on top of the cylinder, the same as for the Ford motor. The operations which have been selected for illustration are shown in outline in the transformation sheet, Fig. 1, being numbered to correspond with the halftone illustrations showing the work being done.

Having milled the locating spots, the cylinder blocks go to a large Ingersoll milling machine of the horizontal-table continuous type shown in Fig. 2. The blocks come to the machine on the roller conveyor shown at the right, and are then locked in position on the strips *A* and *B* and between *C* and *D*. This machine carries 10-in. diameter cutters, some having 14 blades and the others 18 blades. These both rough and finish the bottom flange of the cylinder block at one revolution of the table, the production being 145 cylinder blocks in 8 hours.

The 12 bolt holes for the three bearings are next drilled, this being another departure from average automobile practice, and made necessary by the larger bearings and heavier duties which they must perform. Then two holes of the main bearing are reamed and used as locating points for all future operations.

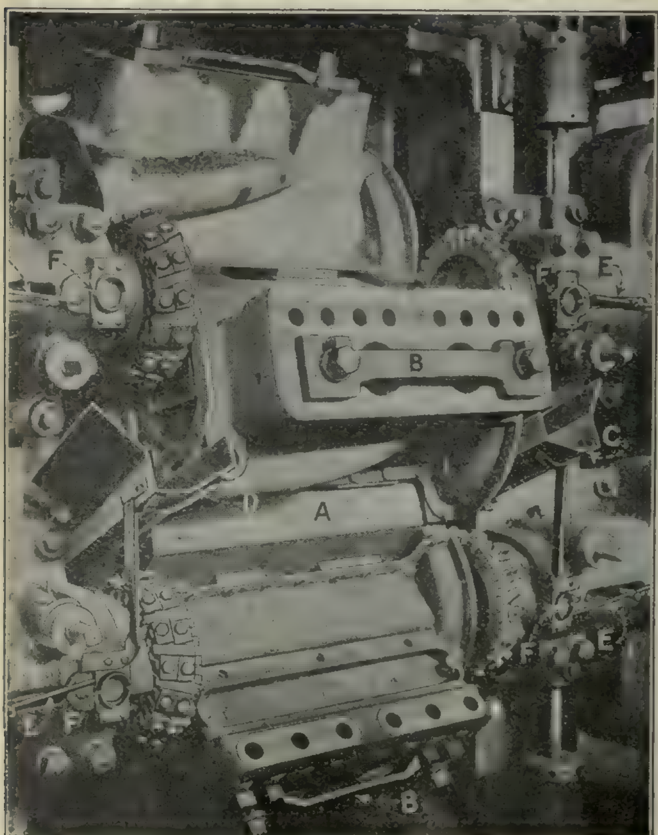


FIG. 4. MILLING BOTH ENDS ON CONTINUOUS MILLING MACHINE

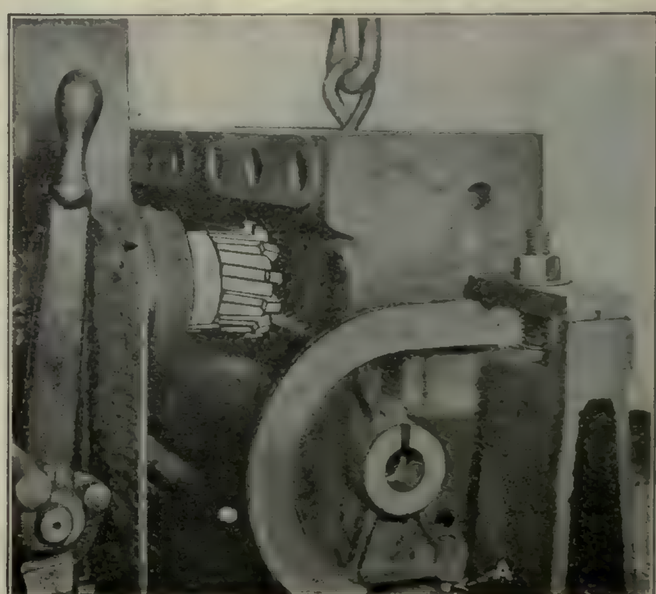


FIG. 5. MILLING THE SEAT FOR THE VALVE-COVER PLATE

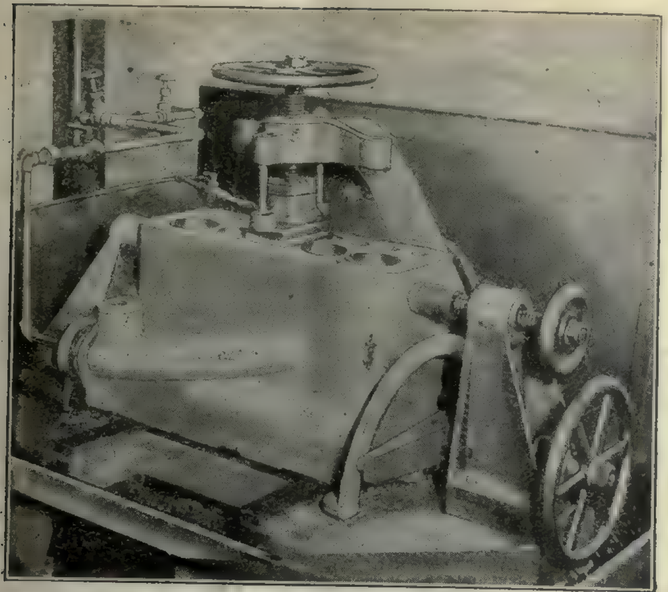


FIG. 7. THE FIXTURE FOR WATER TESTING THE CYLINDER BLOCK

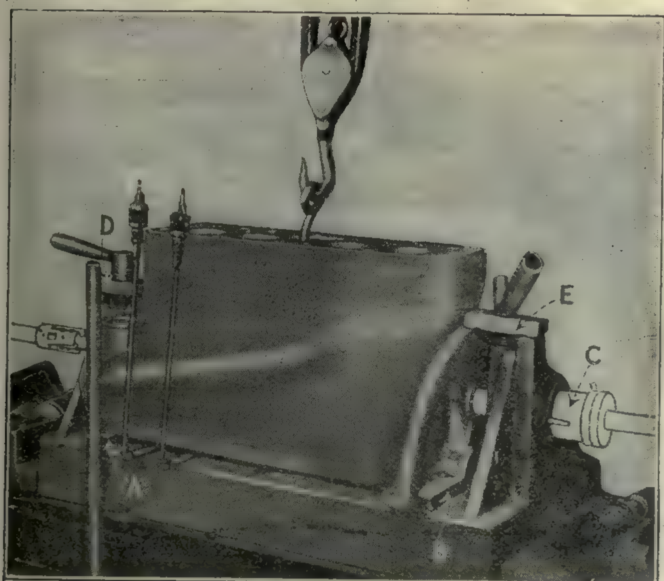


FIG. 8. BORING THE CAMSHAFT HOLE

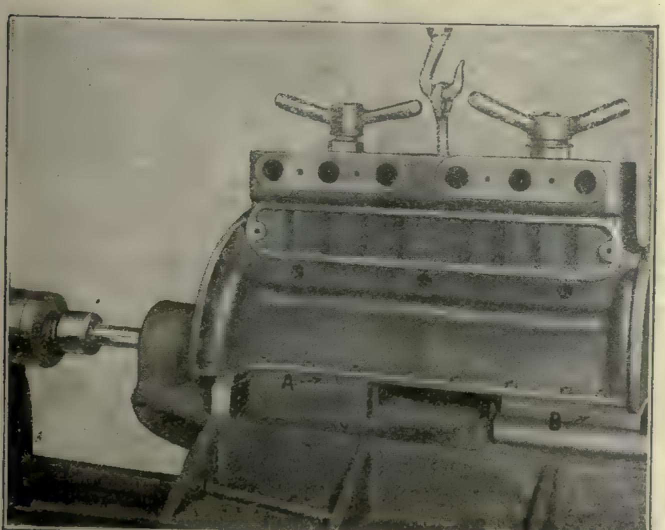


FIG. 9. BORING THE MAIN BEARINGS FOR BABBITTING

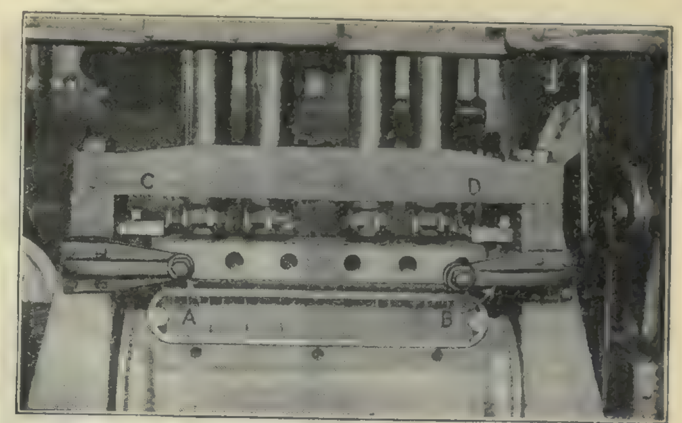


FIG. 6. BORING THE CYLINDERS

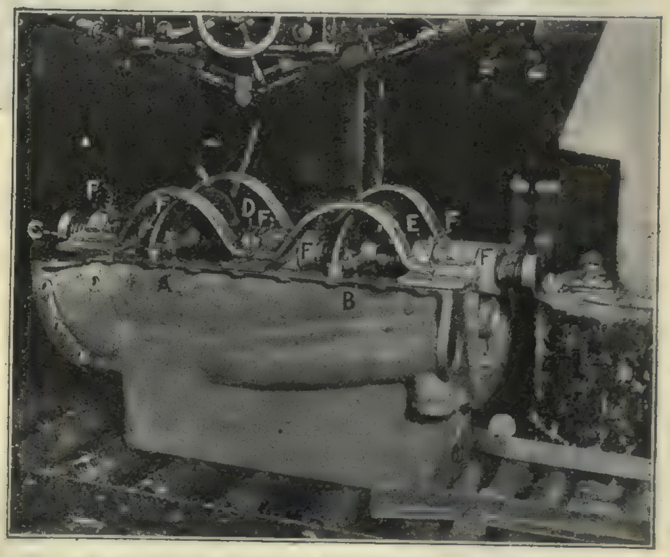


FIG. 10. FIXTURE FOR BABBITTING MAIN BEARINGS

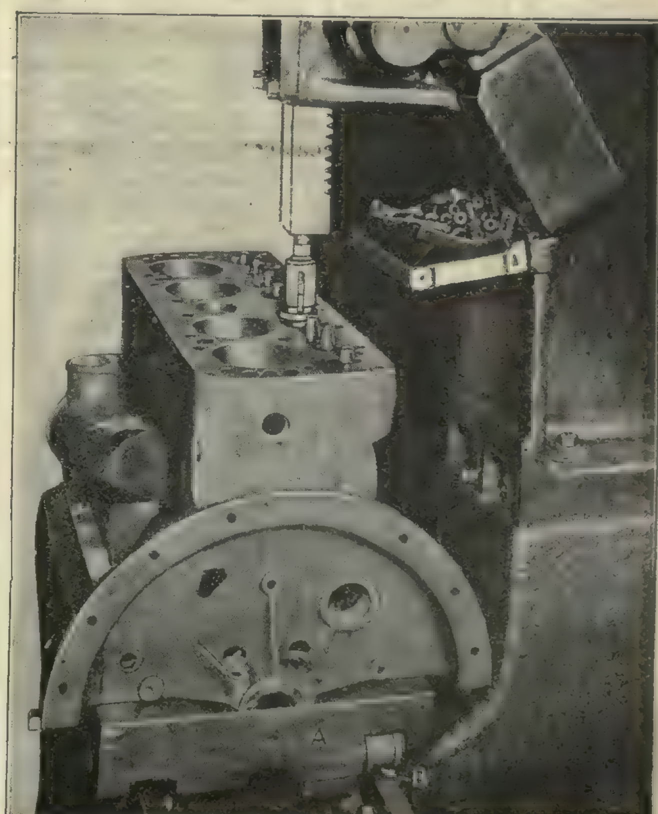


FIG. 11. FORCING END VALVE-STEM BUSHING

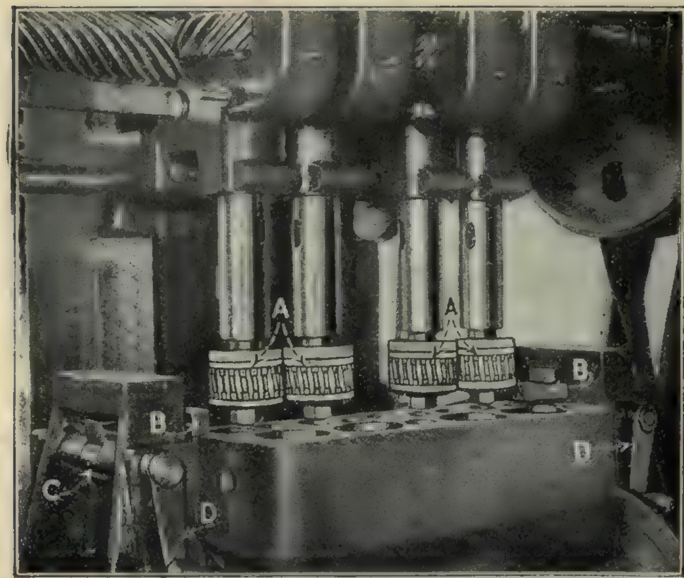


FIG. 12. BURNISHING THE CYLINDER

Next comes the milling of the top and sides of the cylinder block, these being placed in two rows, right and left hand, as shown in Fig. 3. The blocks rest on strips *A*, *B*, and *C;* are located by the reamed bolt holes, while the clamps *D* hold the cylinder block in place. A continuous milling machine has been ordered to handle this work, although the present machine handles 145 cylinder blocks in 8 hours.

A large continuous milling machine of a new type is used for milling the ends, which is the next operation. This is shown in Fig. 4 and is a four-spindle machine, the spindles being located on each side of a six-sided revolving table which carries the work. The work faces are shown at *A*, and the straps used for clamping at *BB*. Troughs *C* and *D* prevent the chips from the upper cutters from interfering with the work of the lower cutters or getting into the lower bearings. Provision is also made on each spindle housing for setting the cutters, setting bars *EE* being provided in each case. These bars are easily held in position by means of the slot in each side of the cups *FF*. This machine carries 11-in. cutters and handles 130 cylinder blocks in 8 hours.

The edges of the valve-stem pockets are next milled as shown in Fig. 5, this showing one of the dowels *A*

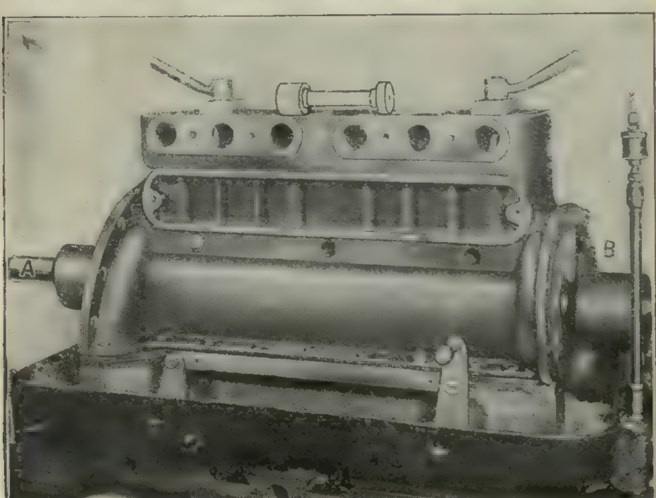


FIG. 13. BORING THE BABBITTED BEARINGS

by which the cylinder blocks are located by the bolt holes in the bearings.

The fixture in which the cylinders are bored is shown in Fig. 6. In addition to the heavy guide for the boring bars which is across the top of the fixture, there are the side stops *A* and *B* and the clamps *C* and *D*. The boring bars remain stationary and the table carrying the work is fed up to the boring cutter.

The cylinder blocks are now water tested for leaks in the jacket, this being done in the fixture shown in Fig. 7. Convenient arrangements are made for covering the various holes which lead to the water space, the three handles shown being easily operated. This fixture handles 300 cylinder blocks per day.

The cylinders are then reamed, the camshaft hole rough-drilled, and other drilling operations performed, after which two double-ended lathes finish-bore and ream the camshaft hole as shown in Fig. 8. This shows the supporting strips *A* and *B*, the substantial bushing *C* which maintains the boring bar in its proper position, and the two clamps *D* and *E*. The oil cups shown lubricate the bearing so as to prevent wear. These machines handle 225 cylinder blocks each in 8 hours.

After various drilling operations, which include anchor holes in some of the bearings, the main bearing

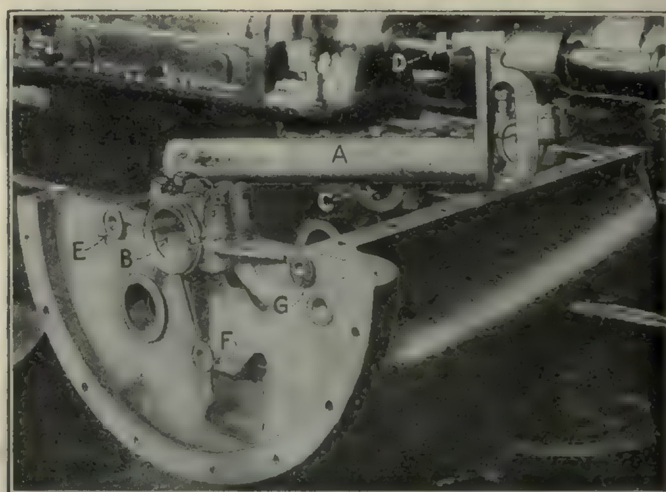


FIG. 14. TESTING THE MAGNET-COIL SUPPORTS

is rough-bored on the fixture shown in Fig. 9. Here the cylinder rests on blocks *A* and *B*, and is held in place by two clamps, being positioned as in previous operations by the reamed bolt holes in the main bearing. It will also be noted that ample provisions are made for handling the cylinder, the eye-bolt affording an easy opportunity for the hoisting hook to lift or lower the casting as the case may be. Here, as in a number of the other operations, Stellite is used for the cutting tools, this including the inserted teeth of milling cutters in some instances. The machine shown handles 150 cylinder blocks in 8 hours.

Babbitting the Main Bearings

The babbitting mandrel, Fig. 10, is supported by the rigid cross-members *A* and *B*, which have hand openings cast in them for easy handling. These rest on the bottom surface and also fit into bolt holes which locate the mandrel endwise. The side frames, which are curved to go over the cross-members *A* and *B*, carry the three pads *C*, *D* and *E*. These pads act as cheeks for the

mold and, together with the collars *FF*, confine the babbitt to its proper channels.

It will be noticed that there are springs around the mandrel between each collar and the supporting members. These allow it to be moved endwise in the bearing to aid in loosening it, should this be necessary. The tracks over the rollers guide the cylinder block as it moves to the next position. This furnace handles 450 per 8-hr. day. Back of the block being babbitted is an outline of the spindles of the special machine for drilling the anchor holes in the bearings.

The bearings are then trimmed by hand at the rate of 500 in 8 hours, after which they are filed at a somewhat higher rate and the main-bearing bolt holes tapped in a special 12-spindle tapping machine, each machine handling 360 per 8-hr. day.

Then the valve-stem bushings are pressed into place, as shown in Fig. 11, a substantial arbor press being used for this purpose and handling 300 in 8 hr. It will be noted that the work is mounted on the block *A* which rolls on the track shown, one of the rollers being shown at *B*. The holes are then reamed and the valve seats machined, the bolt bosses on the bottom flange spotfaced, and holes for various purposes tapped in the usual manner.

Then comes the finishing of the cylinder bores by burnishing, the four-spindle machine shown in Fig. 12 being used for this purpose, in a similar manner to that on the regular Ford motor. The burnishing tools

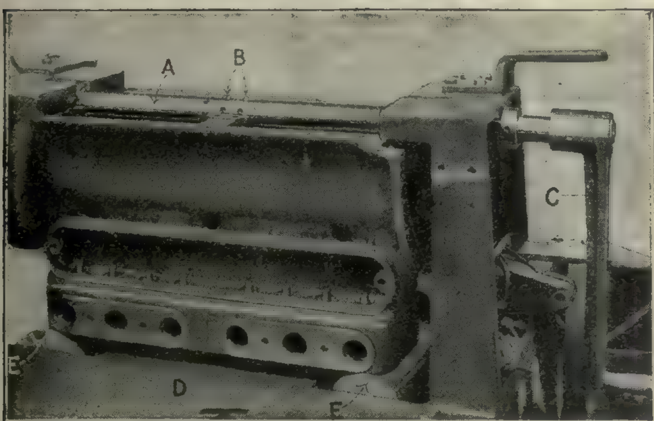


FIG. 15. CUTTING THE OIL GROOVES IN BABBITT BEARINGS

are shown at *AA*, these enlarging the diameter approximately one-thousandth of an inch, and producing a firm, hard surface which has excellent wearing qualities. The quick-acting clamps *BB* are operated by eccentrics, one of these being shown at *C*, the eccentrics being swung into position by the crank handles *DD*. The cylinder burnishing machine handles 450 blocks in 8 hours.

Next comes the drilling of the oil holes for the main bearings, the setting of washers and bolts, and the bolting on of the bearing caps, after which the bearings are bored in a lathe in the fixture shown in Fig. 13. This requires no detailed description, the oil cups for lubricating the bearings, the plug gages for the holes, and the mandrels which position the cylinder block with relation to the camshaft hole being shown at *A* and *B*. These insure the two bearings being parallel and at the correct center distance for the proper meshing of the timing gears. This machine handles 180 cylinder blocks per day.

Then the rear bearings and their caps are faced, and the rear-end flange turned for the magneto spool; after which the positions of the three bosses which support the spool are inspected with the gage shown in Fig. 14. Here the shaft *A* is pushed into the bearings *B* and *C*, and the gage turned so that the plunger *D* can gage the height of the bosses *E*, *F* and *G*. This is done at the rate of 360 in 8 hours.

After this the ends of the bearings are touched up, the core holes plugged, the valve seats finished, and a final water test given the whole cylinder block. The oil grooves are then cut in the main bearing in the fixture shown in Fig. 15, this being a hand-operated fixture carrying the bar *A*, and the grooving cutters *B*, and operated by the crank handle *C*. The cylinders are placed on the table *D*, slid into position under the fixture, and forced up against the overhanging end by the rollers *EE*. This makes a very simple fixture and one in which 900 cylinder blocks can be handled in an 8-hr. day. The oil grooves are then cut in the caps in a similar manner at the rate of 1800 in 8 hr., after which the caps are burred with a hand file and the cylinder block is ready for the assembling department.

Payroll Control

By Thomas J. Walsh
Factory Accountant, Garvin Machine Co.

Absolute accuracy, with a minimum of labor, is obtained from the following method of handling the payroll of a large machine-tool manufacturing plant. Job or unit time cards are used, but the plan may easily be adapted where a daily time card is used.

The controlling function of the method includes the proof of accuracy of the employees' wage extension on the payroll, and in addition the practical if not actual automatic checking of the rates and extensions on the time or cost card.

The common method of the past, and even of today, of making up payrolls has been to post the daily time of the employee, and after the week closed, for the payroll

FORM A

No.	Weekly Rate	Name	Hourly Rate	Daily Rate		Saturday Rate
1	60 00	J. J. Johnson	1 25	10 94		5 30
2	27 44	W. Reilly	59	5 02		2 34
3	33 02	M. Tobin	71	6 04		2 82
4	19 53	S. Wallace	42	3 57		1 68
5	42 32	W. Read	91	7 74		3 62
6	55 20	R. Walsh	1 15	10 06		4 90
7	17 28	D. Ryan	36	3 15		1 53
8						
9	22 56	R. Carroll	47	4 11		2 01
10	37 44	W. Devanney	78	6 83		3 29
11						
12	24 00	M. Canary	50	4 38		2 10
13	16 80	R. Pavona	35	3 06		1 50
14	15 84	A. Jackson	33	2 89		1 39
15	42 72	K. Bourne	89	7 79		3 77
16	414 15			75 58		36 25
17						

FIG. 1. WEEKLY RATE SHEET

clerk to cross-foot the time, extend the wages and add for proof, a very laborious and trying clerical proposition. All this can be accomplished just as well by simply observing the exception and not the rule, or in other words, tabbing the irregular employee and not the regular; it will be found that the employee who is late or absent, or works part of the day, or who works overtime is the one who causes the figuring of the daily payroll amount.

In order to explain the method, two forms *A* and *B* are shown in Figs. 1 and 2. Form *A* may be termed a rate sheet. On the one shown, several employees work on a basis of 46½ hr. per week and the rest on a 48-hr. basis.

As will be noted, hereon are shown the weekly extension, the hourly rate, the daily rate, or extension of 8¾ hr. at the hourly rate, and the Saturday rate or extension of 4¼ hr. at the hourly rate, minus three cents due for fractional adjustments in some cases. For example let us take workman No. 10, W. Devanney, whose hourly rate is 78 cents. His daily rate is 6.83 (8¾ × 78), his Saturday rate is 3.29 (4¼ × 78 = 3.32 — 0.03); his weekly rate is 37.44 (48 × 78).

FORM B

PAY ROLL FOR WEEK ENDING May 1, 1916

TOTAL AMOUNT	NO.	TOTAL HOURS	T.	F.	S.	M.	T.	W.	THUR.	FRI.	SAT.	MON.	TUES.	WED.	NEW MEN	
60 00	1	×														
27 44	2	46½														
38 02	3	46½														
19 32	4	46			8^{10}	8^{18}					− 11	− 10				
42 32	5	46½														
55 20	6	×														
19 80	7	55	7^{45}	7^{45}	7^{15} 4^{30}	7^{45}	7^{45}	7^{45}	+ 18	+ 18	+1 62	+ 18	+ 18	+ 18		
22 56	8															
22 56	9	×														
37 44	10	×														
	11															
23 50	12	47					0/4						− 50			
16 71	13	47¾	7^{51}						− 09							
15 68	14	47½		7^{51}		7^{54}			−	− 08		− 08	−			
34 93	15	39½		×						−7 79						
407 92									+ 09	−7 69	+1 51	—	− 32	+ 18	75 67	
									1 51 18	32					67 89 37 76	
									+1 78	−8 01 +1 78					75 58 75 56 75 76	
									75 67	−6 23 67 89	37 76	75 58	75 56	75 76	407 92 6 23 414 15	

FIG. 2. WEEKLY PAYROLL

For proof take five days at 6.83 = 34.15 + the Saturday rate of 3.29 = 37.44. The sheet is footed and proved by multiplying the total of daily rate by five and adding the Saturday rate which gives us the total for the week.

Before proceeding to explain the functions of form *B*, let me say right here that if none of these men on this sheet were late, absent or worked overtime, the payroll for the week is finished and no calculations, not even cross-addition of hours of each employee, is necessary as will be shown later.

Furthermore, this rate sheet is only affected by either changes in rate, employees leaving or employees being given the blank key numbers. The changes due to these causes are made in a few minutes as they usually affect but a few on each sheet.

This sheet is made up complete at the beginning of the week, and remains unaffected until the close of the week, when new men are rated and old men raised, which changes cause the adjustments on the rate sheet for the ensuing week.

A scrutiny of form *B* will show a composite idea of old and new payroll forms. But there the similarity ends. Note the absence of the daily time posting in the usual column. In its place will be found a few postings, late postings being in black, overtime and absence in red, and absence the entire day being denoted by an "X" in red.

Let us take the case of workman No. 14. He was reported late on Friday, 7.51 (7.45 being starting time), and again on Monday, 7.54, being docked ¼ hr. each day. In the Friday column we find — 0.08 (minus eight cents), and the same thing in the Monday column. He has therefore lost half an hour or 16 cents from the weekly standard. To obtain the amount of his weekly pay, it is only necessary to deduct 16 cents from 15.84 as shown in form *A*.

Men regular or full time are denoted in the hours' column by an "X" in black which is equivalent to the weekly extension as shown on form *A*. The 46½-hr. total is shown so as to differentiate these men on that weekly basis.

Now as to the daily proof of cost extension on the job tickets and payroll: note the calculations in the Friday column; a plus of 18 cents (½ hr. overtime) and minus 7.79 and 0.08, or a net minus of 7.69 for the day on this sheet. Referring to the footing of the daily rate on form *A*, we have 75.58, and deducting the minus of 7.69 we have 67.89 as the amount of cost extensions for this group of men for the day. If there is any disagreement it will be found right away, no matter whether it is an error in rate, extension, or time, or a missing job or cost card.

Where a job cost-card system is used, these cards are sorted according to workmen's numbers, run through an adding or tabulating machine in blocks of fifty for checking purposes and the payroll and production costs are thereby balanced.

In the lower right-hand corner of form *B* will be found a summary of the daily calculations which prove the weekly extension, together with a summary of the pluses and minuses which again furnishes proof of the figures on form *A*.

In conclusion it may be said that the only calculations necessary under this method are caused by irregularity.

The Swaging Machine and Toolroom Methods of Making the Dies

BY W. E. THOMPSON

Toolroom methods for producing the dies used in the swaging machine, for reducing and shaping steel and other wires, are here described. When the swaging dies are needed in quantities, as where a battery of swaging machines are in constant service, mechanical aids to their rapid production have been devised.

SWAGING, or reducing the cross-sectional area of metal bars, wires, or tubes by means of dies carried in a rotating holder, and which are caused to reciprocate by rolls, or circular cams, is one of the best methods known for changing the size and form, but is one that is not thoroughly understood. It may be considered as a simple forging or kneading operation, the metal being drawn out in length as the diameter is decreased by quick hammer blows and squeezes.

A variety of cross-sections may be produced by this process, some of which are illustrated in Fig. 1. The simpler forms of reduction are those shown at *A*, *B* and *C* which are respectively: a reduction of round stock to a smaller round section, a square bar reduced to a round section, and a reduction of round tubing. These three examples are produced by using a head in which the dies can open to only a limited space.

At *D* and *E* are examples of reductions made in special heads, in which the dies are opened and closed

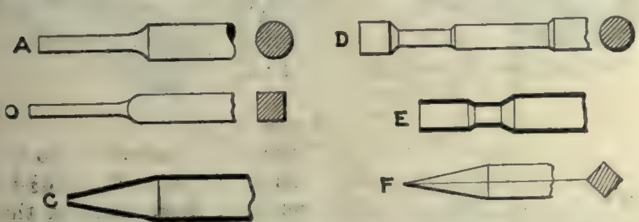


FIG. 1. SHAPES PRODUCED BY SWAGING

independently of the rolls by means of wedges or separate cams. At *F* is an example of a square bar reduced to a square point in a machine, in which the dies and the bar rotate together, and in which the bar is periodically removed from the dies and automatically indexed through a turn of 90 degrees.

The advantages of the swaging process over other methods are numerous and the most important of these are as follows: (1) The elimination of waste material or "scrap"; (2) the refining of the molecular structure by the forging and kneading action of the dies; (3) the high finish that may be obtained on the surface of the material; (4) a sharp point may be produced commercially having a hard, high finish; (5) gold-coated base metal may be reduced and the original relation of the thickness of the gold coating to the base-metal filling maintained; (6) a very high temper may be imparted to non-ferrous metals that cannot be hardened by heat treatment; (7) it is a practical method of forming tubing from a large to a small diameter; (8) the highest rate of production may be maintained.

A common type of swaging machine head is shown in Fig. 2. It consists of a cast-iron body *A*, into which is forced a hardened-steel ring *B*. The inside surface of the ring is ground concentric with the axis of the die head *C* after assembling. The die head is made of low-carbon steel and has a hardened U-section box *D* set in it. This box is ground and lapped in the groove to insure parallelism of the sides and bottom, and in it

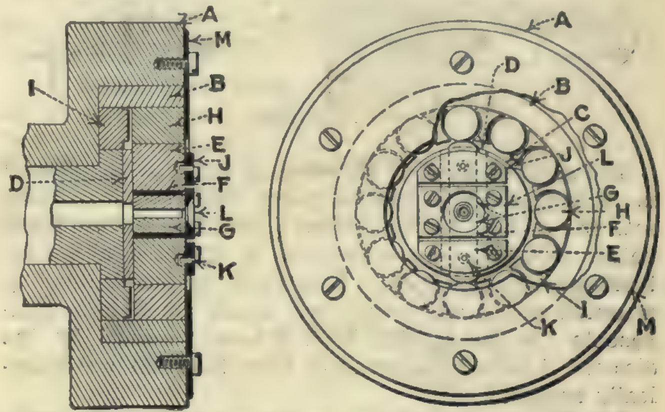


FIG. 2. DRAWING OF SWAGING MACHINE

slide the hammer blocks *E*, packing pieces *F*, and the dies *G*. These parts are hardened, ground and lapped to a sliding fit, and the packing pieces regulated so that the dies are firmly closed as they pass into diametral line with the hardened and ground rolls *H*. These rolls, which act as cams, are free to roll on the inner surface of the ring *B*, and are held in their relative positions by a roll cage *I*.

The amount that the dies open in this type of head is regulated by two plates *J*, each carrying a pin *K* which enters a hole in the die larger than itself. The plates are clamped by screws passing through elongated slots. They are set according to the class of work being operated upon by means of a standard gage consisting of a block of the proper thickness.

If the dies are allowed to open too far, especially pointing dies, the metal will be carried between them and the wear will be excessive; if they do not open far enough, the metal will not reduce.

The dies and packing plates are held in the die

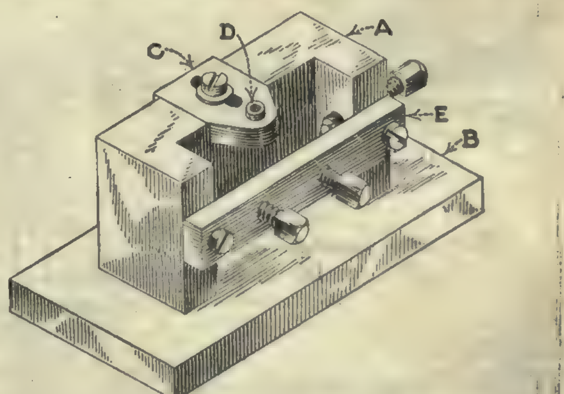


FIG. 3. DRILLING JIG FOR SWAGING DIES

slot by a plate *L*, and a plate *M* holds the rolls and oil. It is very essential that oil be used freely in all swaging operations, both on the work and in the head. Without oil to lubricate the surface of the reduced section, the dies will wear too rapidly and render the process very expensive. A stream of oil is used on all automatic machines and the work is dipped in oil when handling by hand.

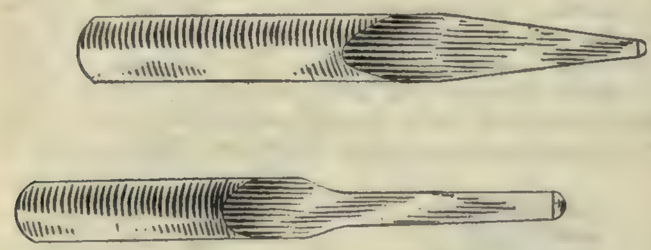


FIG. 4. TOOLS FOR FORMING IMPRESSION IN SWAGING DIES

The simplest method of handling parts to be reduced is to hold them in special pliers and introduce them into the dies by hand, but most machines have a work holder mounted on a slide that is operated either by hand or mechanically. The work holder is usually mounted with a spring between it and the slide to compensate for the sudden back pressure caused by the dies and it *must* be so mounted when the slide is mechanically operated.

The dies used in these heads must be made of the best grade of steel, as they are subjected to over 5000 blows per minute in some cases, and any defect in the steel due to its composition or heat-treatment reduces the life of the die enormously. Because of the speed with which the metal is shaped between these dies, the latter wear out, or change form, rapidly, especially when working on steel or german silver, and frequent replacement is necessary when the work is to be held within narrow limits of accuracy.

Practically all of the wear comes upon a small portion of the working surface, where the greatest reduction of the work takes place. This soon causes irregularity, or roughness on the surface of the work as well as a change in size, and to avoid machine delay, it is necessary to keep duplicate dies ready for service. It is the purpose of this article to describe the methods generally used to make these dies in quantities, and to repair them after they have worn beyond their limit of accuracy.

The die blanks, of various sizes, are machined into

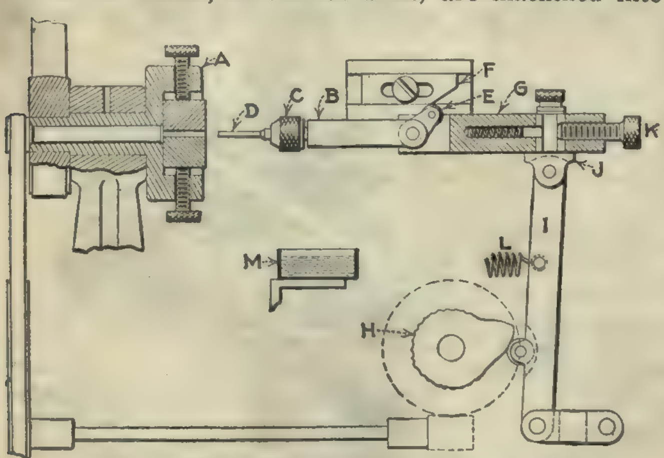


FIG. 5. DIAGRAM OF LAPPING MACHINE

blocks, leaving allowance for grinding all over, and are then annealed. Large dies may be relieved in the center of their side faces to reduce the grinding and lapping necessary after hardening. All dies not to be made into pointing dies should have a groove milled lengthwise through the exact center of their working surface, this groove being smaller than the finished form. Its object is to guide the drill used to enlarge the hole to its finished size. Dies to be finished by forcing a master form into them are left without this groove.

To produce a pair of master dies or original forms, the jig shown in Fig. 3 is used. This consists of a cast-iron box *A* attached to a base *B*, and supporting an adjustable bushing plate *C*. Bushings of various sizes, as at *D*, are made to interchange in this plate and are located in the center of the dies by lines on the plate and box. The dies are held in place in the box by screws both in the box itself and in the swinging arm *E*.

A pair of dies prepared as before mentioned are clamped in this jig and a drill slightly smaller than the smallest diameter of the reamer is passed through them. The bushing is then changed and a special reamer used to finish the form to size and shape. These reamers are usually made from drill rod as shown in Fig. 4 and, after heat-treating, are honed to a smooth cutting

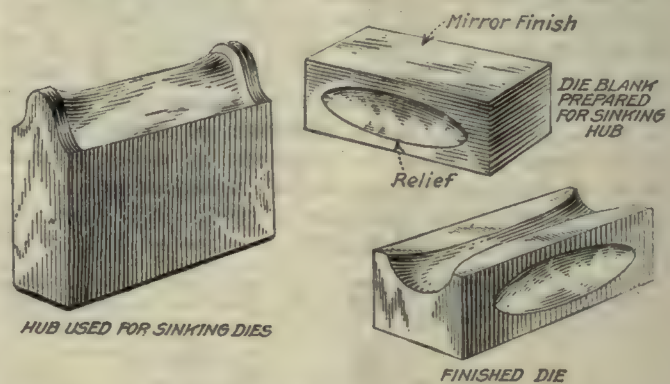


FIG. 6. SHAPES OF DIES

edge. The speed and feed used for reaming must be comparatively slow, as any grooves or imperfections in the formed surface will require an excessive amount of lapping to remove. After reaming, the hole is lapped to a smooth finish, using a copper lap of the same form as the reamer and a very fine abrasive. The dies are then ready for heat-treatment.

After hardening, the dies are ground all over as follows: The face that is nearest flat is set in contact with a magnetic chuck, and the opposite face ground to a surface; the die face is then ground parallel to the first finished surface, and the remaining faces ground square with the die face and to the proper side. The side faces are then lapped to a free sliding fit for the die-head slot in which they are to be used.

After they are finished on the outside they are clamped in a holder similar to Fig. 3, but having no bushing, and the form is lapped to the exact size and shape required on the work, using a very fine abrasive to finish with.

This final lapping usually consumes considerable time. It is done either in a drilling machine or the semi-automatic lapping machine shown diagrammatically in Fig. 5.

This lapping machine consists of a rotating die holder *A*, in which the dies are centered by means

of adjusting screws; a bell crank lever *B* carrying a chuck *C* for holding the lap *D;* and a cam roll *E* operating in connection with the cam *F*. This bell crank lever is pivoted on a slide *G*, the motion of which is controlled by the cam *H* and lever *I*.

The lever pivot *J* is adjustable by means of the screw *K*, and the spring *L* holds the lever *I* in contact

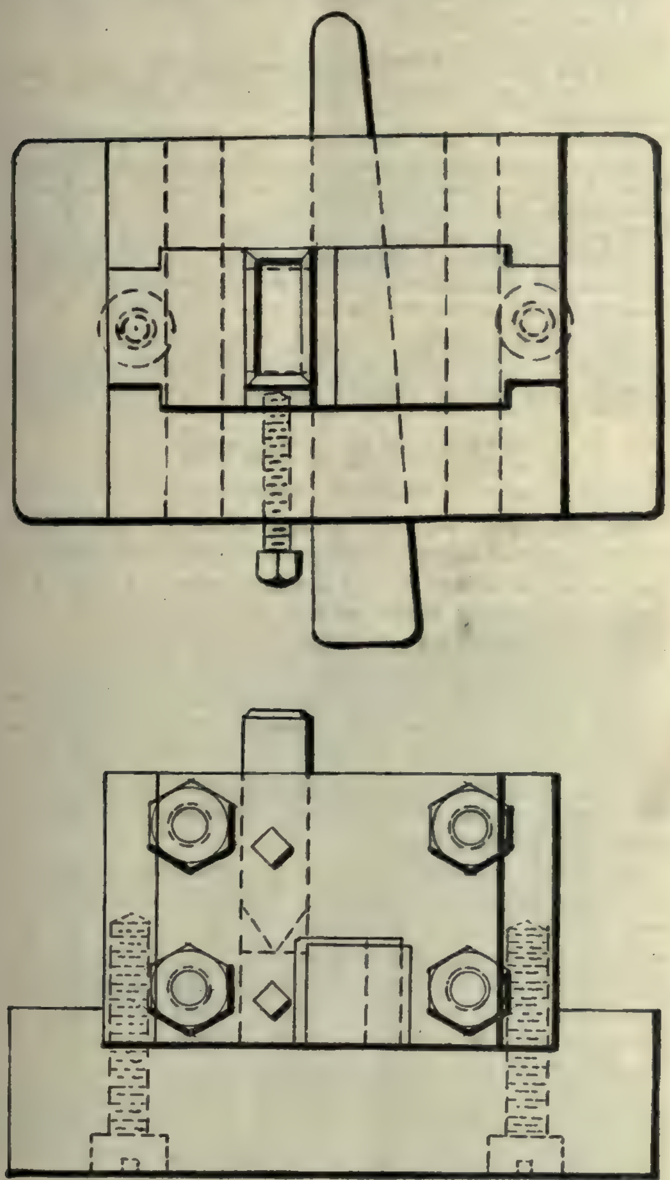


FIG. 7. FIXTURE TO HOLD DIES FOR HUBBING

with the cam *H* which is operated from the spindle through a worm and wormwheel. At the extreme rise of the movement, the lever *B* drops and the lap is momentarily immersed in a receptacle *M* containing oil and abrasive. The lap is reciprocated within the dies by a series of slight depressions in the cam, and the screw *K* is adjusted at intervals as found necessary.

Dies may be produced by the foregoing methods at a speed sufficient to keep a large battery of swaging machines in operation, but where large quantities of interchangeable dies are to be made the following process is more expeditious:

A pair of master dies are made by the process above described and tested in a swaging machine. One of these dies is used to produce a hub as shown in Fig. 6. The die and hub blank are clamped in the fixture shown in Fig. 7 and the hub blank pressed into the die form. It is then milled and finished by hand.

The process of making the dies is the reverse of the hub making. The hub is left longer than the die to obtain strength, and, after hardening, the form is highly polished and the outside ground true with the form.

The working face of the die blank must be highly polished before pressing the hub impression into it, as any scratch or depression in the surface is carried into the form by the hub, necessitating much lapping to get it out. The best method of getting a smooth, flat surface is to grind on a fine hard wheel, lap it with flour emery on a lap plate, and then obtain the mirror finish necessary for working gold-filled material by rubbing the surface of the die blank on a pine block charged with powdered sapphire.

Almost all steels have a tendency to change during heat-treatment and, when extreme accuracy is necessary, they must be lapped by hand to the correct size; but as the amount of material to be removed is very small, the time required to finish is but a small part of that needed to finish a reamed die.

Instructions to Toolmakers on Diemaking

By M. J. Zimmer

I am sending you a copy of instructions, one of three hundred that I had multigraphed while toolroom foreman for the International Time Recording Co. These were made up during the war when diemakers were scarce and we had to make our own.

Perhaps its best virtue was to teach each man what we thought was the best way to do the job; as you know, each man has his own thoughts and ways in diemaking and will go on in his own way, right or wrong, until taught differently.

The time and expense was small and I think this scheme could be worked out to advantage in many other shops where a uniform method of production is required.

Plane the punch, die, stripper, pad and get out the bolster for same. While machining operations are going on, study the blueprint for best possible way to lay out the die.

Grind and blue, punch and die, and lay out die. Next, drill dowel holes in die, but do not ream to size. Then transfer these holes on through into stripper and pad.

Drill out shape of die, being careful not to let holes run into each other. Put die, stripper and pad together, lining up with dowel holes previously drilled and using plugs made for this purpose. Now transfer all holes from die into pad, stripper and bottom bolster, and then take the pieces apart. This method has saved separate laying out of design to pad, stripper and bolster.

Ream dowel holes in die, and put in screw holes and any other holes necessary; open up holes for design until core is ready to drop out. File and finish shape of die; plug dowel holes and all other holes that are near edges. The die is now ready for hardening.

Before sending die to be hardened, lay stock for punch on die and trace outline with a sharp scriber. This will prevent you from being held up for work while die is being hardened, which will probably take a day or two. Send the die and specify the kind of steel with your order number to the hardening department.

Next place punch in shaping or other machine best adapted for machining same and try to work within 0.005 in. of line, all around. Should you finish this before receiving the die from hardening, you still have your pad and stripper which requires considerable drilling and the stripper will require machining to let stock through.

With a file, break all sharp corners on these pieces, also on bolster and punch holder.

Upon receiving die from hardening department, grind the top and bottom. The side of the die that is bellied most grind last; this will prevent rocking while grinding first side. If edges need grinding or squaring, do so, but do not put grinding or finishing where it is not needed, especially on parts that are not hardened as this runs up the time on the job and in no way helps the die to do good work.

By watching these points and planning your work ahead, you will save quite a few hours on your total time which will be a greater credit to you than a high polish which is soon lost when the die reaches the press room.

After grinding the die we are ready to shear the punch through. With the right amount for shearing all around (about 0.005 in.) the die, sharp, hard and a uniform clearance of about ½ deg. on a side, you should have no trouble in shearing the punch through. Examine every ⅛ in. or so to make sure the punch is going in square and that the chips are not choking the die, which might cause a bad break.

When your punch is through with the exception of about ⅛ in., remove it and file off the remaining surplus chips and stock. This to prevent breaking off pieces of the punch.

If your die clearance is just right and you have left the proper amount of stock on punch for shearing and the cutting edge of the die has held up, you will have no difficulty in removing the punch from the die; often it will lift out with the fingers, but if conditions are otherwise the punch will drive out nearly as hard as it drove in and will have deep scars all over its surface.

If the punch has sheared well we are now ready to file the clearance. Let the blanking punch be smaller than the die as explained in the *American Machinist* Handbook, page 271. If allowing for piercing punches let the die be larger than the punch plus 0.001 in. for shrinkage or closing in of metal after punch is withdrawn.

If there is considerable stock to remove from punch for clearance, use a coarse pillar file No. 00 and finish with a No. 2 pillar file. If there is but little to remove, smooth punch with a No. 2 file.

Next, drill pilot holes, if any are required and do what other work is necessary; then harden punch all over and draw temper from back. This is best done in the lead pot as the back must be soft enough for riveting to prevent pulling through pad. Do not draw the temper from punch until ready for mounting in pad.

We are now at the point where our punch is hardened. Grind top and bottom. Lap the dowel holes in the die until a good fit for a drive fit reamer.

Line the stripper up with the dowel holes in the die and clamp both pieces together firmly. You will remember that the dowel holes in the pad and stripper have not been reamed as yet, only drilled. This for shrinkage or expansion that may have taken place in hardening of die.

Now ream through the die and stripper, unclamp and do likewise to the pad. Next, clean all parts thoroughly with gasoline, and dry them.

Place the stripper and die together the way they should go and drive in the dowel pins to line them up. Place the back of the punch up through the die from the bottom, and place the whole under the shearing press and give one or two good blows.

Remove the parts and do what filing is necessary to the stripper and then shear the punch through. File the stripper again to make the punch an easy fit unless the punch is slender and requires support from the stripper.

Do same to the pad with the exception of the final filing. The punch must be a good fit in the pad and stand square. Bevel the opening in the pad to suit the headed over portion of the back of the punch.

We can now draw the back of the punch and head it over and drive it in the pad. After this, grind the back of the punch and pad together until they are flush. If there now remains more punches to locate in pad, say piercing punches, proceed thus: Clean parts and place the die with two small parallels, about one-quarter square between. Centralize the punch in the die with small strips of tin or paper between punch and opening in die. Clamp together and spot through piercing holes in die with drill that is a good fit in holes. Remove the die and enlarge holes to size required for piercing punches. Insert punches and now try in die for line up; if all right, mount die on bolster and screw it fast, but do not ream for dowel holes until the last thing.

Now mount punch pad and screw fast. If punches line up with the die, ream and dowel the die, remove and place on stripper, the stop arrangement having been decided on, and machining completed. Screw and dowel die, stripper and bolster together.

Line up again and if satisfactory ream and dowel pad, again lining up, which will prove O. K. if care has been maintained.

Make sure of your part and tool numbers and stamp them in a conspicuous place; and with a few finishing touches such as breaking sharp corners, etc., the die should be complete ready for the inspector.

The foregoing directions if carefully followed will help you in completing a blanking die within a reasonable time, and time as you know is one of the important items considered before an increase in your rate is turned in.

The rules as given are not iron-clad and may be changed to suit conditions. The author had in mind an average man and an average job when he wrote them.

What's in a Name?

By E. M. Long

On page 816, vol. 51, of the *American Machinist*, there appeared some comments by Sandy Copeland on the names of things in the machine shop. I think his position is poorly taken, as can be proved by his own statements regarding spiral gears.

Accepting his definition of spiral, he is mistaken in saying there is no such thing as spiral gearing. One of my earliest recollections of gearing included a crown gear having a single spiral tooth and was used in a tallying mechanism. Later, the Warner Speedometer Co. used a crown gear having a number of teeth arranged in a spiral form.

He is also in error in limiting his definition of "spiral" to the clock-spring form. The New Standard Dictionary, one of the best authorities in the country on the meaning of words, says that a spiral, in form, may be cylindrical, conical, Archimedean or logarithmic, and one definition of spiral is "helical." Also the definition of spiral gear is one having teeth arranged spirally or worm-fashion around its circumference.

By the way, I would like to know what is the accepted dividing line between a worm (when used in gearing) and a helical gear? I believe that a single-thread worm is truly a one-tooth helical or spiral gear, but for convenience in making ourselves understood, we call it a worm. How many threads can it have before it becomes a spiral gear? Personally, I have drawn the line between three and four. Perhaps it should be between four and five. I should like to know what is the accepted usage.

Also, I would like to ask why our manufacturers of lathe mandrels do not place upon them some universally accepted mark showing which is the small end. Time and again have I tried first one end and then the other in the effort to drive or force a mandrel out of the work, and I know that I am not alone in this experience. It would also be a convenience in placing the mandrel in the work. It seems to me that a large letter S stamped on the small end of the mandrel would be a good way of overcoming this annoyance. The manufacturer who first does something of this kind will win the thanks of thousands of mandrel users.

Industrial Motor Control—II

BY C. W. STARKER

Are you satisfied with your present system of motor control? Perhaps you will find suggestions for bettering your present installation in the many types of automatic direct-current motor controls covered in this article.

(Part I was printed on page 195, Jan. 22 issue.)

THE three classes of controllers previously described have in common the characteristic of being manually operated. The second and particularly important group of controllers is known as automatically operated, or magnetic controllers. This group has two subdivisions, semi-automatic and full-magnetic.

DIRECT-CURRENT SELF-STARTERS

The simplest form of automatic starter is a single-pole magnet switch, Fig. 11, which is obtainable in sizes from 500 to 4000 amp. The switch is closed by the pull of a magnet which requires only a small amount of current flow, while ¼ to ½ amp. is usually sufficient to hold the switch in the closed position. These switches are particularly suited for remote control where it is desired to control a heavy current from a distance, and where it would be too expensive to run the main leads to a remote point. Magnet switches may be operated by any kind of single-pole switch or by a set of push buttons, Fig. 12, having one button for the "on" and the other for the "off" position. A desirable feature of this switch is the "safe" button. This button may be turned into such position that it is impossible to start the motor from any other station until the button is turned back to the "on" position. In order to prevent burning of the contact, arc shields and magnetic blowouts are provided for all sizes. These switches are also manufactured as double-pole magnet switches which cut out both sides of the circuit.

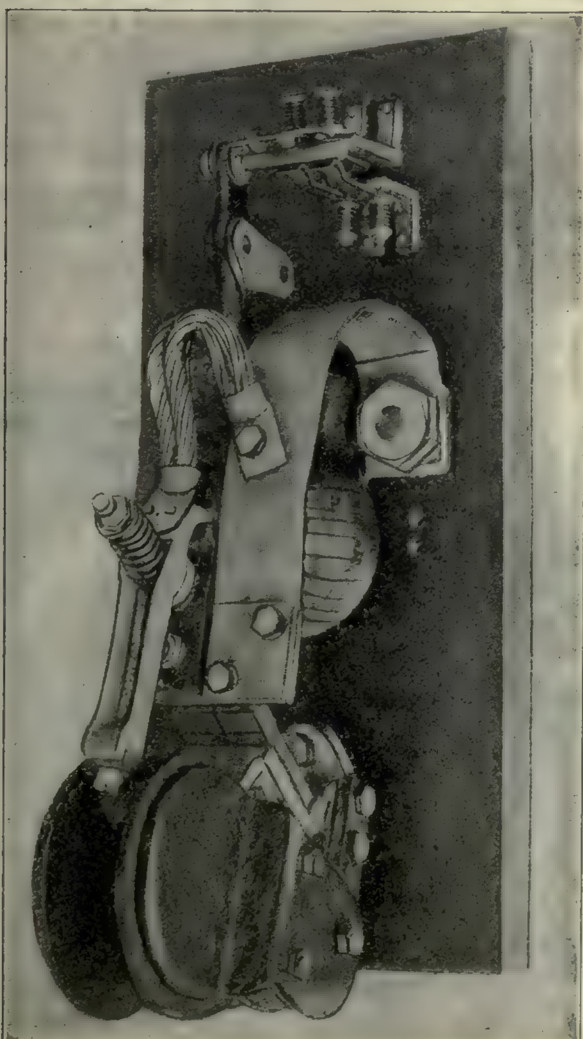


FIG. 11. SINGLE-POLE MAGNET SWITCH FOR REMOTE CONTROL OF LIGHTING AND POWER CIRCUITS

It is frequently desired to have the acceleration of the motor take place in a certain predetermined time, and to meet this requirement, time-limit self-starters are available in which the rate of acceleration is controlled by an oil or air dashpot. Such a starter is shown in Fig. 13. In operation the oil or air passes through small openings and, by varying the size of the opening, the time of acceleration can be adjusted to suit load conditions. This form of control is very generally applied to pumps, fans, compressors, elevators, etc. If remote control is desired, the switch can be operated by a knife or push-button switch, or by such special devices as float switches for oil or water tanks, or by diaphragm or pressure regulators on air, gas or fluid systems. It is often desired to employ self-starters in connection with small motors of ¼ to 2 hp., and for this purpose counter-electromotive-force self-starters, Fig. 14, are used. In these the starting resistance is automatically cut out in a single step by the action of the solenoid when the motor has attained approximately one-half normal speed; that is, they are operated, as the name implies, by the counter-electromotive force, the amount of which is proportional to the speed of the motor.

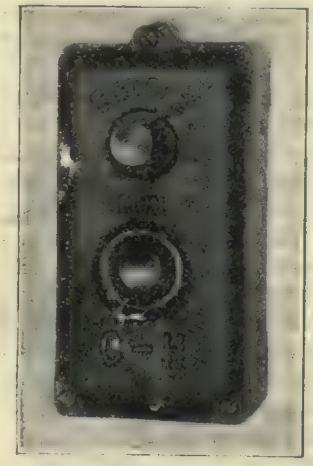
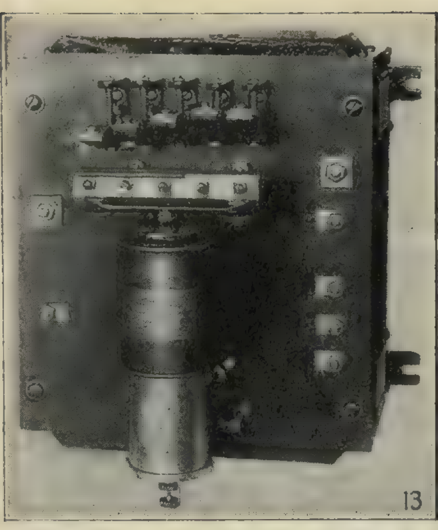
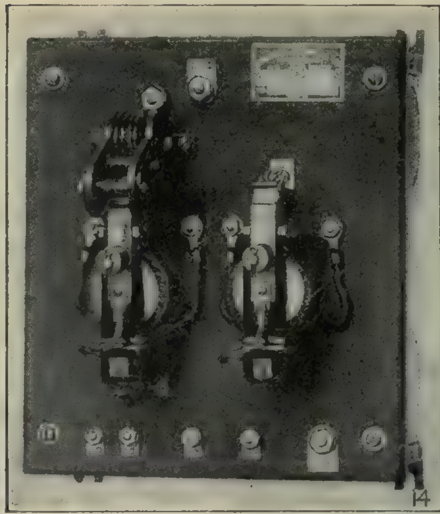
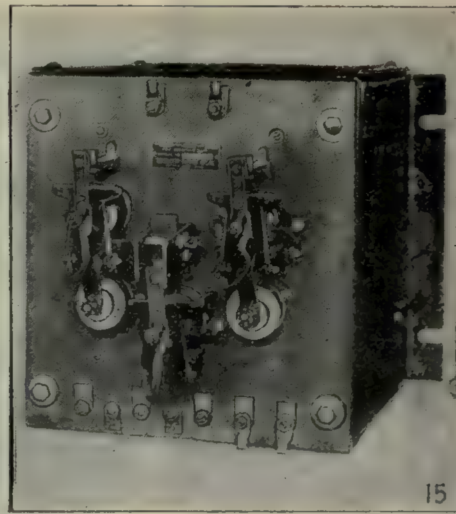


FIG. 12. A PUSH-BUTTON CONTROL STATION FOR SELF-STARTING SPEED REGULATORS

Another type of magnetic starter is based upon the automatic cutting out of resistance in steps by using a series of clapper-type switches with series coils. This is done in such a way that each accelerating switch is magnetically prevented from closing until the motor current has fallen to a certain predetermined value. This type of starter, known as the magnetic lockout self-starter, Fig. 15, is frequently employed for automatic remote control of motors for heavy-duty service on large pumps, fans, compressors, machine tools and other heavy machinery. They may be equipped with magnetic blowouts, magnetic main switch, overload release, knife switch and fuses, mounted on a panel

FIGS. 13, 14 AND 15. SEMI-MAGNETIC CONTROL SWITCHES
Fig. 13—A time-limit self-starter. Fig. 14—Counter-current controlled starter. Fig. 15—A magnetic lockout self-starter

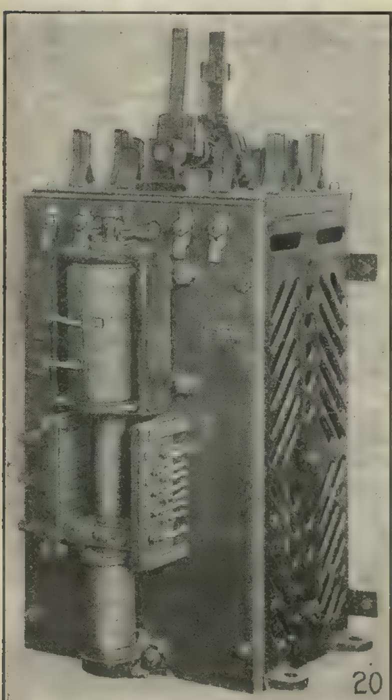
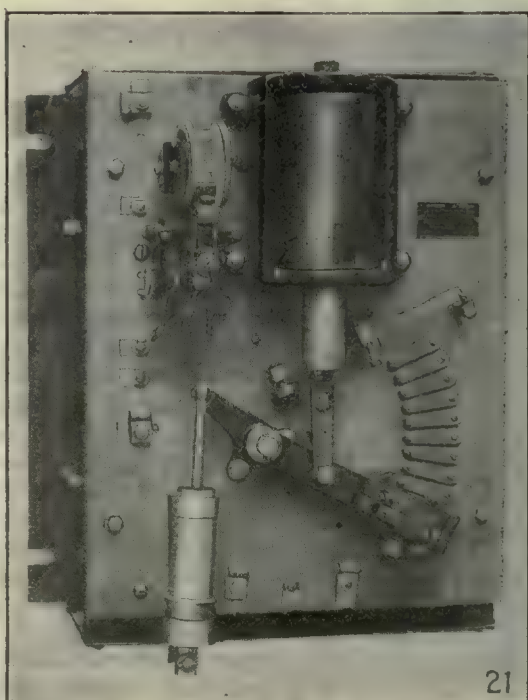
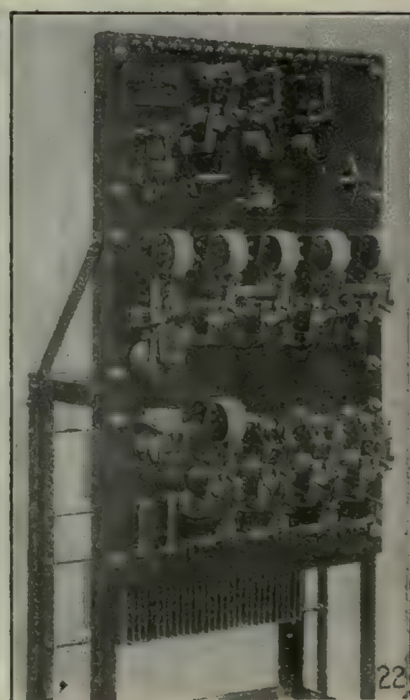
as one complete unit. Modifications are obtainable where the control is to be installed in connection with mine and fire pumps or mine fans where wide fluctuations in line voltage may occur and where the starters are located in damp places.

According to their functions, automatic machine-tool controllers may be divided into three groups, namely: controllers for plain starting, controllers with speed settings and controllers with speed-regulating features. The first-mentioned type is used in connection with constant-speed motors, and may be non-reversing—for starting and stopping only—or for reversing service. A controller combining all of these features is shown in Fig. 16 installed on an engine lathe. The handwheel for operating the controller is within reach of the operator at all times, and with installations of this type, there is no danger of any one accidentally coming in contact with current-carrying sparks.

An interesting control for machine-tool operation is shown in Figs. 17 and 18. Here a semi-mechanical reversing starter is connected to the stops on the platen of a planing machine. The motor is automatically reversed at the end of each stroke, and brought up to a predetermined speed before entering the cut. Push-button controls are placed at different points on the machine so that the starting or stopping of the motor is at the finger tips of the operator. Dynamic or electro-mechanical brakes should always be a part of such equipment. In case of current failure, the brake is automatically applied to bring the motor and machine to a quick standstill, preventing serious damage to the equipment.

CONTROL FOR MACHINES USED IN PRINTING PLANTS

For the control of machines used in printing plants which require motors of 1- to 3-hp. capacity, self-starting speed regulators, Fig. 19, are used. They are controlled by either a double-pole main-line switch or by push buttons. The closing of this switch ener-

FIGS. 20, 21 AND 22. TYPES OF ELEVATOR CONTROLLERS
Fig. 20—Semi-mechanical, direct-current elevator controller. Fig. 21—Pivoted-arm type of semi-magnetic controller. Fig. 22—Full-magnetic controller for high-speed elevator

gizes a solenoid, the plunger of which is attached to a contact arm, and, by means of the latter, resistance is cut out step by step. Five to 10 steps are usually provided, and a speed regulation of 50 per cent by armature control and from 20 to 100 per cent by field control is obtainable commercially. The usual electro-mechanical braking features may also be added.

With automatic machine-tool controllers, there are a number of special points which should be brought out. The use of magnetic lockout switches makes the controller very simple both electrically and mechanically, and series relays, protecting resistors, etc. are thereby eliminated. In order to insure that the last contact remains closed during fluctuations of line voltage, or strengthening of motor fields, a shunt coil is used. Speed-setting controllers are provided with accelerating relays which insure that the motor always starts under full field and, after the armature resistance is all out, automatically accelerate the motor to the speed to which the field rheostat is set. Speed-regulating controllers have two relays, one for acceleration and one for deceleration. The accelerating relay serves to limit the rate of field weakening, while the decelerating relay prevents too rapid strengthening of the motor field when stopping or reducing speed from the master controller; thus excessive dynamic braking currents or return surges of current from the motor to the line are avoided. In drum-type controllers, arc barriers should be used between the contact fingers, and, in the higher capacities, magnetic blowouts should be added.

FIG. 16. TYPICAL AUTOMATIC CONTROLLER APPLIED TO A LATHE

The low-voltage protection should, with all machine-tool controllers, be so arranged that the motor will not start upon return voltage until the operator desires. The importance of the foregoing statement cannot be too strongly emphasized. To start a motor after a current failure, it will be necessary to press the "run" button if the controller is operated from a push-button switch; or, if operated from a master-drum controller, the handle must first be turned to the "off" position, and then moved to a starting position.

The control of elevator motors is a particularly interesting branch of industrial motor control. The field is very large and rather specialized, so that only a few main points of broader interest to machine-shop men will be briefly touched upon. Elevator motors are divided into three classes according to the service: slow-speed freight elevators, moderate-speed passenger elevators, and high-speed passenger elevators. The control equipment naturally follows these divisions, and in additions has the two subdivisions, semi-magnetic and full-magnetic control, operation of the controller in all cases being by car switch, push button or rope.

A simple semi-mechanical elevator controller built in capacities of from 5 to 25 hp. and intended for slow-speed service is shown in Fig. 20. It has a reversing switch mounted on a control panel which carries a solenoid operating rheostat. Its operation is as follows: By means of a wheel, rope or lever, the reverse switch is thrown into the running position, the solenoid is energized, and the plunger with contact fingers travels

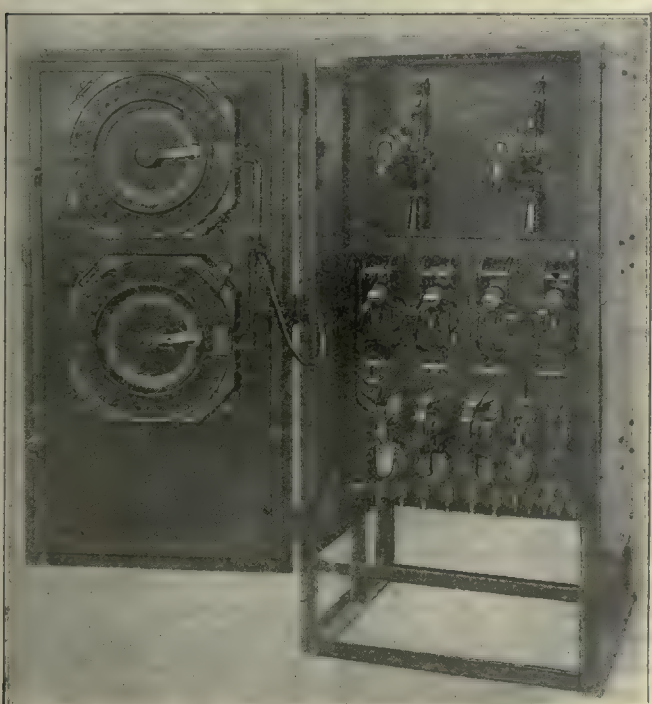


FIG. 17. SEMI-MECHANICAL CONTROLLER FOR A PLANING MACHINE

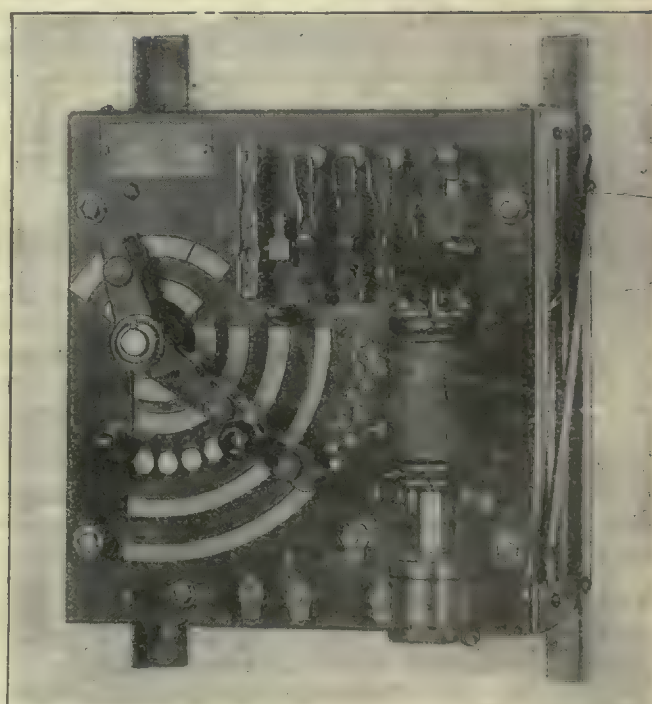


FIG. 19. SELF-STARTING SPEED REGULATOR FOR PRINTING PRESS

upward over the stationary contacts, cutting out resistance in doing so. An air dashpot, as shown, regulates the time consumed, and at the limits of travel of the elevator a traveling nut is arranged to throw the switch to the "off" position. The contact arm may be pivoted to swing in a circle, as shown in Fig. 21, the operation of this type of controller being similar to the one just described.

These controllers are typical for a slow-speed service, while the full-magnet type of elevator controller, shown in Fig. 22 is intended for high-speed, passenger-elevator service at 350 ft. per minute car speed or less, and is operated by a switch mounted in the elevator car. Acceleration to normal speed is governed by series relays in the armature circuit and above normal to high-speed acceleration is governed by magnetic-field-weakening switches with a series relay in the shunt-field circuit. Overload protection, dynamic braking and slow-down features are also provided. The slow-down speed obtainable is about 30 per cent of normal speed.

The push-button control is especially adaptable for foundries or shops where there are two or more landings, and eliminates the necessity of an attendant. The car is started and automatically stopped by simply pressing a series of button switches located at the different landings.

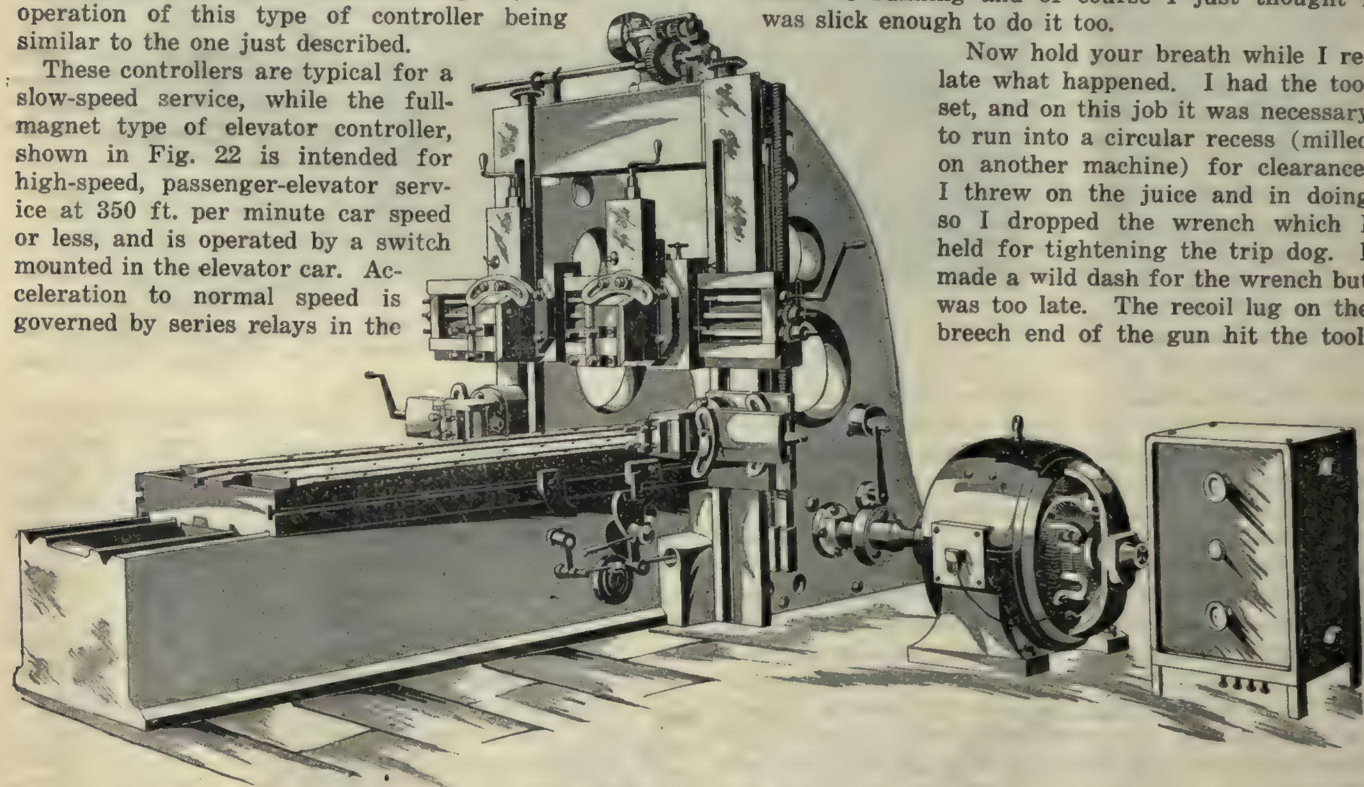


FIG. 18. THE CONTROLLER ATTACHED TO A PLANING MACHINE

Rules of Etiquette To Be Observed in the Machine Shop

By H. L. Wheeler

I would like to inform Charles Eldridge, who writes upon the above subject on page 1048, Vol. 51, that I once performed the impossible stunt of running the platen of a planing machine on to the floor.

It happened this way:

It was at the time when I was, what Mr. Eldridge would call a junior machinist, in one of the Government arsenals. The machine was a large motor-driven planing machine with three speeds, accelerated reverse, and all the other up-to-date trimmings that went with a big planing machine at that time. The job was a 4.7-in. field gun mounted on centers and the operation consisted of planing the outer contour of the gun to a templet layout.

One or two other apprentices on the job before me had made good and passed along to something else, so it was now my turn. I had good luck with the first gun and got it off all right and had mounted my second. I had many times seen a man setting the trip dogs with the machine running and of course I just thought I was slick enough to do it too.

Now hold your breath while I relate what happened. I had the tool set, and on this job it was necessary to run into a circular recess (milled on another machine) for clearance. I threw on the juice and in doing so I dropped the wrench which I held for tightening the trip dog. I made a wild dash for the wrench but was too late. The recoil lug on the breech end of the gun hit the tool, which was of Novo steel and about $\frac{7}{8}$ x $1\frac{1}{2}$ in. section, and snapped it off like a pipe stem while the toolpost and slide were torn from the crossrail. Believe me, there was some fireworks for a few minutes.

I jammed on the reverse and that platen sailed by me like the Chicago limited. This all happened in a very few seconds, and by the time the platen hit the floor I was sweating along the spine as though I had been struck with the palsy. I just let her rip; that's about all I could do, or knew what to do, probably on account of my inexperience. The platen, however, positively did hit the floor. When I woke up, I was before a military tribunal consisting of a lieutenant-colonel, a major, a captain and several lieutenants, all doing their bit for the Government.

If Mr. Eldridge or any one else doubts my statements, please be informed that somewhere in the musty archives of the War Department in Washington can be found a full and complete report of the event, signed, countersigned, and decorated with all various brands of red tape and signed and sworn to by me, with several affidavits and witnesses.

I tried to prove an alibi, but the evidence is strong against me that I once performed the "impossible." I was excused on the grounds of ignorance, youthful appearance and inexperience. This happened about sixteen years ago. I have since traveled some and have worked in a goodly number of shops, but I have never heard of the thing happening to anyone else. I might add that I believe it to be a very rare occurrence.

U. S. Government Sales and Belgian Machine Tool Conditions

BY ALEXANDER LUCHARS

This is the concluding article of the series on conditions in the machine-tool and kindred industries in Europe. It was written in Brussels on Aug. 15, and considerable of the information it contains has now lost it value, but it may be of some interest to manufacturers whose products are sold in Belgium. In this article will be found a summary of preceding articles on Great Britain, France, Italy, Switzerland, Holland, Germany and Scandinavia, and a comparison of labor and material costs.

A MATTER of great importance to American machine-tool manufacturers is the amount and effect of sales of tools by the United States War Department in Belgium. As our manufacturers already know, these are being sold at 1914 prices plus 55 per cent. c.i.f. Antwerp; the 55 per cent. being figured not only on the 1914 cost of the tools, but on the freight and other costs. Three years' time is given the buyers by the Belgian government, and this item in the terms is perhaps more attractive to the buyers than the low price. A discount of 10 per cent. is given for each year a tool has been in use, unless it has been used so little that its value has not been affected.

Under the arrangement made, the U. S. War Department sells these tools to the Belgian government, which markets them through *La Construction Metallique*, a coöperative society organized to do business without profit, and composed of Belgian manufacturers in the machinery and metal manufacturing industries, any one of whom may become a member by paying a small fee. Any member of *La Construction Metallique* may buy any number of these machines on the above terms, without regard to whether or not they are to replace machines stolen by the Germans. *La Construction Metallique* includes 18 subsidiary groups of manufacturers, among them makers of automobiles, locomotives, machine tools, motors, engines, etc. The original arrangement for financing these sales was based on a credit of $22,000,000 granted to the Belgian government by ours; $3,000,000 worth of machine tools were sold, and it was then found that the $22,000,000 credit had been used by the Belgian authorities without reserving any of it to pay for the tools. After some delay a second arrangement was made which is now in force, under which the tools are to be paid for from the $50,000,000 Belgian credit recently negotiated with American banking institutions.

About $3,000,000 worth of machine tools have already been sold, and it was stated by an officer in authority that it was expected to sell about as much more—in all, about 4000 machines. The selling of small tools is now being considered. No accurate list of tools owned by our Government is in possession of the U. S. officers in Brussels, nor of the Director of Sales, C. W. Hare, whose office is in Paris. Mr. Hare controls the sales of all our surplus war material, and has several efficient assistants who are in direct charge of the sale of tools in Belgium. Under the present arrangement a Belgian manufacturer places his order for various machines without knowing, apparently, whether or not our War Department has them in stock. If it has not, then he is expected to take some other size or make, subject perhaps to a price adjustment up or down. This might work out if only a few machines were sold, but with 4000 there can hardly fail to be trouble with deliveries and settlements, and whoever has this to handle is not to be envied. The sales are made in dollars by the U. S. War Department; and the prices at which the machines are bought by Belgian manufacturers are presumably subject to the fluctuations of exchange, unless a heavy loss is to be made up somewhere.

One of the officials in charge of these sales advanced the following reasons in support of them: (1) That the tools had to be sold *somewhere*, and that they would probably do more good in Belgium than elsewhere and would also keep the Germans from selling a considerable part of the amount; (2) that the Belgians need tools badly to reëquip their factories, and have not the money to buy them on ordinary terms of payment; (3) that many Belgian manufacturers are buying American tools who never had one in their shops before, and this sale should make a future market for them which will be worth some transient loss. Of course I handed out some good machine-tool-manufacturers' answers to these statements; but as you all know about what you would say, I will take up no space for repetition work.

The Belgian machine-tool dealers are not considering the proposition from any philanthropic standpoint. They say that the prospective enormous Belgian demand has almost disappeared, because manufacturers are waiting to see how much of their equipment they can get from Uncle Sam. One dealer told me that for this reason an order amounting to 300,000 francs, with prospects of a further increase to a million, was canceled. Another dealer says that machines sold by the United States Government are being bought only by those who have had considerable experience in the past with American tools and know them well. The medium-sized and small plants that have been the largest buyers of German machines heretofore have not so far bought any American tools and appear to be waiting until they can again buy in Germany. In spite of this heavy load on the market, a fair business is being done in American tools at current prices, showing that except for this sale a splendid business would be going on.

After investigation there seems to be no doubt that receipts were in most cases given by the Germans for the machine tools and other machinery stolen from Belgian works, and that the tools were also tagged or otherwise marked to facilitate identification. It is also true that an effort is being made by the German authorities to collect and return these machines. Mr. Rother, one of the staff of Schuchardt & Schutte in Berlin, is in charge of the return of these machine tools. But restitution is not easy.

It is stated on good authority that only about one-

fifth of the machine tools taken away have been returned. The Cockwill Works, from which some 3500 were taken, have had about 300 returned. The Minerva Works, which lost a large number, have got back almost none. One large press was returned to them, but the cost of getting it back, replacing some of the parts and reërecting it, left but a small part of its original value. The large works can afford to send people out to search for their machines and see that they are returned, but this is too expensive for a small concern, and if the machines are found they may be worn out. Many Belgian manufacturers are not trying to get their machines back, apparently expecting to buy new ones through *La Construction Metallique* or some other source. There is no special fund to reimburse these manufacturers for money spent for reparations. They will have to await the distribution of the indemnity, probably a process of years. There is nothing in the statements that some of the Belgian tools had been repaired and resold by the Germans.

All the important Belgian works are said to have placed large orders for machine tools—some in the United States and some in Scandinavia. I heard of none being placed in Germany, but some people say that if the difference in price continues it is only a question of time before machines will be bought there. It requires quite a lot of patriotism to keep turning down prices from 25 per cent. to 50 per cent. less than are being paid; but the Belgians will do it for a time.

Some machine-tool makers are getting ready for business, but no important concerns. The report that the big Fabrique Nationale, at Herstal, intends to make machine tools appears to have started from their decision to make some special tools for their own use. There some 4500 to 5000 machines were stolen by the Germans and but a few have been returned. Only about 2000 hands are now employed there.

Labor

The cheap labor which made Belgium a formidable competitor in European and foreign markets is as much ancient history as the 34 shillings a week of the Yorkshire machinists. Belgian labor has gone up since the war and may keep on going up, although some people here think that the apex has been reached. It is reasonably certain to work up to an equality with that of other European countries.

I noticed yesterday a letter in the London *Times* from an English manufacturer saying that "railway fastenings," which were £9 7s. a ton in 1914 in England and about the same on the Continent, were now £44 to £46 in England and £30 in Belgium, a difference which will prevent English manufacturers from selling into South America and other foreign markets. If our English friend will be patient for a time he will see a change in Belgian prices.

The king is wonderfully popular among all classes, and his throne, which stands among the Continental nations like the traditional lone pine, is in no danger; but that doesn't mean the Belgian workers are not going to get enough pay to live at least as well as in 1914. Some are getting such wages now, but there are other low-wage scales still in effect that will have to be brought up to the average level.

In spite of the 119 recorded (and no one knows how many unrecorded) strikes in Belgium between Jan. 1 and May 1, 1919, the number of unemployed workers has steadily decreased. The great strike of railway and postal employees for an advance in wages, which meant an increase of 350 million francs during the first three months, has just been postponed, because the workers came to see the untold injury such a strike would cause the nation during the period of reconstruction, thus indicating a willingness to listen to reason which is not always a part of the labor program.

Employers seem to recognize the changed conditions, and have not only increased wages but have arranged a gradual reduction of the hours of work, which were 10 before the war, are now 9, will soon be reduced to 8½, and in 1920 to 8. Some plants have an 8-hour day now. Machinists' wages have increased from 225 per cent. to 295 per cent. (the present rate being from 19 to 34 U. S. cents an hour) according to the locality and class of work.

Those who are particularly interested in the development of Belgian industries of all kinds should send to the Department of Commerce for the reports of Trade Commissioner H. T. Collings, who has been in Belgium for about a year, and during that time has compiled a mass of valuable information regarding the industries he has been investigating. In this letter I have necessarily left untouched any subjects covered by his reports.

There have been quite a number of changes among Belgian dealers during the war. The A. H. Schutte warehouse was leased by the Allied Machinery Co., and recently bought by Alfred Herbert, Ltd., who will occupy it as soon as the Allied lease expires. Isbecque & Co. has given up its Antwerp place, and its main office and wareroom are now located at 36 Rue Otlet, Brussels, where it has very convenient accommodations. Henri Benedictus has also closed his Antwerp place and has taken the Steinhaus quarters at 133 Rue du Progress, which are well adapted to his business. R. S. Stokvis et Fils are at the same place, but find it too small for their requirements. Fenwick Freres still have their Belgian headquarters at Liege, but have decided to move to Brussels in about three months, and the tendency among Belgian machine-tool dealers is to concentrate in that city.

Packing and Shipping

Some of our manufacturers are still careless about packing and shipping, although more than plenty has been published about these requirements. Many breakages occur because light projecting parts, like gear guards and small pulleys, are not detached. In one lot of 10 light grinding machines I saw, four of the machines had broken parts—all of which must be remade and fitted by the buyer. In one heavy machine the lead counterbalance for the spindle had not been locked, and the constant motion caused it to work into an adjoining gear. Machines that have been taken apart by the makers are frequently sent without the parts being numbered or any diagram or instructions for reassembling. Most manufacturers do not properly slush parts of their machines liable to rust. "Sweating holes," about 1½ in. in diameter, one at each side of the case to admit of air, are advised. All heavy cases should be well strapped, weights should conform to those in catalog or invoice to avoid trouble with Custom House; and (this I wrote 15 years ago) all cases should have the contents indicated and should carry the numbers and marks furnished by the buyer.

For many years previous to 1914, Belgium was a

hive of industry, and I believe she will recover more quickly from the effects of the war and enjoy a greater proportionate degree of prosperity than any other European nation. The love of the Belgians for their king, and their trust in him, will insure the blessing of a stable government which will be worth hundreds of millions to Belgium during the coming period, while her neighbors are going on with costly experiments in economics and government. I think Belgium's prosperity and expansion will work out largely in the manufacture of metal products. Higher wages having come to stay, Belgium will be a very large buyer of machine tools, especially labor-saving machines, and the great part of these machines will be bought, not by the great works like the Fabrique Nationale, Cockwill or Minerva, but by hundreds of small shops that we never have heard of, which will start up, grow and expand with Belgium's growth and expansion. Compared with the volume of these purchases during the next 10 or 20 years the six-million-dollar sales of our War Department will cut a very small figure. Whether or not most of these tools will be bought in the United States depends upon a number of factors—the principal one now is exchange. If anyone is banking on Belgium buying tools from us out of gratitude, or for any other reasons than strictly business ones, he may as well forget them. The enmities engendered by the war may last for a long time, but the friendship, as applied to business, has already disappeared. France and Belgium will buy in future where they can get the most for their money, excepting possibly in Germany—for a time.

Summary of European Industrial Conditions

Great Britain

Demand was good in July for machine tools, and many manufacturers full of orders, but output restricted by labor troubles, and no immediate prospect of improvement. Some tendency toward specialization. Comparatively few British machine-tool builders have profited by their experience during the war; many are continuing pre-war methods. Motor-car manufacture is very active. Various associations have been formed to facilitate manufacture and selling and develop foreign trade. A number of firms have started making small tools and accessories. About 200 shops are now engaged in machine-tool building, having about 31,000 employees. Small tool and accessory lines comprise about 100 shops with about 7500 employees.

France

The enormous expansion in the use of machine tools during the war caused a surprisingly small increase in the number of French machine-tool builders. Two or three of the older firms have enlarged their plants and improved their equipment, but the remainder do not appear to have made any changes of importance since 1914. Labor is settling down, and French thrift again controls the situation. Business in machine tools appears to be good, especially in the northern and northeastern parts of France, but even in those sections French manufacturers are buying German machines rather than American on account of the difference in price, which difference is accounted for principally by the present exchange rates. The large number of American tools used in France during the war, most of which were creditable examples of American products, have been a great help in educating French manufacturers in the use of machines of the best quality. It is probable that after the present demand for machine tools in France is satisfied, there will follow a quiet period, which in turn will be followed by a gradual and healthy increase in demand, keeping pace with the expansion of the French metal manufacturing industries.

Italy

During the war 42 factories produced machine tools in Italy, and all but about a dozen have returned to their pre-war product. Lack of coal and other natural resources is a heavy handicap to Italy, and the industrial outlook there is very uncertain. Few manufacturers are educated to the desirability of buying expensive American tools, which must be sold in competition with German tools at much lower prices. A good many American tools used in munition work are coming on the market.

Switzerland

Before the war there were only two machine-tool building concerns of any importance in Switzerland. To these were added about a dozen, most of them continuing in business and producing more machine tools than the small Swiss machine-tool market can absorb; but there will continue to be a demand for American tools of high reputation, because Swiss mechanics appreciate machines of quality. At the present time, with German tools selling for much less than American, it is evident that only the high reputation and sterling qualities of American machines will enable foreign dealers to sell them in Switzerland.

Holland

There has been a distinct increase in the manufacturing industries in Holland during the war. A great many Dutch machine-tool dealers, being unable to get American machines during the war, turned to German makers, and the Dutch market is now flooded with German machines. It is estimated that these stocks will not be worked off until about 1921, and then only if shipbuilding and other industries requiring them continue to be prosperous.

Germany

There are now 320 machine-tool builders in Germany, nearly all belonging to a German tool builders' association which had only 72 members before the war. The members of the association employ about 60,000 men, in addition to a fairly large number of women. They manufacture practically all types of machine tools, many of which are close or direct copies of American makes, and are offering them all over Europe at prices which make American competition difficult. The low German prices are caused largely by the depreciation of the mark.

Austria

In what remains of Austria the machine-tool industry and all others are on such an uncertain footing as not to warrant consideration, and in Hungary the new government is too young for anybody to venture an opinion about the future. In Prague, business is said to be encouraging, and the Czecho-Slavic government apparently is growing in strength. Machinery dealers in Berlin say they are doing a good business with

Finland, and expect to with Russia when conditions are settled.

Scandinavia

Reports from the Scandinavian countries indicate that the German competition there is so keen that it will not be possible for some time to come to sell American machine tools to any extent, German machines being offered for about half the price of American tools. Scandinavian industries which were busily engaged during the war and made large extensions, are now able to market only 50 to 60 per cent. of their capacity, and are therefore not in the market for machine tools to any large extent.

Cost of Materials

The following figures give an idea of the increase in the cost of raw materials: In Great Britain, mild steel bars, from £6 5s. 0d. a ton in July, 1914, to £19 in June, 1919. Pig iron, from £2 14s. 0d. a ton in July, 1914, to £8 10s. 0d. in June, 1919.

In Germany pig iron increased from 74.50 marks per ton in 1914, to 356.50 marks in 1919. These prices have now dropped from 52 to 90 marks per ton, but the Pig Iron Union states that at the reduced price the blast furnaces are working at a heavy loss. Steel sections sold for 110 marks per ton in May, 1914, and for 520 marks per ton in May, 1919. High-speed steel sells for 27.50 marks per kilogram.

Great Britain—Machinists' wages in 1914 averaged from £1 14s. to £1 19s. per week, and in 1919, £3 12s. to £3 15s. In addition to this increase in wages, the hours have been reduced from 53 or 54 hours to 47 hours, and a further reduction to 44 hours per week is being considered. For women in the machine industries 18 years of age and over, not engaged in men's work, the present minimum is 38 shillings per week. Higher rates are paid to women engaged on men's work.

Germany—The wages of machinists and machine operators in 1914 varied from 0.48 to 0.75 mark per hour. The present wages for corresponding classes of workers vary from 2.55 to 4 marks per hour. Blacksmiths received from 0.95 to 1.15 marks per hour in 1914, and are now receiving from 3.50 to 4 marks per hour. In this connection it should be stated that the production per hour per man during the first six months of 1919 was only about 50 per cent. of the production prior to the war. All over Germany the 8-hour day prevails, and in some shops 44½ hours is the standard working week.

France—Machine operators in 1914 received from 0.95 to 1.25 frs. per hour. In 1919 the rate is 3.75 frs. Assemblers received in 1914 from 0.95 to 1.90 frs. per hour, and in 1919, 3.80 frs. per hour. Unskilled labor now receives 2 frs. per hour, which is double the wage in 1914, while toolsmiths receive from 4 to 5 frs. per hour, which is about three times the 1914 rate. Eight hours is the legal day.

Belgium—In the machine-shop industries in Belgium, a 54-hour week was the rule, except when the workers are employed by the government, in which case a 48-hour week is standard. A gradual reduction is arranged to an 8-hour day in 1920. Belgian wages as compared with June, 1914, show an increase of from 150 to 200 per cent. In the early summer of 1919, machinists received from 85 to 105 francs per week of 54 hours.

Sweden—Machinists receive about 12 crowns per day, while toolmakers get from 16 to 20 crowns per day.

For convenient comparison, the present wages in the United States are here given. In Detroit, the prevailing rate for machinists is 75 cents per hour, and for laborers and helpers, 50 cents per hour, with the latter asking for an increase to 60 cents per hour. In Philadelphia, rates for machinists vary from 65 to 80 cents per hour. In Pittsburgh, helpers and laborers get from 30 to 40 cents per hour; machine operators with limited skill, from 40 to 50 cents; medium-class machinists, from 50 to 60 cents; first-class machinists and medium-grade toolmakers, from 60 to 70 cents; and high-class toolmakers and machinists on exceptionally important work, 70 to 80 cents an hour. In Connecticut, wages vary from 45 to 65 cents per hour for machinists, with unskilled labor paid at from 32 to 40 cents an hour. Toolmakers receive from 55 to 75 cents an hour. In New York City, toolmakers receive from 75 to 85 cents an hour, and in exceptional instances, for the very highest class of diesinkers, from $1 to $1.10 an hour.

Various Notes in Response to Inquiries

During the war there has been a greater permanent development in machine-tool building in Germany than in any other European country, and she will be our strongest competitor in future.

It will be some years before France will be able to fully utilize her new coal and iron resources, and it is difficult to forecast the effect on British industry during that period. It seems to me that these changes will work out more to the advantage of Belgium than any other European country, for several years.

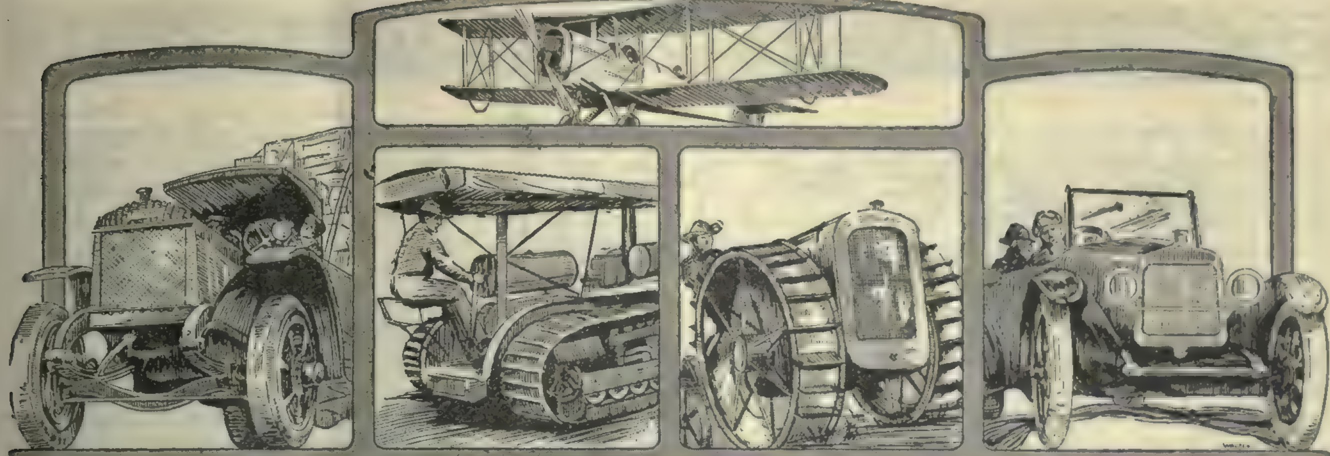
Our manufacturers must depart from their custom of requiring payment against B of L New York, if they are to do business with Europe. This custom is almost as great a handicap to foreign trade as the present exchange rates.

Swedish manufacturers have formed an association under the name of Svenska Verktygsmaskinfabriks Export Aktiebolaget, which is said to be offering machine tools on payment of 20 per cent. cash and the remainder to be left at 5 per cent. interest until the exchange rate becomes normal.

The decrease in German efficiency referred to in the article on that country is not paralleled in any other country, although the demoralizing effects of war conditions are visible everywhere. There is considerable "slacking" in Great Britain and discouragement in Italy, but from different causes. The spirit of unrest in Great Britain is nearing the peak, but there and here the labor situation is a long way from normal—by which I mean conditions under which employers can rely on labor and figure their future labor costs with certainty. In Belgium and France labor unrest is subsiding. In Italy it is impossible to foretell what will happen.

German manufacturers are planning and working to regain their markets. Germany formerly had an enormous trade with Russia, and as soon as conditions warrant will surely resume commercial relations with that country.

The countries where our machine-tool manufacturers will find the strongest competition are Great Britain and Germany, although Scandinavia and Switzerland will sell in their own and other European markets.



AUTOMOTIVE CONSTRUCTION

"Caterpillars" and Their Construction—IV

By K. H. CONDIT

Managing Editor, *American Machinist*

The controversy between the high-speed, light-weight automotive engine experts and those who advocate the slower, heavier type still rages, one side leading in one field of development and the other somewhere else. The latter class finds one of its shining examples in the caterpillar-tractor motor.

(Part III appeared in our previous issue.)

If THE motor is the heart of an automobile it is equally vital to the traction engine and in ordinary tractor use it is subjected to strains that would induce angina pectoris, heartburn, or valvular trouble of a serious nature in a weak organ. Consequently, it must be sturdy to a marked degree and able to give steady service under all sorts of conditions. The British army went a long way in supplying all sorts of weather to test the caterpillars by using them in France, Gallipoli, Egypt and Mesopotamia in all seasons. At this writing there is no record of their having been used at Archangel or on the Murmansk Coast but they would undoubtedly have given the same reliability under such arctic conditions because they have already done similar work in Rocky Mountain snowdrifts.

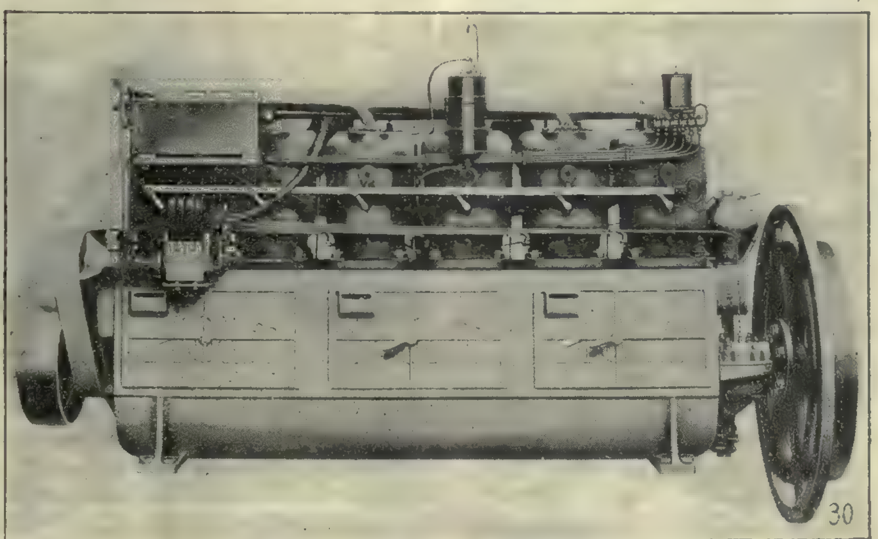


FIG. 30. SIDE VIEW OF 120-HP. ENGINE

As most of this series has been devoted to the 120-hp. caterpillar this description will be confined to the six-cylinder motor used in that machine which differs materially from the ones used in the smaller models. The demands of the various governments for which the Holt Manufacturing Co. was building tractors were so insistent, that standardization of a line of motors of varying power, as the design of the Liberty motor was standardized, was out of the question, and the L-head cylinders of the "120" bear slight resemblance to the detachable I-head ones used in the "75." Each gives results, however, which is the principal requirement.

The 120-hp., six-cylinder engine, shown in Figs. 30 and 31, develops its rated power at 550 r.p.m. With such a slow maximum of speed no attempt has been made to counterbalance the crankshaft and the unconventional firing order of 1-3-5-6-4-2 is used without undue vibration and rock. The cylinders have a base of 7½ in. and a stroke of 8 in., placing this motor among the largest mobile internal-combustion engines built. With cylinders of this size even a low-compression motor requires some form of compression release to enable it to be started by hand; on this one relief cocks, low on the side of the cylinders and connected by a long bar, are fitted as shown in Fig. 30.

An extra-heavy Stewart vacuum tank is fitted to take care of the fuel feed to the carburetor when the tractor travels up or down a 100-per cent. grade—not an unusual feat, by the way. Lubrication is by combined gravity, splash and force feed; a double-gear pump drawing the oil from the crank case and supplying the splash troughs, while a gravity oiler at one end of the

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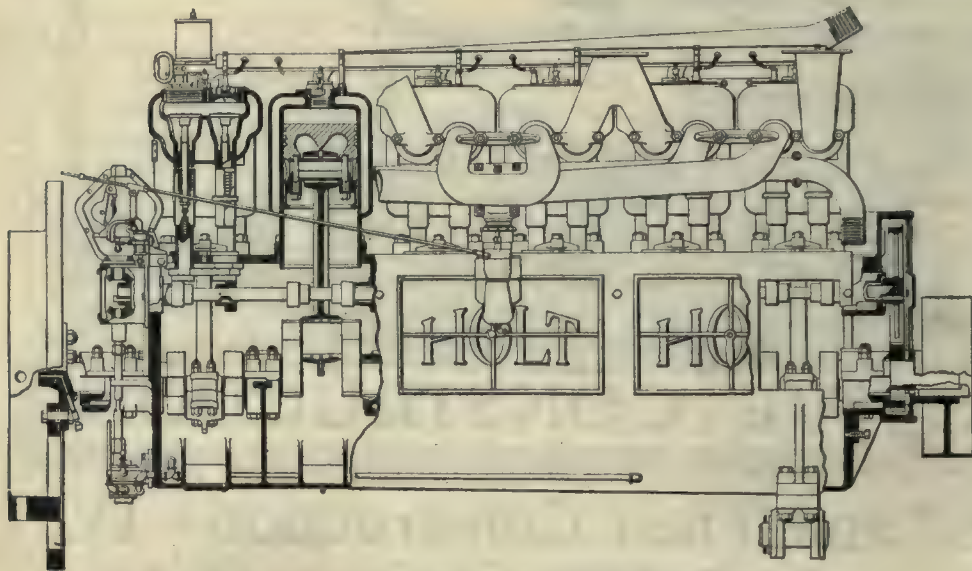

FIG. 31. PARTIAL SECTION OF 120-HP. ENGINE

motor and a belt-driven force-feed lubricator at the other feed cylinder walls and main bearings.

Air strainers remove the dust from the carburetor intake air, a very necessary task on a traction engine, and ignition is by high-tension magneto with impulse starter. An unusual feature is the separation of the water circulating pump from the engine, it being mounted independently on the main frame and driven by the same flat belt which drives the fan.

The crank case is of the barrel type and is provided with large side plates which afford access to the bearings and permit the removal of connecting-rods and pistons without disturbing the cylinders. The crank cases are iron castings and the machine arrangement to take care of them is quite compact.

In Fig. 32 it will be seen that the sides of the two cases facing the man with the steel scale are inclined inward at the top. For the first machine operation the case is placed with the inclined face downward and resting on wedges, in which position the opposite side and the top are planed simultaneously. The cases are then shifted to the milling machine shown in Fig. 32 by means of an air hoist running on an overhead rail and the tapered side is milled, wedges again being used to bring it horizontal. The case is then turned over and the bottom is milled, the operation shown in the illustration. Efficient use of the machine is indicated here by the set-up of two cases on the table and the row of radiator headers lined up along the side to make use of the side heads at the same time.

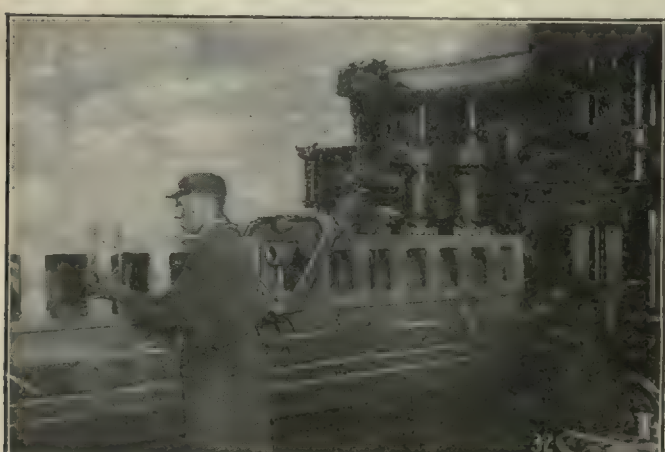

FIG. 32. MILLING CRANK CASES AND RADIATOR HEADERS

The next shift takes the cases to horizontal boring mills where the ends are milled, the end holes bored and the camshaft and crankshaft bearings bored and reamed. Top and bottom holes are drilled in ordinary drilling machines, a simple templet jig being used for the top.

The crankshaft is a 0.35 to 0.45-carbon-steel drop-forging nearly 8 ft. long and is heat-treated to an elastic limit of 65,000 to 70,000 lb. per sq.in. Upon entering the shop it first passes through the rough-grinding department where the burrs and rough spots are removed. It then goes to a 24-in. lathe with graduated bed where it is laid out, the steadyrest grooves turned and the extra lengths cut off. The flange is next turned and faced and the main journals turned to limits of 0.004 in., Fig. 33. The shaft is then transferred to a lathe with offset centers and the crankpins are turned to the same limits. The six holes for the flywheel bolts are next drilled in a horizontal drilling machine and finally the journals are ground to limits of 0.001 in. and the crankpins to 0.002 in.

FIG. 33. TURNING CRANKSHAFT MAIN JOURNALS

The heavy, singly cast, iron cylinders start their course in the machine shop at a drilling machine where the priming-cup hole in the center of the head is drilled and counterbored to serve as a locating point for succeeding operations. The cylinder is then placed in the heavy pot-chuck shown in Fig. 34 and rough- and finish-bored to 0.015 in. to 0.018 in. from final size. Another tool chamfers the end of the bore. The following transformation, made on an adjacent machine, consists of facing the flange and turning the skirt and the work is then sent to the drilling machines where the first operation is to drill the four stud holes to act

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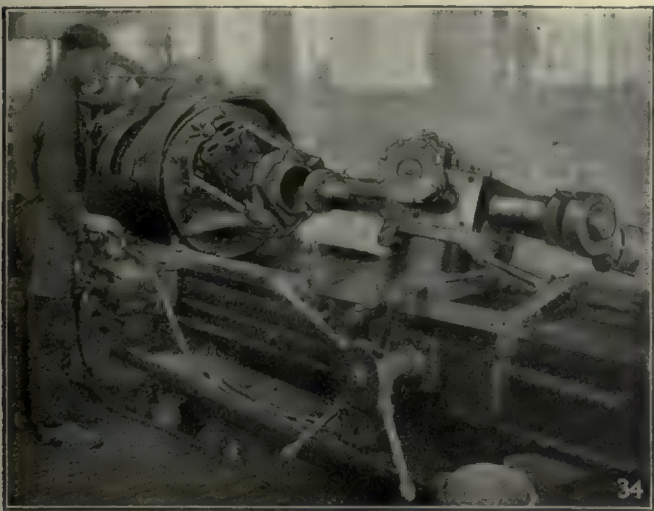

FIG. 34. BORING THE CYLINDER

as locating points for the other drilling operations. The valve seats and valve-stem guides are bored and reamed and the pipe-connection holes drilled and tapped and the cylinder then proceeds to the milling department where the upper and lower water manifold flanges and the inlet and exhaust port flanges are faced. The bore is then finished in an internal grinding machine, water being circulated through the cylinder water jacket during the process.

Fig. 35 shows the piston and connecting-rod assembly. The various machining operations on the rod were taken up in detail in the previous series of articles on the "75" as built in the Stockton, Calif., plant of the Holt Manufacturing Co. The four-bolt type of bearing-cap connection and the oil scupper on the cap are worthy of note. The piston itself is of cast iron with three compression-ring slots and three oil grooves. The piston pin is held in by two setscrews which run clear through the pin and into recesses in the bosses, the piston-pin bushing being held in the connecting-rod.

The raw piston casting goes first to an 18-in. lathe where the lower lip is rough-bored and the face turned. The outer surface is then rough-turned and the solid end faced. After this the piston goes to the heat-treating department where it is baked from 60 to 80 min. at a temperature of 1400 to 1500 deg. F. to relieve cooling strains and prevent distortions. The lower lip and face are next finish-turned and the outside finish-turned, slotted and faced in an automatic turret lathe. Oil weepers and pin retainer holes are next drilled. The rough-grinding operation is then completed and the piston moves to a turret lathe where the piston-pin holes are bored and reamed and the bosses faced. Finish-grinding completes the part.

This takes care of only a few of the motor parts but most of the machine work is quite conventional and is noticeable principally because of the size of the work. Here again pressure of war work has kept old methods in force to prevent possible hold-ups in production.

The radiator, however, possesses several unusual and valuable features. Front and rear views of the radiator are shown in Fig. 36 which illustrates the double coil-spring supporting arrangement to protect the more or less fragile tubes from the shocks of traveling over rough ground and, in the rear view, the sight glass through which circulation is observed and the sheet metal shroud to insure air being drawn through all parts of the radiator.

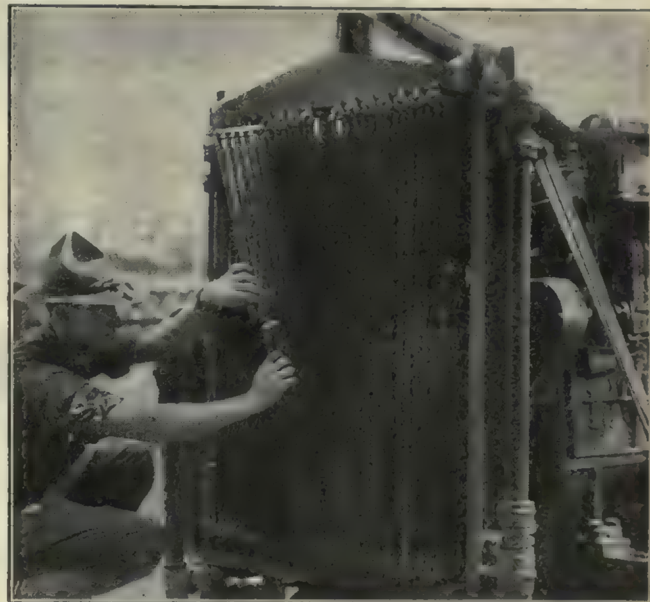

FIG. 37. REMOVING DAMAGED RADIATOR SECTION

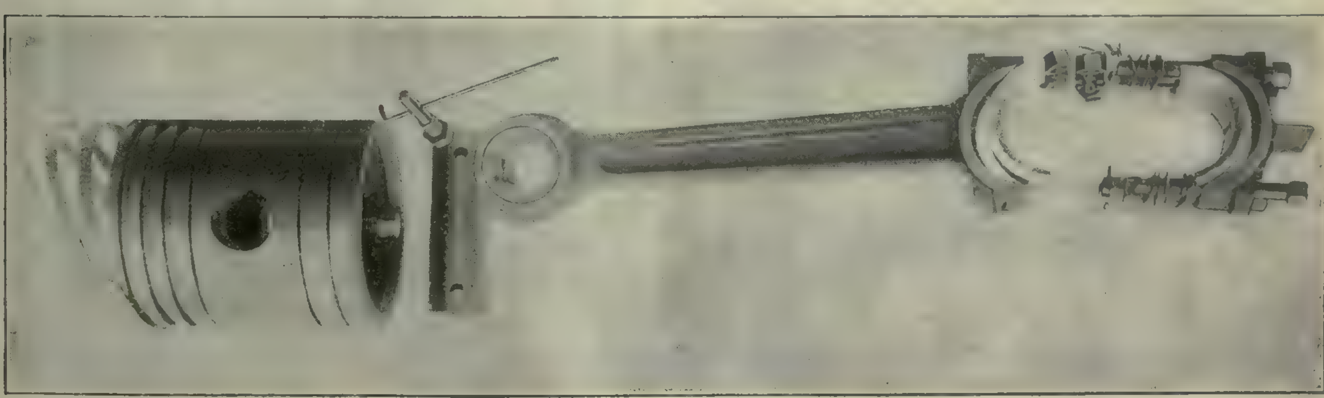

FIG. 35. PISTON AND CONNECTING-ROD PARTS

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The radiator consists of upper and lower cast-iron headers and two channel-iron side members which are bolted together and in which are mounted the 32 radiator sections. Each section has five copper tubes with spiral fins which are fitted into brass section headers. The section headers are held in place by the three-pronged dogs shown and are readily removable for repair as illustrated in Fig. 37. This feature is particularly valuable for field service or military work where a repair shop is not readily available. If extra sections are not available and the damaged one is beyond fixing the radiator may be kept working at almost its ordinary efficiency by replacing the damaged section with blind gaskets inserted between the header holes and the section header ends, thus cutting off the circulation from the damaged unit. Leaving out the broken piece altogether and plugging the header holes would result in most of the air being drawn through the vacant spot thereby allowing the rest of the radiator to heat up too much.

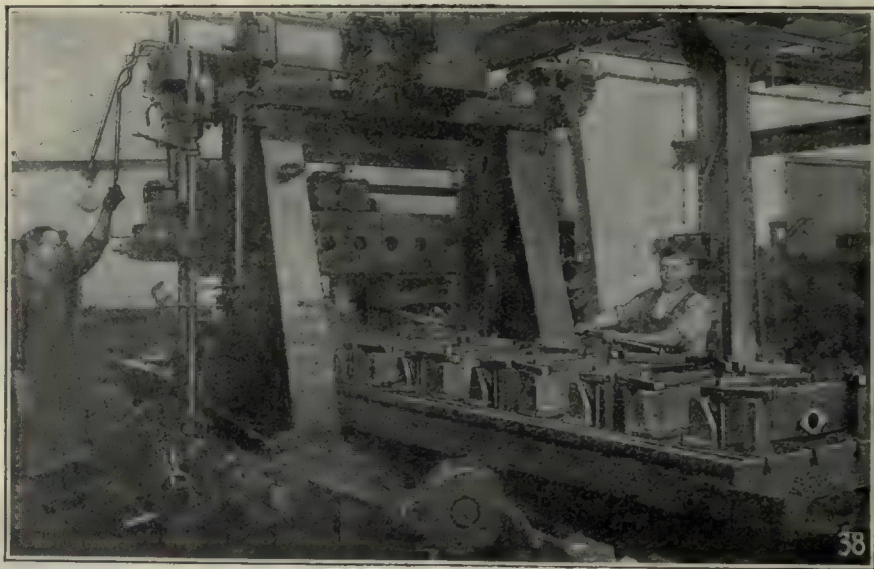

FIG. 38. STRING-MILLING RADIATOR HEADER ENDS

Milling operations on the cast-iron headers are interesting principally from the number of pieces set in the machine at one time. The facing of the top flange is shown in Fig. 32, where the pieces are set up alongside the crank cases to make use of the side heads of the machine. In Fig. 38 the headers are shown set for the end cuts, 14 pieces being put in

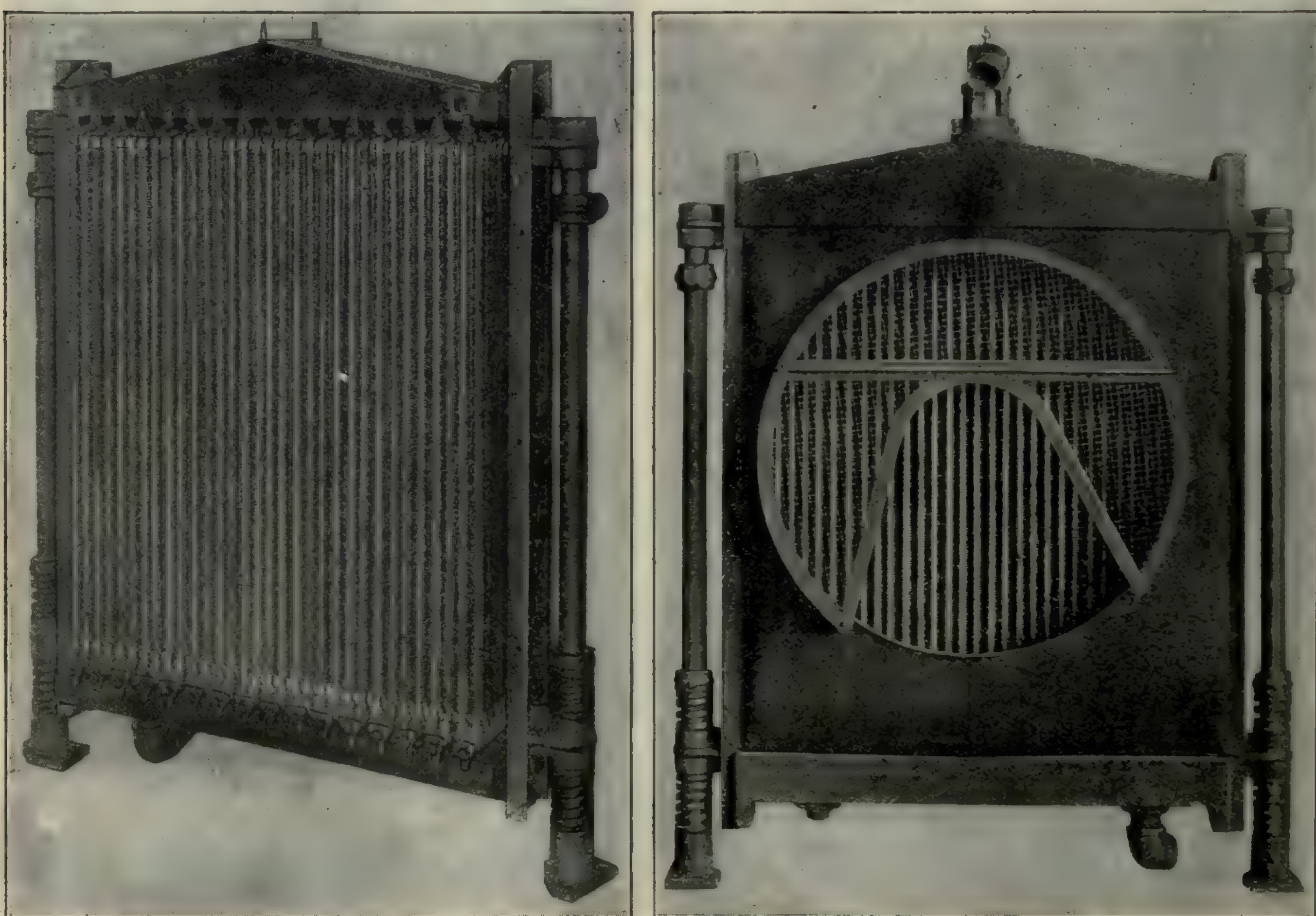

FIG. 36. FRONT AND REAR VIEWS OF RADIATOR

the machine at once. The other milling operation on these parts consists of finishing the surface for the tubes and is done on a vertical milling machine. The holes for the section headers and retaining studs are drilled in a 16-spindle drilling machine and the tapping is done in a Garvin tapping machine.

Machining of the brass section headers includes reaming and countersinking the five holes for the copper radiator tubes and hollow-milling the end which enters the radiator header. A $\frac{3}{16}$-in. hole is also drilled in the baffle plate to permit air to enter when the radiator is being drained. This is made necessary by the fact that the circulation system is a closed one which would become air bound if this hole were not drilled. The headers are next dipped in muriatic acid and then in hot solder to tin them.

In the meantime the finned copper tubes have been stripped at the ends and for a short distance in the center for a supporting clamp and the ends tinned. Five tubes are then assembled into each pair of section headers and soldered in place and each section is tested under 20 lb. water pressure for leaks.

The sections are then assembled in the radiator frame and the radiator is tested under the same water pressure as the headers. The inspectors on this test are provided with hammers and electric spot lights and they don't hesitate to use both to determine the presence of leaks.

The final installment will take up the assembly and testing of caterpillars at the Peoria plant.

Four Simple Fixtures for Motor Work

By Frank C. Hudson

While large production enables the designing and employment of fixtures of various kinds which are too expensive for the ordinary shop, it often requires fully as great designing ability to prepare fixtures simple enough to be used economically with small production. The first two illustrations show the methods of the Autocar Co., Ardmore, Penn., in grinding the head of its valve lifter.

Fig. 1 shows a lifter *A* clamped into position ready to be placed on the table of a small horizontal-spindle grinding machine. The body of the lifter rests in the V-block *B*, while the head is positioned by the plunger *C* which is pressed back as the head makes contact with it. The T-head bolt *D* is then swung into the position shown and is tightened by the handle *E* which is virtually a nut for drawing the work against the holder. Two of the valve lifters are usually ground at the same time, but in the picture one has been omitted so as to show the construction of the fixture more clearly.

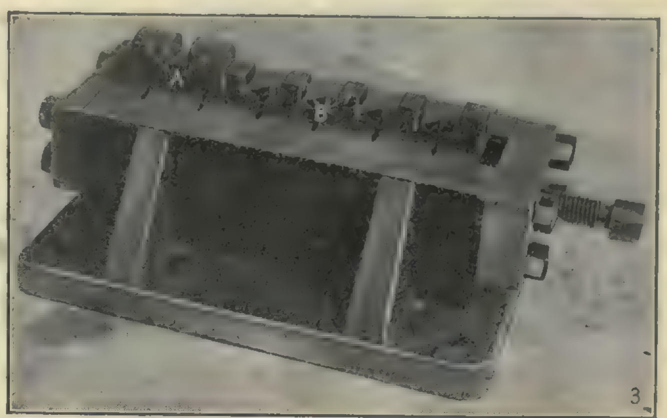

FIG. 3. MULTIPLE MILLING FIXTURE FOR VALVE LIFTER

For grinding the radius on the head, another simple fixture, Fig. 2, has been provided. The body of the valve lifter *A* rests in a V-block *B*, the side of the head previously ground resting against the stop *C*. The radius is then formed by turning the movable part of the fixture on its axis, the stop *D* being provided so as to make it easy to handle the fixture without undue attention.

A multiple milling fixture for these same valve lifters *A* is shown in Fig. 3. The action is easily understood as the blocks *B*, used for clamping, float in the body of the fixture and all are held with a uniform grip by tightening one screw. The floating of these blocks make it possible to machine any desired number from one up to its full capacity.

The fixture shown in Fig. 4 is the outcome of more or less satisfactory results in grinding the square shaft

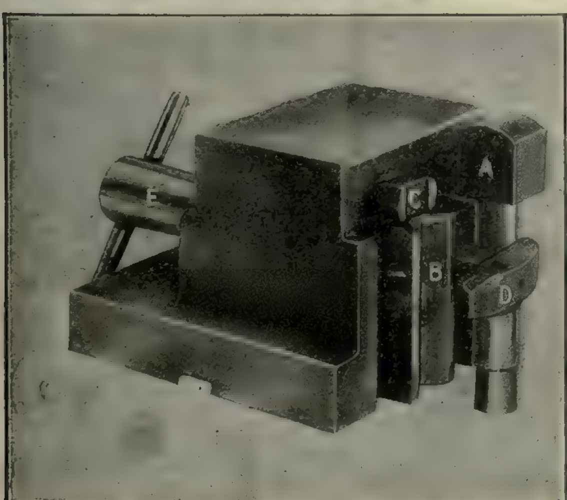

FIG. 1. GRINDING FLAT FACE ON VALVE PLUNGER

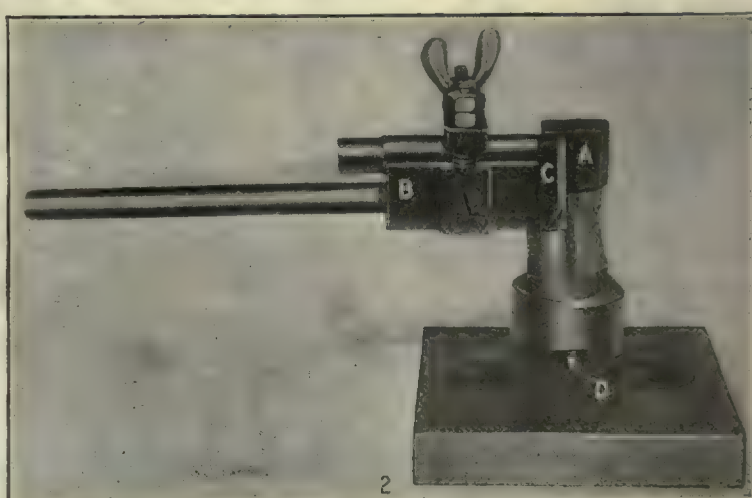

FIG. 2. HOW THE RADIUS IS GROUND

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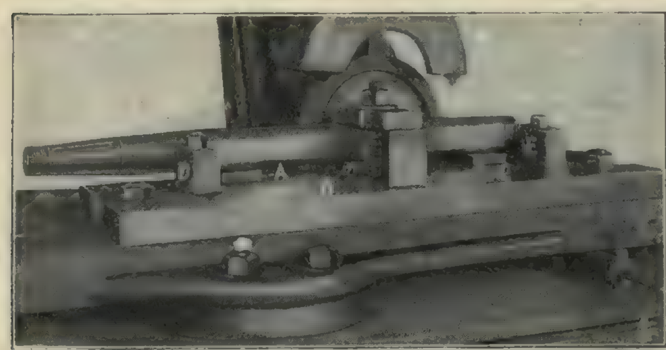


FIG. 4. GRINDING A SQUARE SHAFT WITHOUT CENTERS

shown between centers. After the shaft has been milled, it is laid on the hard-steel blocks *A*, *B*, and *C*, with the cylindrical ends in contact with the stops *D* and *E*. The strap *F* holds it in place, but requires very little pressure. After the first side is ground, the shaft is turned so that the ground side rests on the hardened-steel blocks, and, as these are at right angles with the spindle of the grinding machine, the second side is finished at 90 deg. from the first.

By locating the cylindrical surfaces against the stops *D* and *E*, it is an easy matter to grind the four sides concentric with the shaft itself. An adjusting screw enables the fixture to be kept square with the grinding-machine spindle, so as to secure parallel instead of taper sides.

Milling Fixture for Crank-Case Gear Cover

By I. B. Rich

Fig. 1 shows the fixture used by the Pierce-Arrow Motor Car Co. for milling the joint surface on the crank-case gear cover. In order to avoid any springing of the casting under the pressure of the milling cutter, it is supported at 13 points properly distributed around the edge.

These supporting points are mounted on suitable springs so that they will make good contact with the under surface of the casting and at the same time take care of any irregularities which may exist. After the casting is firmly steadied on these supporting points and clamped in position by the three studs shown, each supporting plunger is then fastened in its position by the setscrew provided for this purpose.

This has proved very successful and no difficulty is experienced from the springing of the valve-gear-cover casting, even though it is of light section and a fairly heavy cut is taken.

FIG. 1. MILLING FIXTURE USED FOR MILLING CRANK-CASE GEAR COVER

The construction details of this fixture are shown in Fig. 2. This shows the work in position and the way in which the spring-actuated supports make contact on the under side of the bolt flange. It also shows how they are held by setscrews after being properly positioned.

The type of washers used is also shown, some being in the form of C- or open-side washers having three raised points for contact with the work, though in one position a solid washer is used.

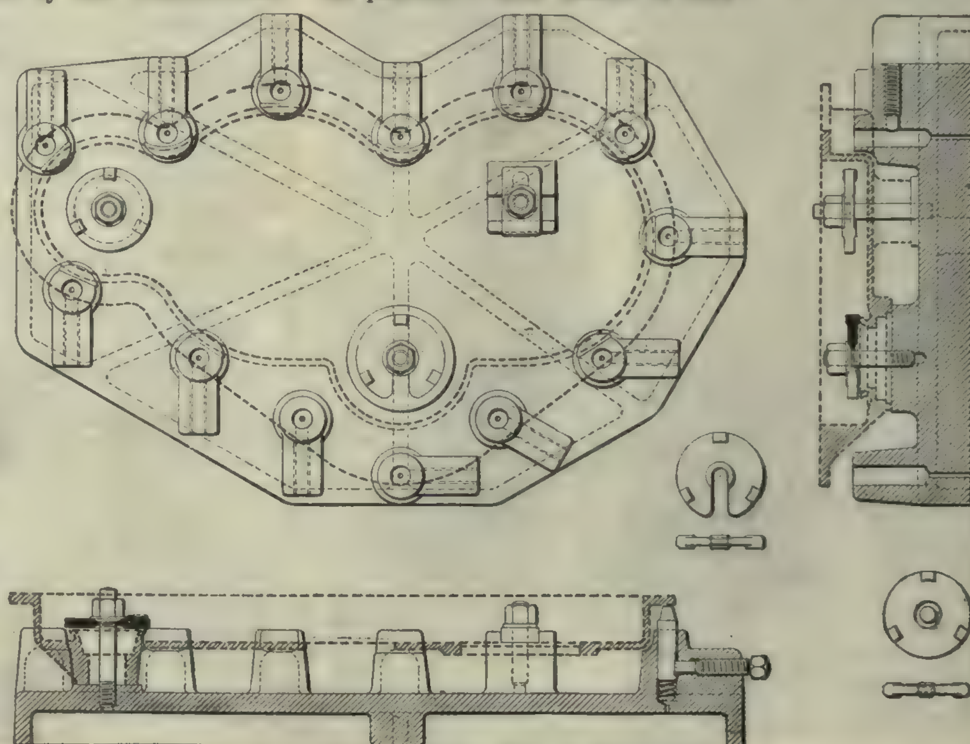


FIG. 2. DETAILS OF THE FIXTURE

How to Use Stellite

BY G. L. KRONFELD

Stellite is an alloy composed of cobalt, chromium and other semi-rare metals and as its strength is much less than that of steel it will consequently not stand the rough usage frequently given the latter metal. This article deals with stellite as used in the art of cutting metals, the object being to outline a few points that should be taken into consideration, as well as to describe some of the tools made from this alloy.

FOR ordinary shop practice No. 2 grade stellite is recommended for steel and No. 3 for cast iron, malleable iron and other cast metals. A No. 4 grade stellite has been manufactured, but this grade has not been sufficiently commercialized to enable any definite information to be given in regard to it. The writer also recommends No. 3 grade stellite for hard steel, nickel steel, chrome-vanadium steel and hard metals in general. It is advantageous in all cases to determine the proper grade of stellite to use on hard and tough steels by actual test. On soft grades of cast iron No. 2 grade stellite will often show up to decided advantage, especially in the inserted teeth of milling cutters.

Stellite works best at high speeds and consequently it is not economical to use it on machines that will not stand the "gaff," or are in such condition that the work cannot be machined at efficient speeds and feeds. One of the sources of trouble when using stellite is the belting. Slack, oily, badly patched and worn belts are not coincident with good shop practice, irrespective of the kind of cutting tool used. There is absolutely no use speeding up a machine or trying to obtain heavy cuts unless there is the proper "push" behind the tool and, in the writer's judgment, it is false economy to use stellite unless the equipment in every sense of the word is capable of doing what is asked of it.

When first using stellite it is recommended: For machining cast iron and malleable iron, at first to maintain the usual depth of cut and rate of feed and increase the speed between 25 per cent. and 50 per cent. over that when high-speed steel is used; for machining steel with stellite, a little discretion should be used and, to start out with, the feed should be slightly decreased and the speed increased 25 per cent. to 100 per cent. according to its hardness and toughness. Anybody conversant with ordinary shop practices can readily judge, once the tool and work are running satisfactorily, how to adjust his feeds and speeds to obtain the most economical commercial results.

As a general rule it is not economical to increase the speed to such an extent that the amount of work done between grinds falls below that of high-speed steel. Most efficient results are attained when the tool life of stellite is equal to, or better than, that of high-speed steel. Where the conditions are favorable, a tool life of stellite can readily be attained which is considerably longer than that of high-speed steel, in spite of the increased cutting speed. Under certain conditions, such as machining hard castings, hard steel, etc., where it is not possible to increase the speed or feed it has still been found advantageous to use stellite on account of its considerably longer tool life. Stellite cuts best when the tool has a dull-red, almost invisible, glow. This fact has been disclosed very often in actual practice when an increase in tool life has been obtained, not by decreasing but by increasing the cutting speed and, sometimes, the feed, instead of decreasing them. This fact should be kept in view, although in general the rule that increased tool life is obtained by decreasing the cutting speed should be followed.

There is nothing mysterious about the grinding of stellite tools—the same fundamental principles being involved for stellite as for high-speed steel.

On account of the hardness of stellite, tools made from it should never be given a "lip." The term lip should not be confounded with the terms back rake or side rake. On account of the peculiarity of stellite, however, departure from the fundamental rules has often lead to good results.

The writer recommends the rakes given in the accompanying table for stellite tools, which can be readily obtained on tools made from standard bar stock either used in toolholders or welded onto carbon-steel shanks.

TABLE OF RAKES RECOMMENDED FOR STELLITE TOOLS

Metal To Be Cut	Back Rake	Side Rake	End Rake
Cast iron, malleable iron and other cast metals	5 to 10°	0 to 8°	4 to 7°
Steel	5 to 14°	3 to 10°	4 to 7°
Brass	0 to 4°	0 to 4°	4 to 7°

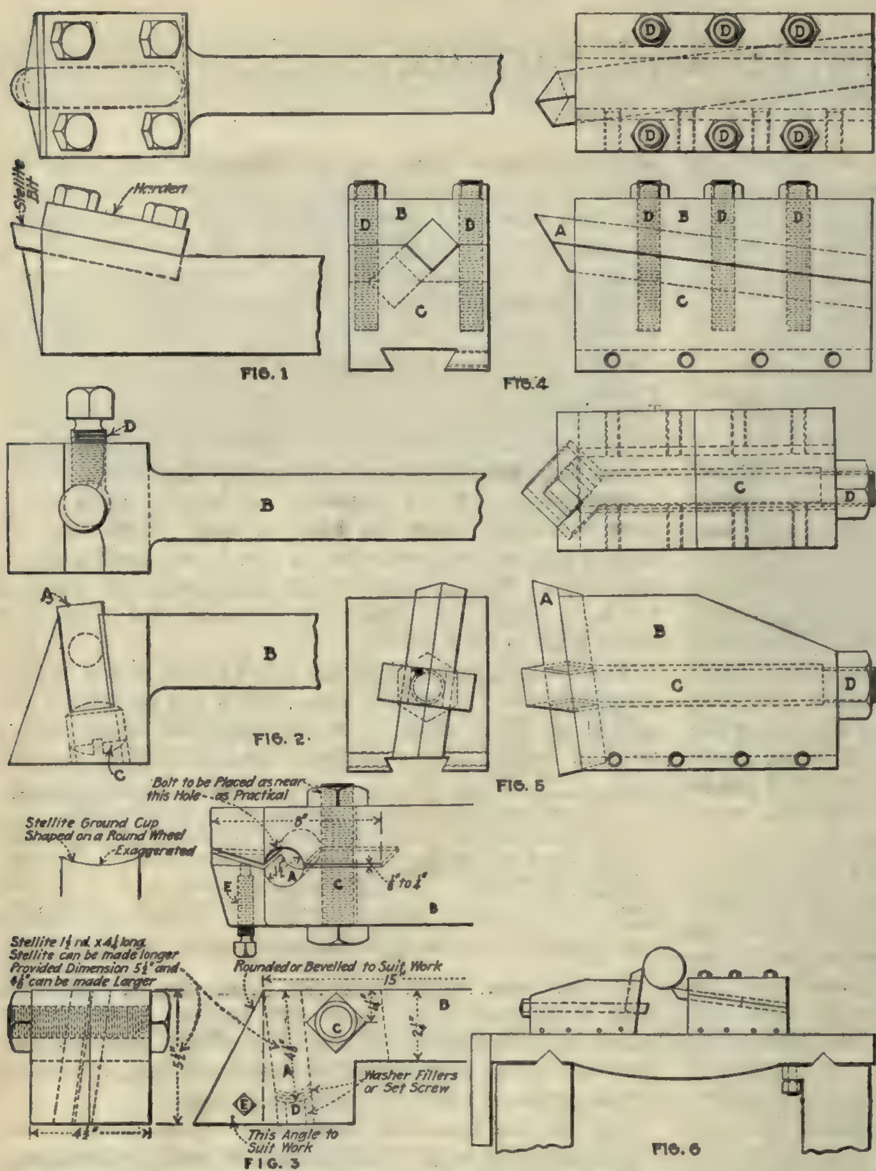
It has been found that cast iron can be machined with a flat tool (that is, a tool without back or side rake) but a back rake at least is strongly recommended that will give a lip angle of 68 deg. to 81 deg., according to the grade of cast iron to be machined.

Due to the fact that stellite is a cast product the metal is harder on the outside than toward the core, and on this account the writer suggests that a stellite tool should not be ground on the top except when absolutely necessary. For this reason it is recommended that only sufficient side rake be given a tool to allow the chip to run off nicely. Standard commercial toolholders are made so that a back rake is given the bit; and where comparatively light cuts are taken, the machinists should be instructed not to grind the top of the stellite tool.

One of the chief troubles when using stellite is breakage. When deciding what type of toolholder to use, this fact should be given due consideration. There are several toolholders on the market suitable for stellite. It is the writer's experience that the toolholder giving the best results will hold the stellite firmly as near the cutting edge as possible and not in any way bend the bit. Irrespective of the type of toolholder used, care should be taken that the top and bottom are perfectly flat and free from chips. It has been the writer's experience that almost 90 per cent. of breakage trouble has been due to neglect of the above precautions. As a guide, it is suggested not to allow the bit to project unsupported farther than its depth.

The writer will describe a few homemade toolholders that have been used with success.

Fig. 1 shows a toolholder used successfully on various kinds of work. The sketch is self-explanatory. This



FIGS. 1 TO 6. EXAMPLES OF HOLDERS FOR STELLITE TOOLS

Fig. 1—A holder for square tools. Fig. 2—A holder for round tools used for turning shells. Fig. 3—A split holder for roughing tools. Figs. 4 and 5—Holders for holding square tools on end. Fig. 6—Method of using holders shown in Figs. 5 and 6.

holder is economical as the stellite can be used until but very little is left.

Fig. 2 shows a toolholder that was used successfully for finish rough-cutting and finish-turning shells. *A* is the stellite tool, *B* the toolholder body, *C* an adjusting screw, *D* a setscrew for holding the stellite tool *A* rigidly. It will be noticed that the stellite tool (¾-in. in diameter in this case) is set up on end and ground cup shaped. When the tool becomes worn in one spot the operator loosens setscrew *D* and gives the stellite tool *A* a slight turn and then tightens setscrew *D* again, thus gaining a new cutting edge on his tool. He can now proceed with his work without taking his holder out of the toolpost and without making any major adjustments on his lathe. This ¾-in. round tool will give four to five cutting edges on each end; making eight to ten per tool.

Fig. 3 shows a toolholder similar to that shown in Fig. 2. This was used very successfully for rough-turning shells. The 1½ in. in diameter stellite tool *A* is clamped in the split toolholder *B* with bolt *C*. Washer fillers *D* are inserted as the tool wears down. Setscrew *E* is used to force open the split, should the stellite bit stick. The ends are ground cup shaped and each end will give at least four cutting edges. It must be borne in mind that tools, as shown in Figs. 2 and 3, offer too much resistance and consume too much power for ordinary shop practice although for their special purposes they gave excellent results.

Figs. 4 and 5 show holders for holding 1-in. square stock on end. The stellite tool *A* in Fig. 4 is clamped down by bolts *D* between the two body halves *B* and *C*. Fig. 5 shows the tool *A* held firmly against body *B* by pull rod *C* and nut *D*. As can be readily seen, both tools are used as diamond tools and the required rake ground on the end. The set-up on the lathe of both the toolholders (Figs. 4 and 5) is shown in Fig. 6, which is self-explanatory.

The above describes a few home-made toolholders in which stellite has been used successfully. Shop problems are so manifold, however, that it will always pay to investigate the designing of a suitable toolholder for production work, irrespective of the kind of cutting tool adopted for the particular job.

It has sometimes been found that stellite will give good results when the tool is set above the center, especially when chatter occurs. The writer has set the stellite tool 1 in. to 1½ in. above center when machining 6-in. shells and forgings of large diameter and has obtained longer tool life than when the tool was set on center or only slightly above. However, this point should not be taken as a general rule.

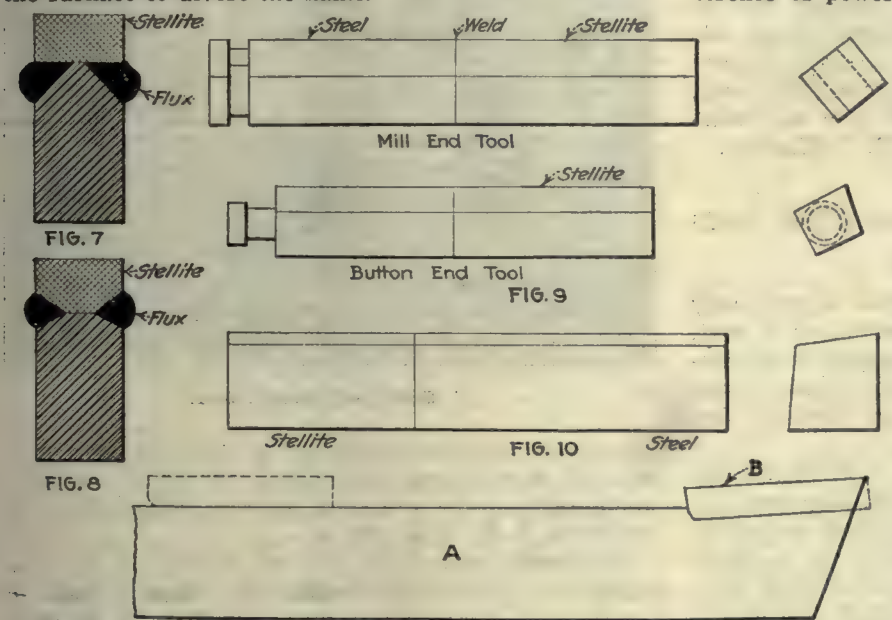
When stellite was first introduced many advocated welding it to steel shanks, either electrically or by the oxy-acetylene process. Such procedure is, in the opinion of the writer, too severe on both the stellite tip and the shank; although thousands of tools so welded have been used with astonishing success. A method of welding is as follows: The carbon-steel shanks and stellite tip are prepared as shown in cross-section in Figs. 7 or 8. The two units are then placed on a plate and welded together, soft iron or steel being used as a flux. Electric or oxy-acetylene welding of stellite tools is not recommended. Stellite can be successfully butt-welded onto steel shanks with an electric butt-welder, the process being similar to that of butt-welding steel. Butt-welded tools are advocated by many for Lo-Swing lathe tools and tools for Potter and Johnson automatics, as shown in Figs. 9 and 10.

Welding Stellite to Carbon Steel

For welding stellite to carbon steel, the writer strongly recommends the use of "Tip-It" welding compound. This compound affords an efficient and simple welding process, which is as follows: The shank *A* and the stellite tip *B*, Fig. 11, are first prepared so as to have a good welding fit. The stellite should then be placed back toward the tail of the shank and the shank

preheated in a furnace or forge up to 1700 deg. F. or 1800 deg. F.[1] The stellite should be a very dull, almost invisible, red. When the proper temperature has been reached, the shank should be removed and the welding surface cleaned with a file or wire brush to remove any scale that has formed, and a layer of the Tip-It welding compound sprinkled on this welding surface. The stellite tip is then put in place and the tool heated up to between 2000 deg. F. and 2100 deg. F. when the welding compound will flow. This will be indicated by a slight blue flame. When the welding temperature has been attained, the tool should be subjected to light pressure, approximately 50 lb. per square inch. A small air press, an arbor press, a screw press, or vise, turned up vertically, can readily be used for this purpose.

Care should be taken that there is plenty of coke bedding under the tool in a coke fire or forge. When using a gas or oil furnace, oxidation sometimes takes place when the flame strikes the tool directly. Oxidation can be overcome by placing a couple of bricks in the furnace to divert the flame.



FIGS. 7 TO 11. EXAMPLES OF WELDED TOOLS

Figs. 7 and 8—Welding stellite tips to steel shanks. Fig. 9—Welded tools for use in Lo-Swing lathe. Fig. 10—Welded tool for use in Potter and Johnson automatic lathe. Fig. 11—Method recommended by the author for welding stellite tips to steel shanks.

Besides the arc and oxy-acetylene welding processes, butt-welding and welding with Tip-It, many ways of fastening stellite tips to carbon-steel shanks have been tried with varied success. Brazing with copper and brass, both in sheet and powdered form, has been used. The writer, however, does not recommend copper or brass, as the results are too uncertain.

The Question of Coolants

The question of coolants is often raised; and as a general rule a coolant should not be used with stellite tools as they cut far better under a dull red heat than when cold. It is the writer's experience that Taylor's findings, that an increased speed can be obtained by using a coolant, is maintained for stellite. Where a coolant has been tried unsuccessfully the trouble can be invariably traced to the fact that the machine was not capable of giving the increased speed or standing the extra "gaff" necessary to create enough heat to the tool for it to maintain its cutting edge and consequently an abrasive action occurred. The above conditions were conspicuous in plants manufacturing shells. On the smaller machines it was generally not advantageous to use a coolant, while on the larger and stronger machines a coolant often worked to distinct advantage. These results have also been noted under commercial conditions with cast and malleable iron, as well as steel, except of course that the amount of increase in speed will vary accordingly.

[1]Stellite is not affected by heat until a temperature of over 2200 deg. F. is reached, after which it will melt rapidly.

The Williams Internal Gear

To the Editor:

The discussion on page 1083, Vol. 51 of the *American Machinist*, relative to the Williams internal gear is interesting, but Mr. Trautschold's reply does not fairly answer the objections to his original statement. He states that driving near the wheels makes the transference of power more economical than in the case of worm-drive transmissions. Tests by David Brown and Lanchester indicate efficiencies of 96 per cent for a worm gear. Surely, no internal gear could exceed that efficiency and Mr. Trautschold states plainly that the spur gear is more efficient than the bevel gear.

In Mr. Trautschold's internal-gear axle there are two sets of spur gears and one set of bevel gears transmitting the power, in the place of a single set of gears used with the worm drive. There are also at least four more bearings in his internal gear drive than there are in the worm-gear drive. As each and every set of bearings or gears absorbs some power, two additional sets of gears and four additional sets of bearings in the internal gear drive must give it a great handicap in competing with the worm drive.

Mr. Trautschold's "homely" comparison indicates that he has confused torque and power. There is no inherent power advantage in having the internal gear fastened directly to the wheel; therefore, if the worm-wheel in a worm-drive axle is larger than the internal gear in an internal gear drive axle, it is possible, by using Mr. Trautschold's "homely" comparison, to prove that the worm drive is more efficient.

With reference to Mr. Trautschold's statement that there is more economy in an internal gear drive, his attempt to figure out the relative efficiency of the worm drive and the internal gear is certainly a most arbitrary determination. His assertion cannot be proved on paper and has never been proved in road or laboratory tests. The worm-drive adherents claim 96 per cent efficiency and the most enthusiastic internal-gear-drive adherents only claim 92 per cent. If the worm drive is more efficient, how can its use entail a greater consumption of gasoline?

The internal gear preceded the worm gear as a truck drive in England. It has been replaced to such an extent that practically all English trucks are now built

with the worm drive. This year more than 65 per cent of all American trucks are equipped with worm drive, which shows an increase over last year. The producer of the highest-priced trucks in America and the producer of the greatest quantity of trucks in America have each standardized on the worm drive. The internal gear drive can be built and can be purchased for fully 25 per cent less than the worm-gear-drive axle. In the face of these figures, would Mr. Trautschold have us believe that the internal gear drive is appreciably superior to the worm drive? If he really thinks so, he has a remarkably poor opinion of the intelligence of American truck manufacturers and users.

The writer has been connected with the manufacture of both worm-drive and internal-gear-drive axles and is familiar with actual tests. He is therefore familiar with facts to offset Mr. Trautschold's theories and cannot refrain from expressing surprise that Mr. Trautschold should make such radical arbitrary assumptions. He is still more surprised to think that he would try to back up his arbitrary figures by stating that he "understands" that axle economies "approaching" his figures have been realized. If his understanding is based on actual figures, it would only be fair to the general public and manufacturers of axles, to give out something more definite. R. L. MURPHY.

A Compact Storage Shed for Steel Bars

BY PETER F. O'SHEA

The shed shown in the illustration stores a good many various sizes and kinds of steel. Everything is neat, compact, and instantly accessible. The open-work construction, while strong enough to hold a great many tons, admits light to every part of the shed, so that each bar of stock is in plain sight.

Such a shed adjoins the cutting-off room of the tap, die and reamer plant of the Greenfield Tap and Die Corp. It is also used as the main steel storeroom for the other seven plants of the corporation, to which it issues steel on requisition to their branch raw-material stores. Unloading and loading is done in the foreground through a wide double doorway.

Steel requisitioned from the racks as raw material for the adjoining plant is not brought out the front door again, but is taken back through the central asile, which at the farther end opens directly into the cutting-off room.

A trolley rail underneath the ridge pole of the shed, carrying a chain fall, handles the incoming and outgoing steel. The trolley rail extends through the front wall and projects for several feet over the yard, so as to be above the motor trucks for unloading and loading; or the trucks may also back into the shed itself, the floor being flush with the yard outside. Both the floor and the yard in front of the shed are cemented.

Long bars are stored on end in the back of the shed, in vertical compartments. Short bars are racked horizontally, as can be seen, in the forward part of the shed. The bays for short bars are built of hard-wood posts, channel iron and angle-iron anchors. The compartments are 14 in. across the front from center to center, and spaced 4 ft. 6 in. deep from the front of the first row to the front of the next row of posts behind. Holes are spaced up the middle of each post, and through corresponding holes of all the posts in one row is inserted ½-in. wrought-iron pipe. Through the pipe in turn is inserted a ⅜-in. iron rod to back it up and give it strength. These composite rods hold the weight of the steel stock. They are strong, easy to make and inexpensive.

The horizontal bars divide the vertical bays into tiers of compartments in which the steel can be slid in and out very easily.

Records of the contents of the compartments are kept on the side wall in the aisle by the foreman of the steel shed.

These records include not only a perpetual inventory but notations of what compartment each kind and size of steel is stored in, and for what purposes this steel is intended. The destination of certain varieties of steel is also marked on the edge of the compartment.

A STEEL-STORAGE SHED

The vertical bays are designed by numbers, 1, 2, 3, 4, etc., left to right, on each side of the aisle. The horizontal compartments in each bay are lettered from the top down, A, B, C, D, etc.

Permanent tags nailed top and bottom to the edge of the post beside each compartment tell what material the contents are reserved for. The tags on the shipments of steel are left on after they are in the rack, or tucked into the space between the compartment lable and the post, as if into a pocket or envelope. Long bar stock is taken care of farther back in the shed, by standing each rod on end on the cement floor. But to keep the varieties separate and so that every rod will be accessible, this part of the shed is also divided into distinct compartments. Each of the side-aisles serves two bays, one on each side. A bay is divided into skeleton compartments simply by having iron rods project horizontally a short distance from the wall into the aisle, so that two of them catch an armful of bars and hold them from tipping over.

The weight of the steel as it stands on end is entirely on the cement floor. The more compartments there are, the more nearly the steel rods are balanced, and the easier it is to keep them from falling over sidewise on each other. There are no fronts to any of the compartments. Once the steel rod is tipped forward from the back of the compartment, it is free to fall forward into the aisle. Steel is carried in and out vertically. It doesn't need much elbow room to handle steel in this way.

This sort of shed involves the least possible motion, and every piece of steel in it is instantly accessible.

Combined Trimming and Shaving Dies

BY FRANK H. STANLEY

In the manufacture of some small machines there are often many parts that are so nearly alike that to make blanking tools for each piece would entail an endless expense. Such pieces can all be blanked by one set of tools and the variations in dimensions and contour may be taken care of by trimming dies built into the same blocks as the shaving dies. In this article the author de scribes and illustrates in detail some such combinations of dies that are both novel and ingenious.

A PIECE of work involving both trimming and shaving is shown in Figs. 1 and 2. This is a small steel cam with a radius, from center to point, of $\frac{13}{32}$ in. It is used on a calculating machine, and it forms an unusually interesting application of the trimming principle, for the blank is not made from sheet stock, but instead is produced in the screw machine where it is turned out to the form of a disk 0.080 in. thick, with a hub finished to 0.280 in. in diameter, and a hole drilled and reamed through the center to 0.155 in. Thus in the shape of a thin disk it is passed through the press tools for the making of the cam contour instead of being finished by the more conventional process of milling to shape.

The cam is made both right and left hand, one of each being required for each calculating machine. The dies are correspondingly made for right- and left-hand lobes, a duplication of die openings being made necessary by the hub extending at one side of the cam. The disks are placed in the dies with the hub located in the round end of the opening, and the punch, upon descending, removes all of the superfluous metal around the cam by forcing the latter into the die. The cam is pressed down into the die by the punch to a sufficient distance to allow the next blank disk to enter hub down, but with the lower face of the disk resting upon the face of the die.

The construction of the die is shown clearly in Fig. 2. The die openings are located at a distance of $1\frac{1}{16}$ in. apart to allow two blank disks to clear one another when placed for trimming and to permit the punches being made separately with ample size of base for stability. The shape of the punches is seen in the

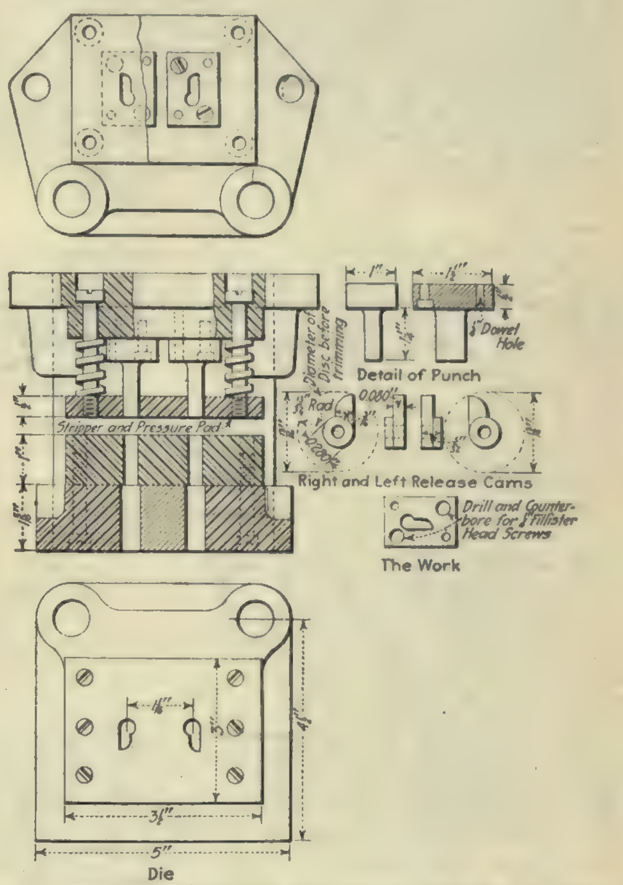


FIG. 2. DETAILS OF WORK AND TOOLS SHOWN IN FIG. 1

detail, and it will be noticed that each is made with a base 1 by $1\frac{1}{2}$ in. in area and secured by two $\frac{1}{4}$-in. fillister-head screws and two dowel pins of the same diameter.

The pressure pad and stripper, carried by the punch head, are fitted closely to the punches and are normally held downward upon the work when the slide descends by means of four stiff pressure springs located at the corners on $\frac{5}{16}$-in. screws. The action of the springs and plate upon the upstroke is, of course, to strip from the punches the trimmed off portion of the disk.

The shaving of the cams is accomplished in the dies shown in Figs. 3 and 4.

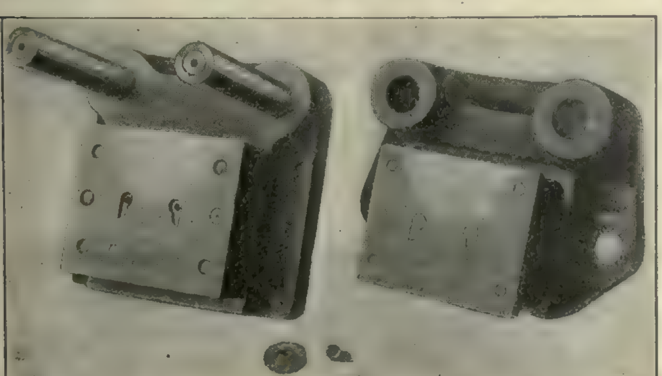


FIG. 1. WORK TO BE TRIMMED AND SHAVED AND THE PRESS TOOLS FOR THE OPERATION

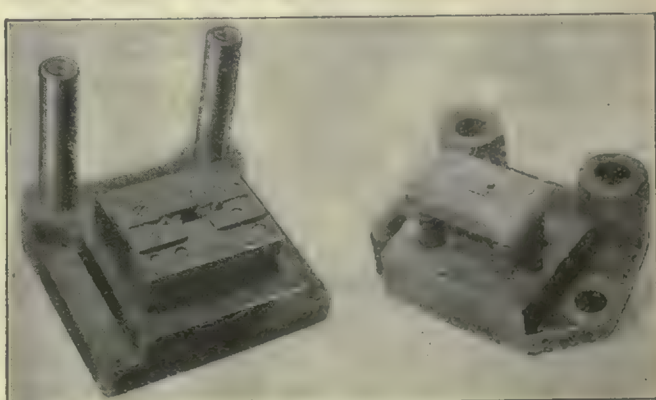


FIG. 3. PRESS TOOLS FOR SHAVING THE CAM

Like many of the tools illustrated in previous articles, the trimming and shaving dies for the cams and those that follow are provided with guide pins or pillars for preserving truth of alignment with consequent accuracy and longevity in operation.

The steel piece in the foreground of Fig. 5 is another example of trimming and shaving work, which is shown in detail in Fig. 6. This small lever, which is blanked from half-hard steel stock, is 0.140 in. thick and prior to reaching the dies shown in Figs. 5 and 6 it has been

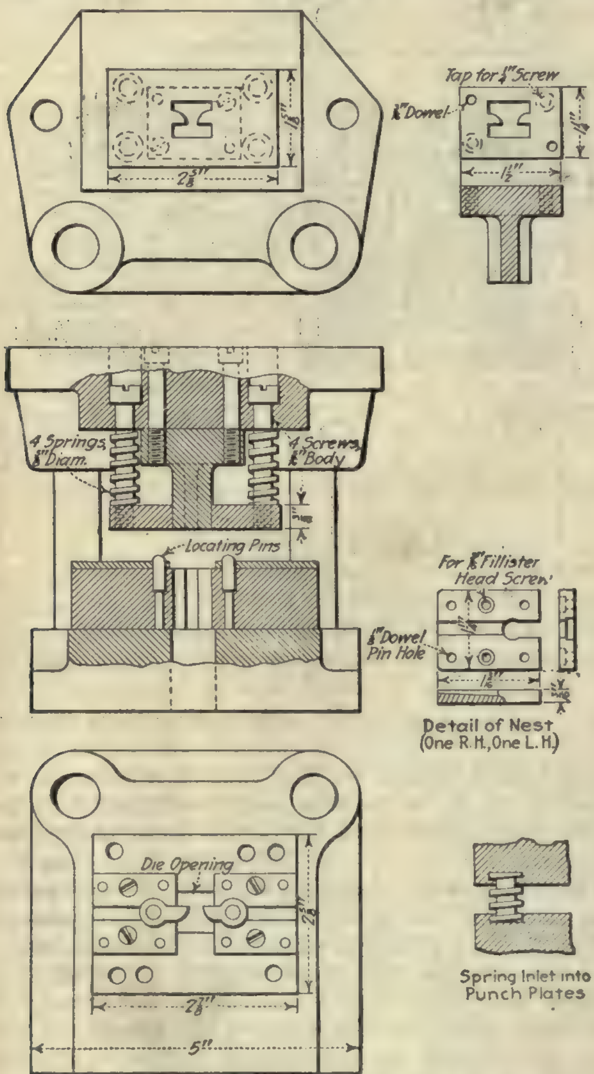


FIG. 4. DETAILS OF TOOLS SHOWN IN FIG. 3

shaved all the way around and pierced in separate press operations. The heel of the lever and the point have been milled down to dimensions given, and the object of the operations in the present dies is to trim the round end to an angle, as shown at A, Fig. 7, and shave it accurately.

The die is so made that the right-hand side of the opening, Fig. 6, is adapted for trimming the work to form the V point, while the opposite side is for the shaving operation, as indicated in the plan view. The blank, No. 1, at the right, is shown as it appears after trimming, and the other piece, No. 2, occupies the shaving position. After the latter is removed, the blank at the right side is transferred to the left and a fresh blank placed in position 1 for trimming. Thus at each stroke of the press one piece is trimmed and another shaved. The latter operation removes about 0.010 in. of metal from each side of the angular point.

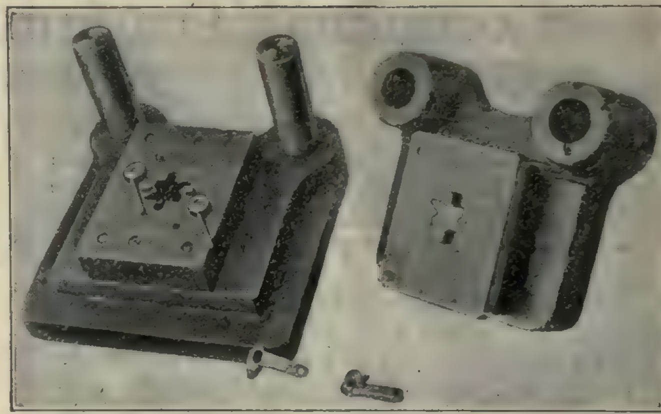


FIG. 5. PRESS TOOLS FOR TRIMMING AND SHAVING THE LEVER

The method of holding the work at each side of the die is to slip it over two locating pins which fit the small round hole at the end and to oblong opening in the head of the work, and then swing the eccentric binder B by the small handle, to secure the piece in place.

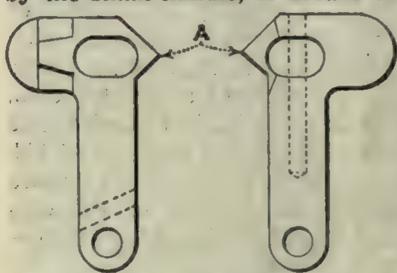


FIG. 7. WORK PRODUCED BY TOOLS SHOWN IN FIGS. 5 AND 6

The punch is illustrated in plan and by several elevations. It has two guiding extensions CC, which are ¼ in. longer than the cutting face and which enter the corresponding guide openings C^1C^1 in the die to that depth before the cut is started. The shoulders DD fitting between sides D^1D^1 in the die still further steady the punch for the trimming and shaving cuts. The pressure pad or stripper fitted over the punch is controlled by four springs under the corners.

Another form of shaving die combined with piercing tools is illustrated in Figs. 8 and 9 for operators on the two rocker-arms shown in Fig. 10. These two steel

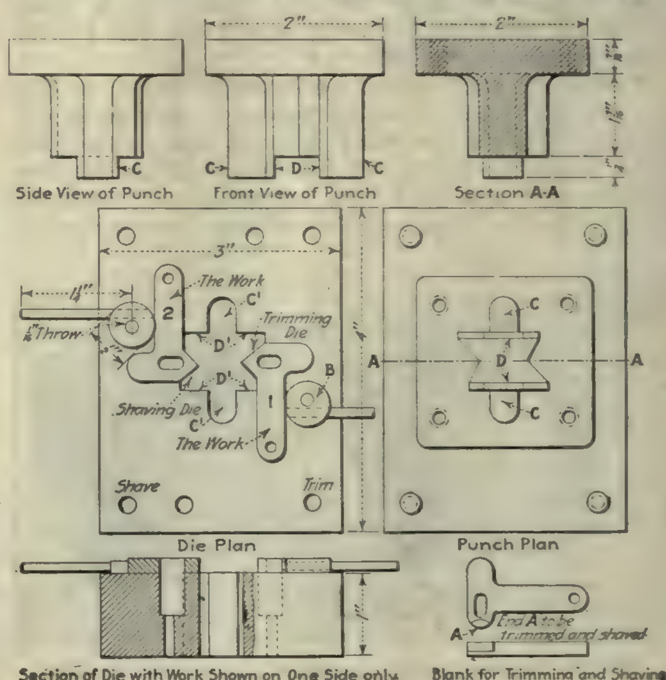


FIG. 6. DETAILS OF TOOLS SHOWN IN FIG. 5

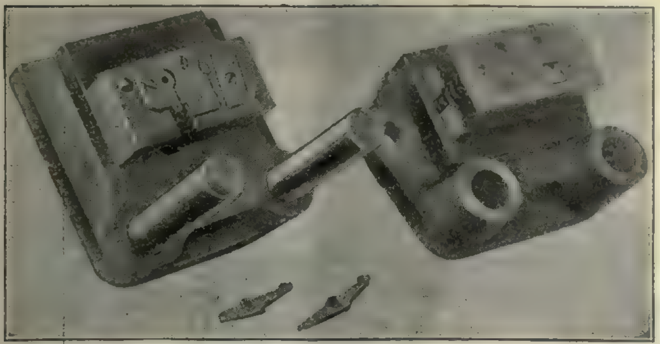


FIG. 8. COMBINED SHAVING AND PIERCING TOOLS

pieces are blanked from $\frac{3}{32}$-in. stock and are alike as they come from the blanking dies. The trimming and piercing dies in the illustrations are then used for piercing one-half of the lot of rocker-arms as at *X*, Fig. 10, and for trimming off and piercing the other half of the lot to make the shorter piece *Y*.

The drawing of the die and punch plate in plan view, Fig. 9, shows the method of placing two blanks at once in the nests on the die face.

Thus the trimming punch A^1 trims off the end of one of the rocker-arms at *A*, the portion removed being

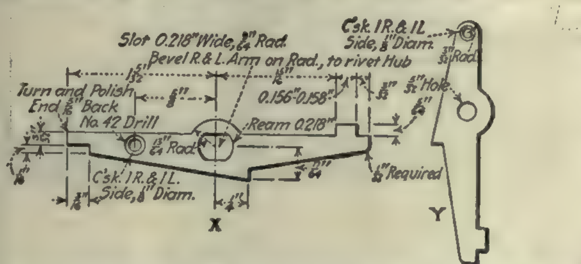


FIG. 10. THE WORK TO BE TRIMMED AND PIERCED BY TOOLS SHOWN IN FIGS. 8 AND 9

indicated by dotted lines. The punch B^1 and the die B^2 pierce the hole *B*; the punch C^1 and die C^2 pierce the larger hole *C*. The rocker-arm *X* at the left is pierced by punches D^1 and E^1, which act with dies D^2 and E^2, to form the holes *D* and *E*. The end of the work in this side of the die is not trimmed.

The trimming punch A^1, it will be noticed, enters into and is guided by the slotted opening A^2 in the rear of the die. It performs its work before the piercing punches enter the blanks. The die hole B^2 for this end of the short rocker-arm is formed in the trimming die itself, as shown by Fig. 8, but the other piercing dies are in the form of bushings which are inserted in the die plate.

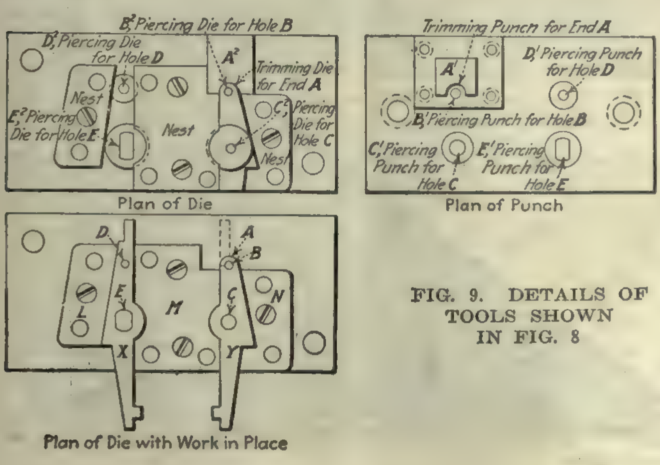


FIG. 9. DETAILS OF TOOLS SHOWN IN FIG. 8

The nests for the two pieces worked in these dies are made up of three plates *L*, *M* and *N*, which are secured by screws and dowels to the die face. These nest plates are made to match the straight edges of one side of the work and the tapered edge on the opposite side. The wide center of the work is blanked to a radius of $\frac{13}{64}$ in. and this circular portion fits into a similarly shaped seat in one of the edges of the middle nest plate *M* to locate the piece endwise.

Practical Points in Depreciation

By L. L. Thwing

Formerly Appraisal Expert for Machine-Tool Section of the Air Service

In an article on page 761, Vol. 51, W. W. Pollock has followed what is apparently a general custom of making scrap value one of the factors in the depreciated value of a machine. It is not disputed that iron and steel have a definite, if fluctuating, scrap value but there are other factors which if given due consideration will indicate that this practice is a refinement not warranted by the accuracy that can be maintained in the more important factors of depreciation.

Briefly, it is only necessary to point out that the average per pound price of machine tools is certainly not less than thirty cents, while an average price of No. 1 machinery scrap is one and one-half cents per pound. Thus the gross scrap value of a machine tool is less than 5 per cent of its replacement value and any appraiser who thinks he can hold his other errors within this limit is deceiving himself and his client.

A detailed analysis will show this even more plainly. After it has been decided to scrap a machine, the next move in actual practice is to have the millwright's gang come in and dismantle it, take down the countershaft, put the machine on skids and take it away.

The price of scrap metals as quoted in the trade journals is a consumer's price, f.o.b. cars. The local dealer who buys your scrap bears all the expense of collection and separation of steel and cast-iron parts, cost of transportation, and breaking into pieces small enough for the foundry to use. You may be sure that all of this will be reflected in the buyer's offer.

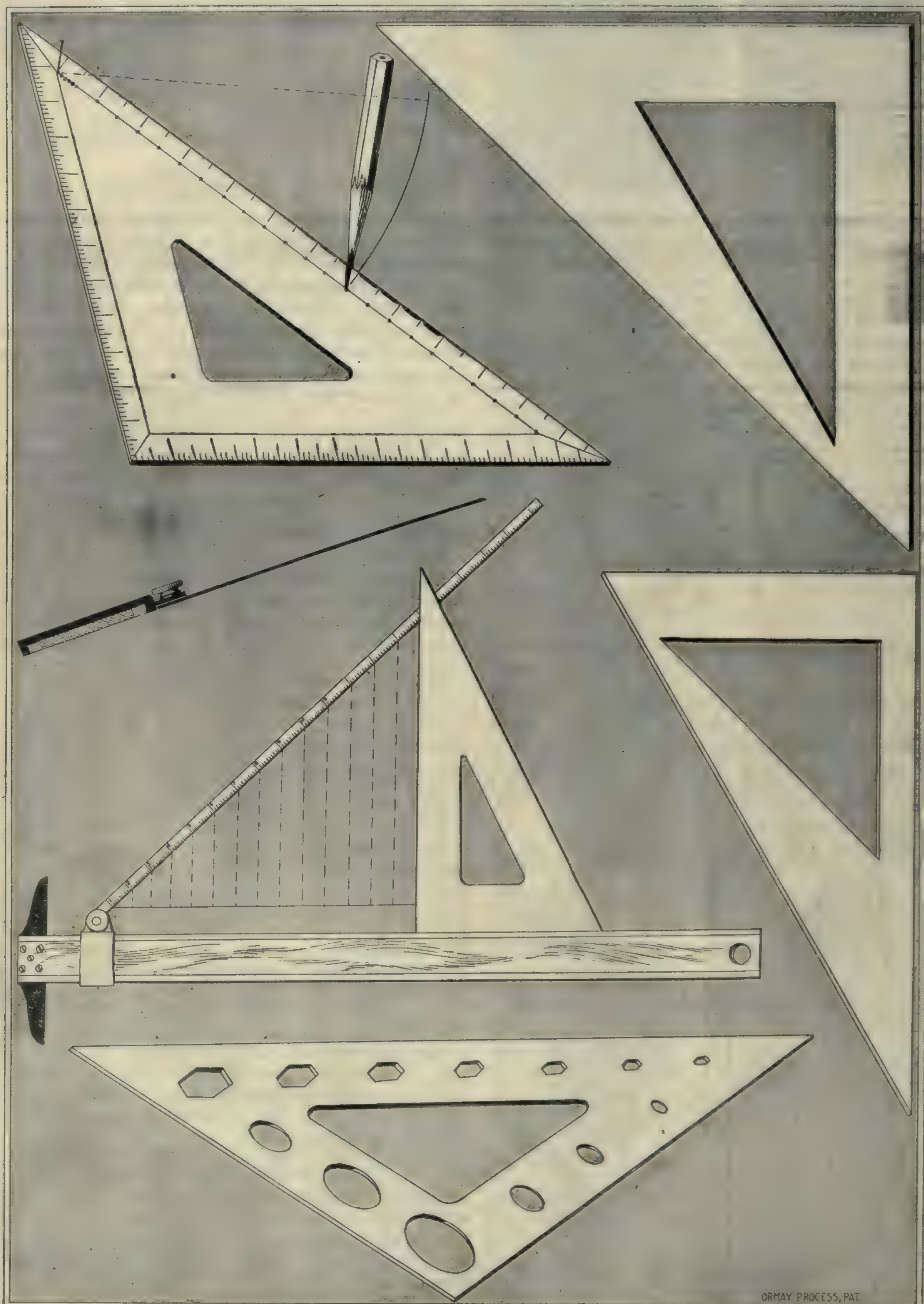
To give a specific example, a ten-year-old 14 in. x 6 ft. engine lathe weighs 1500 lb., and at $30 a ton has a gross scrap value of $22.50. However, for reasons previously enumerated, $15 would be a liberal offer from your scrap man. To dismantle and remove the lathe from the shop will require at least three hours for two men at 50 cents an hour. Allowing 100 per cent overhead, and deducting this cost from $15, we have a balance of $9 as the net scrap value of the lathe. A new lathe of this type sells for $700 today, and $9 is approximately 1.3 per cent of that amount.

Assuming that a machine has been depreciated for wear, obsolescence, and lack of utility—a total of 40 per cent: Shall we now make an addition of 5 per cent, assuming that this is the net scrap value, in hope of securing further accuracy?

Appraisal is not an exact science. It may be that the true depreciation is either 35 or 45 per cent. If we add 5 to our original 40, our final result will be 45 per cent, which is either exactly correct or a 10 per cent error. In other words, if you attempt to introduce an allowance or correction of any percentage which is equal to or less than your limits of error you are gambling with results on a "double or quits" basis.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS

US
ARMY ORDNANCE NEWS

Manufacture of Artillery Range Finders—III

By GEO. H. THOMAS

It is necessary that the dials and scales, which in range-finding apparatus enable the gunner to determine his angles of elevation and site, shall represent the highest attainable degree of accuracy, and to that end the special tools and methods herein described were devised. (Part II appeared in our last issue.)

BECAUSE of the extreme degree of accuracy required in the graduated scales of range-finding apparatus and the impossibility of preventing small errors from creeping in during the manufacturing operations, the graduating of all such scales is made an after operation, being accomplished by means of special precision machines and devices for indexing and checking after the apparatus is otherwise finished and partly or wholly assembled. The principle of checking the smaller radius of the graduated scale against the amplified reading of a master scale is employed in all these devices. The illustration, Fig. 26, shows the French make of gun sight mounted upon the trunnion of a false gun carriage in the same manner that it would be mounted in actual service. The straight-edge *A*, to which is attached the gunner's quadrant *B*, represents the barrel of the actual gun, the elevation of which is determined by the rotation of the trunnion of which the casting *C* is an extension. The large graduated dial *D*, mounted upon the same axis, measures in degrees this angle of elevation and is checked at the major points by the gunner's quadrant. These positions were then verified by bringing the optical lunette of the range finder to bear on a distant target, the position of which has been determined by computation and measurement. As each major setting (5 deg. of arc) was obtained and checked, a line was scribed on the drum scale, which may be seen through the window in the housing at *E*.

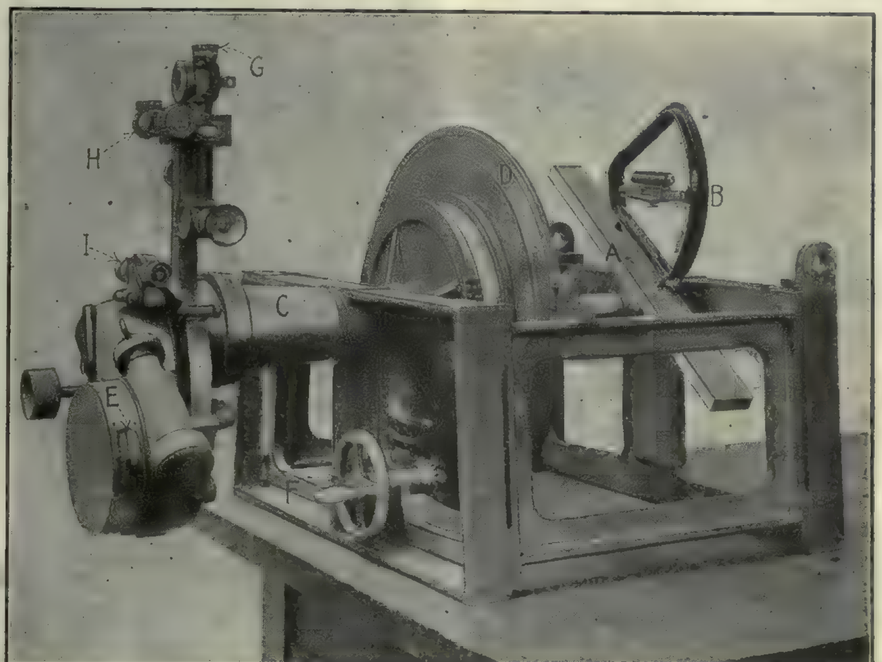


FIG. 26. FRENCH GUN SIGHT MOUNTED ON FALSE GUN FIXTURE

Thus, three independent means of locating the divisions were available, and if any discrepancy was evidenced, it was investigated and the fault corrected before marking the drum scale.

This method eliminated the possibility of accumulated error, which might have been caused by inaccuracies in the manufactured parts of the mechanism, by excluding from the process all consideration of the mechanical movements and establishing the divisions directly from the position of the gun. The trunnion of the gun was turned from one position to another by means of the handwheel *F* through the medium of the bevel and worm gearing and their connecting shafts. Upon the range finder at *G* and *H*, and upon the angle of site *I*, are thimbles and dials with micrometer graduations which enable the gunner in actual service to direct the movements of the gun with extreme accuracy. The details of these parts are shown in the line drawing, Fig. 27

In ordinary methods of manufacture it would be permissible to roll the graduations upon these parts by contact with a master or type dial but such methods would give results far from the degree of accuracy required in this case; therefore, each dial was individually engraved upon the apparatus shown in Fig. 28.

The graduating device was improvised upon a disk

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grinding machine, by the use of a tail block from a pair of milling-machine centers which was opposed to the center in the disk; a turret slide from a screw machine; a Rivett slide rest; a 24-in. disk graduated as the work required; and a magnifying glass to align correctly the graduation marks with the stationary indicator located at the top of the disk. The disk was turned by a small friction wheel operated by the handwheel to be seen at the left end of the machine table.

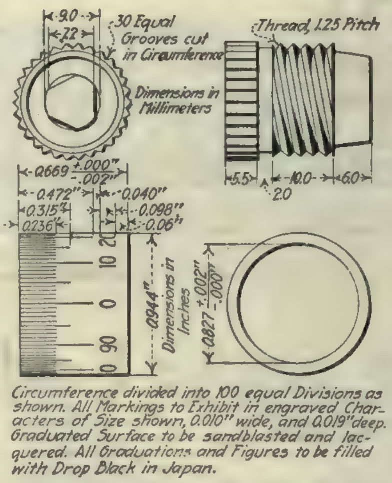

FIG. 27. MICROMETER THIMBLE, SHOWING THE GRADUATIONS

The turret slide is operated in a direction to and from the face of the disk by means of the large bent handle, and the Rivett slide rest, holding the marking tool, is mounted upon it. The work is supported between the two opposed centers so that the marking tool travels in a line parallel with its axis.

A stop-pin on the slide contacts with a disk upon the base, this disk having notches of different depths cut in its periphery at the point where the stop-pin strikes. A ratchet operated by a pawl attached to the slide turns this disk one step at each movement of the slide, thus providing for a longer mark at each fifth, and a still longer mark at each tenth division. The graduations on the master dial were brought into alignment with the line on the indicator by observing them through the magnifying glass.

The methods employed by the French in putting in the marks representing the subdivisions of the drum scale were clever and ingenious. The machine is shown in Fig. 29. The operation requires a considerable degree of skill and experience.

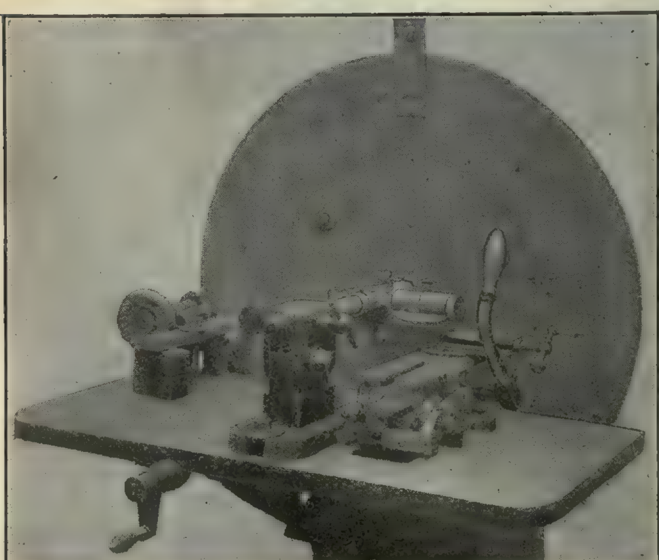

FIG. 28. FIXTURE FOR GRADUATING THE MICROMETER THIMBLE

The machine has an indexing spindle turning upon a vertical axis and carries on its upper end a large dial which is accurately graduated. A precision worm gear is integral with this dial and its worm is under control of the operator's left hand through the compensating device below *A*. The work to be graduated is held upon the upper surface of the master dial and the engraving is done by a tool supported from the overhanging arm.

The worm gear on the master dial has 360 teeth and upon the worm shaft is a micrometer thimble having 60 divisions, thus giving direct readings in minutes of arc. The compensating device consists of a threaded sleeve of comparatively coarse pitch which determined the position lengthwise of the worm shaft. A gear upon the end of the sleeve is provided with adjustable stops which are so set that, by turning the sleeve the distance between stops, any error in any major division is compensated for. An adjustable scale upon the sleeve allows this error to be equally distributed over each major division, the exact position of whose limits is determined by vernier upon the large dial.

FIG. 29. FRENCH MACHINE FOR SUBDIVIDING THE DRUM SCALE

How It Is Done in America

While the French methods are interesting and instructive, a comparison of them with those followed in America to accomplish the same result may be of interest.

The American device, shown in Figs. 30 and 31, is double; two of the devices being mounted on the same baseplate. A Rivett headstock fastened to one corner of the plate holds the work by means of a mandrel and collet. Above the headstock, on a casting which sets over the latter, is mounted the cross-slide of a screw machine in such manner that its line of travel is parallel to the center line of the headstock spindle. To this cross-slide is attached a slide-rest so positioned as to give a movement transversely to the center line of the spindle and also a vertical movement; thus a tool held by it has movement in three directions at right angles.

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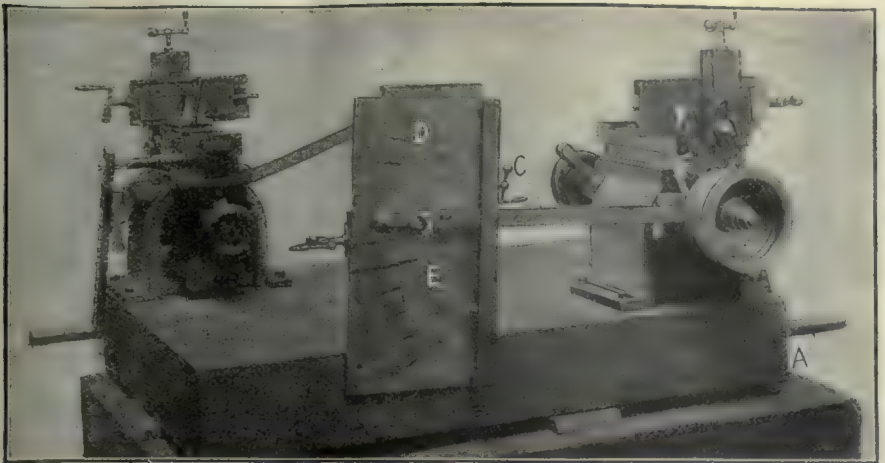


FIG. 30. AMERICAN DEVICE FOR SUB-DIVIDING THE DRUM SCALE

The movement of the slide which is parallel to the center line of the spindle is of course the one that provides for the marking, and is made by means of the lever *A*, Figs. 30 and 31, the same system of stops being used for making long and short marks as is described in reference to Fig. 28, the arrangement being much more clearly shown in Fig. 31 at *B*.

The spindle of the headstock is free to turn but the work is clamped in the end of the radius bar *C* (not visible in Fig. 31).

A second screw-machine cross-slide mounted to the left of the headstock has a horizontal movement to and from the work spindle and upon this slide is fastened the large index plate *D* having a row of holes distributed over an arc, the radius of which is approximately ten times that of the drum to be marked.

This radius is, however, variable, the index plate being moved to or from the work by means of the cross-slide upon which it is mounted, such movement being allowed by the radius bar by reason of the slip joint *E* near its outer end. The clamp holding the work in the radius bar may be loosened by turning back the wrench *F*.

With the index pin in the first hole in the master plate the marking tool is brought into coincidence with one of the major divisions already established on the drum by the means previously described. The index pin is withdrawn and placed in the last hole of the master plate, when, if the marking tool does not now coincide with the *next* major division, compensation is made by increasing or decreasing the length of the radius bar, and altering the position of the master plate to correspond. This cut-and-try method is continued until the difference between the first and last positions of the pin exactly corresponds to major divisions on the drum, after which it is a simple matter to subdivide the latter into the number of parts represented by the number of holes in the master plate. The operation of setting for, and graduating a single drum is about 30 minutes.

FIG. 32. FRENCH MACHINES FOR ENGRAVING NUMBERS ON THE DRUM SCALE

In engraving the figures on the drums the French so classified the work and distributed it among several engraving machines that each machine was confined to certain figures, the work passing from one machine to another until the engraving was complete. By this method the amount of skilled labor required was reduced to a minimum, the machines being so arranged and set as to make mistakes practically impossible. The battery of engraving machines and their operators are shown in Fig. 32.

The method employed in this coun-

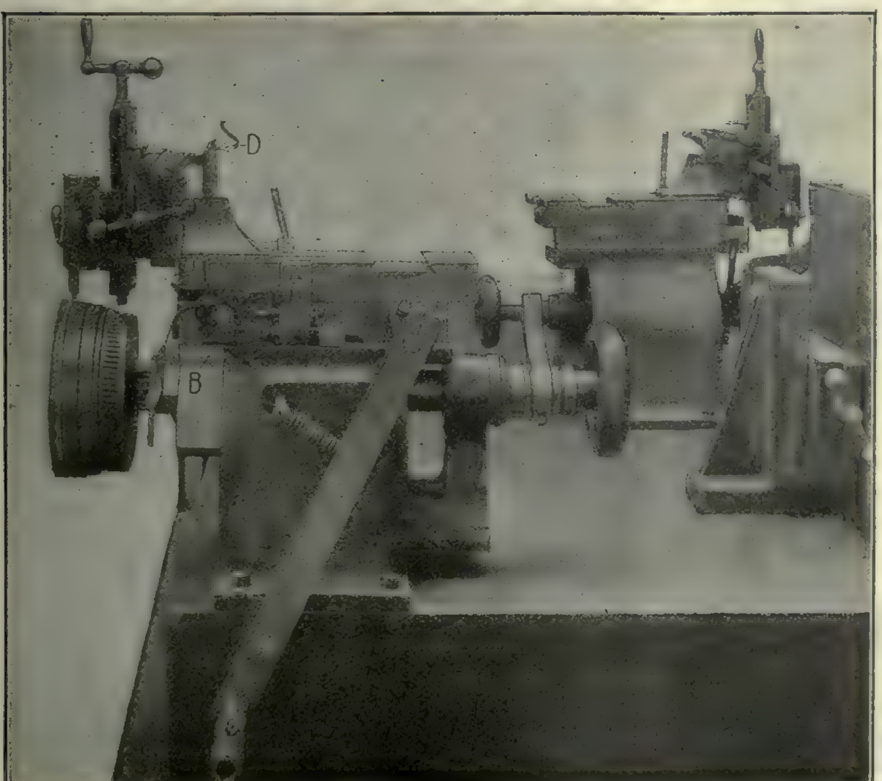


FIG. 31. AMERICAN DEVICE FOR SUB-DIVIDING THE DRUM SCALE

ARMY ORDNANCE NEWS

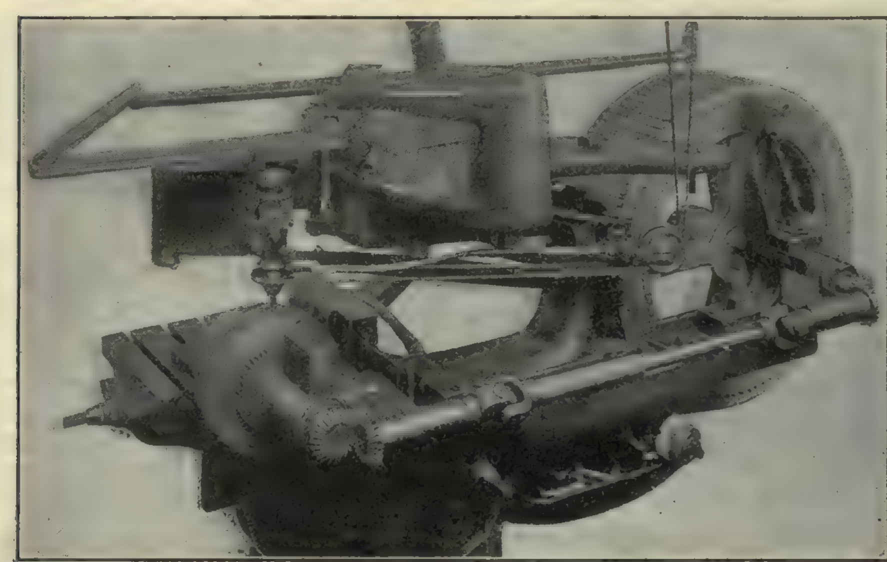


FIG. 33. THE AMERICAN METHOD OF ENGRAVING THE DRUM SCALE

try provided for the completion of the engraving upon a single machine which may be seen in Fig. 33. An aluminum master drum was made a fac-simile upon a large scale of the drum to be engraved. The indexing pins locked the master drum by means of holes in its face while the drum to be engraved was connected with the master through the gearing shown in the foreground, making its movements coincident with the master.

The time required to engrave a drum with this machine was reduced 50 per cent. over the previous method.

Rules for Autogenous Welding

The following rules, adopted by the Committee on Standards for Locomotives and Cars, U. S. Railway Administration, for the purpose of preventing the abuse of autogenous welding for purposes for which it is not well adapted, have been sent to the regional directors by Frank McManamy, assistant director of the Division of Operation, with instructions to direct all roads to observe the rules in the construction or repair of locomotive boilers, so that any failures which may have been caused or contributed to by unrestricted or improper use of autogenous welding may be prevented:

1. Autogenous welding will not be permitted on any part of a locomotive boiler that is wholly in tension under working conditions, this to include arch or water bar tubes.

2. Staybolt or crown stayheads must not be built up or welded to the sheet.

3. Holes larger than 1½ in. in diameter when entirely closed by autogenous welding must have the welding properly stayed.

4. In new construction welded seams in crown sheets will not be used where full size sheets are obtainable. This is not intended to prevent welding the crown sheet to other firebox sheets. Side sheet seams shall be not less than 12 in. below the highest point of the crown.

5. Only operators known to be competent will be assigned to firebox welding.

6. Where autogenous welding is done the parts to be welded must be thoroughly cleaned and kept clean during the progress of the work.

7. When repairing fireboxes a number of small adjacent patches will not be applied, but the defective part of the sheet will be cut out and repaired with one patch.

8. The autogenous welding of defective main air reservoir is not permitted.

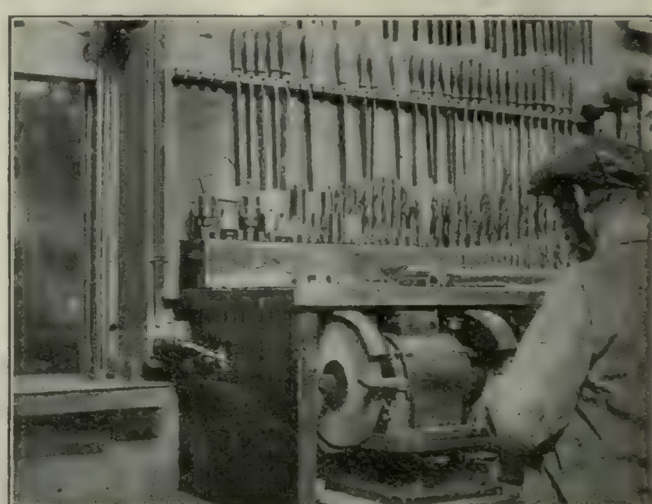
9. Welding rods must conform to the specifications issued by the Inspection and Test Section of the United States Railroad Administration for the various kinds of work for which they are prescribed, which specifications will be issued later.

A Toolroom Convenience

BY FRED D. HOOD

The contrivance illustrated may savor of pampering the toolkeeper, but since anything which adds to his convenience usually enables him to give better service, it is not only justifiable but good business.

The machine illustrated is a tool grinding machine with two 10 x 1-in. wheels and is used for general light tool grinding. Mounted on a sliding shelf under a bench as close as possible to the toolroom window, it can be pulled out for use instantly. It is furnished with a comfortable seat for the operator. The convenience of position saves the toolkeeper many steps as he can answer all questions, at least, without stopping his machine or even getting up from his seat. This alone is a big help in catching up after a day that has been particularly hard on tools. In this case it has increased efficiency about 25 per cent.



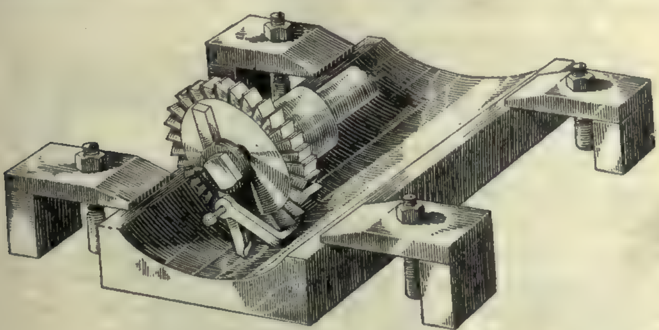
A TOOLROOM CONVENIENCE

An Improvised Fly-Cutter

By Gustave Remacle

Having to machine a piece of material 6½ in. long and 4 in. wide as shown in the sketch, a toolmaker saved considerable time by machining the concaved surface in the Van Norman Duplex milling machine.

When the block had been machined to the required outside dimensions, a line was marked off with a height gage, to be used later when indicating the center of the piece, which was then roughed out in the shaping machine; after which it was located upon the table



AN IMPROVISED FLY-CUTTER

of the milling machine and lined up with the spindle of the machine. A milling cutter 3½ in. in diameter was selected and a bench lathe tool of high-speed steel was clamped to the cutter.

By means of a ground parallel and height gage, the tool was adjusted to cut the desired radius. This done it was only necessary to machine the piece to the required depth and the job was completed. The slotting cutter held the tool rigidly and served its purpose well. The inclination of the body of the tool served to prevent chattering or digging in. The tool was ground at the cutting edge so as to provide top rake.

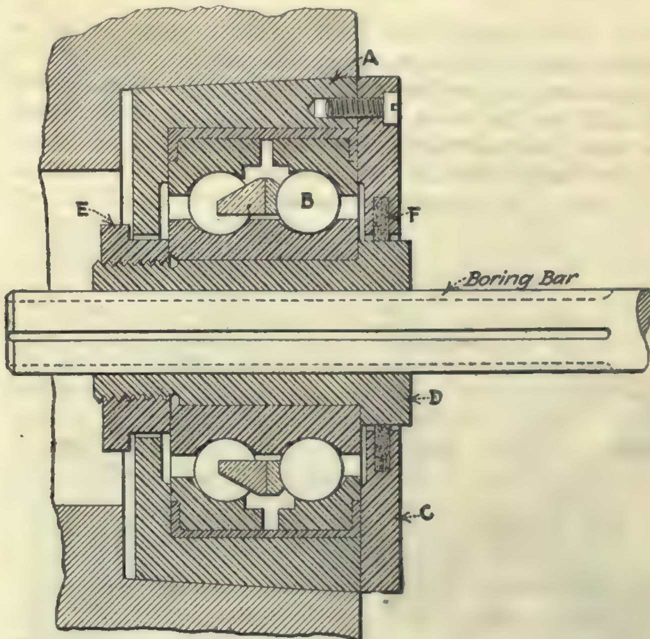
Ball-Bearing Pilot Bushing for Boring Bars

H. M. Fay

Most of us are familiar with pilot bushings held in chucks or faceplates on lathes or turret chucking machines. These are generally made a running fit for the boring-bar pilots and forced in the jaw side of the chuck.

The illustration shows a bushing for this purpose in which a standard commercial ball bearing of the double-row type for taking radial and thrust loads is used. The essential parts of this construction consist of a shell *A*, driven in the chuck in the usual manner, in which the ball bearing *B* is contained, being held in place by the plate *C*. The outer ring of the bearing is a snug fit in the shell.

Mounted in the inner shell is a bushing *D* and this is securely clamped therein by the screw collar *E* while a felt washer at *F* keeps dirt and chips out of the bearing. The boring bar is a sliding fit in the bushing *D* and it is apparent that the advantage of reduced



BALL-BEARING PILOT BUSHING

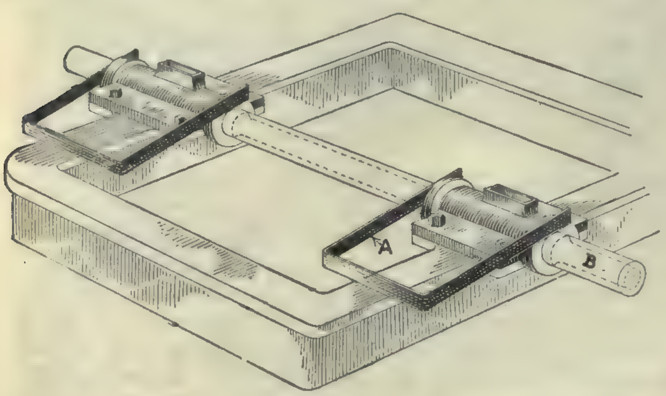
friction, common to ball-bearing constructions, applies to pilot bushings so constructed. This results in much less wear of the boring-bar pilots as they merely slide in the bushings and do not revolve. The bushings *D* are readily removable to accommodate different diameters of boring bars.

Device for Babbitting Bearings

By John Vincent

For babbitting bearings it is customary to use an arbor with adjustable collars which are brought up against the ends of the boxes and held in place by means of setscrews to prevent the molten babbitt from spilling out. This saves the time required for sealing the ends of the boxes with putty which is necessary when collars are not used. The collars are often made with shoulders on their inside faces which fit into the

outer ends of the boxes a fraction of an inch and serve to support the arbor reasonably near to the center of the boxes. The setscrews take time to set up and will eventually make rough spots that add to the difficulty of removing the arbor; therefore, one shop has substituted the steel springs shown at A in the accompanying illustration, which are easy to put in place and hold the collars firmly against the boxes. These were



DEVICE FOR HOLDING COLLARS ON BABBITTING ARBORS

made of flat spring steel stock, suitably tempered, after having been bent to the shape shown.

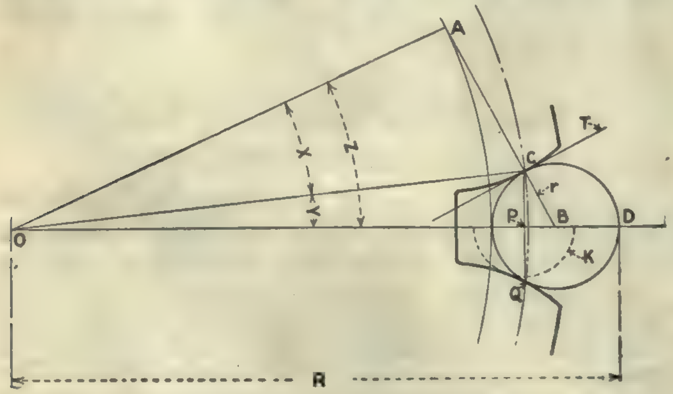
Another feature for arbors that are to be used continually on the same job is the relieving of the part between the bearings and on one outside end as shown by the dotted lines B. This saves considerable time in the removal of the arbor after the bearing metal has set.

Formulas for Gear Plug Gage

By F. W. Shaw

C. H. Dengler gives formulas on page 76, Vol. 51, *American Machinist* for use in calculating the diameters of the plugs used in gaging gears by the plug method and for ascertaining the radial distance to the outside of the plug. He has erroneously assumed that the center of the plug, when this makes contact with the tooth flanks at the pitch circle, lies within the pitch circle. Since, however, it lies without the pitch circle, the published formulas are evidently wrong. The dotted circle K, struck from a point P within the pitch circle, must obviously cut the tooth flank if it meets the latter at the point Q at the pitch circle.

Now, two curves in mutual contact, and not cutting, can have their centers or instantaneous centers only in the line which lies at right-angles to their common tangent (as T); that is, in the case in point, in the line



GEAR-GAGING PLUG DIAGRAM

AB. The only point at which the center of the plug can be located, if it is to touch at both C and Q, is at B.

In the diagram herewith, the angle X is known, for it is the pressure angle; the angle Y can be ascertained for it is four right-angles divided by four times the number of teeth or 90 deg. divided by the number of teeth; the angle Z is obviously the sum of angle X and Y. If we determine OA, the radius of the base circle, OB and R—hence $OB+R$, the required data—can readily be calculated. Now $OA = OC \cos X$ (OC being the pitch circle radius and therefore known).

The formula for the plug diameter is:

Diameter of plug

$= 2r = 2\ (AB - AC)$

$= 2\ (OA \tan Z - OC \sin X)$

$= 2\,OC\ (\cos X \tan Z - \sin X)$; eliminating OA, to avoid calculating it. (1)

Radius over plug

$= R = OB + R$

$= AB \operatorname{cosec} Z + R = OC \cos X \tan Z \operatorname{cosec} Z + R$

$= OC \cos X \sec Z + R$ (2)

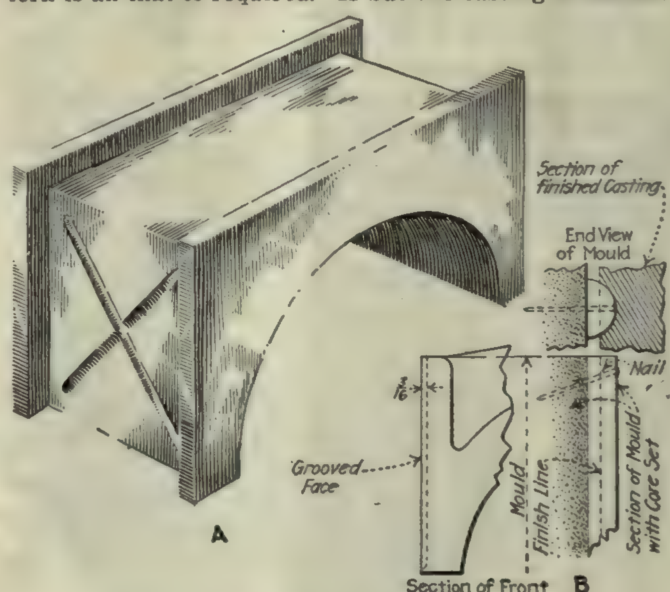
It is interesting to note that gears with even numbers of teeth can be checked with an ordinary micrometer or vernier by using two plugs resting in opposite spaces. For gears with odd number of teeth, the method is also available if one calculates the plugs occasioned by the plugs not being diametrically opposite—quite a simple calculation by the way.

Coring Oil Grooves Instead of Chipping Them

By M. E. Duggan

The other day I saw a machinist cutting the oil grooves in the two sliding faces of a large journal box with a chisel. These grooves were $\frac{3}{16}$ in. deep, $\frac{1}{2}$ in. wide, totaling 5 ft. in length, and were as shown at A in this illustration. All this labor and time could have been saved had the grooves been made in the casting in the foundry.

The job may be done in the foundry in the following simple way: One-half of a core $\frac{3}{4}$ in. in diameter is fastened to the sides of the mold with nails as shown at B. Marking the location of the grooves on the pattern is all that is required. If but one casting is wanted



CORING THE OIL GROOVES IN JOURNAL BOX

a single line drawn through the center of the groove or grooves will answer the purpose just as well as a "black and white" varnish finish.

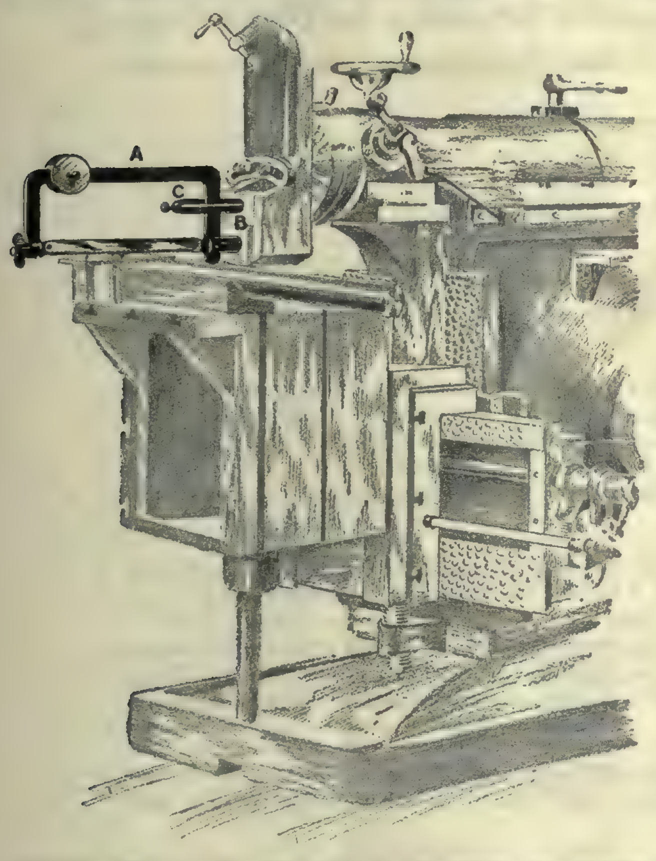
For these oil grooves no special corebox is necessary; the cores are taken from stock. Not all patternmakers know this, as was clearly shown in the foundry a short time ago where such a pattern was fitted with core prints, and coreboxes made, one for the straight part of the grooves and another to make the jointed cross-section.

Converting a Shaping Machine Into a Power Hacksaw

By Wm. Denton

The man in the small job shop has to exercise considerable ingenuity to get out work that would present no problem at all to the foreman of a fully equipped establishment.

For example: our little shop did not have a power hacksaw, as our sawing jobs were limited to an occasional small piece that could quickly be cut off by hand. When one day we faced the necessity of cutting off a large number of pieces from fairly sizeable bars we wanted a power saw, and we wanted it very badly.



HACKSAWING ATTACHMENT TO SHAPING MACHINE

Wanting a thing, however, is far from getting it, as we have previously discovered, so the work was started in a shaping machine with the usual results: constant attendance, of course; snagging and occasional breaking of the tool, caused by slippage of the work in the vise; exasperation and intense desire to do it some other way.

The expenditure of a little gray matter and a few hours work served to make a fairly serviceable hacksaw out of the shaping machine as illustrated herewith.

A frame *A* was first made to take a 12-in. blade. A block *B* was fitted to the clapper box in place of the clapper, and an extra hole drilled through the box and block parallel to the taper-pin hole. A slotted arm *C*, which was forged integral with the block, formed a yoke to which the rear upright member of the frame was fitted, and a cap, closing the end of the slot, contained a setscrew which acted as a stop to prevent the saw frame from falling too far.

Adjustable weights were made to slide on the upper member of the frame. The feed of the saw was entirely by gravity and its downward movement was limited by the setscrew. The vertical slide of the machine was used only to adjust for different sizes of work to be cut.

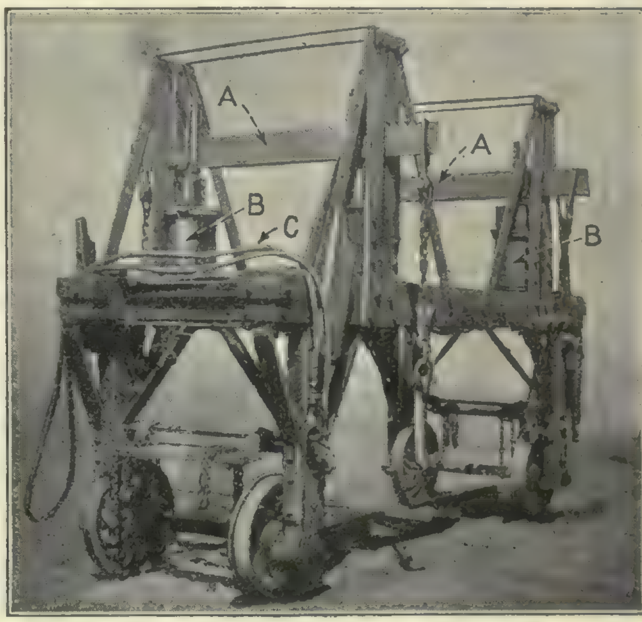
The converted machine could not compete in speed with a regular power saw, but it required no attention beyond setting for each piece and thus proved a valuable acquisition to a shop not equipped with the latter machine.

A Handy Rig for Transferring Car Trucks

By Robert Bruce

The illustration shows a handy rig for handling car trucks and for transferring them from one track to another.

A truck can be rolled underneath the rig from any cross track and then hoisted clear from the rails by the hooks and chains attached to the equalizing bars *AA*.



RIG FOR TRANSFORMING CAR TRUCKS

Hoisting is done by compressed air delivered to four cylinders whose pistons are attached to the equalizing bars.

Two of the cylinders may be seen at *BB*. Air is supplied through the hose *C* which can be attached to one of the many air outlets in the shop yard.

With a truck hoisted clear from the rails the whole affair can be rolled on its track and the truck delivered to the shop or placed on any one of the cross tracks in the yard.

This rig is in use in the yards of the Chicago shops of Chicago & Northwestern Railroad.

Pittsburgh Chamber of Commerce Committee Report

This is the report of the Pittsburgh Committee on Trade and Commerce which was unanimously approved by the Board of Directors. It opposes the adoption of the Compulsory Metric System.

Pittsburgh, Pa., Jan. 22, 1920.

TO THE BOARD OF DIRECTORS,
Chamber of Commerce of Pittsburgh.

Gentlemen:

Your Committee on Trade and Commerce has given careful attention to the question of the adoption of the metric system of weights and measures, as suggested in the report of your Committee on Suggestions and Recommendations which was referred to this Committee for consideration.

At the present time there is being conducted by an organization styling itself the "World Trade Club," with headquarters in San Francisco, an active campaign favoring immediate legislation to make compulsory the exclusive use of the metric system and thousands of letters have been pouring into Washington from all parts of the country, with the result that a bill has been prepared for presentation to Congress. It is not at all clear who and what the World Trade Club may be or from what source its evidently abundant finances are procured. It is certain, however, that the country is being flooded with a mass of literature quoting innumerable authorities on the subject. In a casual glance through one of the pamphlets we find the statement:

> "In the British Isles, however, currency not being decimal, but divided into guineas, pounds, crowns, half crowns, florins, half florins, shillings, half shillings, pence and farthings, etc., . . ."

In this statement the effort to create sentiment against the sub-divisions has led to inaccuracy, inasmuch as the guinea has long been obsolete, and the half florin and half shilling never existed. It is possible that on examination more inaccuracies would be found in the great mass of literature so lavishly distributed.

The metric system was legalized in 1866 by virtue of an Act of Congress. Thus, for over fifty years, it has stood on a legal parity with the English system and fully available to all who wished to use it. *Is it not therefore fair to say that if it cannot win on its own merits by voluntary adoption under the protection of this law, it is not entitled to win under a law of force?* The present attempt is to prohibit the use of the existing system and make the metric standard the one exclusive official system.

At this time, when as a result of the world war, production and commerce are in a chaotic condition, and when the whole world is hungry for the products of the two greatest nations whose commerce would bear the whole burden of this inopportune tampering with the fundamentals, it would be folly to make "confusion worse confounded" by attempting any such radical change.

It is, and always has been, the practice of Pittsburgh Manufacturers to quote upon inquiries as well as to execute orders based on the metric system. This is readily done by converting into our own equivalents.

Three-fourths of the world's manufactured goods and more than a large majority of the machine tools used in Latin-America are produced on the system of measurements which we use today.

As soon as it became known that the Chamber was to consider this subject, your Committee began to receive in rapid succession communications from prominent manufacturers and representative organizations, all but two of which vigorously condemned the effort to further disrupt our industrial and commercial conditions by inopportune tampering with such a vital basis of production. Among these correspondents might be mentioned the American Hardware Manufacturers' Association, the American Institute of Weights and Measures, *Iron Age*, the American Flexible Bolt Company, the American Spiral Spring and Manufacturing Company, Fawcus Machine Company, Harris Pump and Supply Company, Homestead Valve Manufacturing Company, Keystone Driller Company, Lockhart Iron and Steel Company, Locomotive Stoker Company, J. & J. B. Milholland Company, the McConway & Torley Company, Penn Bridge Company, Pittsburgh Machine Tool Company, Pittsburgh Piping and Equipment Company, H. K. Porter Company, the Simonds Manufacturing Company, Standard Underground Cable Company, James B. Sipe & Company, Union Switch and Signal Company, United Engineering and Foundry Company, Westinghouse Electric and Manufacturing Company, Westinghouse Air Brake Company, the Wilson Snyder Manufacturing Company, the Carnegie Steel Company, and the Rosedale Foundry Machine Company.

Only two firms appeared to favor the meter-liter-gram system, and one of these qualifies its opinion by stating "unless the changing over would have an effect that we do not know of." That effect, as indicated above, would be to practically eliminate from the world's markets the products of the two great commercial nations affected by increasing inefficiency and decreasing production through the changing of standards, gages, dies, tools, drawings, specifications, patterns, machinery, etc., and the enormous expense incident thereto, at a time when costs are higher, production lower, and demand greater than ever before.

Be it therefore resolved, That the Chamber of Commerce of Pittsburgh unqualifiedly condemns all efforts to effect any change in the existing system of weights and measures as impractical and inimical to the trade and general commercial interests of our country, and

Be it further resolved, That copies of this resolution be sent to the Chamber of Commerce of the United States, to our Representatives and Senators in Congress, and to the Chairman and members of the Committee on Coinage, Weights and Measures, to the American Chamber of Commerce in London and to the Hon. David Lloyd George. Also, to the Chamber of Commerce in San Francisco.

Respectfully submitted,
ROBERT GARLAND,
Chairman

Millholland Number Two Friction-Head Screw Machine

The Millholland Machine Co., Indianapolis, Ind., has lately added to its line a new No. 2 friction-head screw machine which is illustrated in Fig. 1. In general appearance this machine closely follows the lines of the other sizes of Millholland screw machines. A noticeable feature is that the headstock and bed are made of a single casting. This has a heavy web extending up to the center line of the spindle, which braces the spindle-bearing housings and aids in eliminating vibration on heavy forming cuts.

The spindle is made from a high-carbon, hammered steel forging and is bored to take bar stock up to 1 in. in diameter. The automatic chuck is so designed that it accommodates itself to minor variations in diameter of the stock. The swing over the bed is 14 in. and over the cutoff, 7 inches.

The friction head and back gear, shown in the rear view, Fig. 2, are so designed that the back gears may be engaged or disengaged by means of the large center lever shown back of the cone pulley. When the work does not require back gears, they can be disengaged and the spindle gear can be wedged in such a way as to form a very effective spindle brake where quick stopping of the spindle is an important element of the production time.

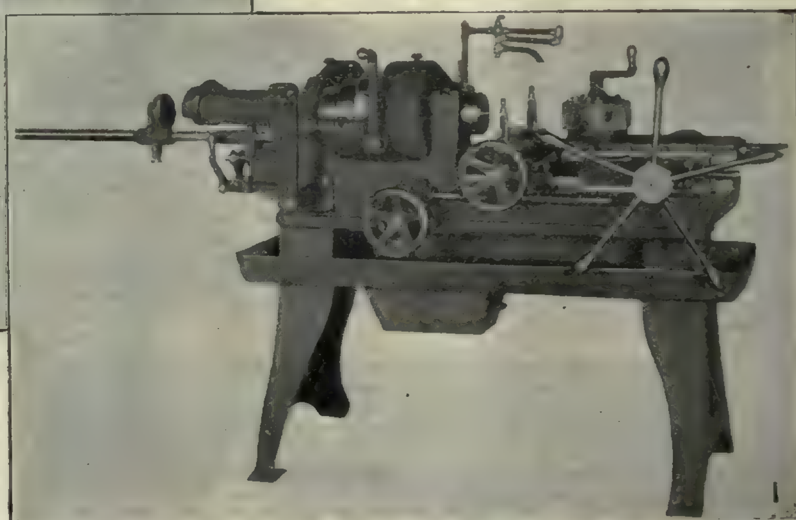


FIG. 1. THE MILLHOLLAND NO. 2 FRICTION-HEAD SCREW MACHINE

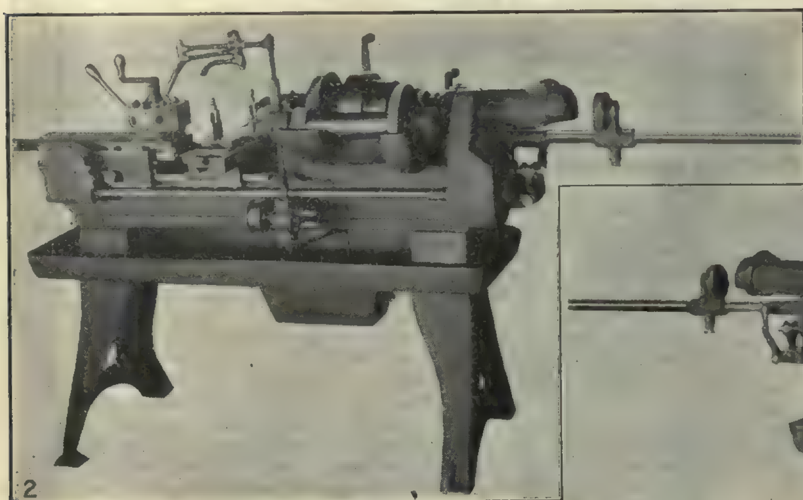


FIG. 2. REAR VIEW OF MILLHOLLAND NO. 2 SCREW MACHINE

Specifications

Automatic chuck capacity, square $\frac{11}{16}$ in., hexagon $\frac{7}{8}$ in., round 1 in.; hole in spindle, $1\frac{3}{32}$ in.; holes in turret, $1\frac{1}{4}$ in.; swing over turret slide (diameter), $4\frac{5}{8}$ in.; diameter of turret across faces, $7\frac{1}{4}$ in.; length that can be turned, 7 in.; greatest distance end of spindle to turret, 15 in.; swing over bed, 14 in.; swing over cut-off, 7 in.; diameter of spindle bearings, front $2\frac{1}{4}$ x $4\frac{1}{4}$ in., rear 2 x $3\frac{1}{2}$ in.; lever movement of cut-off, $5\frac{1}{2}$ in.; friction head; feed changes, 0.005, 0.010, 0.015; width of belt for cone, $2\frac{3}{4}$ in. double; pulleys on countershaft, 10 x 14 in.; width of belt for countershaft, 3 in.; countershaft speed, steel, 230 r.p.m.; brass, 560 r.p.m.; spindle speeds (at 560), 338, 560, 932; (at 230), 138, 230, 382; floor space of machine, 60 x 26 in.; extension of wire feed rod, $47\frac{1}{2}$ in.; weight, net 1,300 lb., crated 1,500 lb., boxed for export 1,710 lb.

Hand longitudinal adjustment and screw feed to the cut-off give an added working range. The turret is of the standard Millholland design and has a power feed attachment. The selective-speed gear box gives three feed changes for every spindle speed. These feed changes are available while the machine is in operation.

The machine is furnished regularly equipped with an unbreakable steel pan, coolant pump, piping, countershaft and the necessary wrenches.

Definitions of Export Quotations

THE conclusions and definitions set forth here are the recommendations of a conference of the National Foreign Trade Council, Chamber of Commerce of the U. S. A., National Association of Manufacturers, American Manufacturers' Export Association, Philadelphia Commercial Museum, American Exporters' and Importers' Association, Chamber of Commerce of the State of New York and the Merchants' Association, which was held in New York City recently.

In their order these definitions of export quotations are the normal situations on which an export manufacturer or shipper may desire to quote prices. It is understood that unless a particular railroad is specified, the property will be delivered to the carrier most conveniently located to the shipper. If the buyer, for the purpose of delivery, or in order to obtain lower transportation charges, desires that the goods be delivered to a carrier further removed from the shipper and entailing a greater cost than delivery to the carrier most favorably situated, the carrier to which the buyer desires delivery of the goods should be named in the quotation. The term "cars or lighters" as used herein, is intended to include River, Lake or Coastwise ships, canal boats, barges, or other means of transportation, when so specified in the quotation.

1. When the price quoted applies only at inland shipping point and the seller merely undertakes to load the goods on or in cars or lighters furnished by the railroad company serving the industry, or most conveniently located to the industry, without other designation as to routing, the proper term is: "F.O.B. (named point)."

Under this quotation: (A) Seller must (1) place goods on or in cars or lighters; (2) secure railroad bill of lading; (3) be responsible for loss and/or damage until goods have been placed in or on cars or lighters at forwarding point, and clean bill of lading has been furnished by the railroad company. (B) Buyer must (1) be responsible for loss and/or damage incurred thereafter; (2) pay all transportation charges including taxes, if any; (3) handle all subsequent movement of the goods.

2. When the seller quotes a price including transportation charges to the port of exportation without assuming responsibility for the goods after obtaining a clean bill of lading at point of origin, the proper term is: "F.O.B. (named point) freight prepaid to (named point on the seaboard)."

Under this quotation: (A) Seller must (1) place goods on or in cars or lighters; (2) secure railroad bill of lading; (3) pay freight to named port; (4) be responsible for loss and/or damage until goods have been placed in or on cars or lighters at forwarding point, and clean bill of lading has been furnished by the railroad company. (B) Buyer must (1) be responsible for loss and/or damage incurred thereafter; (2) handle all subsequent movement of the goods; (3) unload goods from cars; (4) transport goods to vessels; (5) pay all demurrage and/or storage charges; (6) arrange for storage in warehouse or on wharf where necessary.

3. Where the seller wishes to quote a price, from which the buyer may deduct the cost of transportation to a given point on the seaboard, without the seller assuming responsibility for the goods after obtaining a clean bill of lading at point of origin, the proper term is: "F.O.B. (named point) freight allowed to (named point on the seaboard)."

Under this quotation: (A) Seller must (1) place goods on or in cars or lighters; (2) secure railroad bill of lading; (3) be responsible for loss and/or damage until goods have been placed in or on cars or lighters at forwarding point, and clean bill of lading has been furnished by the railroad company. (B) Buyer must (1) be responsible for loss and/or damage incurred thereafter; (2) pay all transportation charges (buyer is then entitled to deduct from the amount of the invoice the freight paid from primary point to named port); (3) handle all subsequent movement of the goods; (4) unload goods from cars; (5) transport goods to vessel; (6) pay all demurrage and/or storage charges; (7) arrange for storage in warehouse or on wharf where necessary.

4. The seller may desire to quote a price covering the transportation of the goods to seaboard, assuming responsibility for loss and/or damage up to that point. In this case, the proper term is: "F.O.B. cars (named point on seaboard)."

Under this quotation: (A) Seller must (1) place goods on or in cars; (2) secure railroad bill of lading; (3) pay all freight charges from forwarding point to port on seaboard; (4) be responsible for loss and/or damage until goods have arrived in or on cars at the named port. (B) Buyer must (1) be responsible for loss and/or damage incurred thereafter; (2) unload goods from cars; (3) handle all subsequent movement of the goods; (4) transport goods to vessel; (5) pay all demurrage and/or storage charges; (6) arrange for storage in warehouse or on wharf where necessary.

5. It may be that the goods, on which a price is quoted covering the transportation of the goods to the seaboard, constitute less than a carload lot. In this case, the proper term is: "F.O.B. cars (named port) L.C.L."

Under this quotation: (A) Seller must (1) deliver goods to the initial carrier; (2) secure railroad bill of lading; (3) pay all freight charges from forwarding point to port on seaboard; (4) be responsible for loss and/or damage until goods have arrived on cars at the named port. (B) Buyer must (1) be responsible for loss and/or damage incurred thereafter; (2) handle all subsequent movement of the goods; (3) accept goods from the carrier; (4) transport goods to vessel; (5) pay all storage charges; (6) arrange for storage in warehouse or on wharf where necessary.

6. Seller may quote a price which will include the expense of transportation of the goods by rail to the seaboard, including lighterage. In this case, the proper term is: "F.O.B. cars (named port) lighterage free."

Under this quotation: (A) Seller must (1) place goods on or in cars; (2) secure railroad bill of lading; (3) pay all transportation charges to, including lighterage at, the port named; (4) be responsible for loss and/or damage until goods have arrived on cars at the named port. (B) Buyer must (1) be responsible for loss and/or damage incurred thereafter; (2) handle all subsequent movement of the goods; (3) take out the insurance necessary to the safety of the goods after arrival on the cars; (4) pay the cost of hoisting goods into vessel where weight of goods is too great for ship's tackle; (5) pay all demurrage and other charges, except lighterage charges.

7. The seller may desire to quote a price covering delivery of the goods alongside overseas vessel and within reach of its loading tackle. In this case, the proper term is: "F.A.S. vessel (named port)."

Under this quotation: (A) Seller must (1) transport goods to seaboard; (2) store goods in warehouse or on wharf if necessary, unless buyer's obligation includes provision of shipping facilities; (3) place goods alongside vessel either in a lighter or on the wharf; (4) be responsible for loss and/or damage until goods have been delivered alongside the ship or on wharf. (B) Buyer must (1) be responsible for loss and/or damage thereafter, and for insurance; (2) handle all subsequent movement of the goods; (3) pay cost of hoisting goods into vessel where weight of goods is too great for ship's tackle.

8. The seller may desire to quote a price covering all expenses up to and including delivery of the goods upon the overseas vessel at a named port. In this case, the proper term is: "F.O.B. vessel (named port)."

Under this quotation: (A) Seller must (1) meet all

charges incurred in placing goods actually on board the vessel; (2) be responsible for all loss and/or damage until goods have been placed on board the vessel. (B) Buyer must (1) be responsible for loss and/or damage thereafter; (2) handle all subsequent movement of the goods.

9. The seller may be ready to go farther than the delivery of his goods upon the overseas vessel and be willing to pay transportation to a foreign point of delivery. In this case, the proper term is: "C. & F. (named foreign port)."

Under this quotation: (A) Seller must (1) make freight contract and pay transportation charges sufficient to carry goods to agreed destination; (2) deliver to buyer or his agent proper bills of lading to the agreed destination; (3) be responsible for loss and/or damage until goods have been delivered alongside the ship and clean ocean bill of lading obtained (seller is not responsible for delivery of goods at destination). (B) Buyer must (1) be responsible for loss and/or damage thereafter and must take out all necessary insurance; (2) handle all subsequent movement of the goods; (3) take delivery and pay costs of discharge, lighterage and landing at foreign port destination in accordance with bill of lading clauses; (4) pay foreign customs duties and wharfage charges, if any.

10. The seller may desire to quote a price covering the cost of the goods, the marine insurance on the goods, and all transportation charges to the foreign point of delivery. In this case, the proper term is: "C.I.F. (named foreign port)."

Under this quotation: (A) Seller must (1) make freight contract and pay freight charges sufficient to carry goods to agreed destination; (2) take out and pay for necessary marine insurance; (3) be responsible for loss and/or damage until goods have been delivered alongside the ship, and clean ocean bill of lading and insurance policy have been delivered to the buyer, or his agent. (Seller is not responsible for the delivery of goods at destination, nor for payment by the underwriters of insurance claims); (4) provide war risk insurance, where necessary, for buyer's account. (B) Buyer must (1) be responsible for loss and/or damage thereafter, and must make all claims to which he may be entitled under the insurance directly on the underwriters; (2) take delivery and pay costs of discharge, lighterage and landing at foreign port of destination in accordance with bill of lading clauses; (3) pay foreign customs duties and wharfage charges, if any.

In reaching the conclusions set forth in this statement the Conference considered the fact that there are, in more or less common use by manufacturers in different parts of the United States, numerous variations of these abbreviations, practically all of which are employed to convey meanings substantially synonymous with those here defined. For instance, there are manufacturers who quote "F. O. B. Cars," "F. O. B. Works," "F.O.B. Mill" or "F. O. B. Factory" meaning that the seller and buyer have the same responsibilities as those set forth in section 1. The Conference considered all those variations and determined to recommend the use of "F.O.B. (named point)," as "F. O. B. Detroit," "F. O. B. Pittsburgh," etc. Of the considerable number of these abbreviations which are used in the United States, the Conference felt that the form "F.O.B. (named point)" is most widely used and understood, and therefore should be adopted as the standard of practice.

The chief purpose of the Conference is to simplify and standardize American practice, and to that end it urges manufacturers and exporters to cease the use of synonymous abbreviations and quote habitually in the terms here recommended, just as far as these terms will cover the price conditions which it is desired to arrange with the buyer.

Variations of the abbreviations recommended in other sections also are in more or less common use throughout the United States. The recommendations of the Conference set forth above apply to them with the same force as to those cited under section 1.

Manufacturers and exporters are urged to bear in mind that the confusion and controversies which have arisen have sprung in part from the use of an excessive number of abbreviated forms with substantially similar meanings, as well as from the use of abbreviations in a sense different from their original meanings, or in an application not originally given them and different from the sense of application understood by foreign buyers.

In simplified and standardized practice lies the best hope of reducing confusion and avoiding controversy.

The Conference urges upon manufacturers and exporters the very great importance at all times of making their intention in whatever quotations they employ so thoroughly clear as to be impossible of misunderstanding or misinterpretation. It is much better to take the time and space at the outset to make the quotation clearly understood,

Schools Get Your Machines Now

By Val Francis

It seems to me that the various educational institutions are too slow in taking advantage of the provision of the Caldwell bill and I want to urge, as strongly as possible, that trade schools, technical institutions, local boards of education, etc., grasp this opportunity to expand their present facilities for industrial training as much as possible.

Several months ago I placed an application in the most reliable school of my district for admittance to the machine-work class. It was quite provoking to be informed that there was no vacancy for the present term and that my application would be filed for future consideration. Upon inquiry, I learned that other schools were in this same predicament. The next term came and again a notice was sent to me containing precisely the same information as the previous one.

This time, I did not accept the assurance of a future consideration, but wrote a letter to the superintendent stating that it was absolutely necessary for me to gain admittance, giving him the particular reasons. A short time later I received a post-card to go to the school for a preliminary interview. I met the superintendent, and, after a short talk, he told me that there was a vacancy in the forge-shop and heat-treatment class; that, if it was accepted, I would be admitted to the machine-work class the next term. This was a good offer, and I jumped at it, the result being that I started in the next night.

After a few nights getting acquainted with my fellow-students I found that I was quite fortunate and that most of them had much longer waiting periods. Most of these students are in the forging class under the same conditions that I am. They did not apply for the forge shop; however, now that they are in, they unanimously agree that forging and heat-treatment are good things to know about.

It seems to me that the number of school shops provided is entirely inadequate. Space to place machines does not appear to me to be the determining factor. Remember, the students are there and are all waiting for the opportunity to be admitted to the schools.

Another thing concerning students: In one of the articles published in the *American Machinist*, a paragraph stated that when the present-day student spoiled a piece of work he laughingly blamed the machine, or something else, and was quite apt to repeat the performance. As a school-shop student allow me to say in defense that none of my fellow-students, so far as I have observed, has ever made the same mistake twice. Also, each is man enough to take the blame upon himself when he does spoil work, and, further, a large percentage have been in the service and all are serious-minded young fellows.

than to be compelled in the end to go through vexatious controversy or litigation, which costs not only time and expense but customers as well. Misunderstandings can best be avoided if the seller will formulate a written statement of the general conditions under which his sales are to be made, and will see that the foreign buyer possesses these terms of sale when considering a quotation. The items which may be included in such a statement, deal with: delivery, delays, partial shipments, shipping instructions, inspection, claims, damage, and payment.

Explanations of Abbreviations

F.O.B.—Free on board.
F.A.S.—Free alongside ship.
C. & F.—Cost and freight.
C.I.F.—Cost, insurance and freight.
L.C.L.—Less than carload lot.

The quotation "F.O.B. (named port)" as "F.O.B. New York," "F.O.B. New Orleans," "F.O.B. San Francisco," is often used by inland producers and distributors to mean merely delivery of the goods at railway terminal at the port named. This abbreviation originated as an export quotation and had no application to inland shipments. It was used only to mean delivery of the goods upon an overseas vessel at the port named. That, in fact, is the meaning universally given to the phrase among foreigners, and is the meaning which the best practice among exporters requires it invariably to have. But because of the confusion which has arisen through the use of that form with a different meaning by inland producers and distributors, and in the interest of unmistakable clarity, the Conference most strongly urges the invariable use by American manufacturers and exporters of the form "F.O.B. Vessel (named port)." This adds only one word to the abbreviated form and has the great advantage that it cannot be misunderstood. It also avoids the difficulty which might arise among foreigners not always well versed in American geography, through confusing an inland forwarding point with a shipping port at seaboard.

The Conference calls attention to the fact that in selling "F.A.S. Vessel" manufacturers and exporters should be careful to have their agreement with buyers cover explicitly the question of responsibility for loss after goods have been delivered on the wharf or alongside the vessel and before they are actually loaded on the ship. There is no generally established practice on this point. The recommendation of the Conference in the definitions of responsibility under section 7, sets up a rule which it is hoped will lead to the establishment of a standard practice.

It is understood that the provision of lighterage covered in several of these recommendations is only within the usual free lighterage limits of the port, and that where lighterage outside such limits is required, it is for buyer's account.

In order to avoid confusion in another particular, attention is called to the care which must be exercised in all cases in making weight quotations. The net ton, the gross ton and the metric ton, all differ in weight. Similarly, there is a variation in the use of the term "hundredweight" to mean either 100 lb. or 112 lb. It is therefore not sufficient to quote a price per "ton" or per "hundredweight." Instead the Conference recommends the use of the terms "ton of 2,000 lb.," "ton of 2,240 lb.," or "ton of 2,204 lb.," etc., whichever is intended.

It is also important to note that a carload lot in the United States means the quantity of the particular commodity in question necessary to obtain the carload freight rate for transportation on American railways. This quantity varies according to the commodity and also varies in different parts of the country. Certain commodities being more bulky than others, the minimum carload for them is less than for heavier products occupying less space. The load required may range anywhere from 12,000 to 90,000 lb. Consequently, it is important, when quoting prices applicable to carload lots, so so state and to specify the minimum weight necessary to make a carload lot of the particular commodity for the particular shipment in question.

The Conference points out that in quoting "C. & F." or "C.I.F.," manufacturers and exporters moving large quantities of material by one vessel should be careful to ascertain in advance the buyer's capacity to take delivery. This because, under these terms and as a condition of making the freight rate, transportation companies may require a certain rate of discharge per day, and that rate of discharge might be in excess of the buyer's capacity to take delivery. In such event an adjustment with the transportation company would be necessary, which might affect the freight rate and consequently the price to be quoted.

The Conference also strongly urges shippers clearly to understand the provisions of their insurance protection on all foreign sales, irrespective of the general terms used thereon. In almost all cases it should be possible, when making shipments by steamer, to obtain insurance cover giving full protection from primary shipping point to designated sea port delivery, and/or foreign port delivery. As ordinary marine insurance under F. P. A. conditions, that is, free of particular average, gives no protection against deterioration and/or damage to the merchandise itself while in transit, when caused by the recognized hazards attending such risks, shippers should endeavor in all cases to obtain insurance under W. P. A. (S. P. A.) conditions, that is, with particular average (subject to particular average), when in excess of the customary franchise of 3 to 5 per cent. Under such form of insurance, underwriters will be called upon to pay claims for damages when these exceed the stipulated franchise.

The Conference points out that inasmuch as fees for consular invoices and similar items are arbitrary charges fixed by foreign governments, they are not included in the terms of C. & F. or C.I.F. quotations, and it is part of the duty of the buyer to meet them.

Finally, the Conference strongly recommends, as a most effective measure of simplification, the general practice of quoting for export, as far as possible, either "F.A.S. Vessel," "F.O.B. Vessel" or "C.I.F." Concentration on this small list, all of which terms are readily understood abroad and are difficult of misinterpretation, will, it is felt, be markedly influential in avoiding confusion and controversy.

The European Situation

By Charles D. Oesterlein
The Oesterlein Machine Co., Cincinnati

In my opinion, the year 1920 is most apt to prove vicious because of the great temptation, on the one hand, to expand our plants and take care of the tremendous business being offered in the United States today. This is overshadowed by the contingency, on the other hand, of a possible collapse in Europe which cannot otherwise but be reflected immediately in the United States.

In order that a fair appreciation of the reasons may be had on which this belief is founded it will be necessary to refer to many experiences of my recent visit throughout ten of the European countries which extended over the latter half of last year.

It is not sufficient to argue merely that we can expect very little European business because an adverse exchange relation now exists between the United States and European countries, forcing them to pay a high premium for our dollars with which American goods can be bought. This is perhaps alright so far as it goes, but it does not give us a key to the situation responsible for this result, nor does it tell us what to expect next.

To state some of the bare facts of the overseas situation, there is a shortage of coal and food which runs nearly on to a point of total absence in at least parts of the central countries.

A hint can be taken regarding the seriousness of the coal situation in Germany from the fact that there was such an acute shortage in November that for two weeks there was not a single passenger nor freight train run in the entire country, the sole exception being food trains. Prior to this absolute discontinuance there was only one train running for every two or three trainloads of passengers and the writer was forced to stand with hundreds of others during practically the entire trip while passing through that country.

One must only note the want of coal in such countries as Holland and France and interpolate to gage the situation in the enemy countries.

Holland is so short of coal, although a neutral country, that as you pass through it you see many large meadows simply ruined because of taking up peat which seems to form the top layer of earth on which the grass grows. The amount of coal allowed per family to rich and poor alike is scarcely sufficient to heat one room for the winter.

When you come to consider France, heat in hotels was absolutely prohibited by law until after Nov 1, when after raising hotel rates to what might have been considered the limit, hotels adopted a policy of charging separately an additional amount for heat which in my case was consumed while passing through the lobby.

In view of these facts, think of what the coal situation must be in Germany and Austria, especially since the former has lost her main coal fields to France.

Surely without coal to run the railroads materials can not be transported, raw materials can not be delivered to the industries, finished materials can not be removed; in fact, without coal, almost all industries are paralyzed through lack of power.

But what seems to me to seal the fate of the central countries is this: They must now buy food and exchange goods for food at all costs. The German mark is less than a skeleton of its former self—worth one-twelfth its pre-war value, and going down. At the same time Germany must not only pay her own war costs, but as well all that is physically possible toward that of her enemies. Furthermore, the Allies' demands will have to have first consideration which will not leave a very handsome balance with which she can pay interest on her own indebtedness and buy food and certain other essentials. Upon failing to pay interest on loans from neutral sources foreclosure proceedings will be in order and the beginning of a rapid collapse may follow immediately. As an illustration of the indebtedness to neutrals, I was informed that one banking institution alone in Sweden, the Skandanavisha Credit Aktiabolaget, negotiated a loan of 150,000,000 kr. (about $37,500,000) to Germany during the war and it might be assumed that on such an item the interest must be paid in kronens which on the present basis of exchange would alone require 93 million marks annually. As an individual item this amount is rather insignificant but from this example it is plain that the countries' contracted indebtedness has multiplied many fold.

On the other hand reparations to the Allies have likewise to be made on a basis of exchange severely unfavorable to Germany. Not millions but billions upon billions are required. Much tangible property has already been attached. Steamships and railroad rolling stock are examples. From the writer's recollection it seems that nearly one-fourth of all the freight cars and passenger cars in France were formerly German as witnessed by the double eagle which has only a white cross painted through it.

It also seems as though surplus stocks of all kinds of material and goods in Germany are being turned back into cash at whatever sacrifice is necessary to close a deal. This includes machine tools. The limits to which they are going may be illustrated by the following: In spite of the fact that Germany has been at war with Italy there was a solid shipload of German machine tools forwarded last fall, two-thirds of which was unloaded in Genoa the other one-third going to Naples. One German firm has already opened offices in Milan to look after the material and another has travelers in Italy.

There is a large meadow near Delft in Holland where thousands of machine tools are unloaded in the open and exposed, and prospective buyers are asked to name their own prices for them. This simply reflects the desperate condition within the country.

As a summary of the above we may say that in Germany there is a critical shortage of food, coal and other raw materials and transportation facilities and her credit is practically that of a bankrupt. She and her allies are, however, asked to strip themselves of what remains and make up the balance of the cost of the war in labor spread over years.

This is all justly to be expected but if we are to believe that Germany's acts during the war were as told, she is not past taking up Russia's debacle and refusing to work—if before that development another form of internal eruption doesn't result in the complete collapse of the nation.

And yet, it seems that Austria is in still worse shape at the moment than Germany. Reports also indicate that Poland needs assistance. Italy has just added to her troubles through the last election in November by placing the socialists in control of the government. This by the way resulted in a demonstration in the way of a general strike tying up entire cities while the writer was there. The industrial portion of Spain was in a turmoil with a general strike in Barcelona which drove the writer out of that country rather hurriedly, having been reliably informed that over 300 people were killed in a similar strike only six months earlier.

Armies and navies are all consuming and nonproducing which accounts for the fact that during the war the nations involved consumed more than they produced. The result is an unfavorable trade balance and reflects direct in the money exchange between nations. The effect can be seen from the following illustration: At about the end of July last year the English pound sterling would only buy $4.40 of our money instead of $4.86, its normal equivalent. For the reason of this premium the English were not inclined to buy from America, feeling that the pound would come back in value, and they didn't want to suffer the consequent loss.

Along with mention of this condition came reference to America as the country whose pockets were already bulging with money. Just imagine how the feeling of that time has been intensified throughout the further falling off of the British pound to a value of only $3.70 to $3.80, whose value is yet to be depreciated by reason of the reduced purchasing power of our dollar. And yet, when the pound could still buy $4.40 the British Government made known her foreign policy, which as I remember in substance anticipated protection for home industries and encouraged co-operation between British producers in handling the country's exports. The intent seemed clearly one to get the business which competing nations had formerly gotten, and restrict invasion of her home markets.

Remember, English money had only depreciated to 80 per cent of its former value whereas German money has depreciated to 8 per cent; how much less is it possible for Germany to compete in industry? This same exchange situation places nearly the whole of Europe in a difficult situation, the seriousness of which is so important that nations are just now being called together in convention to see if means can be found to avoid a catastrophe.

Prices also come into play. To repeat figures given by an important Swiss machinery dealer who had ten days previously visited plants in Chemnitz, Germany, two marks seven pfennigs an hour is the average rate paid then to machinists. This was equivalent to less than five cents an hour. No man receiving such a sum can pay a war tax. But on the basis of this rate the cost of product is figured which surely accounts for low prices on German goods. Now wait until relief distributions are made in Germany. Food coming from America for instance must be paid for in dollars and twenty-four marks today buy one pre-war mark worth of food. If the workman is to buy this food he must receive twenty-four marks for each one he now receives plus what he requires with which to pay this war tax. Allowing that he cannot hope to live in quite such circumstances it is still plain to see how German prices will go.

I was told time and again by machinery dealers in Sweden, Denmark and Switzerland that German manufacturers think nothing of advancing prices from fifty to a hundred per cent at a time, indicating that the process was already going on rapidly last fall. Surely before long the whole German indebtedness must be saddled on to their products, and then who can afford to buy them?

In industry consider for a moment the machine-tool situation. It is hardly likely that Germany can in any event soon again carry on a large export business because of the tremendous acceleration given to this industry in neutral countries during the war. Imitations of American machines may be expected to take the place of German machines in many instances. The writer made inquiry—having seen many grades of finish on the No. 8 B. & S. cylindrical grinding machine—to find out which firm is making this imitation. The answer was that in Sweden alone eleven different firms imitate this specific machine. Four copies of a certain milling machine also presented themselves. In Switzerland, whereas before the war there were only a handful of machine-tool builders of which only one was of importance, today there are probably 150, according to the statistics published in the country. Even Spain is producing machine tools. The writer was surprised to see imitations of his own milling machines being produced in Christiania, Norway.

In conclusion such an analysis as this convinces me that a grinding, wearing process is going on and will soon reach the climax when an explosion may occur and the conflagration will surely reach us here in the event.

Therefore, before tempting extensions are made with which to take care of our immediate domestic business, a thorough consideration of this phase of the European situation is surely to be recommended.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

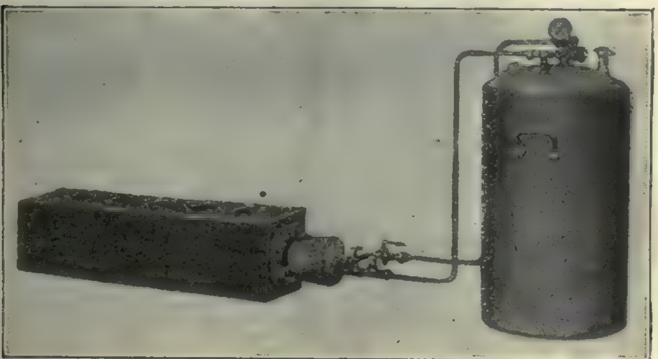
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

"Hauck" No. 2F Heater for Drying Small Ladles

A practical and simple arrangement for heating a number of small ladles simultaneously is being manufactured by the Hauck Manufacturing Co., Brooklyn, New York. The outfit, as shown in the illustration, consists of a sheet-iron firebox and a 20-gal. steel fuel tank. The box is framed on the inside with angle iron and lined with firebrick. A Hauck furnace burner supplies the heat. The ladles are placed bottom side up over the opening in the box and the flame from the oil burner shoots up through the openings, quickly drying the linings of the ladles. The number of openings provided for the ladles varies, as the firebox is made in different lengths to suit requirements. The burner is provided with a regulating valve and is designed to consume any grade of fuel oil, crude oil, or kerosene, delivered under a pressure of 20 to 100 lb. per square inch. The tank containing the oil is charged with compressed air and has a gage and regulating valve for oil and air. The pipe connections between the firebox and the tank are made of a length to suit conditions.



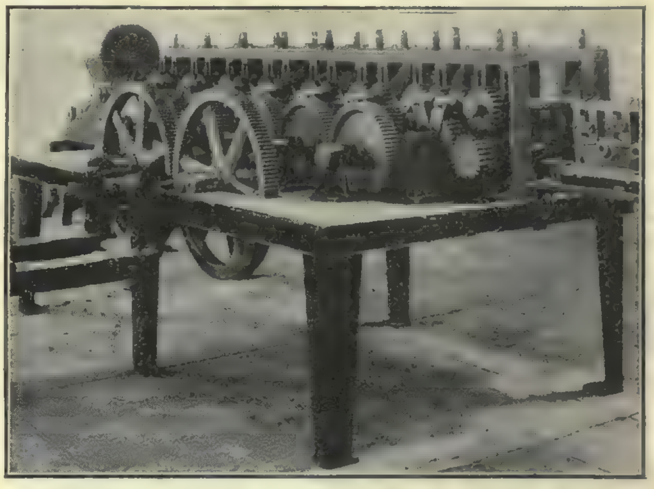
"HAUCK" HEATER NO. 2F FOR SMALL LADLES

United Molding and Tube Rolling Mill

The United Machine and Manufacturing Co., Canton, Ohio, is manufacturing a rolling mill that has a capacity to roll tube and molding sections at the rate of 60 to 300 ft. per minute, the amount varying according to the width, design of section and length of stock used.

The eight sets of spindles permit the rolling of a wide range of designs, the maximum width developed amounting to 13 in. The upper and lower spindles are power driven, providing positive roll action. The upper spindles have ample vertical adjustment adaptable to a variety of sizes and shapes, and provision is made for regrinding the roll dies when occasion requires. The spindles are of high-carbon crucible steel, hardened and ground, and running in phosphor-bronze bearings. Keyways are cut the full length of the spindles between the housings to permit the use of roll dies of variable widths.

The arrangement of the gearing distributes the application of power equally to the eight rolls, the initial drive being from a rawhide pinion attached to the motor. The feeding-in device or guide is composed of a set of horizontal tool-steel rolls hardened and ground and mounted in phosphor-bronze bearings. Different widths of stock are guided into the die rolls by the vertical grooved rolls of the feeding-in device, which are mounted on spindles carried on an adjustable cross-slide. The roll bearing blocks are mounted in housings that can be adjusted transversely on the platen without changing the vertical adjustment of the rolls.



UNITED MOLDING AND TUBE ROLLING MILL

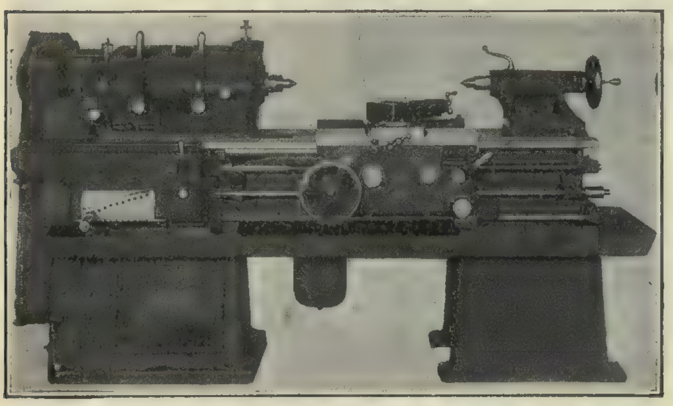
Reed-Prentice 14-Inch Geared-Head Lathe

The Reed-Prentice Co., Worcester, Mass., has placed on the market a 14-in. geared-head lathe as shown in the accompanying illustration.

The gears in the headstock are of the selective type, enabling the operator to obtain any one of the eight speeds without slowing down or stopping the machine or removing the tool from the cut. The speeds are obtained through spur gears and internal expanding

friction clutches, operated by three levers which must always be in operative position; when any one of the levers is in the neutral position the spindle will be at rest.

The spindle bearings are hardened and ground and run in bronze boxes that are scraped to a fit on the bearing surfaces. A spindle locking device is provided for use when removing the faceplate or chuck and is so arranged that it must be disengaged before the spindle clutch can be engaged. A geared pump in the



REED-PRENTICE 14-IN. GEARED-HEAD LATHE

Specifications: Spindle bearings (front, $2\frac{1}{2}$ x 5 in.; rear, $1\frac{3}{16}$ x 3 in.); hole through spindle, $1\frac{1}{4}$ in.; taper hole, Jarno, No. 4; number of speeds, eight; number of feeds (44), 0.0045 to 0.0667 in.; threads cut, 4 to 60; taper attachment will allow turning 18 in. at one setting; will turn $26\frac{5}{8}$ in. long with 6-ft. bed; floor space, $41\frac{1}{4}$ x 91 in.; weight (net, 2,800 lb.; boxed, 3,200 lb.).

headstock supplies all bearings, except the two main spindle bearings, with lubricant.

The apron is of the double-plate type and access may be had to all the internal mechanism without dismounting it. The lead-screw nut is so arranged that it can not be engaged in conflict with any of the feeds. Both longitudinal and cross feeds are friction operated.

The machine may be driven either by belt direct from the line shaft or by motor. The regular equipment includes a taper attachment. The steel pan shown in the illustration is only furnished as an extra.

Wilton Round Master Blocks

The Wilton Tool and Manufacturing Co., 84 Linden Park St., Boston, Mass., has added to its line a series of round master gage blocks put up in sets of different combinations.

The illustration shows set "H" comprising 16 blocks varying from 0.100 to 2.00 in., the variations being

WILTON ROUND MASTER BLOCKS

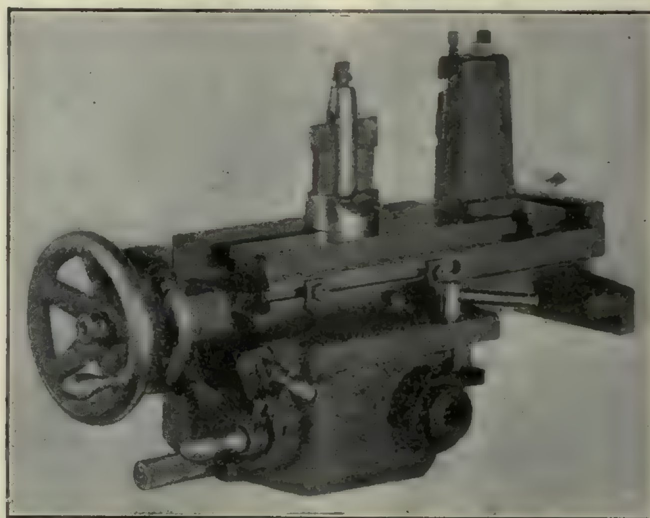
such as to give all dimensions by thousandths from 0.400 to 8 in.

Other sets give dimensions from $\frac{1}{16}$ to $1\frac{15}{16}$ in. by sixteenths; 0.10 to 2.10 by tenths, and 1 to 41 mm. by millimeters.

It is claimed that these gages are accurate to within 0.000015 in.

Millholland Power Cutoff for Screw Machines

The power cutoff slide illustrated is a feature of screw-machine construction as manufactured by the Millholland Machine Co., Indianapolis, Ind. It is intended for use when it is desired to do facing and forming while the turret tools are in operation. It has a simple and powerful friction drive. An automatic stop is provided that is tripped by either of



MILLHOLLAND POWER CUTOFF FOR SCREW MACHINES

two adjustable dogs. A hand trip lever can also be used when desired. The dial is graduated in thousandths and is provided with clips for quick reading. Eight feed changes in both directions are available through the feed-box of the machine. The lower lever is used to reverse the power feed in either direction.

Avey Automatic Drilling Machine

The Cincinnati Pulley Machinery Co., Cincinnati, Ohio, has brought out the automatic drilling machine shown in the accompanying illustration and which can be used as an automatic, semi-automatic or as a plain hand feed drilling machine.

The spindle can be advanced by hand ahead of the power feed without disengaging the latter and the clutches will pick up the power feed wherever the hand feed is dropped.

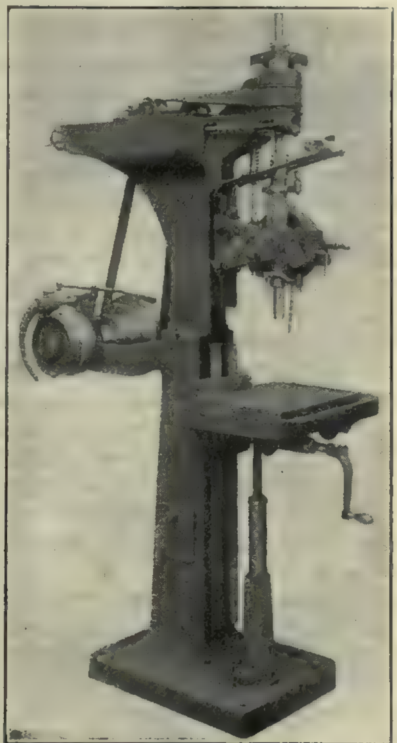
The counterweight can be regulated to accommodate different weights of tools and the shock of the returning spindle is taken up by an adjustable spring plunger.

The change from semi-automatic to full automatic operation is simply accomplished. The hand feed lever has a ratchet device whereby it can be set in any relation to the spindle or can be disengaged so as to remain idle when the automatic feed is in use.

All revolving members are mounted on annular ball bearings.

If desired, an automatic cut-off valve for the lubricating system can be furnished. With this device the lubricant will only flow while the drill is cutting.

Another device that can be attached is one that will limit the number of cycles the spindle will make before automatically stopping. This is useful in connection with automatic fixtures when operating on pieces having more than one hole of the same diameter.



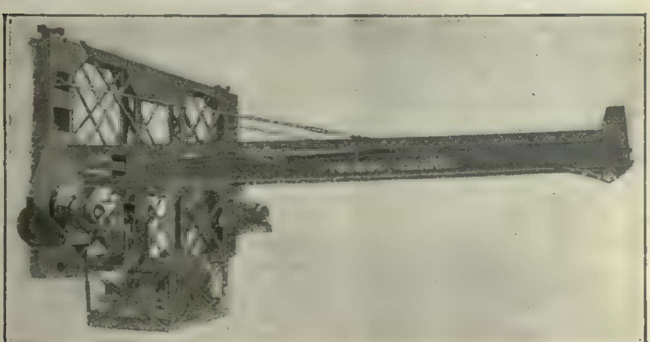
AVEY AUTOMATIC DRILLING MACHINE

Specifications: Stroke, variable from 3/8 to 5 in.; maximum number of strokes per min., 30; speeds, 4; feeds, 4; capacity, 3/4 in. in cast iron, 5/8 in. in steel; maximum spindle speed, 3,500 r.p.m.

The machine can be furnished in the gang type having from two to six spindles.

Toledo Wall Crane

The traveling wall crane shown, is now being furnished regularly by the Toledo Bridge and Crane Co., Toledo, Ohio. It is made in two sizes with capacities of three and five tons each, both having an effective reach up to 30 ft. The crane serves as an auxiliary to the regular overhead crane, or it may be used as an independent unit. Power for the longitudinal travel is furnished by two motors connected in parallel and operated through one controller. The motor pinion engages the driving gear which is pressed on and keyed to the double-flanged and cast-steel truck wheel. A foot brake operated from the cage is provided to control the longitudinal travel and to stop the crane without the necessity of plugging the motors. The brake is of the band type, the brake wheel being mounted on the armature shaft of one of the motors. The location of the cage is optional or may be omitted entirely, as rope-operated controllers can be substituted and all operations controlled from the floor. Where rope control is employed, the foot brake is omitted and a solenoid brake substitued. The solenoid brake performs two functions. It serves to stop the motor, thus providing for a rapid reversal, and it also acts as a holding brake when the load is brought to rest through the dynamic braking action. The crane can be furnished for either direct or alternating current.



TOLEDO WALL CRANE

Garvin Cam Milling Machine

The feature that distinguishes this machine from previous designs of the Garvin Machine Co., New York City, is the change from vertical to horizontal spindle.

The machine is designed for cutting either flat or cylindrical cams. Fig. 1 shows it arranged for flat cam work. In this set-up the work is mounted on the end of the work arbor toward the spindle, with the former at the outer end of the arbor. Worm gearing drives the work arbor from the universal power feed shaft, to be seen at the front of the machine. Power is transmitted through spur gearing, giving three changes of feed when cutting flat cams.

The arm containing the work arbor pivots on the forward end, and is guided at the rear end by a substantial guide bracket mounted on the table. The arm has, in addition to its own weight, detachable weights to keep the former pin against the former, thus counteracting the stress of the cutter. These weights can be added to

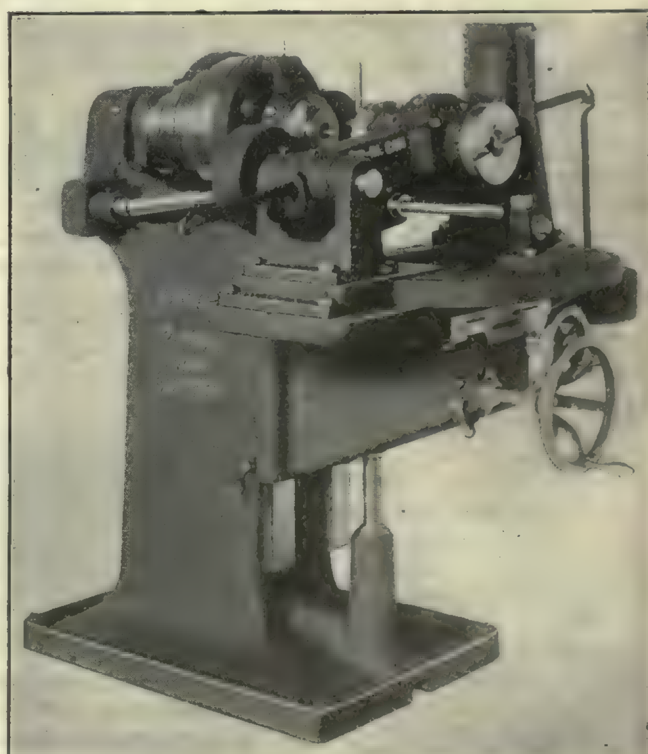


FIG. 1. GARVIN CAM MILLING MACHINE SET UP FOR FLAT CAMS

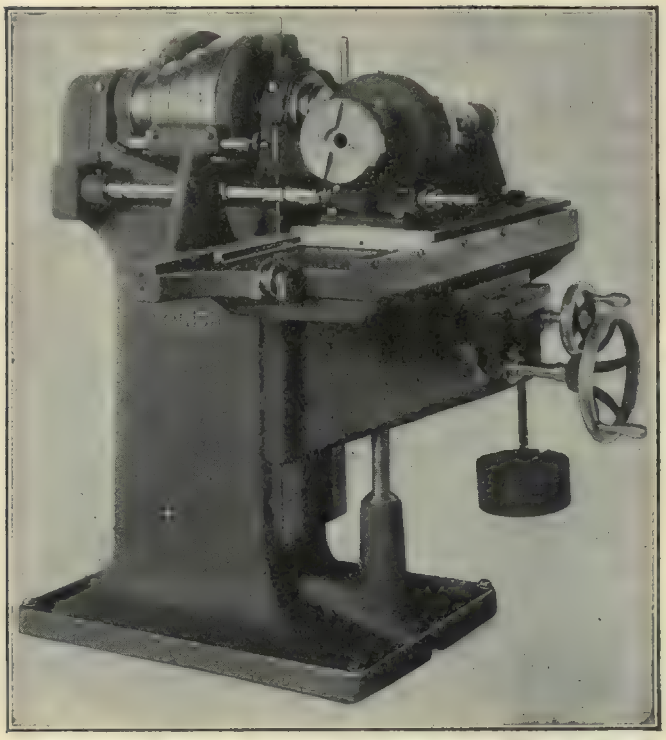


FIG. 2. GARVIN CAM MILLING MACHINE SET UP FOR CYLINDRICAL CAMS

either end of the arm, and are arranged to release the pressure on the former when cutting steep angle cams.

Fig. 2 shows the machine arranged for cutting cylindrical cams. In changing from the flat to the cylindrical cam fixture, the entire slide shown bolted to the saddle of the machine can be taken off and laid aside. The universal power feed shaft readily detaches for this purpose and attaches to the cylindrical cam fixture.

In operation the feed rotates the work arbor, the work being mounted on the far side of the fixture and the former on the other end of the work arbor. The former pin, shown at the front of the machine, is kept against the former by weights.

The movement of the cylindrical cam fixture is very sensitive, as it works on large balls in a V-shaped, tool steel track. The feed of both attachments can be disconnected by a clutch, permitting hand-feed control by a crank attached to the squared end of the worm shaft. This will be found handy in setting up for cams that are cored, also for helping over steep angles.

The spindle of the machine is of Garvin standard milling machine construction. All gearing is protected by housing. There are two changes of feed provided on the machine for use when cutting cylindrical cams. The following are the specifications:

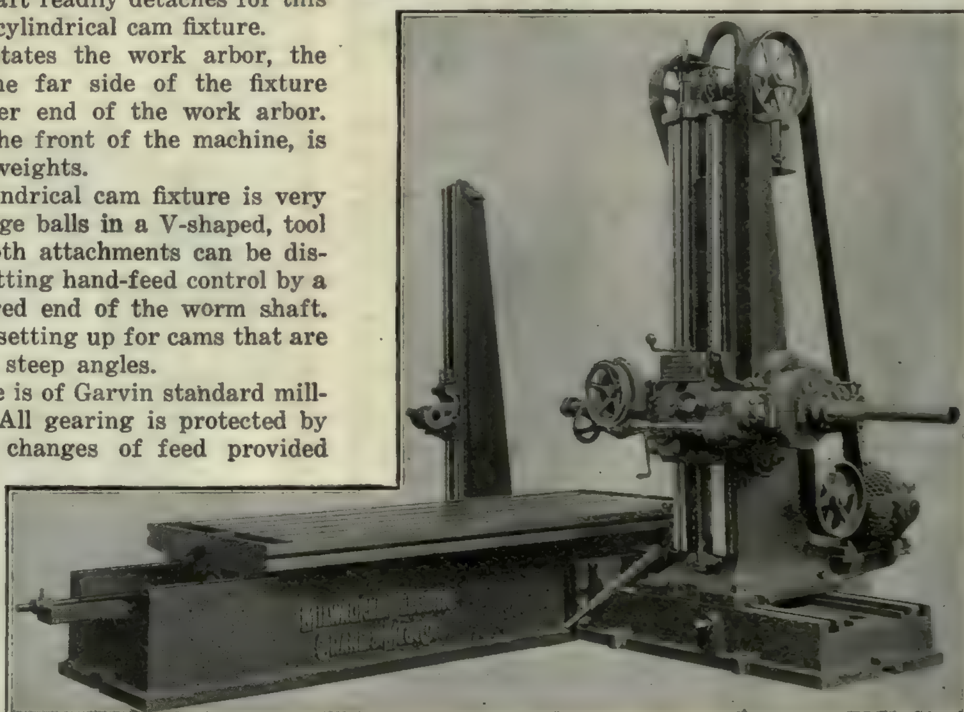
Capacity any type of cam, 1 in. to 12 in.; taper hole in spindle, No. 10 B. & S.; size of cutters used, $\frac{3}{16}$ to 2 in.; number of feed changes by four-step friction cone pulley, 8; cylinder cam throw, $9\frac{1}{2}$ in.; flat cam throw, 6 in.; number of feed changes on flat fixture only, 3; number of feed changes on cylindrical fixture, 2; swing of cylindrical fixture, $12\frac{3}{4}$ in.; speed of friction pulleys on countershaft, 120/160; space, 44 x 54 in.; domestic shipping weight (both fixtures), 2,700 lb.

"Milwaukee" Horizontal Drilling Machines

The Milwaukee Electric Crane and Manufacturing Company, Milwaukee, Wis., has just introduced a line of horizontal drilling machines designed to cover a wide range of drilling and boring and especially suited for operating—at one setting—on pieces too long or bulky for the usual type of machine. Double setting of work is not only a waste of time but a frequent cause of error when boring holes for shafts or bearings which are required to be exactly parallel, as in the case of gear housings for spur or helical gears, the teeth of which must bear evenly along the entire length of face. Originally, a homemade tool supplied with a rolling or rail table had a range of usefulness that has been sufficiently recognized to justify a modern design and a refinement of details to secure greater durability and accuracy in operation, as well as the more rapid change in speed and manipulation made possible by the use of direct-connected, variable-speed, reversible motors. The ideal drive would be obtained, if it were possible, by belting the motor to the spindle with but a single gear reduction, but as this is not feasible, the scheme adopted comes as near to it as possible in the matter of simplicity and directness.

The line includes several sizes, the smallest being No. 25-A, and the next largest being the No. 25, which is shown in the illustration.

The spindle is of high-carbon steel and accurately finished; the front bearing is $2\frac{1}{2}$ in. in diameter by $7\frac{1}{2}$ in. long; middle bearing, $2\frac{3}{8}$ diameter by 6 in. long, and the driving end is $2\frac{1}{4}$ in. in diameter with two beveled keyways. The front end is fitted with a ball thrust bearing and No. 5 Morse taper hole, arranged with



MILWAUKEE HORIZONTAL DRILLING MACHINE NO. 25

Specifications: Spindle front bearing, $2\frac{1}{2}$ x $7\frac{1}{2}$ in.; spindle rear bearing, $2\frac{3}{8}$ x 6 in.; spindle driving end, $2\frac{1}{4}$ in.; spindle Morse taper, 5 in.; spindle speeds—standard, 20-400; spindle feeds, six; spindle feed, 24 in.; spindle quill diameter, $4\frac{3}{8}$ in.; spindle elevation, minimum to table, 3 in.; spindle elevation, maximum to table, 60 in.; table, width by length, 4 x 9 ft.; column movement on base, 24 in.; run of table on bed, 9 ft. 6 in.; run of column on slide, portable, 6 ft.; length of column slide, portable, 10 ft. 3 in.; variable-speed motor, $3\frac{1}{2}$ hp.

special cross-key and nuts for drawing up and releasing boring bars or tools. The spindle torque is not transmitted through the tang of the drill socket or boring bar when the work is heavy.

The spindle quill is of semi-steel, $4\frac{3}{8}$ in. in diameter, with heavy rack teeth cut for 24 in. feed, arranged to cut out the drive automatically when the spindle reaches the extreme in or out run of the feed range. Danger of stripping the feed mechanism by over-running when the feed is worked near the extremes of the run is thus avoided.

The spindle is geared for standard speeds of 20 to 400 r.p.m., which may be increased or reduced when special service is to be met. With a four to one motor speed range and sixteen-point controller, thirty-two different speeds are obtainable with a single back-gear ratio of about five to one.

All gears are of steel, wide face and carefully cut, run in oil and are supported on both sides by large bronze bearings arranged for ample and continuous lubrication. Power is transmitted through four reductions of spur gears to secure minimum boring speed and maximum torque.

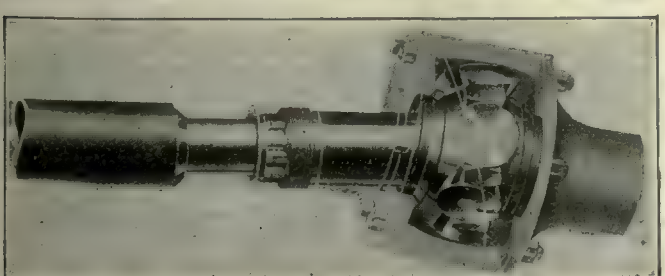
The standard spindle feeds provided for this drill are 9, 14, 20, 30, 50 and 70 thousandths per revolution. The feed is cut in or out by means of a trip lever and quick return or advance secured by means of the hand wheel on the quill-pinion shaft. Gears for change of feed are of steel and phosphor bronze, of wide face and heavy pitch and run in oil-tight case for constant lubrication. The quill drive worm wheel is of bronze, entirely covered, and the worm is of hard steel, running in oil.

Carriage elevating and lowering mechanism is operated by power or hand and the driving gear is provided with a limiting torque clutch to secure safety to the mechanism in case the carriage is clamped too hard to the column when the power drive is thrown into gear. The hand adjustment is used only to secure final setting of the carriage. A steel scale on the face of the column indicates the distance from the top of the table to the center of the spindle and a corresponding scale is carried by the outboard column.

The drill column is mounted on a side extension of the bed and is movable to or from the table to suit the size of the work and reduce the overhang of the spindle. This is an important advantage in many cases where end-milling and facing is necessary and secures more accurate spotting of the drill than is possible with a long overhang.

Ream Universal Joint

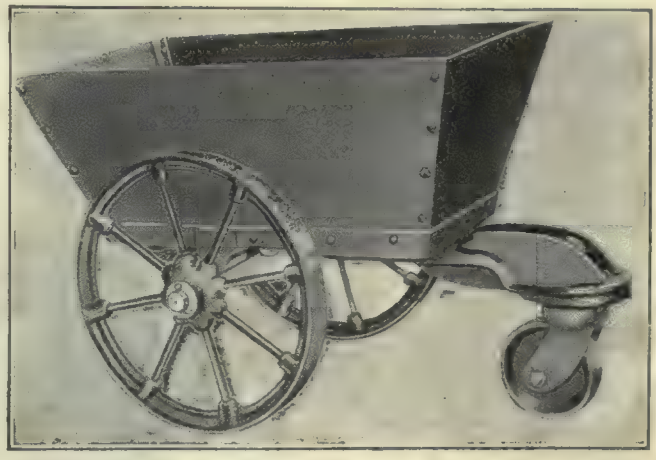
The universal joint illustrated is a product of the R.-S. Manufacturing Co., Kansas City, Mo. The design employs a flexible member having six lugs arranged to engage a like number of rollers that are mounted upon the inner portion of the case. The arrangement is intended to combine the universal action of a ball-and-socket joint with the anti-friction qualities of a roller bearing. The device is well made from drop-forgings and bar stock. The rollers and the curved surfaces of the lugs are hardened and ground. The device is balanced, and said to be free from backlash and to withstand end thrust without injury to the assembly. The mechanism is dustproof and waterproof and is packed in grease before shipment. While designed primarily for use in connection with automobiles it can be furnished for use in other commercial fields where flexible couplings are required.



REAM UNIVERSAL JOINT

Haskell Shop Truck

The shop truck illustrated is a product of the Wm. H. Haskell Manufacturing Co., Pawtucket, R. I. It was designed for general utility purposes and is suitable for carrying bolts, nuts, small castings, etc., in process of manufacture. It is of all-steel construction equipped with flat-tired wheels and is built to support heavy weights. The front wheel is supported on ball bearings and is placed in such a position that the truck steers very easily. The body of the truck is made from $\frac{1}{8}$-in. stock, reinforced at the inside corners



HASKELL SHOP TRUCK

Dimensions: Height, 26 in.; length, 44 in.; width, 26 in.; body, 21 x 31 in., by 13 in. deep; side wheels, 20 in. in diameter with $2\frac{1}{4}$-in. face; front wheel, 7 in. in diameter with $2\frac{1}{4}$-in. face; cubical contents of body, $3\frac{3}{8}$ cu.ft.; net weight, 300 lb.

with heavy angle irons. The axle is made from a steel bar $1\frac{7}{8}$ x $1\frac{1}{2}$ in., the wheel bearings being turned to $1\frac{7}{16}$-in. diameter. The truck is made in one size only.

Adapting a Quick-Change Drill Chuck to a Wide Range

By Geo. C. Hanneman

In drilling a small part with two sizes of drills, $\frac{3}{16}$ in. and No. 50, it was found impossible to obtain a quick-release automatic drill chuck to take both sizes. As it was not advisable to install a two-spindle drilling machine or do the job in two set-ups, the No. 50 drills were soldered into $\frac{3}{16}$-in. shanks. This was considerable work to keep up, as a great many were used.

The final solution of the problem was to turn down the handle of a small pin-vise to $\frac{3}{16}$-in. and use this, with the No. 50 drill inserted, the same as a $\frac{3}{16}$-in. drill. This gave a quick change and cut out the upkeep expense.

Sparks from the World's

By E. C. Porter,

Permanent Exhibition of Construction Machinery Established in New York

The Allied Machinery Center, comprising a permanent exhibit of the products of fifteen non-competing manufacturers, was formally opened by the Allied Machinery Co. of America in New York last week. The new center occupies 30,000 sq.ft. of exhibition and office space at Center and Walker Sts. and was established as part of an educational and sales promotion plan in the field of heavy construction.

A fundamental aim of the enterprise is the education of the plant user in sound construction economics—in using the right machine and particularly, where the size of the job warrants, the right combination of equipment for doing the work with the maximum of economy and speed. As a supplement to the actual machines on exhibit at the center, there will be representatives qualified to analyze the construction problems of prospective purchasers and suggest the methods and plant equipment best adapted to the work contemplated. In addition a series of motion pictures has been prepared showing approved practice in the use of machinery in all of the representative types of construction work.

The machinery center consists of two parts. The main display of equipment is staged on the ground floor, while each of the companies forming the pool of exhibitors has an executive office on the second floor. The range of products covers concrete mixing and distributing equipment, mechanical loaders, steam shovel, trench excavator, road-roller, steam boiler, hoisting engine, saw mill, shovels, wheelbarrows, lighting devices for night work, steel forms, industrial track, locomotives, electric transfer trucks, gasoline motors, earth moving equipment including scrapers and cars.

The following firms are represented at the Machinery Center: Austin Manufacturing Co.; Austin-Western Road Machinery Co.; Barber-Greene Co.; Carbic Manufacturing Co.; C. H. & E. Manufacturing Co., Inc.; Clyde Iron Works; Cook Motor Co.; A. B. Farquhar Co., Ltd.; Hydraulic Pressed Steel Co.; Lakewood Engineering Co.; Parsons Co.; Sterling Wheelbarrow Co.; Thew Automatic Shovel Co.; Western Wheeler Scraper Co.; Wyoming Shovel Works.

At a luncheon given Jan. 27 to celebrate the opening of the Allied Machinery Center the speakers included Joshua W. Alexander, Secretary of Commerce, Senator Edge, W. L. Saunders, George Edward Smith and former Secretary of Commerce W. C. Redfield.

New Vice President for Westinghouse Electric International Company

Edward D. Kilburn, who, since March 15, 1917, has been New York district manager of the Westinghouse Electric and Manufacturing Co., was recently

EDWARD D. KILBURN

elected vice president and general manager of the Westinghouse Electric International Co.

Mr. Kilburn graduated from Cornell University, and immediately after leaving college he entered the employ of the Westinghouse Electric and Manufacturing Co., for a number of years being located at the Syracuse office of the company. Subsequently, he was transferred to the Westinghouse Machine Co. with headquarters at New Haven, Conn. In 1915 he returned to the company as manager of the power division of the New York office. A year later he was made manager of the railway and lighting divisions.

New Name for Construction Firm

The Moore-Sieg Construction Corporation, Waterloo, Iowa, has changed its name to the Sieg Construction Corporation. W. R. Sieg, formerly secretary and treasurer, is now president.

Representatives of Thirty Nations to Attend Convention of Foreign Trade Council

James A. Farrell, chairman of the National Foreign Trade Council, an organization composed of 75 of the leading American merchants and manufacturers engaged in foreign trade, announces that thirty foreign nations representing Central and South America, Canada, Australasia and the Far East, will have trade advisors at the Seventh National Foreign Trade Convention to be held at San Francisco, May 12-15, 1920, for the purpose of supplying first-hand information in regard to the markets of their respective countries.

The countries from which trade advisors are expected are as follows:

Canada.

Central America—Mexico, Panama, Salvador, Honduras, Costa Rica, Guatemala, Nicaragua.

South America—Colombia, Venezuela, Ecuador, Peru, Bolivia, Brazil, Paraguay, Uruguay, Argentina, Chile.

Australasia—Australia, New Zealand, Tasmania, Straits Settlement.

Far East—Dutch East Indies, Indo-China, India, Philippines, Siberia, Siam.

War Department Settles 23,214 Contracts

Contracts liquidated by the War Department to date consist of 18,354 formal agreements valued at $1,198,847,000 and 4,860 informal valued at $972,465,000. It has cost $259,783,000 to liquidate these contracts. There are 4,349 contracts still to be liquidated. Of these the value of 4,215 is known and amounts to $1,792,218,000.

Sales reported to the Director of Sales for the week ended Jan. 16, amounted to $3,414,448 or 27 per cent of those the preceding week. The average sales amount for the five preceding weeks was $8,223,550.

Kearney & Trecker to Open a Store in Cleveland

Plans for extending its activities in Cleveland are being completed by the Kearney & Trecker Co. About Feb. 1 this firm expects to open a store, for the display and sales of machinery, at 738 Superior Ave., N. W. The Cleveland district will be under direction of C. J. Sturgeon, formerly with the W. M. Pattison Supply Co. The stock will include a line of Milwaukee milling machines, and cutters and arbors to go with them.

Industrial Forge

News Editor

Remedying the Exchange Crisis in Franco-American Trade Relations

A leading firm of American exporters has made the following agreement with its representatives in France, with a view to avoiding as far as possible the exchange crisis at present prevalent.

Goods are shipped and invoiced in dollars. The French firm does not send dollars or francs in payment, but deposits with a local bank, for the account of the American exporter, an amount in francs corresponding to the amount of the dollar invoice at the current rate of exchange. This amount is corrected every month to correspond with the fluctuations in the rate of exchange, that is, if dollars rise, an additional deposit is made to cover the difference in exchange.

New invoices are all dealt with in the same manner. An agreement has been made between the exporters and the importers for the transmission of the money deposited when the exchange rate shall have reached a level satisfactory to the importer. This agreement is for a period of two years, and, if at the end of that period, exchange has not fallen sufficiently to allow of the transmission of the money without loss to the importers, a further agreement will be negotiated between the two parties.

The money is deposited with a bank having correspondents in the United States, and the American exporter is enabled, if required, to borrow money in the United States against the deposits standing to his credit in France. The French deposit bearing interest, the American exporter incurs little or no expense in connection with his American loans, as the interest paid in France offsets that he may have to pay in the United States.

John F. Dodge Dies of Influenza in New York

John F. Dodge, one of the Dodge brothers, automobile manufacturers of Detroit, Mich., age 54, died of pneumonia and influenza at the Ritz-Carlton Hotel, New York, on Jan. 14, 1920. He was attending the Automobile Show in New York with his brother, Horace E. Dodge, when taken ill.

Mr. Dodge was born in Niles, Mich., and was the son of a machinist and ironworker. After his public school education he served as an apprentice in his father's machine shop. In 1886, he moved to Detroit to follow his trade. He was shortly afterward joined by his brother, Horace E. Dodge, and for years the brothers worked together as wage-earning machinists.

Their first business venture was in 1901, when they opened a shop of their own, employing twelve persons. They built parts for automobile concerns just starting in business.

In 1912 the brothers announced their intention of entering the automobile business on their own account. The

JOHN F. DODGE

enterprise was successful from the beginning, and under the impetus of the war it grew until to-day the Dodge interests employ approximately 18,000 persons.

One of the Dodge brothers' efforts after the United States entered the war was a $10,000,000 ordnance plant, which, despite the skepticism of military experts, produced the delicate recoil mechanism of the French 155 millimeter guns. Machinery for this plant was built in Dodge factories and within a year after its construction was started it was shipping twenty of the mechanisms daily to the proving grounds.

Opens an Office in Philadelphia

The Latrobe Electric Steel Co. announces the opening of an office in the Finance Building, Philadelphia, Pa., under the direction of Edwin M. Ong.

Trade Currents From New York, Cleveland and Chicago

New York Letter

There has been little change in the machine-tool situation here during the past week.

Prices are stable after the increases posted at last writing, but consistent rumors that more increases are on the way are going the rounds.

Orders still continue small with volume steady, and a tendency upward is noted in the weekly sales. It is expected that small orders of the one-two-three variety will prevail until March first at least.

Local agents for wood-working machinery have been advised by their principals in some cases not to commit themselves as to deliveries. Factory conditions that tend to slow up production are held responsible. One concern that distributes through one of the larger local companies has written that on one type of machine alone they are more than one hundred orders behind, with no relief in sight.

Things are running smoothly in the used-machine-tool field, with milling and planing machines leading the demand.

Evident in the used-tool houses are large quantities of line-drive equipment. This reflects the tendency of machinery users to adopt direct motor drive wherever possible.

There is a brisk demand for motors ranging from 2 hp. to 7½ hp. with few offerings.

The Savage Arms Co. has placed a list of machine tools in the second-hand market through C. A. Calleson as New York agent. Some of these machines have never been out of the original cases—a situation met with in most of the Government sales.

With sales steady, and no disturbing elements, the machine-tool men locally are well satisfied with the situation at present.

Cleveland Letter

More hesitancy on the part of general manufacturing firms in placing orders for equipment is noted during the last week by Cleveland machinery producers and distributors. It is assumed that there is uncertainty as to possible outlet for production, and for this reason manufacturers are reluctant to stock up with equipment without assurance that there will be sufficient demand for their own output. There is a suspicion in industry generally that another six months may see a significant change in business conditions.

The automotive industry hereabouts asserts that $24,000,000 worth of new business was contracted for, following the recent automobile show.

As yet, no definite plans for increased production have materialized, but when machine-tool lists are issued by the automobile manufacturers, it is expected that they will run to large proportions.

Should the heavy demand continue, there will be a shortage in machinery and tools before another three months passes, according to leaders in equipment field. Already deliveries have slowed down, due to coal, car and material shortage and also to bad weather conditions. In some instances equipment ordered has been delayed in delivery 12 to 14 weeks.

Unless there is marked improvement in weather conditions, resulting in release of coal cars in this vicinity, it will tend to prolong the machinery production shortage. The latest coal shortage has curtailed production in many industries in this section. Some manufacturers are running from day to day on their fuel supply, but the break in the weather during the past week has aided in releasing fuel, so that no plant yet has had to shut down.

The Marsh Motor Car Company will be ready soon to start manufacturing cars. On the 100-acre tract acquired by this company on Ridge Road at the Belt Line, 25 acres will be given over to workers' houses. At the beginning 900 persons will be employed.

Chicago Letter

Automobiles hold the center of the stage this week, with the pleasure-car show going on at the Auditorium and the truck show at the Stock Yards Amphitheatre. This national gathering of auto builders usually brings a flood of machinery inquiries. At the present time dealers are noticing but little increased business from this source, due, probably, to the fact that auto manufacturers, truck manufacturers and tractor builders everywhere have been heavy buyers for some months. Millions of dollars worth of machine tools are on back order for delivery to this class of consumer.

Railroad business is still non-existent. Various opinions are still being aired as to when the inevitable buying will begin. It is understood that at least one of the great trans-continental lines will not be ready to take up the matter of shop equipment until its program of maintenance of way and rolling stock is well under way, which means late in the fall of 1920. It is noted that builders of railroad cars and track appliances are making some inquiries, but few bona fide purchases have been made in this line.

Chicago dealers are finding all they can do in handling current business, with no time left to worry about when non-buying interests are going to enter the field. Heavy tools remain in great demand with special emphasis being placed on large planing mills, boring mills and lathes. These are being taken by forging works to an especially heavy degree. Builders of automatic combustion plants and refrigeration machinery are all busy, and are persistent buyers of machine tools of all types.

The large number of garages with repair shops in connection which have been erected in Chicago in the last few months have been a factor in increasing call for drill presses and small lathes. Many machine shops and factory additions which were initiated last spring, are also nearing completion, and orders covering equipment for them are much in evidence. Local dealers have been physically handicapped the last few days by the epidemic of influenza. Fatalities are very low, but illness has been sufficiently prevalent to render everyone more or less short-handed. Coupled with very bad weather, this has rendered delivery of orders a mean problem.

The Monighan Machine Co., builders of drag-line excavators, are having plans drawn for the erection of an addition to its plant to cover over 50,000 sq.ft. at a cost of about $300,000. Commonwealth Edison Company announces the early building of a large power plant on the far South Side. Aside from several fairly good sized auto service stations, no other enterprises involving ultimate machinery purchases have been announced this week.

Opportunity to Supply Machine Tools to a Far Eastern Nation

The New York district office of the United States Bureau of Foreign and Domestic Commerce lists an opportunity of supplying a large amount of machine tools to a Far Eastern nation that is about to engage in aircraft construction in a large way. There are approximately twenty-six machines required in the initial order, including lathes, planing machines, boring mills, drilling and grinding machines and forge shop equipment. To interested parties who are listed on the Exporters Index, information in detail will be given, together with the name of the local representative of the principal, at room 734, New York Customs House. Refer to (FE-70).

There is also an opportunity to place equipment in Macedonia, mostly at Salonica and Kavalla. The Greek Consulate in New York can supply information relative to this.

Warner & Swasey Holds Sales Meeting

The Warner & Swasey Co. held its annual sales meeting recently at the Cleveland headquarters. About fifteen members attended, coming from points as far distant as Boston and Minneapolis. Out-of-town representatives made reports on their respective territories, and a general interchange of ideas, to acquaint them with conditions in other parts of the country, was given. The meeting was held under leadership of L. K. Berry, domestic sales director.

Porto Rican Exposition Announced

According to present plans, a fair and exposition will be held at San Juan, Porto Rico, some time in June, the main purpose of which will be to call to the attention of the inhabitants of the island such American industrial and agricultural machinery and products as will be of value in developing native agriculture and industries. The exposition is to be held under the auspices of the Porto Rico Development Company, which is incorporated under the laws of Porto Rico for the purpose of holding annual expositions for displaying American machinery and products not now produced in the island. The project has been indorsed by the Insular Government, and a commission of leading business men has arrived in Washington to seek the co-operation of the Government departments and of American manufacturers. Inquiries should be addressed to Hon. F. Cordova Davila, Resident Commissioner for Porto Rico, House Office Building, Washington, D. C.

Restoring Expired American Patents in Finland

Because of interrupted international postal service during the war, several foreign patentees in Finland were prevented from paying their patent fees, and consequently their patents expired. During 1919 some such patentees applied to the Finnish State Council for restoration of expired patents, and as a rule these applications were granted. In the opinion of the Minister of Commerce and Industry, such procedure is preferable to a general prolongation of the time for paying the patent fees. In reply to a letter from the office of the Minister of Commerce and Industry the minister says:

"I would suggest that all American citizens who own patents in Finland and whose patents have expired should apply in each individual case to the State Council to have their expired patents restored."

Conditions at the Krupp Plant in Germany

The following information has been given by a visitor to the Krupp plant at Essen, early in December:

The plant is making no war munitions now. The skilled workmen formerly occupied in the manufacture of arms and ammunitions are being trained to turn out high-grade industrial machinery, such as auto gears, motors, high-speed gears, milk separators, railroad locomotive cars, etc. One of the foremen told the visitor that the Krupp factory plans to attain an output of at least one locomotive and perhaps ten cars a day within six months from date.

The former gun shop has been converted into a machine shop; the fuse

(*Continued on page 322b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Milling Machine, Continuous Circular
Ingersoll Milling Machine Co., Rockford, Ill.
"American Machinist," Nov. 27-Dec. 4, 1919

Illustration shows machine of the single-station type, requiring but one operator who loads and unloads the fixtures as each one is brought to the proper station. While this is being done the work in other fixtures is passing beneath the cutters uninterruptedly. Machines of this type have been built with tables from 30 in. to 84 in. in diameter, according to the work they were designed for. No limit has been fixed either for the size of the table or the height of the spindle above the table. Diameter of table, 30 to 84 in.; spindles, two; adjustment of spindles, 6 in.; revolutions of table, one in 4¾ min.; fixtures, three; power required (motor belt), 10 hp.; weight, 9000 lb.; floor space, 24 sq.ft.

Milling Machine, Continuous Circular
Ingersoll Milling Machine Co., Rockford, Ill.
"American Machinist," Nov. 27-Dec. 4, 1919

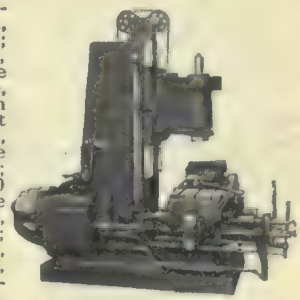
A machine built for larger work is shown here. In this machine the table revolves about a center column which also supports the head carrying the spindles. Two cutters are used for roughing, as a single cutter large enough to cover the work would impose too great a strain on its spindle. This machine can be built either with a single station or with multiple stations as the character of the work and the requirements of the user may indicate. Diameter of table, 60 in.; spindles, three; distance between table spindles, maximum 24 in., minimum 18 in.; spindle adjustments, 6 in.; revolutions of table, one in 12 min.; fixtures, five; power required, 15 hp.; weight, 24,000 lb.; floor space, 45 sq.ft.

Milling Machine, Continuous Circular
Ingersoll Milling Machine Co., Rockford, Ill.
"American Machinist," Nov. 27-Dec. 4, 1919

This machine is a three-station machine and is provided with six spindles, three for the roughing and three for the finishing cutters. As illustrated the table is equipped with nine fixtures and the service of three operators is required to load and unload them. The table makes one revolution in 13½ min., giving the machine a productive capacity of 120 pieces per hour. Diameter of table, 70 in.; spindles, six; distance between table and spindles, maximum 18 in., minimum 12 in.; spindle adjustment, 6 in.; revolutions of table, one in 13½ min.; fixtures, nine; power required, 15 hp.; weight, 24,000 lb.; floor space, 45 sq.ft.

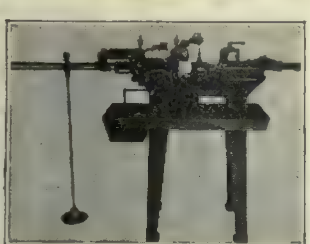
Milling Machine, Vertical No. 44
W. K. Stamets, Pittsburgh, Penn.
"American Machinist," Nov. 27-Dec. 4, 1919

Spindle to column, 15 in.; surface of table, 14½ x 48 in.; length, 56 in.; longitudinal feed, 44 in.; crossfeed, 16½ in.; vertical feed, 19 in.; maximum distance, spindle to table, 24 in.; minimum distance, 0 in.; minimum head bearing on columns, 19 x 25½ in.; adjustment of spindle sleeve, 6 in.; taper hole, No. 12 B. & S.; diameter of spindle at taper, 4 in.; spindle speeds, 12; range of spindle speeds, 12 to 200 r.p.m.; changes of feed, 12; range of feeds, ⅝ to 17 in.; cone pulleys, 12, 13¾ and 15½ in.; belt, 3½ in.; T. and L. pulleys on countershaft, 16 x 3¾ in.; speed of countershaft, 420 r.p.m.; power, quick adjustment of table, saddle or head, 11 ft. per minute; height of machine, 7 ft. 7 in.; length of table, 8 ft. 4 in.; distance front to rear, 8 ft. 6 in.; net weight, 7800 lb.



Screw Machine, No. 0
Foster Machine Co., Elkhart, Ind.
"American Machinist," Nov. 27-Dec. 4, 1919

The No. 0 and No. 1 machines, which are of $\frac{7}{16}$- and $\frac{13}{16}$-in. bar capacity respectively, are designed for high spindle speed and sensitiveness of operation, so essential in machines of small bar capacity. They are built in the three-step-cone pulley, plain-head type only. The turret slide, which is operated by a hand lever, has an effective longitudinal movement of 3 in. for the No. 0 machine and 5 in. for the No. 1 machine. The No. 0 machine can be equipped with a compound rest, which is interchangeable with the lever-feed cutoff ordinarily furnished. Round turrets are used.



Screw Machine, No. 7
Foster Machine Co., Elkhart, Ind.
"American Machinist," Nov. 27-Dec. 4, 1919

Automatic chuck is of spring collet type; hood and spindle nose designed to present short overhang. Collet-operating mechanism differs from design heretofore used. Automatic chuck fingers equipped with rollers. For the bar-feed operating mechanism on the No. 0, No. 1 and No. 3 machines, the single supporting rod is used, but for the No. 5 and No. 7 machines the stock-support slides on two parallel bars. The continued motion of the automatic chuck lever, as it opens the collet, feeds the bar forward. This is accomplished through a system of links and levers in such a manner that the automatic chuck and the bar feed are operated intermittently. The No. 3, No. 5 and No. 7 machines have hexagon turrets.

Grinding Machine, Surface
S. Holmes & Co., Bradford, England
"American Machinist," English edition, Nov. 22, 1919

Designed for grinding molding box races. The cup wheel is 14 in. in diameter by 4 in. deep, running at 1,400 r.p.m., drive to spindle by 3½ in. belt. End thrust is taken on balls; weight of the grinding spindle, etc., supported by eight helical springs, the ball race and spring box being covered; on the grinding wheel, a sheet-iron guard is carried. Driving pulley runs loose in a sleeve and drives by two screwed studs to a collar on top and then by two keys to the spindle, with clearance between pulley and collar. Main bearing is 2¼ in. in diameter by 9 in. long, formed by a loose split bush. Table measures 24 in. x 27 in.; T-slots cut from the solid; is elevated or lowered 13 in. by telescopic screw; has movement of 14 in. to or from the standard by 25 in. crosswise. Guaranteed accurate at the four corners to within 0.001 in. Total weight of machine is 30 cwt.

Gear-Generating Machine
J. Parkinson & Son, Shipley, England
"American Machinist," English edition, Nov. 22, 1919

To cut lighter gears up to 12 in. in diameter by 4 in. face and 5 diametral or ⅝ in. circular pitch. Two cutter boxes may be mounted so that two groups of gears may be cut simultaneously, machine being equally adapted for the production of single gears or for mass production. Headstock carrying the blanks is fixed to the bed, the spindle being horizontal. Work mandrel located in a fixed position; cutter slide head arranged to move to accommodate the blank diameters, movement by handwheel in front of the machine. Handwheel is also used for setting cutter to depth. Machine will cut diameters from ½ in. to 12 in., pitches of 5 d.p., ⅝ in. circular pitch or 5 module, spiral gears up to 60 deg., and a maximum width of 4 in. Maximum distance, end of spindle to outer support, 16½ in.; hole through spindle, 1½ in. in diameter; taper, No. 12 B. & S.; mandrel, 1¼ in. in diameter. Driving pulleys are 12 in. in diameter for a 3 in. belt and run at 330 r.p.m., the maximum power taken being 4 hp. Floor space, 54 in. x 72 in.; net weight, 4,300 lb.

Clip, paste on 3 x 5-in. cards and file as desired

shop to the making of all kinds of bolts and screws; and the gun-carriage shop to the making of Diesel motors.

The most important work the visitor saw, in point of magnitude, seemed to be the repair of locomotives; he also saw them making steel car tires. Boiler plate was also being made with the machines formerly used in making armor plate.

One of the Krupp superintendents stated that they were seeking to sell a great deal of extra machinery, lathes, etc., which had been installed during the emergency of war. It was also stated that during the war the area of land occupied by the plant was increased 70 per cent.

Previous to the war (in 1914) 41,263 men were employed in the works at Essen, and 39,028 were employed at places outside of the main factory, making a total of 80,291 employees. During the war a total of about 171,000 laborers and mechanics were employed. At the present time the total number is reduced to 84,876, of which 44,758 are employed in the factories.

The workmen at the plant are reported as being fairly well satisfied with wages and living conditions and they now work eight hours a day instead of twelve, as during the war.

Year's Imports and Exports Estimated

Exports of the United States for the year 1919 exceeded the volume of imports for the year by more than $4,000,000,000, according to reports recently issued by the Department of Commerce. The excess of exports over imports by $4,017,000,000 for the year establishes a new record in the history of foreign trade.

The total of exports for the past year the Department estimated at $7,922,000,000, as compared with exports of $6,149,000,000 for the year of 1918, an increase of over $1,500,000,000. Imports for the past year totaled $3,904,000,000, it was estimated, as against imports of $3,031,000,000 for the year 1918.

American Chamber of Commerce Formed in Bolivia

American business men of La Paz, Bolivia, met in the American consulate on Dec. 12 and organized a body to be known as the "American Chamber of Commerce of Bolivia." All American firms established in Bolivia will be eligible for membership. The American Minister of Bolivia, Hon. Samuel A. Maginnis, was elected honorary president, and Consul Ross Hazeltine was made honorary vice president. The following active officers were elected: President, George A. Easley; vice president, L. M. Salisbury; secretary-treasurer, Victor L. Tyree.

Fourteen American companies established in Bolivia form the membership to date.

Are You a Neat Mechanic?

By the News Editor

Few mechanics realize what a tremendous influence appearances have to help or hinder them in their progress. They do not seem to appreciate the value of always being well groomed, of being smartly and becomingly dressed in looking around for a position.

One's personal appearance, his dress, his manner, how he carries himself, what he says and how he acts, mean as

much to him as the display and advertising of goods in a merchant's window.

A mechanic's appearance is taken as an indication of his ability to turn out a neat and satisfactory job. He is advertising himself as a success or a failure. It is admitted that clothes do not make the mechanic, but the habits of the man are quite often judged by the neatness of his clothing.

The mechanic who is neat about his person usually has his tools easily located, and systematically arranged.

He takes pride in keeping his machine neat and clean, and his tools in good shape and ready for immediate use. He seldom borrows tools, and usually dislikes to loan them. His clothing may be cheap and may be badly worn, but when it is clean and mended and has a tidy appearance, no one thinks less of him for not dressing better.

The efficient foreman of any shop will insist on having the floors clean, free from oil, waste and rubbish. He will have all castings systematically piled so they may be easily identified. He has very little use for the sloppy mechanic.

Cleveland Schools Buy Government Machine Tools

Cleveland school authorities have availed themselves of the Government's offer of machine tools to educational institutions at 15 per cent of the original cost to the Government.

Machinery costing approximately $8,500 was purchased as an opening order, and it is reported that other orders will be placed shortly.

The pupils of the East Tech. and West Tech. High Schools will benefit first. Milling machines, an engine lathe, pneumatic hammer, portable electric grinding machine, and an Acme screw machine comprise the initial purchase.

Warner & Swasey Investigate Export Field

C. J. Stilwell, foreign sales manager of Warner & Swasey, has left for Europe where he will spend three months studying trade conditions.

Most of his time will be spent in England and France with attention to Continental Europe as circumstances permit.

Short Trade Notes

The Toledo Machine Tool Co., Toledo, Ohio, has closed a building contract with the Sheldon Engineering Co., for the construction of a $60,000 power plant.

* * *

The Cadillac Motor Car Co., Detroit, Mich., is building a $300,000 assembly plant at Milwaukee, Wis.

Business Items

The Modern Tool Co., Erie, Pa., has opened a new branch office in The Bourse, Philadelphia, Pa., in charge of B. Roen, formerly of the Chicago office. Mr. Roen is succeeded in the Chicago office by Carl Johnson.

The Bagley & Sewall Co. has purchased the plant equipment of the C. A. Harmon & Son Machine Co., 275 State St., Watertown, N. Y., and will transfer the machinery and plant equipment to its main plant at Pearl and East Moulton Sts., Watertown, N. Y.

The Duff Manufacturing Co., Pittsburgh, Pa., has announced the opening of a branch sales office in the Book Building, Detroit, Mich., in charge of Frank J. Hunt. This new office will handle the output of the forge department of the Duff Manufacturing Co.

The Black & Decker Manufacturing Co., Baltimore, Md., exhibited at the Chicago Automobile Show its electric air compressors, portable electric drills and electric valve grinding machines. The company had its headquarters at the Congress Hotel and was represented by fifteen members of the firm.

(*Continued on Page 322d*)

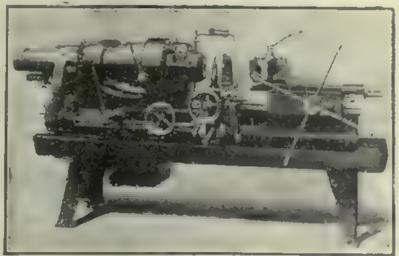
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Turret Lathe, No. 6

The Warner & Swasey Co., Cleveland, Ohio

"American Machinist," Nov. 27-Dec. 4, 1919

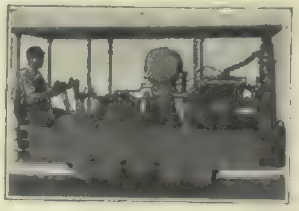


Specifications: Swing: over bed, $20\frac{3}{8}$ in.; over carriage guides, $18\frac{3}{4}$ in.; over cross-slide, $9\frac{1}{4}$ in. Capacity of automatic chuck: round, $2\frac{1}{4}$ in.; square, $1\frac{9}{16}$ in.; hexagon, $1\frac{13}{16}$ in. Spindle hole, $2\frac{21}{32}$ in.; thread on nose, $6\frac{3}{4}$ in. diameter; pitch, five per inch. Cone: three steps; width of belt, $3\frac{1}{2}$ in. Turret: tool holes, $1\frac{3}{4}$ in.; center of holes to top of slide, $3\frac{5}{8}$ in.; width across flats, $10\frac{1}{2}$ in.; power feeds, four. Heavy-duty carriage: cross-travel, 10 in.; longitudinal travel, 14 in.; power feeds, six. Standard carriage: cross-travel, 9 in.; longitudinal travel, 10 in. Countershaft (double-friction): pulleys, 14 in. in diameter; belt, 4 in.; speeds for brass, 320 r.p.m.; speeds for steel, 160 r.p.m. Horsepower required, three. Floor space, 32 x 104 in. Weight, 3,600 lb.

Locomotive, Industrial

Burton Engineering and Machinery Co., Cincinnati, Ohio.

"American Machinist," Nov. 27-Dec. 4, 1919



Designed to operate on either gasoline or kerosene and is built in sizes from $3\frac{1}{2}$ tons to 25 tons. Power is transmitted direct through a spur friction acting on the face of the flywheel. Spur friction wheel is 22 in. in diameter slidably mounted on a large shaft supported by Hyatt heavy-duty bearings. Friction wheel may be shifted across the face of the flywheel by a hand lever, obtaining the full range of speed forward or back. Steel roller chains running on cast-steel cut sprockets are used throughout. Motor is Herschell-Spillman four cylinders, cast enblock. Engine equipment includes Bosch high-tension magneto, Zenith automatic carbureter, Pierce mechanically driven governor, and radiator having a cast-iron shell, honeycombed core and spring hangers.

Cutter, Inserted-Tooth.

New Britain Tool and Manufacturing Co., New Britain, Conn.

"American Machinist," Nov. 27-Dec. 4, 1919

The body of the cutter is made of mild steel and the blades of high-speed steel. The pins that hold the blades in place are parallel and are a light drive fit in their respective holes, which latter are drilled at an angle of 6 deg. from parallelism with the center line of the cutter. Width of cutters can be restored after wear by loosening each alternate pin, driving the corresponding blade to one side, and again tightening the pin. The cutter is then ground to its original width, the offset blades furnishing the cutting edges on one side and the alternate blades on the other.

Counterbore, with Renewable Cutter

The New Britain Tool and Manufacturing Co., New Britain, Conn.

"American Machinist," Nov. 27-Dec. 4, 1919

The shank is made of carbon steel and drives the cutter by means of a keyway across its end, into which fits a substantial key made integral with the cutter. Cutter is held in position by the removable pilot which passes through it and is secured to the shank by a setscrew. A shallow tapered groove in the shank of

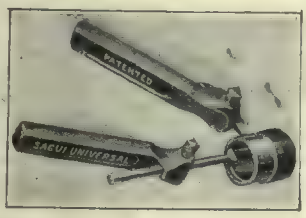
the pilot takes the point of the setscrew and, because of its taper, tends to draw the cutter back against the shank, holding the parts tightly together.

Cutter is made with long lips to provide for repeated grindings of the cutting edge. Various sizes of pilots are furnished with the tool.

Toolholder, Universal.

Universal Tool and Manufacturing Co., Inc., 680 South 11th St., Newark, N. J.

"American Machinist," Nov. 27-Dec. 4, 1919

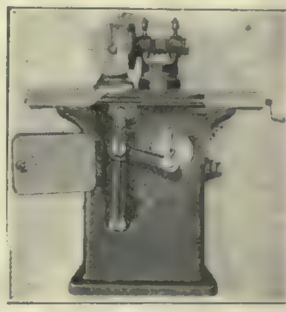


The toolholder is called universal, because it is convertible to right-hand turning, left-hand turning, or boring, and is suitable for tools made from either square or round stock. The illustration shows two views of the same tool with the setscrew in different positions, a threaded hole being at both sides for that purpose. The hole for the toolbit is broached square besides being reamed and will hold square or round stock equally well.

Grinding Machine, Face.

Cleveland Machine Tool Co., Cleveland, Ohio.

"American Machinist," Nov. 27-Dec. 4, 1919

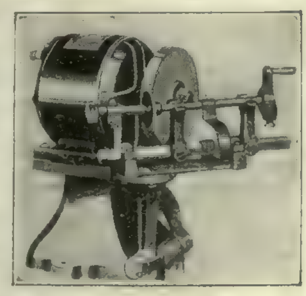


Specifications: Capacity diameter, 12 in.; thickness, 6 to 10 in.; table, 42 x $9\frac{3}{4}$ in.; stroke, 0 to 6 in.; feed changes, six; drive pulley, 3 x 2 in.; lateral adjustment of saddle, 2 in.; maximum wheel diameter, 8 in.; adjustment of work-head saddle, 6 in.; taper hole in spindle, No. 11 B. & S.; working space required, 57 x 40 in.; net weight of machine, 1500 lb.; domestic shipping weight, 1880 lb.; boxed for export, 1700 lb.; net weight of countershaft, 280 lb.; boxed for export, 380 lb.

Grinding Machine, Valve.

D. F. Dunham, 830 West 37th St., Los Angeles, Cal.

"American Machinist," Nov. 27-Dec. 4, 1919

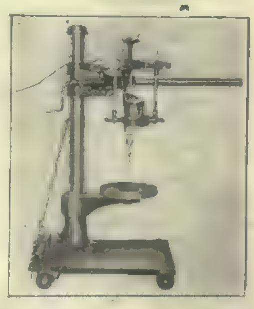


A bench grinding machine designed primarily for valve facing, but with an extra hub and wheel, permitting the grinding of small tools, etc.; has $\frac{1}{2}$ hp. Westinghouse motor of standard construction. It may be quickly made ready for use by connection to any lamp socket; drop cord and plug is included in the equipment. A single snap-switch is used to set motor in motion; machine is always set-up and ready for service; possible to grind valves whose centers have been mutilated or which have no center. Adjustment features adapt the machine for use with valves of various sizes and shapes. While grinding, the valve is moved back and forth across the face of the wheel and at the same time rotated by the hand crank.

Drilling Machine, Portable Radial Multi-Angle

The Multi-Angle Drill Corp., 1 West 34th St., New York.

"American Machinist," Nov. 27-Dec. 4, 1919



Machine is intended for use in connection with any standard electric, pneumatic or hydraulic drills though these are not furnished with the machine except on special order. Regular equipment includes an adapter for connecting the feed screw to the body of any particular make of drill. Case of the machine is mounted on wheels. Rear wheels provided with steering knuckles controlled by the hauling tongue. This enables the machine to be turned and steered in very narrow places. Specifications: Base, 40 x 48 in.; total height, 6 ft. 6 in.; maximum height of drill above floor, 4 ft.; length of arm from center of column, 5 ft. 6 in.; diameter of table, 18 in.; center of table to center of column, $15\frac{1}{2}$ in.; diameter of column, $4\frac{1}{2}$ in.; diameter of arm, 3 in.; will drill holes up to 1 in.; weight complete, about 900 lb.

Clip, paste on 3 x 5-in. cards and file as desired

The Bound Brook Oil-less Bearing Co., Bound Brook, N. J., has completed an additional building, 100 x 180 ft., to its plant. A power plant has also been added as well as an office building measuring 100 x 40 ft., two stories high. The new building adjoins the foundry which was completed in 1917.

The Chicago Flexible Shaft Co., Chicago, Ill., has announced the opening of a branch office at 350 Broadway, New York, for the sale and distribution of its furnaces, forges and heat-treating equipment. J. W. Lazear, formerly with the Brown Instrument Co., Chicago, Ill., will have entire charge of this office.

The Edgar A. Allen & Co., Ltd., steel manufacturer, Sheffield, England, main American office at 718-722 West Lake St., Chicago, Ill., has been incorporated as an American concern with the following officers: J. C. Ward, president; G. R. Bennett, vice-president and general manager; F. C. Leiferman, secretary and treasurer.

The Doehler Die Casting Co., Brooklyn, N. Y., held its annual meeting at its main office on Jan. 5, 1920, and the following officers were re-elected: H. H. Doehler, president; H. B. Griffin, vice president; O. A. Schroeder, treasurer; O. A. Lewis, assistant secretary. The company has also added to its list of officers the following: J. Kralund, second vice president, in charge of production, and Charles Pack, secretary and chief chemist.

The Sullivan Machinery Co, Chicago, Ill., announces the following appointments by the board of directors: Arthur E. Blackwood, formerly manager at New York office, to be vice president in charge of finance and accounting; Howard T. Walsh, vice president, in charge of sales; Gilbert K. Wilson, assistant secretary, in charge of cost accounting; Nathaniel H. Blatchford, Jr., assistant treasurer; Emil A. Krevis, general auditor; Frederick W. Copeland, manager of foreign sales.

Personals

M. M. Cory resigned his position as general manager of the Giddings & Lewis Manufacturing Co., Fond du Lac, Wis., on Jan. 1, 1920.

L. S. Eifel, formerly Chicago representative for the Republic Creosoting Co., Indianapolis, Ind., has resigned and has been succeeded by E. E. Bolte.

A. C. Dann, formerly with the International Plow Co., Hamilton, Ont., Can., has been appointed superintendent of the Oliver Plow Works, South Bend, Ind.

Alfred Spangenberg resigned his position as superintendent of the ordnance department, Mead Morrison Manufacturing Co., East Boston, Mass., and is now superintendent of the Reading Valve & Fittings Co., Reading, Pa.

F. Rodger Imhoff, New England representative of the Precision and Thread Grinder Manufacturing Co., Philadelphia, Pa., has recently been appointed field engineer. Mr. Imhoff will make his headquarters in Detroit, Mich.

J. T. MacMurray, former works manager of the Mead Morrison Manufacturing Co., East Boston, Mass., has resigned his position to become vice president and general manager of the Reading Valve and Fittings Co., Reading, Pa.

Louis R. Chadwick, for a number of years manager of the Seattle branch of the Sullivan Machinery Co., Chicago, Ill., has been appointed manager at New York City, succeeding Arthur E. Blackwood. Mr. Chadwick will have his headquarters at 30 Church St.

S. M. Wetmore has been appointed district sales manager of the Detroit territory for the Hammond Steel Co., Inc., Syracuse, N. Y., manufacturer of tool and alloy steels and die blocks. Mr. Wetmore will have his headquarters at 912-915 Kresge Building, Detroit, Mich.

H. C. Seaman, of the sales department of the E. W. Bliss Co., Brooklyn, has resigned, after having been with the company for 30 years. Mr. Seaman has entered the oil business under the name of the Seaman Oil and Refining Co., with headquarters at 379 Fifth Avenue.

Joseph E. Vincent, Jr., has been appointed Eastern sales representative of the Massillon Steel Castings Co., Massillon, Ohio. Mr. Vincent has his headquarters at 55 Liberty St., New York City, and also has a branch office at 120 Franklin St., Boston, Mass., which is in charge of C. H. Dayton.

Francis H. M. Riley, formerly associated with Vaughn & Meyer, consulting engineers, of Milwaukee, Wis., announces his appointment as Wisconsin representative for the Vulcan Soot Cleaner Co., Du Bois, Pa., the Vulcan Fuel Economy Co., Chicago, Ill., and the Green Engineering Co., East Chicago, Ind.

Charles Osterlein, vice-president and general manager of the Osterlein Machine Tool Co., Cincinnati, Ohio, has just returned from a six months' tour of Europe, during which time he made a close study of industrial conditions. He visited Denmark, Italy, Norway, England, France, Spain, Portugal, Sweden, Holland and Belgium.

Captain Johnson Morgan, formerly purchasing agent of the Midvale Steel and Ordnance Co., Eddystone Rifle Plant, Eddystone, Pa., has joined the sales engineering staff of the Winchester Repeating Arms Co., New Haven, Conn. Captain Morgan served for the past two years in the Ordnance Department, and during the last six months of the war was in charge of the small-arms branch, small-arms and machine-gun section, procurement division.

C. N. Kell has been appointed assistant to the general manager of the forge department of the Duff Manufacturing Co., Pittsburgh, Pa. Mr. Kell was formerly mechanical engineer with the Mandel Corporation, Chicago, Ill., and later assistant superintendent of the Denny Tractor Co., Cedar Rapids, Ia. He is a graduate from the mechanical engineering department of the University of Illinois.

Obituary

Dr. Richard C. McLaurin, president of the Massachusetts Institute of Technology, died at his home in Boston, Jan. 15, 1920, of pneumonia. He was elected president of the Institute in 1908. Dr. McLaurin was born in Lindean, Scotland, June 5, 1870, and his early boyhood was spent in New Zealand where he was educated in the Auckland schools. He then went to Cambridge, and took the degrees of B. A. and M. A., afterward receiving the degree of LL.D. from Cambridge and Harvard, and other universities.

Catalogs Wanted

The J. T. Tractor Co., 1515 Fairfield Ave., Cleveland, Ohio, has installed a catalog filing system and would be pleased to receive trade catalogs on machine tools, equipment and accessories.

Forthcoming Meetings

The American Institute of Mining and Metallurgical Engineers will hold its annual meeting in New York City, Feb. 16 to 19 inclusive.

The First Annual Convention of the A. S. M. I. and the Mechanical Inspection Equipment Exhibition will be held at the Hotel Astor, New York, Feb. 2 to 6 inclusive.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Second Annual Aëronautical Exposition of the Manufacturers Aircraft Association, Inc., will be held at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, on Mar. 6-13, 1920. S. S. Bradley, 401 Fifth Ave., New York City, is the general manager.

February 12, 1920 American Machinist Vol. 52, No. 7

I. Economic Side of the Problem

By Harry N. Knowlton
Manager, Packing Service Department, Safepack Mills, Boston, Mass.

This article is the first of a series dealing with the all-important factor of packing goods for shipment. There is nothing more annoying to a customer than to have a machine part, for example, for which he has been anxiously waiting in order to get his production in full swing, arrive in a useless condition because it was improperly packed. Usually, he proves the fallacy of such economy by ceasing to be a customer of that particular merchant or manufacturer. This subject is of vital importance just now when we have a golden opportunity to secure our share of world trade, and every exporter should study it.

PACKING as applied to shipping may be defined as the putting up of goods in the form of a package for transportation. The package may be a box, crate, carton, bale, bundle, barrel, drum, sack, bag, roll or some other form.

The purpose of packing is two-fold; to protect the goods during shipment, and to afford a means whereby they may be easily and economically handled during transportation and storage. The protection of the goods from damage is as a rule the most important factor, although, in the case of some commodities which are small or of irregular shape, the container or wrapping material, aside from the factor of protection, is indispensable as the only means of affording economical shipment and storage.

The vital considerations in packing goods for shipment are, in the order of their importance:

1. Adequate protection from damage during shipment.

2. Maximum saving of shipping space and gross weight.

3. Minimum cost in packing, handling and delivering at ultimate destination.

Adequate protection from damage is necessarily the most important consideration because if the goods are injured during transportation the principal purpose of packing is defeated, and the time, labor and money spent in packing are wasted. Lack of knowledge of what "adequate protection" constitutes in each case is one of the primary causes of inadequate packing as will be discussed later.

Maximum saving in shipping space and gross weight are of great importance because it is upon either the space occupied by the package or its gross weight that freight charges are based. As freight charges are an expense which must always be added to the price of a commodity to get the delivered price, any saving in freight will be reflected in the delivered price of the goods to the shipper's advantage. Reducing the displacement and weight of packages also saves storage charges, and import duty, in the case of export shipment to those countries where duty is levied on the gross weight of the package.

Minimum cost of packing, handling and delivering is of vital importance, since the total cost of delivery at the ultimate destination affects the delivered price to the customer. A very slight differential in packing and delivery costs is often the determining factor in whether or not one manufacturer's product can compete with another's product in a certain market. In reducing packing costs to a minimum, however, it is a matter of the greatest importance that the quality of the packing should not be lowered to the point where it is inadequate and does not afford sufficient protection to the shipment.

In the past, as a rule, packages have been constructed according to the ideas of the firm or individual who was packing the goods. The interpretation of the Railroad Classification Rule demanding that "all containers must be strongly made from material of sufficient strength to protect the article against the ordinary risks of transportation" has been left to the packer. He has been compelled to judge for himself (except in the case of a few commodities where the construction of the package

is specified) just how well his product should be packed to withstand the ordinary hazards of shipment. This condition is undoubtedly one of the principal causes of inadequate packing in domestic as well as export shipment.

It is only in the last few years that the problem of packing has been scientifically studied and that some of the fundamental underlying principles of package construction have been arrived at. In a few instances these principles have been applied to standard commercial packages with very gratifying results, such as in the case of wooden boxes for canned foods of which over 100,000,000 are used annually. The best example, however, of what may be accomplished by the application of scientific principles in packing is had in the experience of the United States Government during the World War. In packing army supplies for shipment to the troops overseas, savings in ship, car and storage space and savings in costs of packing amounting to many millions of dollars were effected by standardizing packing specifications. In the case of army clothing alone $50,000,000 was saved in cargo space by packing in bales in place of boxes. Numerous savings were also made in packing gun carriages, motor equipment, shells and many other kinds of material. (An article appearing on page 114, Vol. 51, of the *American Machinist*, explains in detail the methods of packing army supplies for shipment overseas.)

The importance of proper packing in both domestic and foreign trade is gradually coming to be realized. One of the best proofs of this is the fact that a number of the largest concerns in the country recently detailed their packing officials to the United States Forest Products Laboratory at Madison, Wisconsin, for a study of the fundamental principles of package design. Also one large electrical manufacturing company recently broke up $4,000 worth of incandescent lamps in testing lamp containers to determine the most efficient type of package.

Good Versus Bad Packing

Good packing not only prevents merchandise from damage during shipment and storage but it is also an advertisement. It shows a consideration for the buyer, an effort to have the goods reach him in as good condition as they left the factory.

Bad packing generally results in damaged goods with consequent loss of money and delay and inconvenience to the buyer in repairing or replacing the merchandise. It also creates a bad name for the guilty concern and places it at a decided disadvantage with competitive firms who understand how to pack properly.

In export trade especially is good packing of great importance. In the case of trade with one foreign country it has even been said that "competition is almost reduced to a basis of good packing rather than competitive merit or superiority of the articles themselves." Our foreign competitors have made a careful study of the special requirements of various countries and as a rule are very careful about their packing. We, on the other hand, have been wont to see how much we could cheapen our packing and still have it suffice. As a rule foreign buyers would rather pay for special packing than have their merchandise damaged during shipment because of cheap, poorly made containers.

One of the best examples of what may be expected to happen to goods which are improperly packed for export shipment is given in a report (Commerce Report No. 85, Bureau of Foreign and Domestic Commerce) from Consul General W. L. Lowrie, Lisbon, Portugal, dated Feb. 12, 1919. The very valuable lesson in this report justifies quoting it here completely:

So much has been written and said about insecure and inefficient packing that it has become an ancient complaint, but a Lloyds' report on a cargo which recently arrived at Lisbon, valued at nearly $5,000,000, may be of interest and value. It is as follows:

"Lisbon, Jan. 25, 1919.—As requested, I proceeded on board the vessel on Thursday and also today for the purpose of examining cargo which was alleged to be in a damaged condition, the vessel having arrived with general cargo for this port and lying moored alongside the quay at Entreposto de Santos. Arriving on board I noted lying about in No. 4 hold a large quantity of small pressed brass and nickel cups presumably for cartridge bases, and found that these had been packed loose in boxes which were broken principally because they were not strong enough or sufficiently secured. They appeared to have been stored a considerable time, for the wood had shrunk and had thus reduced the grip of the nails, a condition conducive to breakage under the usual strain of the loading, stowing and discharging of cargo. It would have been better also had the cases had an inner lining of some strong material to prevent the escape of the small articles when the wood was broken.

"Tin-plate boxes of the larger size were almost all broken insomuch that it was necessary to stack a quantity in bulk in the warehouse, and I noted that a number of the smaller sizes were also broken. I am of the opinion that this material is not packed in sufficiently strong boxes. Copper sheets were packed loose in skeleton cases which in some instances were badly damaged, and since the sheets were not banded together before being placed in the cases, they will escape as soon as one side of the box gives way and be more or less damaged.

"Thin sheet iron was in bundles, but the corners were knocked up and many sheets were bent. One case of long copper tubes was completely destroyed, and many tubes were injured and bent. Sundry other cases of skins, soap, tools, etc., were also damaged, sides being staved in. Here again the wood appeared to be dry and brittle. Cases were discharged from holds in this condition because the damage was not reasonably due to the unloading at this end.

"Tobacco in hogsheads was examined in the hold before

removal was attempted. The hogsheads were already broken in the majority of instances, staves being loose and ends being out.

"Generally speaking, there is nothing unusual in the methods employed in unloading the cargo. I was informed that the vessel had had a good average passage, and I am therefore forced to the conclusion that some damage to the cargo was caused before or during the loading, was augmented by the weight of the cases being stored one above the other in the vessel, and was in many instances unavoidably increased during the discharging here."

Certainly, the application of a few of the fundamental principles of package design would have been beneficial in this instance and the slight extra cost of good containers would have been only a fraction of the money loss in damaged goods.

At the present time American export packing is of vital importance. We are looking forward to greatly increasing our export trade. We have our eyes on foreign markets where trade competition with other countries will be keen. We cannot expect to expand our trade in these markets or to wrest markets from foreign competition if we deliver our goods in a damaged condition while our foreign competitors take special pains to deliver their product in perfect shape. Many a foreign market for American goods has in the past been lost because of poor packing and many a market will be lost in the future if we do not pay more attention to this important matter.

TABLE I. FREIGHT REVENUES AND CLAIMS PAID*

Fiscal Year Ending June 30	Freight Revenue	Claims Paid	Per Cent
1906	$1,640,386.655	$21,086,219	1.29
1907	1,823,651,998	25,796,083	1.41
1908	1,655,419,108	27,554,526	1.66
1909	1,677,614,678	24,916,380	1.49
1910	1,925,553,036	21,941,232	1.14
1911	1,856,504,287	24,209,081	1.30
1912	1,897,692,838	24,593,806	1.30
1913	2,140,083,394	30,516,929	1.43
1914	2,059,891,935	33,379,057	1.62
1915	1,977,933,275	29,528,016	1.49
1916	2,402,210,995	27,738,893	0.95
1916e	2,543,599,117	23,209,639	0.91

eEnding December 31.

*Interstate Commerce Commission Docket No. 10048.

The Loss-and-Damage Problem in the United States

The payments by the railroads of the United States for loss-and-damage claims have been a heavy drain upon their revenues for many years, averaging for an eleven-year period from 1906 to 1916, around $26,000,000 per annum. Table I shows a comparison of freight-claim payments and freight revenues during this period.

Table II is a summary by commodity and Table III a summary by cause of loss-and-damage of the total freight-claim payments made during the calendar year 1914 by all the steam railroads with annual revenues exceeding $1,000,000 each. These two tables are worthy of very careful study as they shed a good deal of light upon the loss-and-damage problem.

Although the causes of loss-and-damage claims given in Table III do not include separately the claims due to inadequate and improper packing, nevertheless the claims due to this cause are included in a number of the other causes as listed. The most important classified causes in Table III where inadequate and improper packing probably enter are as follows: Robbery, other (improperly made packages are easy to get into and encourage pilfering); unlocated loss of entire package, and unlocated loss, other (improper packing and improper marking are both factors which contribute heavily to the loss of packages); rough handling of cars (inadequately constructed packages are subject to damage in the shifting of the contents of a freight car during rough handling of the car); improper handling, loading, etc. (inadequately constructed packages are subject to damage during improper handling and loading).

TABLE II. LOSS-AND-DAMAGE CLAIMS CLASSIFIED BY COMMODITIES*

Commodities	Amount	Per Cent
Boots and shoes	$912,420.63	2.818
Clothing, dry goods and notions	2,194,096.03	6.777
Butter and cheese	323,561.87	0.999
Eggs	686,347.27	2.120
Fresh fruit and vegetables	2,687,393.36	8.300
Live stock	2,211,655.92	6.831
Meat and packing house products	1,031,633.61	3.186
Poultry, game and fish	248,446.98	0.767
Grains	2,718,077.58	8.395
Flour and other mill products	1,394,578.04	4.308
Sugar	405,559.88	1.253
Groceries	1,434,687.68	4.431
Wines, liquors and beers	740,832.78	2.288
Tobacco and tobacco products	613,538.23	1.895
Cotton	404,214.05	1.249
Furniture, new	1,626,330.70	5.023
Household goods	1,011,605.76	3.125
Products of cement, clay and stone	903,881.95	2.792
Glass and glassware	698,614.60	2.161
Stoves	516,895.74	1.597
Iron and steel castings and bars	676,499.42	2.089
Vehicles	492,377.48	1.521
Agricultural implements	256,235.55	0.791
All other commodities	8,186,132.44	25.284
Total	$32,375,617.55	100.000

*Interstate Commerce Commission Docket No. 10048.

The responsibility for damaged packages both in domestic and export shipment has always been a much argued question. The shipper is generally inclined to place the blame on the carrier and say that the damage was due to unnecessary rough handling. The carrier on the other hand is inclined to pass the blame back to the shipper and say that it was due to improper packing. There are undoubtedly many instances when each is right in his turn. However, it is a very difficult thing to draw a hard and fast line between unnecessary rough handling and the more or less rough treatment which a package is bound to receive at congested freight yards, terminals and ports where freight must be handled quickly and where individual attention cannot be given each package or shipment. Regardless of where the responsibility for the damage lies there can be no doubt that in many instances the loss-and-damage question would be entirely eliminated by better and more secure packing.

TABLE III. LOSS-AND-DAMAGE CLAIMS FOR 1914*

Causes	Amount	Per Cent
Robbery of entire package	$659,159.52	2.036
Robbery, other	1,284,250.67	3.966
Concealed loss	688,879.71	2.128
Unlocated loss of entire package	5,156,318.94	15.926
Unlocated loss, other	2,522,271.57	7.790
Fire	790,250.46	2.444
Wrecks	2,096,673.25	6.476
Concealed damage	914,518.10	2.825
Defective equipment	3,506,545.95	10.830
Errors of employees	1,019,136.10	3.148
Rough handling of cars	4,343,481.76	13.415
Improper refrigeration and ventilation	1,035,685.50	3.199
Improper handling, loading, etc.	1,346,061.95	4.157
Delays	2,187,345.17	6.756
Unlocated damage	6,767,634.95	20.903
Forfeitures under penalty statutes	12,561.12	0.040
Total	$32,375,617.55	100.000

*Interstate Commerce Commission Docket No. 10048.

The fact that the railroads of the United States are paying out yearly millions of dollars in damage claims and that improper packing is one of the important

sources of these claims emphasizes the need of the standardization of packing wherever possible. The payment of this enormous loss and damage bill means not only a substantial loss in freight revenue but also a great economic loss of labor, merchandise and materials which might in many instances be saved for the consumption of the nation. Some loss and damage of packages is undoubtedly inevitable in railroad or any other method of transportation, but on the other hand loss and damage due to improper packing is largely within the control of both the shipper and the carrier.

As before stated, the present Railroad Classification Rules leave too much to the interpretation of the packer or shipper. They are so broad and so indefinite that they are susceptible to many different interpretations and this makes their enforcement difficult and in many cases impossible. The adoption and enforcement by the carriers of definite specifications for containers—specifications capable of only one interpretation—will be the solution of that part of the loss-and-damage problem due to inadequate packing.

During the past year a new era has dawned in packing. The two common carriers, the United States Railroad Administration and the American Railway Express Co., have taken steps to improve present packing methods and reduce their loss and damage bill. The placing of these two carriers under Governmental control has made it possible to begin the standardization of specifications and the adoption of standard containers. This would have been very difficult if not impossible under private control owing to competition between the different roads or companies. The Railroad Administration has already adopted standard containers and standard methods of loading some commodities and is at work on other standardization. The American Railway Express Co. has conducted a nation-wide educational "Pack Right, Mark Right" campaign and has adopted new express packing rules, setting forth standard packing methods which will be put into effect in the near future.

The adoption of these new standard packing specifications undoubtedly represents the most important packing reform that has yet taken place and it is hoped that in the future the administration of the carriers will be such that this work of standardization can be carried on to completion.

Compression-Spring Testing Machine

By J. V. Hunter

Springs are frequently specified to sustain a certain weight when compressed to a stated length, and the requirements in this respect are very exacting for the springs used in ordnance work. The labor entailed in the testing of the large number of springs used in the breech mechanism of the 4.7-in. gun led to the design of a special spring-testing apparatus for use in the shop of the Northwestern Ordnance Co., Madison, Wis.

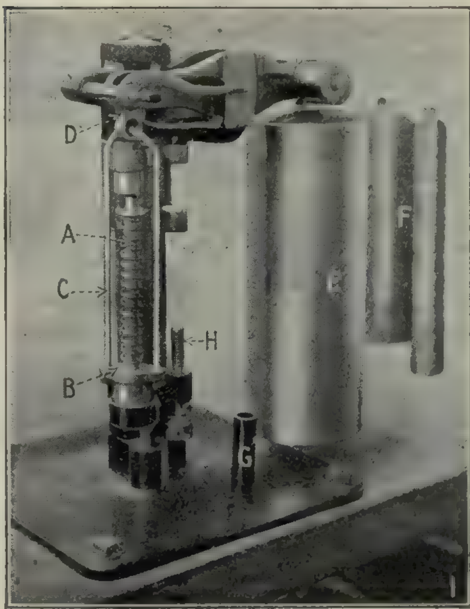


FIG. 1. TESTING MACHINE BEFORE COMPRESSION OF SPRING

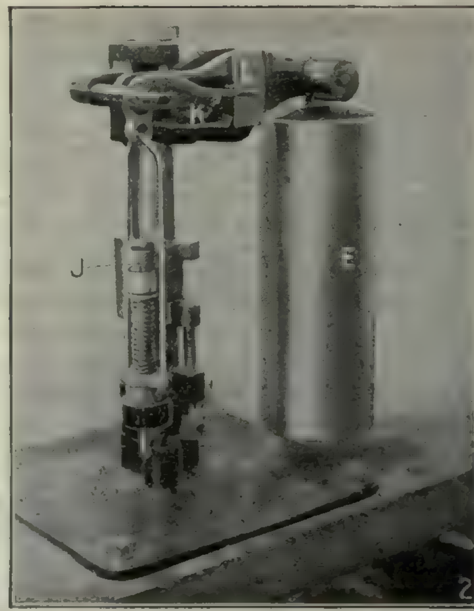


FIG. 2. MACHINE WITH SPRING IN COMPRESSED CONDITION

The testing device is shown with the compression spring in an unstressed condition in Fig. 1. The spring is slipped on a small arbor A which prevents it from springing out of line between the upper and lower bearing points. Its lower bearing B is carried by a stirrup C hanging from the equal arm level D which is counterbalanced on its outer end by the weight E. Some of the different weights provided to meet separate spring specifications may be seen standing in the rear at F. The specified length of the compressed spring is equal to the length of the gage bushing G. This is placed over the end of the screw H and the latter is raised until its end is flush with the top of the bushing.

A foot lever underneath the bench pulls a rod which draws down on the casting J and the upper bearing of the spring, compressing it as shown in Fig. 2. When thus compressed the spring, if within the limit, will balance and raise the weight E, and the pointer K will remain practically stationary at zero on the scale L. A spring too weak or too strong will throw the pointer beyond certain specified limits above or below the zero mark. The apparatus may be very quickly operated, and reduces the time of testing very materially from that required by the older methods.

Holding Slip Bushings

By A. W. Freeman

On page 1002, Vol. 51 of the *American Machinist*, Henry Bowman describes a method of holding slip bushings with a capscrew. I like this method for some kinds of jigs but I think Mr. Bowman failed to catch the point I tried to bring out in my article and sketch on page 336 of the same volume.

It would be impossible to use the capscrew method, as shown by Mr. Bowman, in a box jig where it is necessary to drill from opposite sides, as the screw head projecting above the surface of the jig would prevent the jig from laying flat on its surfaces when drilling from opposite sides.

The "Helmet" Safety Pins and the Machines for Making Them

By S. A. Hand
Associate Editor, *American Machinist*

The wire part of the "Helmet" safety pin is made in an automatic machine that is almost human in its action. This machine takes the wire from a coil, straightens it, cuts it to length, sharpens the point, coils it and finally assembles it to the head. Both this machine and the one for blanking and drawing the head are illustrated and described in this article, in which is also given a description of the manufacture of a two-piece safety pin.

The annual production of safety pins in the United States is approximately 15,000,000 gross, of which a substantial percentage is made at the plant of the Consolidated Safety Pin Co., Bloomfield, N. J., to whom we are indebted for the opportunity to present this article to our readers.

Fig. 1 illustrates the parts of the "Helmet" safety pin in which *A* is the punched blank for the head; *B* is the head as folded or drawn; *C* is the wire for the pin as straightened, cut off and pointed; *D* is the pin coiled and bent, while *E* is the completed pin. *F* is an enlarged view of the point to show its shape.

Blanking and Drawing the Head

The heads are blanked and folded or drawn in one stroke of the double-acting punching machine, Fig. 2. As will be seen in the illustration, three strips of brass are simultaneously fed to the machine from the spools *A* through lubricating compound in the tank *B*, where they are submerged by the rolls *C*. The drawing punches may be seen at *D* protruding through the blanking punches *E*. Each set of punches is operated by separate eccentrics so timed that the drawing punches do not descend until after the blanking punches have completed their work. When blanked from the strip the pieces drop through the dies, and into nesting plates where the drawing punches reach them and force them through the drawing dies below. No blank holders are used and the operation is more one of folding and ironing than it is of drawing, as the spaces between the punches and dies are just enough less than the thickness of the metal worked to accomplish the smoothing out of any wrinkles that may form in folding. By referring to the points *a* in *A* and *B*, Fig. 1, the amount the metal that has been drawn can be seen.

Disposition of Scrap

As the scrap left from blanking would amount to a considerable bulk, provision has been made for cutting it into small pieces by a shearing attachment at the back of the machine, as may be seen in Fig. 3 at *A*. This shear receives its motion from the ram of the machine and cuts a piece of the scrap equal in length to the amount fed for blanking, reducing the scrap to short pieces that can be compactly stowed. The machines make 120 or more cuts per minute, according to the size of the work.

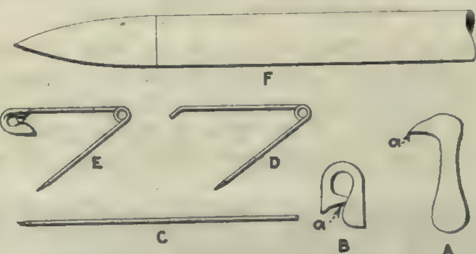
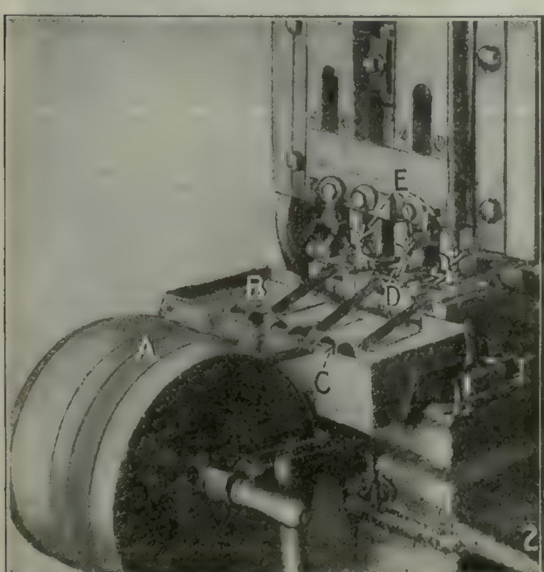


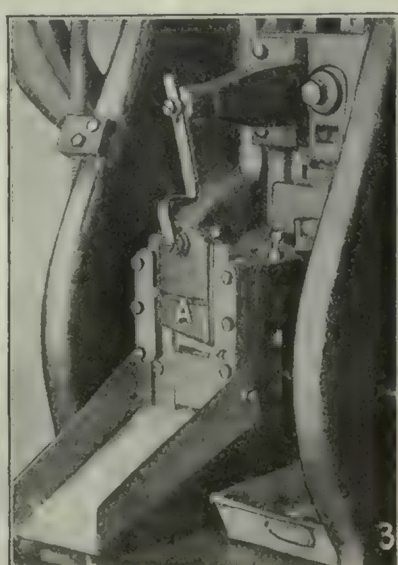
FIG. 1. DETAILS OF A "HELMET" SAFETY PIN

Dipping and Tumbling

The heads are next dipped in a hot solution to clean them from dirt and grease and are tumbled for several hours in sawdust mixed with an abrasive to remove the sharp edges and burrs. The tumbling barrels are made of brass, for if made of iron or steel the work would be discolored.

The pins are automatically made by the machine illustrated in Fig. 4, which is a rear view. This machine takes the wire from a coil, straightens it, cuts it into pin lengths, sharpens the points, coils, bends, assembles them into the heads and fastens them in position. Further details of this machine may be seen in Figs. 5 to 9, and where reference letters are given the same letters refer to the same parts in all the views.





FIGS. 2 AND 3. MACHINE FOR PUNCHING THE HEADS

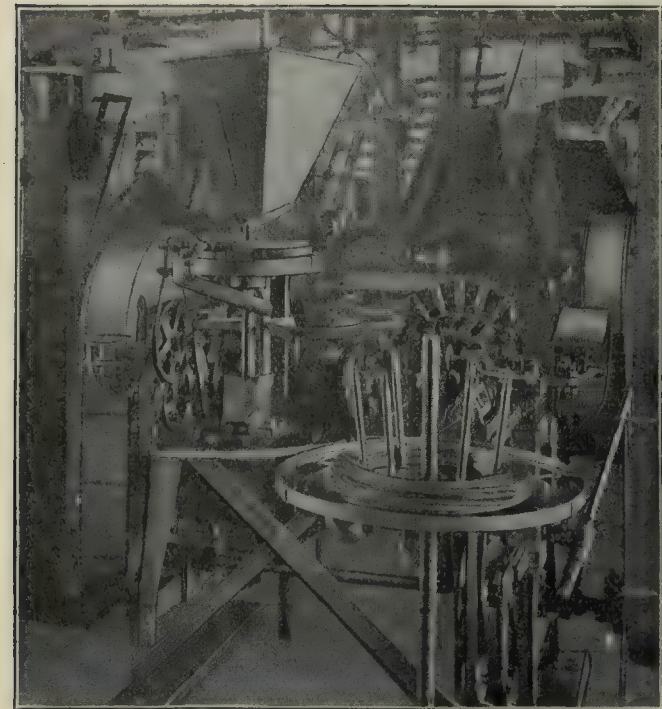


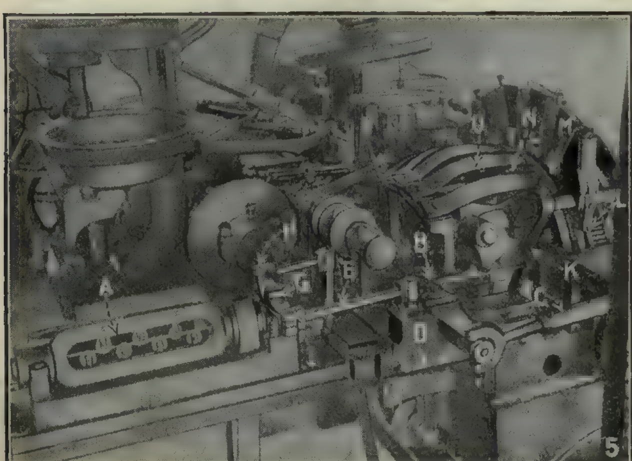
FIG. 4. AUTOMATIC MACHINE FOR MAKING SAFETY PINS (REAR VIEW)

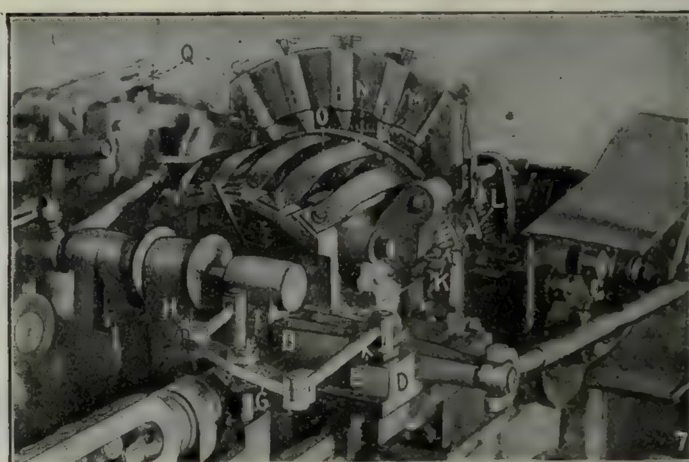
The wire is fed from a coil at the rear of the machine, through the straightener *A*, which is of the usual rotating type and needs no further description. However, as the feeding of the wire is intermittent, inasmuch as it must be stationary while being cut off, it must never be at rest in relation to the straightening rolls or it would be kinked and broken in an instant. Both the straightener *A* and the gripper *B* receive longitudinal motion from an eccentric through the rod *C*, which is attached to the carriage *D*, the straightener being connected to the carriage by the rod *E* through the lever *G*. As the fulcrum of this lever is at *H* and its connection to the straightener at *I*, it is evident that the straightener will only travel half as far and at half the speed of the carriage. In operation the straightener moves forward with the wire, but at half its speed, and is moving backward when the wire is stationary for the cutting off operation. Thus at all times either the wire is moving through the straightening rolls or the rolls are moving over the wire.

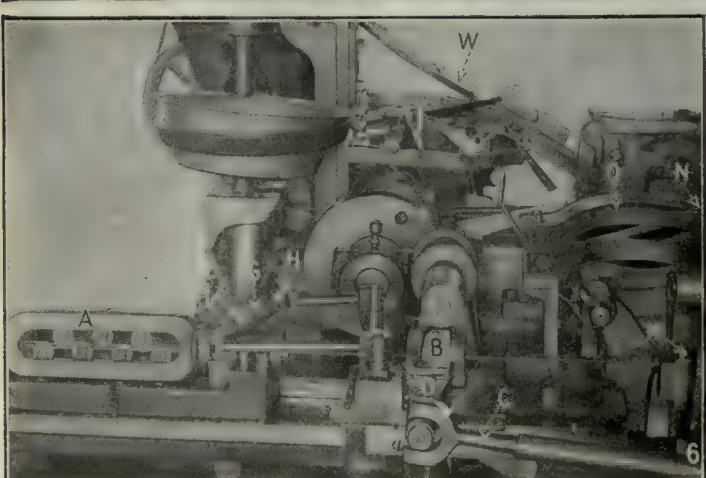
Cutting Off and Sharpening the Wire

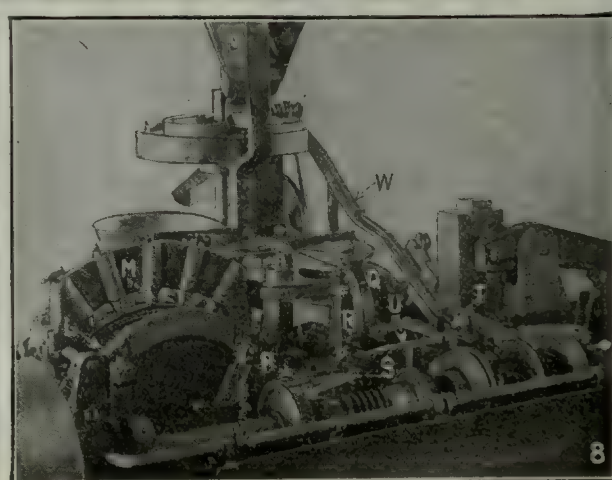
The wire is cut off at *K* and carried laterally to the revolving drum *L* which is composed of two series of disks, one series being cut similar to a gear while the other is plain and of a diameter about equal to the pitch diameter of the one that is cut. The wires enter the drum between the teeth of one set of disks and rest on the periphery of the plain set.

As the two sets of disks revolve in the same direction and one set at twice the speed of the other, it will be seen that as the wires are carried under and in contact with the spring-actuated pads *M*, rolling motion must take place. As the wires revolve they are carried forward with their ends beneath five files *N* attached under the ends of flat springs *O*. These files are set at slightly different angles and make short cutting strokes at the

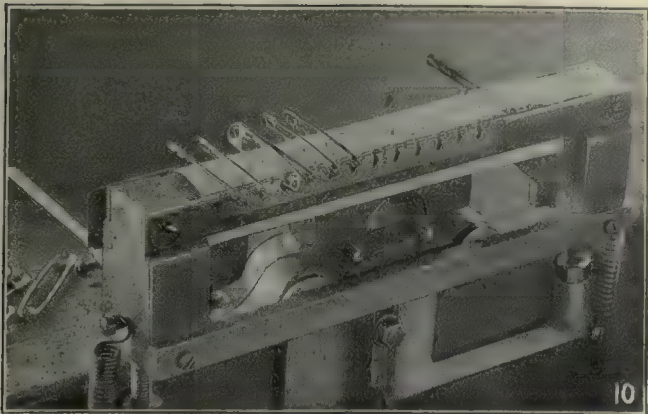
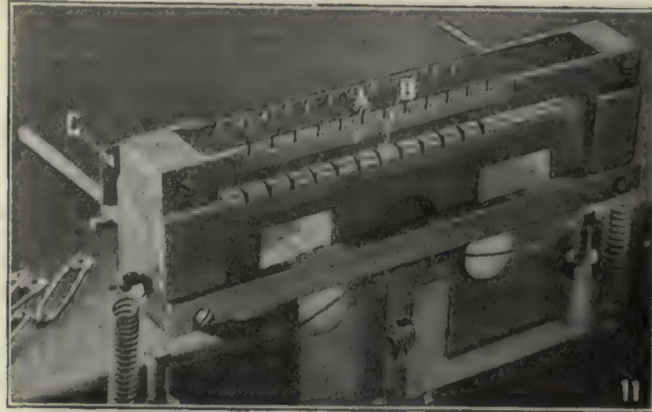








FIGS. 5 TO 8. AUTOMATIC MACHINE FOR MAKING SAFETY PINS (DETAIL VIEWS)

FIGS. 10 AND 11. THE CARDING BLOCK
Fig. 10—The carding block in use. Fig. 11—The carding block empty.

rate of 3000 to 4000 per minute. The purpose of these files is to sharpen the points of the wires, and the reason for setting them at slightly different angles is so that the points will have a somewhat rounding contour rather than one of a regular taper.

Coiling and Bending

From the sharpening unit the wires are carried by a pair of worm conveyors *P* to a table and from there to a second carrying device; by which they are delivered to a mechanism *Q*, where each wire is in turn gripped by a pair of jaws while two operations—coiling and bending—are simultaneously performed. The coil in the center of the pin is formed at *R* and the bend that enters the head is made at *S*. After these operations, the wires, or pins, as they should now be called, are carried to the head-attaching device *T* by the swinging gripper *U*.

In the meantime the heads, having been placed in the hopper *V*, are being automatically selected by a revolving disk and turned with the opening for the pin in the right direction by friction against stationary cam-shaped guides placed close to the disk. From here they are started down the inclined magazine *W*, where they reach the attaching device *T* at the same time as the pins. At this point the bent end of the pin is inserted in the head and the whole, as a unit, fed between a pair of squeezing tools which indent the head in such a way as to firmly fasten it to the pin. From this point the pins are ejected and fall into a receptacle beneath the machine. The production of this machine is 80 to 90 pins a minute.

FIG. 9. DETAILS OF AUTOMATIC MACHINE FOR MAKING SAFETY PINS

After assembling, the pins are either brightened by dipping in acid, japanned, or electro-plated, according to the finish desired.

In plating, the pins are put in wire cages that are revolved while submerged in the plating solution, one electrical connection being made through one of the trunnions by a contact spring to which one of the wires from the generator is attached, and the other through the anode.

Preparing for Shipment

Before the pins can be packed in boxes they must be attached to cards. This is entirely a hand operation, which at first seems surprising when all other operations are performed on automatic machines. However, it was explained that the carding operation also included the inspection of the points and that this was a matter of feeling the pressure required to stick the pins through the card.

The carding block is shown in Figs. 10 and 11. In Fig. 10 the card is in place and has several pins stuck through it. Fig. 11 shows the block empty and ready for placing a card, which is done by slipping it under the guide rails *A*, far enough for the edge to come into contact with the adjustable gage *C*. By depressing a treadle the plunger *B* is raised, bringing the center of the card in a bulging shape above the guide rails. The pins are then stuck through the card, using the notches in the guide rails as spacing guides, and are closed or latched with one motion of the hand. An expert girl can card over 150 gross of pins per day.

A Shock Absorber for Intermittent Gears

By Frank Erwin

There have appeared lately in the *American Machinist* several articles on intermittent gears in which I have been much interested. None of them, however, touched on one phase of the subject with which the writer has had some experience, namely, the elimination of shock in starting and stopping heavy moving parts where the driven gear is smaller than the driver and revolves at considerable speed.

We had to deal with a number of such drives on heavy wire-fabricating machines. The drive consisted of a 20-in. mutilated gear driving an 8-in. pinion which made two turns to one of the driver, the latter turning 60 times per minute. The pinion was held during the idle period by a shoe which closely fitted the curved lug *D*, Fig. 1, cast on the side of the large gear. The

gears had a 2-in. face and the pinion drove two short trains of gears and wrapping spools through a $1\frac{7}{16}$-in. shaft 10 ft. long. It is apparent that the shock of starting and stopping all this was terrific. The cost of breakage was a considerable item and caused much delay for repairs as well as greatly limiting the speed of the machines.

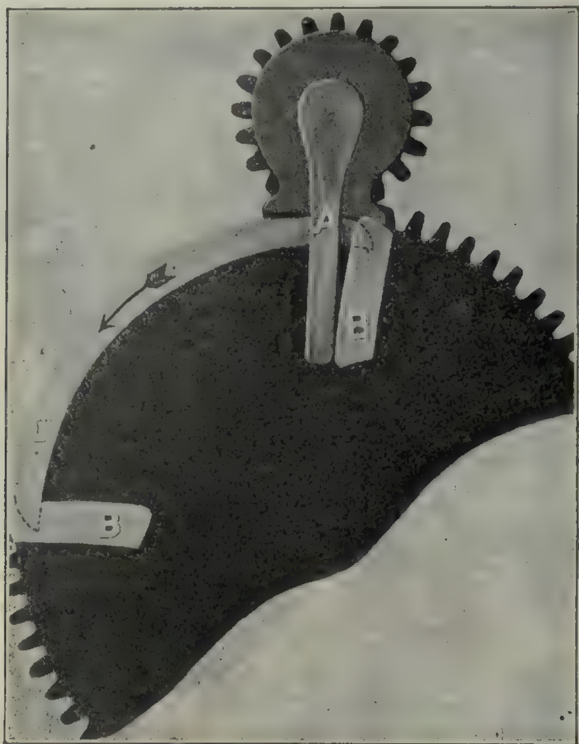


FIG. 1. SHOWING THE SLOW START

Various brakes, cushions, etc., were tried but usually only made matters worse. The device which finally proved successful was designed by the writer and consisted of steel lugs B at the ends of the blank space of the large gear and a finger A attached to the pinion extending radially well in toward the center of the large gear as illustrated by the model.

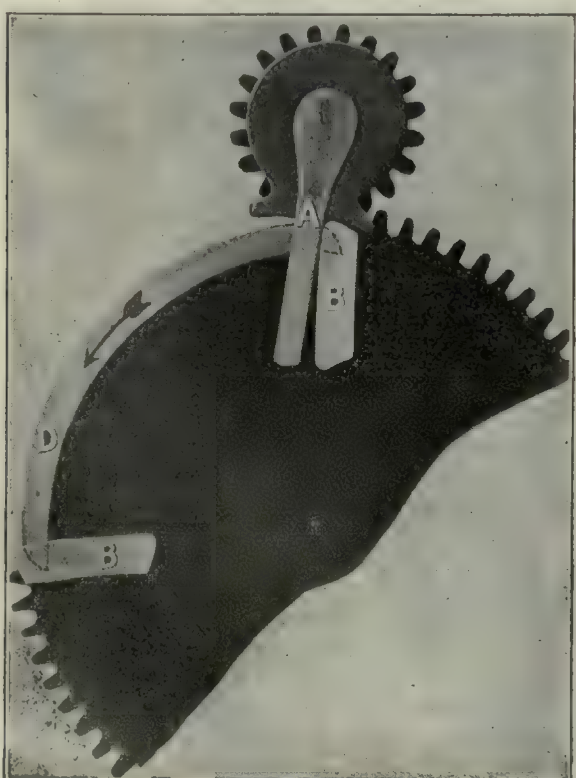


FIG. 2. THE ACCELERATION OF THE MOVEMENT

It will be seen that this arrangement greatly reduces the speed in starting the pinion, by the first point of contact being near the center of the driver and having a relatively slow motion and also by starting the pinion by the end of the long lever, thus for the moment reversing in effect the proportions of the pinion and gear.

In action the point of contact is first at B, Fig. 1, where the motion is the slowest, and as the driver advances, travels toward the periphery of the large gear; the motion imparted to the pinion is accelerated until the point A is reached as in Fig. 2, when the peripheral speed of both gears is the same and the teeth engage without shock or noise.

Order Reversed in Stopping

In stopping the pinion the order is reversed, the contact being first at A, Fig. 3, and moving toward B, thus gradually slowing the pinion down until the shoe rests on the flange D. Fig. 3 shows the gears just as the pinion comes to rest at the end of its period of revolution.

It was found best to make the sides of the lever attached to the pinion parallel, and the faces of the lugs BB of the same radius as the pitch diameter of the large gear. After this device was installed it was possible to materially increase the speed of the machines, and the breakage was reduced to about the same point as with gears running continuously. The noise was eliminated entirely, it not being audible to one standing right beside the machine.

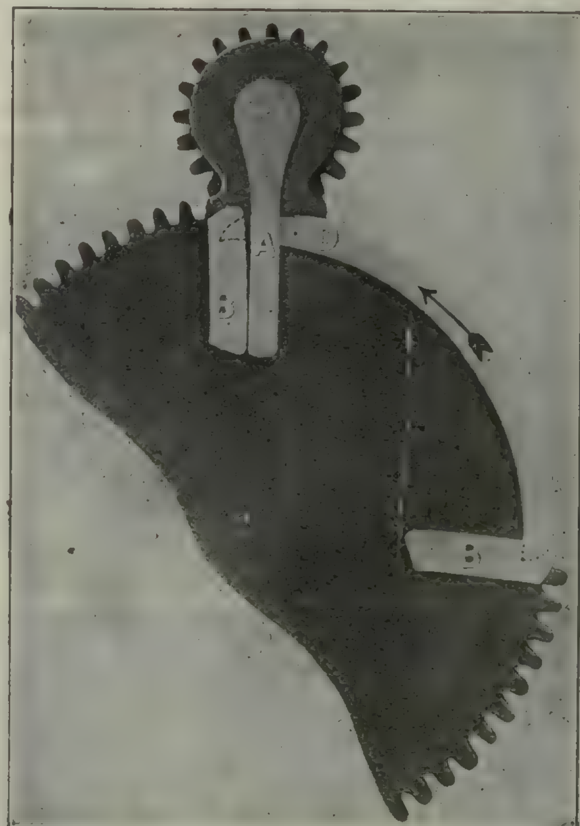


FIG. 3. THE SLOW DOWN AT THE CLOSE OF THE CYCLE

Wage Payment

By
A. L. DeLeeuw

UNREST among the laboring classes has taken on such proportions and is so widespread that it is timely to discuss the various items which enter into the present relations between employer and employee, even if no prescription for a cure can be given at the present time.

The present strife has a number of angles, of which one or more present themselves in individual cases. Quite often an honest attempt is made to reconcile the varying viewpoints of employer and employee, but more often it is purely and simply a question of war, of brute force; and a peace of victory, not of understanding.

It is well recognized that where two parties have a difference of opinion the first step should be to find some common ground from which to start, and that then the second step should be to define clearly and precisely the chief terms which enter into the controversy. It is never difficult to find the common ground between employer and employee.

One reason why discussions so often fail to bring the desired results and why they are often not started at all is that there is no clear understanding of some of the most commonly used terms in these controversies. The writer wishes to call attention to some of these terms, and to some of the misunderstandings in regard to their meaning.

We read practically every day about war between "capital" and "labor," about the demand of the laboring man for the "right to organize," and of his right to insist on "collective bargaining," and yet these three terms, which are perhaps used in every controversy that comes up, are not only not defined but they are actually misleading in themselves.

War Between Capital and Labor

If war between capital and labor means anything at all, it must mean war between capitalists and laboring men. *Capital is the result of past labor used progressively. Without capital, civilization is unthinkable.* Capital is the tool with which the laboring man works. There can no more be war between labor and capital than between the laboring man and his tools. It may be said that this is merely a fine distinction and not a difference, but the writer cannot take this view. Recent events in Russia have shown that there are a large number of people who actually believe and act upon the idea that capital must be destroyed in order to give the laboring man his own. It may be that the leaders who presented this thought did not have capital in mind, but were either referring to capitalists or to the present system of control of capital. But their slipshod way of expressing themselves, or the lack of existing definition, causes a large number of people to think that *capital itself* is at fault.

In late years the control of capital has been more and more centralized, or, in other words, in the hands of fewer individuals. And though it is well recognized that this condition has its advantages in many ways, yet the dangers to which such centralized control may well lead have caused it to be regarded with suspicion and enmity. Capital being the tool with which labor must work, it is but natural that labor should look with suspicion on an attempt to corner the tool supply. For this reason we may naturally expect that labor will insist upon a better control of its tools—capital. It cannot have war with capital, and there is no reason why it should make war against capitalists in general, for it need not be pointed out that many capitalists are good and honorable men who do not deserve the enmity of any one. On the other hand, it may well be conceded that labor has cause to dislike, or even hate, the present system of control of capital.

It has been pointed out many times quite recently that there are really three parties, not considering the general public, which have a right to be heard in this controversy, namely: capital, labor and management. It seems to the author that this merely leads to complication without any compensating features. Management and labor are both labor, but of different kinds. If at times they clash it is not due to unavoidable conditions but merely to defects in one or the other.

The Right to Organize

Another term which should be quite familiar to all of us by this time is the "right to organize."

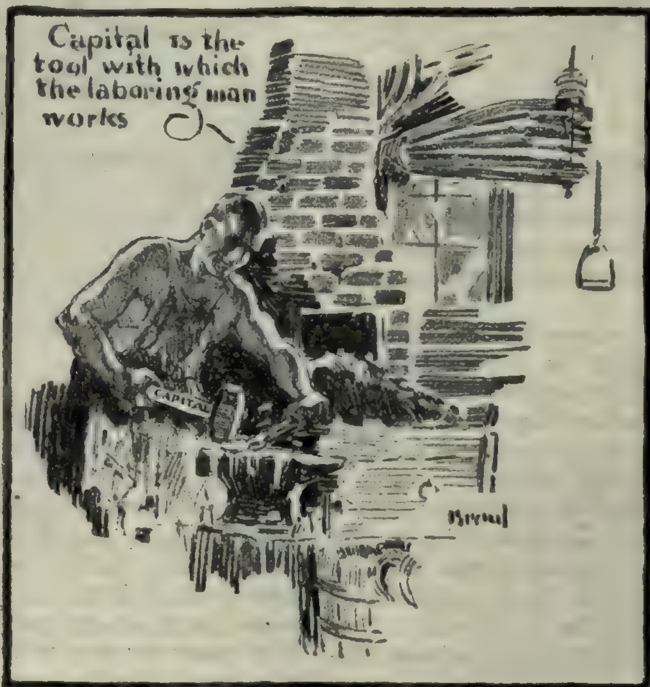
The writer does not believe that there is an appreciable percentage of employers who would deny their employees the right to organize; for instance, for a baseball team, or a brass band, or sick benefits, or co-operative stores or a Bible class. On the other hand, nobody would blame the employers for denying their employees the right to organize for some other purpose; such, for instance, as burning down the plant, or sabotage in the shops, or blowing up the works of his competitors—

*Presented at the annual meeting of the American Society of Mechanical Engineers, New York, in December, 1919.

however beneficial this might be to him in a business way, or for many other purposes.

It follows, then, that the "right to organize" must be further defined or at least limited in its scope before we can judge as to the real right of the employee to organize. If the purpose for which the employee wishes to organize is legal and proper, the third party, the general public, will naturally concede this right and quite as naturally inquire as to whether the employer has really denied this right to his employee.

The facts in most cases where this right to organize has been brought to the foreground, are these: A labor organization thinks it proper that the employees of a certain establishment should be gathered into its union. This, by the way, is perfectly proper, and no objection could be taken to it. The organization succeeds in gathering in part of the employees. The employer, fearing that this activity may lead to a strike, attempts to keep the other employees from joining the union; in other words, he tries to organize them with him instead of with the union. This also is perfectly proper. To make the claim at this point that the employee has been denied the right to organize may be good politics but is not quite correct.



It is doubtful whether in late years there have been many cases where the employer has denied the employee the right to join the union, even if he was not in favor of it. When undesirable conditions or relations existed between employer and employee, or perhaps when union activities led to a strike, it was quite customary to make a demand on the part of the men for the right to organize—yet this right had seldom been denied; but put in this way the general public would get the impression that all kinds of organizations of the employee are taboo. What is really meant by the "right to organize" is that the employer shall give, not to *his men*, but to *some labor union*, the right to come into his shop and organize his men into a union; and apart from the question as to whether this is desirable or equitable, it is certainly different from the idea which the expression "the right to organize" conveys.

Collective Bargaining

Another term which is misleading, even more so than those mentioned before, is "collective bargaining." So far collective bargaining has been collective, it must be admitted, but it has not been "bargaining." In collective bargaining it is supposed that some or all of the employees have delegated the right to bargain for them to some attorney or business agent. In practically all cases this business agent is their union, and this union, according to the term used, is supposed to bargain with the employer. As a matter of fact, however, there is no bargaining, and under the present conditions, there can be no bargaining. There have been cases where the men were entitled to all they asked for, and possibly more; there have been cases where the men were not entitled to as much as they asked for, but the method of bargaining has never been employed, and, in the writer's opinion, *could not* have been employed, to settle the differences. The issue has been brought to a conclusion by strikes, or threats of strikes, which is no more a method of bargaining than when a man points a gun at his debtor to collect a bill. The fact that the bill may be due to him, and even overdue, does not make this a method of bargaining.

There is still another point about this question of collective bargaining which should have all the light possible thrown on it. Is collective bargaining, bargaining by *all* the employees? Is it bargaining for a group or part of a group? If it is bargaining by a union, acting for a group, should the representative, the union, show credentials before bargaining starts? Such a course of action might reveal the weakness of the union or of the employer, but would it not be for the best interests of the third party, the general public?

In offering labor and demanding money, one of the principal requirements of a bargain is missing. When we say that the price of eggs is 75 cents, we mean, per dozen. When we say that the price of land is 200 dollars, we specify, per acre. But when we say that the price of labor is 75 cents, we do not know what this means. There are measures or quantities by which to sell eggs or real estate. But when it comes to buying labor we have no measure nor can we estimate its value by personal observation—except after the labor is done, which is long after the so-called bargaining took place, long after the price was set.

At the present time labor is not sold by measure but a workman sells his time. *This inability to strike a bargain because the value of the product to be sold is entirely unknown, is, in the writer's opinion, one of the greatest difficulties to be overcome before there can be an equitable adjustment of the differences between employer and employee.* The fact that labor is sold by the hour is equally unjust to both parties. Sometimes the employer suffers, sometimes the employee. In all cases it is a source of curtailment of production, and this leads at once to a discussion of wage system.

"Wage" is defined as remuneration for work done. It is also defined as remuneration for time given. The second definition seems to be defective. In the first place, when money is paid for time given it is called "salary." In the second place, and this objection is more serious, time alone is not bought or paid for. There are many occupations in which the employee must wait until something turns up for him to do, and then he is supposed to do it. Take the example of the stenographer, the watchman, the bridge tender, the

crane tender, the machinist's helper. Such people may be idle for a long time, but finally there comes some occasion when they have to do work, and they are supposed to do it. It would not be proper, then, to say that they are paid for their time. It would be more proper to say that they are paid for the labor which they perform within a specified amount of time. Besides time and labor there enters into such cases the requirement of physical presence. When a stenographer is supposed to give eight hours' time, he or she is supposed to be at a given place within that time, say, at the office. That such people are not merely paid for their time is emphasized still further by the fact that they are not paid more when they move further away from, or less when they move closer to, their place of employment.

There are cases where, practically speaking, time alone is sold. Such is the case, for instance, with a stationary watchman. Even in such an extreme case something more than time is paid for: the man's watchfulness and faithfulness. In other cases time and labor are paid for: for instance, with a machinist's helper, or a blacksmith's helper. In still other cases time and skill are paid for: for instance, the man running a large planing machine or boring mill. The writer cannot think of any case where wages or salary are paid for the amount of time alone spent on the job.

In the great majority of cases it is labor that is wanted, or rather the results of labor, and not time. The great problem before us is to find a measure for this labor in order to obtain an equitable way of paying for it. In even the simplest operations of labor there are so many factors which modify the result that it is difficult to establish a unit of measurement. In some of the more complex work it has been possible to subdivide the operations to such an extent as to set a fixed time for a given operation. Such is the case where single operations are done by an automatic machine to which the operator feeds the material, or where he operates a simple machine and performs simple operations such as drilling with a sensitive drill press, using jigs, etc. But even in such simple operations some factors enter which will cause trouble at times; trouble with the machine, breakages, replacement of tools, and the like, are such disturbing factors. However, in such work the disturbing factors are a small percentage of the total, and can be estimated close enough to establish a fair value. It would be possible to extend the number of such operations very largely, but it would require the active coöperation of labor to do it successfully.

In a large portion of work there is a combination of time, physical presence, labor, skill, knowledge, judgment, and probably other factors which are hard to define, such as reliability, steadiness, enthusiasm, loyalty, ambition, and whatnot. To make up a formula which would embody all these elements and from which a man's value could be calculated is, of course, impossible; and yet, unless this can be done there is no possibility of avoiding differences of opinion between employer and employee as to the value of a man's labor. The writer has gone into this matter somewhat at length, because to realize that a mathematical solution is not possible is also to realize that a compromise system *must* be developed.

There are various systems of payment in existence at the present day—there are straight wages, piecework system, various systems of bonus payment, premium payment, and combinations of these systems.

The wage system considers nothing but time and physical presence. A man is selected for a certain task because he or some one else claims that he is fit for that task. If his work is satisfactory he is retained; if not, he is dismissed. Both employer and employee have made a guess. The employee knows exactly what he will get, and guesses at what he will have to deliver. The employer knows exactly what he must deliver, and guesses at what he will get. He has no means to bring the employee's output up to his conception of what it should be, unless the employee falls so far behind the employer's expectations that he makes a new guess and fires the man.

With the piece-work system the employer knows exactly what he will get for his money, but the employee makes a guess as to how much he can reasonably do; he has no control over the conditions which will enable him to do, or prevent him from doing, as much as he is expected.

There are various kinds of bonus systems. The employee may earn his regular wages and get a bonus at stated intervals if his work exceeds the expectations of his employer; or he may be working under the task-and-bonus plan, in which case there is less guessing and more of an attempt at a definite bargain. If the employer is in earnest with such a system, and sees to it that it is possible for the employee to fulfill his task, then this system approaches quite closely to true bargaining.

The premium system is an attempt at gaining the interest of the employee by making him invent improvements in the method of working and sharing the profits with him; but unless the time originally set was carefully studied, and unless all conditions of machinery, tools, existing knowledge and related matters remain unchanged, this system also will lead to controversies and injustices.

To sum up, the pure wage system is no bargaining in any sense of the word; the piece-work system is only bargaining if employer and employee have reached an agreement, and if there is some mechanism by which this agreement can be changed as soon as conditions change; the pure bonus system is nothing else but a

wage system with a kind of profit-sharing plan; the task-and-bonus system, if properly worked out and if accompanied by complete instructions to the employee, is a perfect bargain, but must be constantly revised as conditions change. However, the last-mentioned system carries with it the necessary mechanism to effect these changes.

Whatever attempt has been made up to date to place labor on a contract basis, on a basis of bargaining, has been done entirely by the employer, and has been opposed by organized labor. And yet it is the writer's opinion that the ultimate solution of labor trouble must be based on some method of bargaining, probably collective.

Labor unions are fighting organizations. The underlying principle of their conception was to find the necessary strength in numbers. The unions were the army with which the laboring man fought the employer. There was no other means of accomplishing the aims of the laboring man except to fight, and fight they did; and if fighting has given them, if not all, at least a large portion of what they desired, it is but natural that they should consider war the best means of reaching their ends. Being a war organization they had to consider the employer as the enemy, and as a consequence every act of the employer was to them an act of the enemy, something intended to defeat the union and its aims. The unions, so far, have not offered any constructive suggestion, and this cannot be expected from a fighting organization. Furthermore, it is to the personal interest of union leaders to hold to this system. It may be taken for granted that there have been, and are, many unselfish union leaders, but this does not offset the general tendency of the system to perpetuate itself as a fighting organization, because this has in its turn a tendency to further the interests of the officers.

Another reason why the attempt of the employer to put labor on a contract basis has not been well received by the labor unions, lies in the historical fact that on account of occasional scarcity of work it became one of the principles of the union to take measures to insure that whatever work was available should be sufficient to keep the union men in employment. The three chief means used to accomplish this were: first, to prevent anybody but union men from working at the trade; second, to limit the number of apprentices, or in general, newcomers in the union; third, to limit the output per man. The second item has not been strictly adhered to because it was found that by limiting the number of men in the union the number of men outside the union was increased, thus decreasing the relative fighting strength of the union. The first item has been strictly adhered to, but has often been denied by the union, probably for the purpose of satisfying public opinion. The third item is still generally adhered to, but is mostly camouflaged. Whether the unions should be condemned or praised for the attitude they have taken, is a matter of standpoint. If the true status of the union is that of a fighting organization, then no objection can be taken to these methods. We should not expect war without guns or accidents. Whether the interests of the world at large are best served by having the unions act as fighting organizations is more than doubtful, and the writer for one believes that it is time for the unions to forget some of the past, turn over a new leaf, and prepare for a future in which there shall be peace, progress and production. Taking the aims of organized labor to be proper share of the proceeds of labor, reasonable working conditions and working hours, right to organize, and collective bargaining, the writer believes that these could all be accomplished without strife if the last item, collective bargaining, were put into actual practice instead of being a mere catchword.

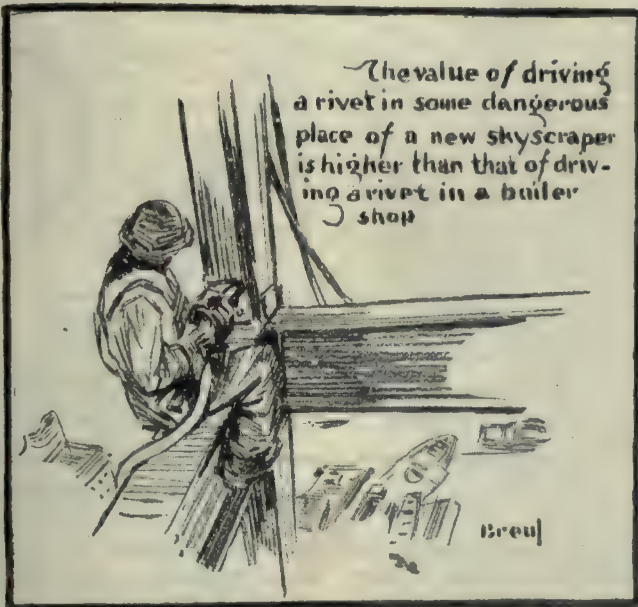
If employers and employees together would put as the first item in their catechism the truth that *the world must produce more in order to have more;* if employer and employee together would try to find an equitable way of estimating the value of work done; if both would subscribe to the truth that no permanent gain can be made by wearing out a man's capacity for work nor by allowing him to work less than he should for the good of the world at large; if then employers and employees together would organize a bureau of research for defining the conditions under which various classes of work should take place; and if finally an attempt was made by both employers and employees to classify men according to their natural or acquired ability, there would be very little reason left why a union should be a fighting organization.

If the writer were the owner of a machine shop and the business agent of a machinist's union should come to him and say that his union did not admit members who are not bona-fide machinists, who are not sober and industrious men, and that the union would see to it that the men would treat the management in a fair and equitable manner, but that, on the other hand, it would want a share in the management in so far as working conditions, wages, working hours, etc., are concerned, and that it would not permit anybody except members of that union to work in that shop, the writer would probably fall around that business agent's neck and hail him as a savior.

Such conditions cannot be brought about at once, nor in a very short time, but they *can* be brought about and now is the time to start the preliminary work.

Up to the present time the unions have acted entirely through their business agents, who sometimes had, and more often had not, a clear idea of the problems involved in the trade they represented. What-

ever knowledge they might have had was not permitted to come to the foreground. One does not make allowances for the enemy's good points during war. It seems to the writer that the time has come for the unions to take the first step along the lines of considering union activities as a legitimate business, and legitimate business cannot shut its eyes to facts, however disagreeable to contemplate they may be. It is his belief that the crux of the solution lies in the establishment of a proper wage system, and that in order to establish such a system *the engineer must come to the assistance of labor* in order to find standards of value for work done. Though it is not likely that there will ever be a time when every human activity can be scheduled and analyzed, yet by far the greater part of industrial operations can be treated in this way. The relatively few operations which cannot be classified and treated in this manner would be such a small part of the total that it would be easy to find a way to compromise when such exceptions occurred.



In estimating the value of operations we must drop to a large extent the idea that wage is the compensation for time. It should be made a compensation for product delivered. The value of the product changes constantly. Changes may be due to the desirability of the product, or to the means employed to produce the product, or to the law of supply and demand, or to other causes. In other words, the relations existing between various products are ever changing; consequently, whatever estimate is placed on the value of the product of labor should be changed from time to time, so as never to have too large a difference between the actual and the estimated value.

It hardly need be pointed out that to set such standards of value of work must necessarily be a gigantic task. In addition to the many technical difficulties in estimating values of products, there are other elements which must not be forgotten. There are many cases where operations are required which call for extreme skill, possessed by only a few—a skill which can never be found in the mass of the people. As a rule, people possessing such skill love to employ their gifts, they love their work and are willing to produce for less than their product is worth. Such skill should be estimated at its proper value, not only as a matter of justice to the workman, but also because he may finally lose his enthusiasm, and industry at large would suffer.

There are operations where steady nerves are essential, some where physical courage is required, others which cannot be successfully carried out without many years of experience. Such points should all be considered. *The value of driving a rivet in some dangerous place of a new skyscraper is higher than that of driving a rivet in a boiler shop.* The ability to judge the temperature of a piece of steel by its color is obtained by many years of experience and it could not be called skill, though it is closely related to it.

Consideration should also be given to what constitutes a proper minimum and a proper maximum wage. In repetition operations it is sometimes possible for the operator to produce large amounts of work but only at the expense of extreme weariness, and in the long run such a man is not employed to the best advantage of the world at large. Recognition of this fact has led to the prescription of rest periods. On the other hand. there may be cases where it is expedient to employ men not skilled in the operation they are supposed to do. This may happen because skilled men are not available at a given time or place, or because special conditions call for an unusual amount of this class of work. Though the value of the product of such men might be low, they should receive not less than a minimum wage. This minimum wage, however, is in itself difficult to determine. A satisfactory minimum wage for an unmarried young man is not at all satisfactory for a married man with a large family.

It is really superfluous to point out the many disturbing factors acting against the establishment of wages in proportion to product. What the writer wishes to emphasize is his belief that, notwithstanding all the difficulties that have been mentioned and the great many other difficulties not mentioned at all, it will be found possible to classify a large portion of the work of the world in such a manner that wages can be set to such a degree of scientific accuracy that the variations caused by the disturbing facts will not be so large but that they will lend themselves to compromise. It is further his belief that such a classification cannot be accomplished by the employers alone, nor by the laboring men alone, but that there should be an attempt at a concerted effort of employers and employees to bring about such a classification. He believes further that when these two classes are working together for a constructive purpose they will find so many things in common that they will be more apt to forget their differences. Finally, he wishes to state once more this belief: *That the real cause of the present-day unrest lies in the fact that there is no unit of measurement which both employers and employees can use; or, in other words, the fact that our present wage system is not based on knowledge and justice, but only on guesswork and on the fear that the one may "do" the other.*

Drawings for Factory Use

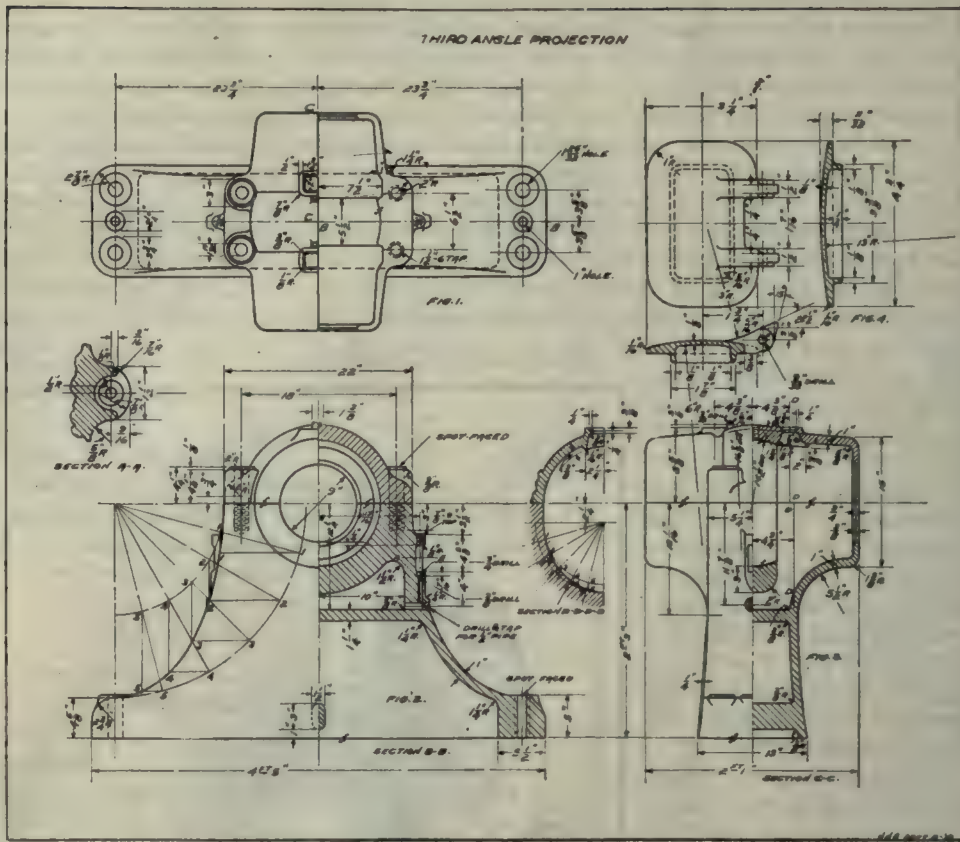
By Harry H. Armstrong

The manner in which drawings are dimensioned for use in the factory is of no little importance, and the simplicity of dimensions on a drawing is just as important as the delineation or projections of the article itself.

To begin with, not only one class of mechanic works from a drawing; if it is a casting, the patternmaker, molder, and machinist have all got to do their part, and each will have dimensions to work from that do not interest the other fellow primarily. Also on forging drawings, the blacksmith makes the rough piece, and the machinist does the machine operations, to make it ready for the assembled device.

In the illustration given, we show three views of a pillow block casting, three enlarged views of the oil door, Fig. 4, and two partial sections, in order to bring out clearly the construction of the article portrayed.

In Fig. 2 we show the side elevation of the pillow block. The left half is looking at the outside surface, while the right half is a section through the center line marked *BB*. Examination of this view will show how the patternmaker can readily find the dimensions he needs, and also the machinist's dimensions are plainly shown. Notice the enlarged section *AA*, to show plainly the construction of the oil indicator, and from the sections *AA* and *BB* this construction is clearly portrayed.



SAMPLE OF SHOP DRAWING

The end view of the pillow block is shown in Fig. 3. Here again the left half is looking at the outside of the casting, while the right half is taken on the section line *CC*, to show plainly the interior and its construction.

Another section is shown, namely, *DDDD*. This is made in order to show the construction of the oil-door receptacle, and also the elliptical shape of the basin, into which the bearing is placed when assembling.

The delineation of the oil door, Fig. 4, is for the patternmaker mostly, as the machinist has only to drill the holes for the hinge rod.

The drawing is made third-angle projection which is the most favored practice, and firms that have been using first-angle projection are gradually swinging to the former method.

Do not get the habit of scattering the dimensions of a certain "boss" or "counterbore" over the whole drawing, but confine your dimensions to at least two views. It means lost time in the pattern shop for the patternmaker to hunt all over the drawing for dimensions that could be confined to one or two views. A good mechanical draftsman soon gets his name up in the factory by the simplicity of his dimensioning.

In Fig. 1 of the drawing, the plan view of the pillow block is shown. Notice that, on the right-hand side, half of the cap is omitted; this is done to show the construction of the basin, looking down into it. It will be seen that the cap is a separate part from the standard or base.

This drawing is not a perfect sample, but is merely portrayed to show the amateur draftsman, or the ambitious mechanic who wishes to be a draftsman, how to set forth dimensions properly, so that the article may be produced in the factory with the least possible delay or confusion.

The draftsman or designer who, in making a drawing, sees it from the patternmaker's or machinist's point of view, is the man who is going to forge ahead and produce results in production.

Always remember it is easier to change a drawing or tracing in the drafting room, than it is to change a pattern or machine in the factory. Therefore, if dimensions are not plain, or the printing is doubtful, take the time to rectify these points and save future trouble by having your drawing right.

Lastly, a good draftsman is not above going to the factory for information from the mechanic. He is the man who understands the tools which make the article, and can offer valuable advice.

Holding a Piece on Parallels on a Magnetic Chuck

By I. A. Hunt

On page 148 of *American Machinist* we note an article under the above title by Joseph C. Fisher.

While Mr. Fisher's idea would apply to certain magnetic chucks, we would like to call to his attention the fact that it would not apply to Heald chucks or to certain other types, due to the fact that the frame of the chuck is not magnetized. On Heald chucks it would be necessary for both parallels to be placed on the pole pieces. As these poles are alternate, positive and negative, the parallels must of course be located on opposite poles.

Industrial Motor Control—III

BY C. W. STARKER

In many ways control apparatus for alternating-current motors is similar to that employed in direct-current service. This article reviews manually operated control apparatus suitable for machine shops using alternating current. *(Part II was printed in last week's issue.)*

WITH alternating-current motors of small capacity, there is no objection to connecting them directly to the line at starting. With 3- to 5-hp. polyphase, squirrel-cage induction motors, this is usually done by a starting equipment such as shown in Fig. 23. Fuses and switch are mounted on a slate panel, which is inclosed in a sheet-steel case to meet safety requirements. In good practice this case is so designed that the door cannot be opened until the motor and fuses are disconnected from the line. The switch is of

FIG. 23. A TYPICAL POLYPHASE ALTERNATING-CURRENT MOTOR STARTER

the three-pole type, as primarily intended for three-phase circuits, but the same equipment can readily be used on two-phase circuits by permanently connecting the fourth lead to the motor. In fuse switches of this type arrangements are made to have the fuses out of the circuit during the starting period, and for automatically cutting them into the circuit as soon as the operator removes his hand from the starting lever. There is therefore fuse protection against overload during running, but the relatively high starting current, being of short duration, will not injure the motor, and does not cause the fuses to blow out.

The operation of these starters is as follows: lifting of the starting lever, which projects out of the side of the case and connects the motor directly to the line, with the fuses out of circuit. As soon as the motor is up

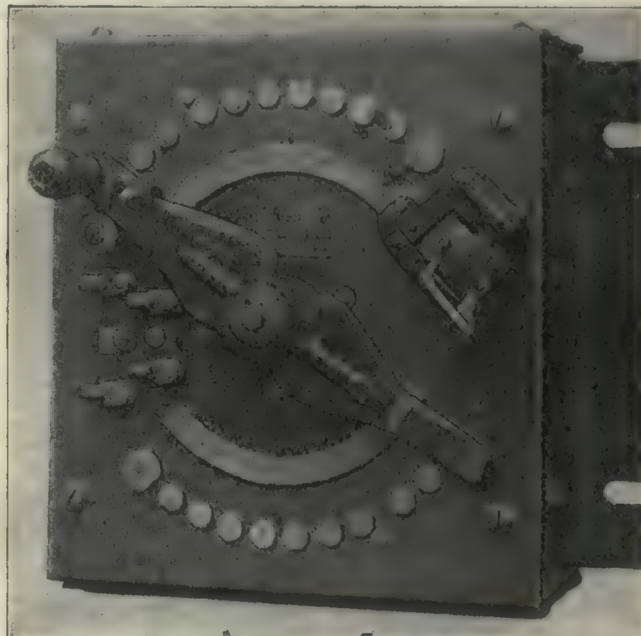


FIG. 24. A MANUALLY OPERATED STARTER FOR ALTERNATING-CURRENT SQUIRREL CAGE MOTORS

to normal speed, the operator releases the starting lever, permitting it to descend to the running position, which automatically cuts-in the fuses. A slight downward pressure on the lever, when in the running position, opens the circuit and brings the motor to rest.

This "throwing on the line," as stated, is permissible only on motors up to about 5 hp. When the motors are of larger capacity, it becomes necessary to provide

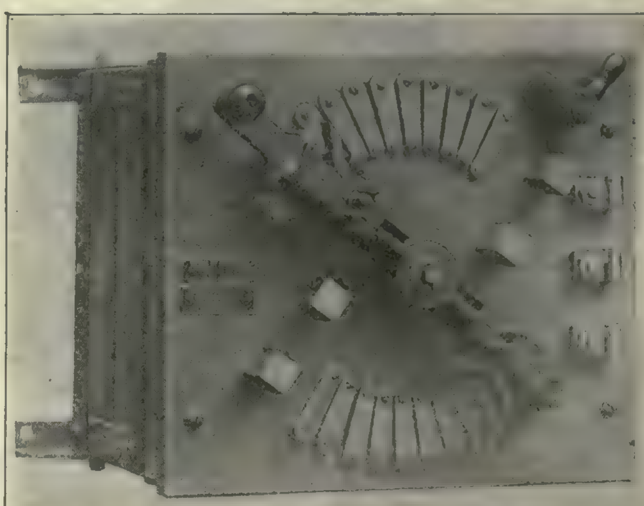


FIG. 25. A POLYPHASE ALTERNATING-CURRENT STARTER FOR SLIP-RING MOTORS

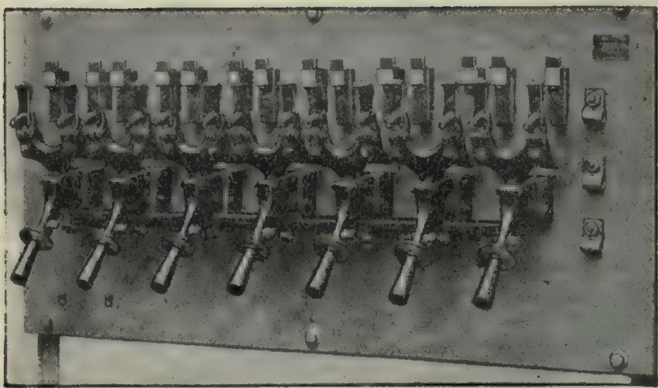


FIG. 26. A MANUALLY OPERATED MULTIPLE-SWITCH STARTER WITH SECONDARY RESISTANCE FOR POLY-PHASE ALTERNATING-CURRENT SLIP-RING MOTORS

some means for reducing the current at starting. This may be accomplished in several ways: (1) Inserting resistance into the primary circuit of the motor is the method used for squirrel-cage induction motors and for single-phase commutator motors; (2) using a starting transformer, in which taps are brought out from various points of the transformer winding, which reduces in steps the voltage applied to the primary winding of the motor during the starting period (this method is commonly used for squirrel-cage induction motors); (3) inserting variable resistance into the secondary circuit of the motor, that is, the rotor (this method obviously can be used only with slip-ring motors). The number of steps required to accelerate a motor from rest to normal speed depends, with either of these three methods, upon the size of motor and also upon the character of the load.

Squirrel-cage motors have relatively low starting torque and are applicable principally to machines requiring small turning effort during acceleration such as centrifugal pumps. Motors, with wound rotor on the other hand, are capable of giving a high starting torque, equal to, or in excess of full-load torque. They are applicable, therefore, to machines which start under partial or full load, as reciprocating pumps, and air compressors. The single-phase commutator motor is also capable of exerting high starting torque during acceleration and can be used with machines starting under partial or full load.

Manually Operated Starters

As in the case of direct-current motor control, alternating-current controllers may again be divided into the two groups of manually operated and automatic or magnetic starters. A manual starter for polyphase motors from 5 to about 30 hp. and intended for use with squirrel-cage motors, starting them by inserting resistance into the primary winding, is shown in Fig. 24. Non-inductive resistance is connected into each of two phases of the primary circuit, whether two-phase or three-phase motor. This resistance is cut out by means of the double-ended lever and is usually proportioned so that approximately 50 per cent. of full-line voltage is applied to the motor at starting. If the motor does not start at this voltage, that is, on the first point of the starter, the lever can be moved to the next one, but these starters should not be used when more than 60 or 70 per cent. of full-line voltage is required to accelerate the motor. As it is not intended to run the motor continuously with resistance in the circuit, the lever is provided with a spring, which returns the lever to the "off" position, should it be left on one of the starting points. A no-voltage release, the function of which was described in connection with direct-current starters, may also be used with these alternating-current starters.

Slip-ring motors, started by resistance in the rotor, use, for capacities up to about 25-hp., manual starters, as shown in Fig. 25, applicable to either two- or three-phase motors. The resistance should be proportioned so as to allow an inrush of current at starting of approximately 150 per cent. full-load current. This starter takes care only of the rotor circuit, and a switch or circuit-breaker in the primary circuit should be provided.

For larger polyphase slip-ring motors, 40- to 600-hp., multiple-switch starters, Fig. 26, are used for manual control, if so desired. Successive steps of resistance are cut out of the secondary circuit by means of separate switches. These are so interlocked that it is

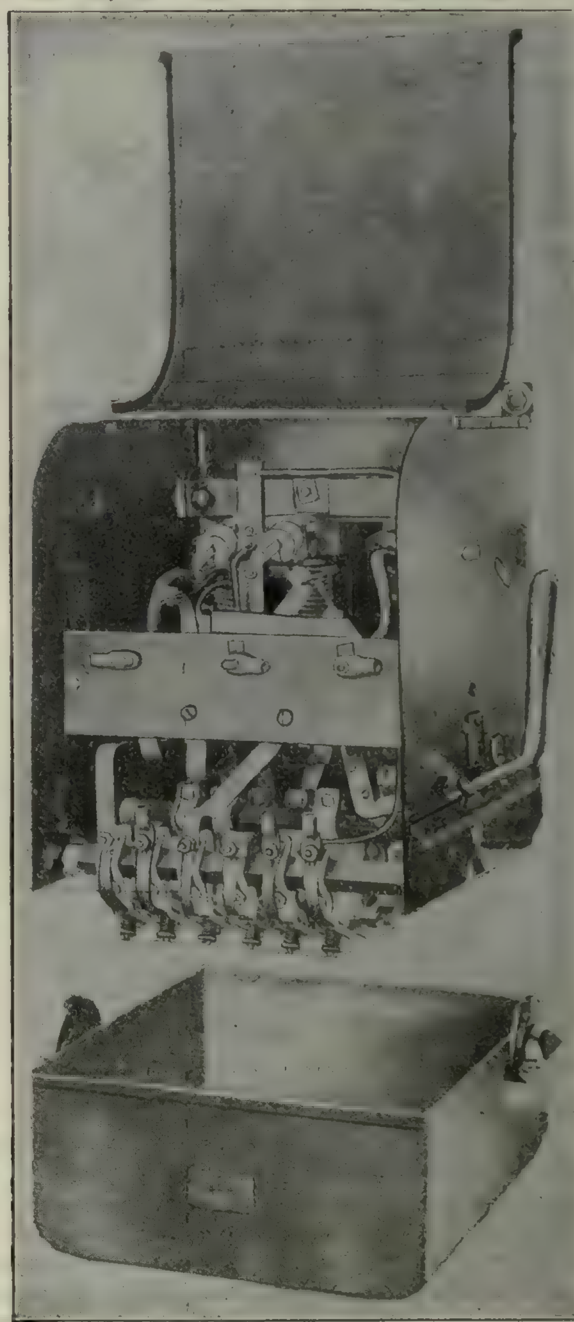


FIG. 27. AUTO-TRANSFORMER STARTER FOR ALTERNATING-CURRENT SQUIRREL-CAGE INDUCTION MOTORS

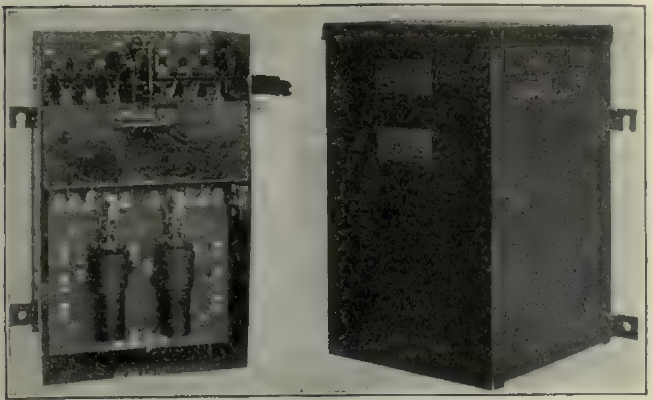


FIG. 28. ANOTHER TYPE OF STARTER OR COMPENSATOR FOR SQUIRREL-CAGE MOTORS

impossible to close them except in the proper order, and it is also impossible to leave the starter with part of the starting resistance in the circuit. The primary is again controlled by a separate switch. If a no-voltage release is provided in the secondary, it should be remembered that the primary switch must also be provided with a no-voltage release.

For single-phase commutator motors, starting rheostats, quite similar to the direct-current type are used. With alternating-current it is essential, however, that the resistor be designed so as to reduce the effect of inductance, in order that the highest possible power factor may be obtained.

Alternating-Current Speed Regulators

The speed of the squirrel-cage motor is fixed by the number of poles and cycles, for instance, on a 60-cycle circuit, 1800 r.p.m. for a four-pole winding, 1200 r.p.m. for a six-pole and so on, except that this so-called synchronous speed is reduced a certain percentage by the slip, fixed by the permanent resistance of the rotor winding. While the squirrel-cage motor, therefore, is a constant-speed motor, the slip-ring or wound rotor motor is used for variable-speed service, by inserting varying amounts of resistance into its secondary.

A polyphase speed regulator of the secondary resistance type for slip-ring motors up to about 15 hp. is shown in Fig. 27. Such regulators are designed to reduce the motor speed about 50 per cent. below normal, providing the motor takes full rated current at normal speed and the correct size of regulator is used. If the motor takes less than rated current at normal speed, the percentage of speed reduction would be correspondingly less. The terms "fan-type" and "machine-duty" regulator have been described in connection with direct-current regulators and the same distinctions are made for alternating-current work. Commercial speed regulators of the former type reduce the speed 50 per cent. with about 30 per cent. of normal current flowing, while those of the latter type use approximately 80 per cent. of the normal current. In ordering or selecting alternating-current speed regulators, in addition to the usual information on hp. volts, frequency, number of phases, fan or machine duty, there should be considered the rotor limitations; that is, the full-load current in the rotor per slip-ring, and the open-circuit voltage between slip-rings should not exceed the amounts for which the various sizes of regulators are designed. Also, independent provision must be made for controlling the primary circuit, as the speed regulator has to do merely with resistance in the secondary.

FIG. 29. A MANUALLY OPERATED DRUM-TYPE REVERSING SWITCH FOR SQUIRREL-CAGE MOTORS (COVER REMOVED)

With single-phase motors of the commutator self-starting type, similar manual speed regulators are used. Such motors are on the market in capacities up to about 10 hp. A speed reduction of 50 per cent. with normal load is commercial practice. To determine the amount of resistors needed, the resistance in ohms, required to give the desired speed, should be calculated and specified.

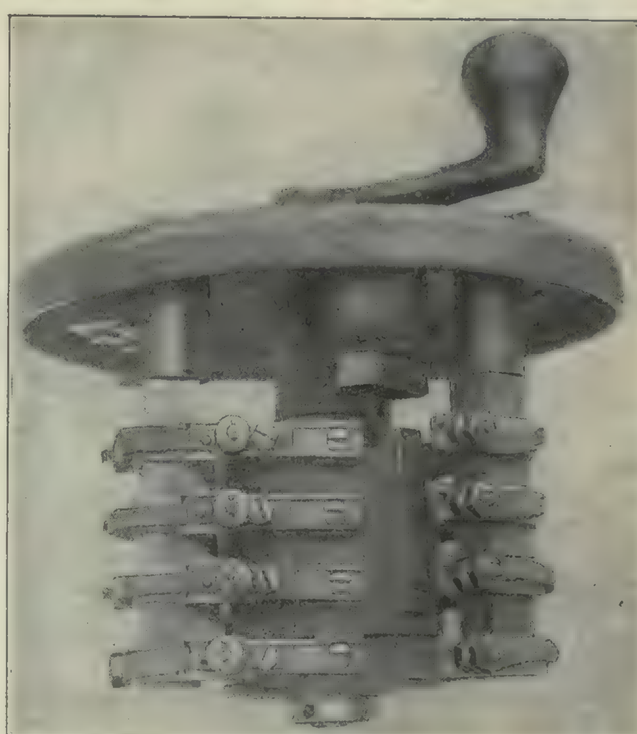


FIG. 30. A DRUM-TYPE, STAR-DELTA, OIL-IMMERSED SWITCH FOR THREE-PHASE INDUCTION MOTORS

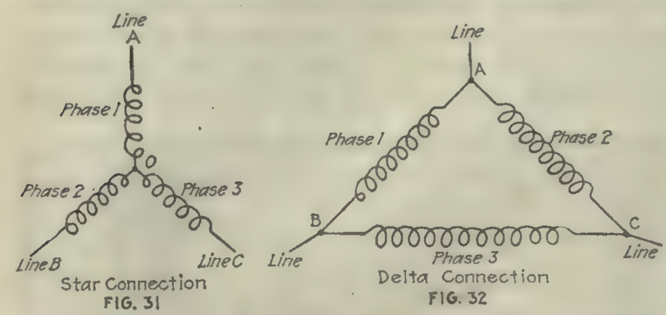
Mechanical modifications of single-phase and polyphase alternating-current faceplate controllers are obtainable for individual installations, quite similar to those described in connection with direct current; for instance, bellows operated for organ-blower service, or pressure-controlled fans, gas-pressure systems, etc.

Auto-Transformer Starters

Instead of reducing the starting voltage by inserting resistance in the primary circuit, which means loss by transformation of electrical energy into heat, the starting voltage may be reduced by means of a

transformer shown in Fig. 28. This form of manual starter is commonly employed with alternating-current, squirrel-cage motors larger than 5 or 7½ hp. These devices are known under the names of auto-transformer starters, auto starters or compensators as the principles of construction and operation are the same in all makes.

It should be understood that this type of starter is designed for use in connection with motor-driven fans, centrifugal pumps and machines of similar load characteristics, or on motors which may be started without load. It is standard practice to connect the transformer so as to supply 65 per cent. of the line voltage for starting, but different taps are brought out from the transformer winding so that by connecting the proper terminals the starting voltage may readily be changed



FIGS. 31 AND 32. A STAR AND A DELTA CONNECTION

to either 50 or 80 per cent. of the line voltage to suit load conditions in the individual case.

The commutating mechanism, Figs. 27 and 28, consists of two three-pole switches which are oil immersed and operated by a single handle. When starting the motor, the first switch is closed, causing the transformer to be placed in the circuit with the motor thereby reducing the inrush of current. After the motor has speeded up, the second operation of the handle closes the second switch, connecting the motor directly to the line and at the same time opens the first switch, disconnecting the transformer. The construction with all makes is such that it is impossible to close the second or line-switch, until the first switch to which the transformer is connected has been closed. This is accomplished by a mechanical interlocking device. The construction is such that the handle cannot be left in the starting position, as it will return to the "off" position, if released by the operator.

Standard auto starters are provided with low-voltage releases actuated by ar alternating-current magnet which holds the second or running switch in closed position. Upon failure of voltage the latch mechanism is released, allowing the running switch to return to the "off" position by the action of a spring. To stop the motor, this low-voltage device is tripped by hand. Remote control for stopping may be obtained from one or more points by using a push-button switch in the circuit of low-voltage coil.

Inverse time-limit overload protection is provided with all auto starters. Two relays are usually provided for either two- or three-phase circuits. These relays are designed to permit current adjustment and adjustment for different time intervals. The latter is done by changing the opening in the dash-pot plunger.

Desirable features from the operating standpoint, and which all manufacturers are endeavoring to incorporate in their designs, are general ruggedness of the apparatus, easy accessibility of all parts, clean-cut arrangement of the various parts and wiring, renewable copper contact pieces with ample surface and self-cleaning properties, and, finally, sufficient supply of oil over the contacts with freedom from oil leakage.

Compensators are commercially obtainable in sizes up to 100 hp. and all standard voltages from 110 to 2200 volts, as well as all standard frequencies.

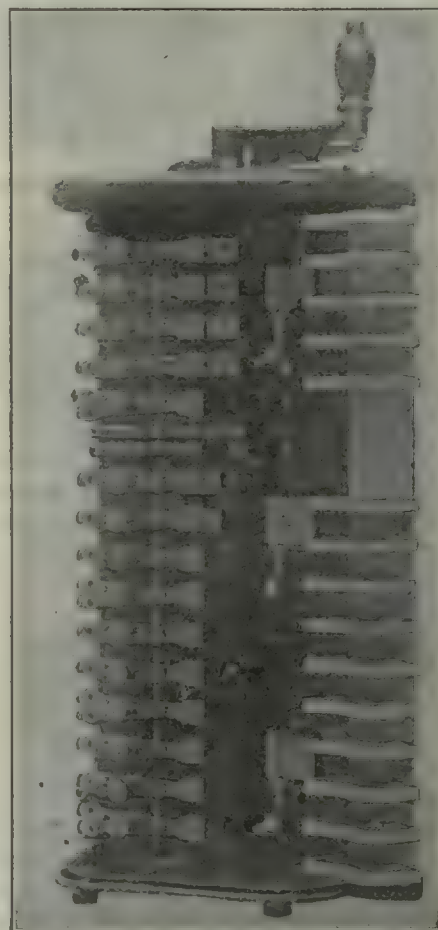


FIG. 33. AN INTERIOR VIEW OF A DRUM-TYPE REVERSIBLE CONTROLLER FOR ALTERNATING-CURRENT SLIP-RING MOTORS

Drum-type controllers are, in general, used in preference to faceplate starters, where frequent starting and stopping is required. They are rugged, easily inclosed, provided with barriers, renewable contacts, etc. They may be reversible or non-reversible, and may be used with squirrel-cage as well as slip-ring motors. Fig.

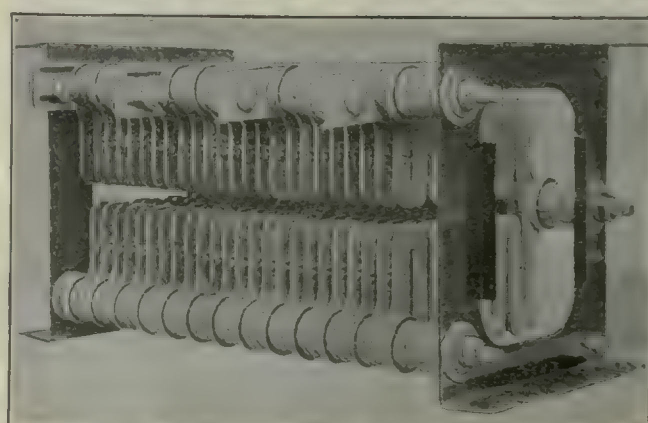


FIG. 34. A TYPICAL GRID-TYPE RESISTANCE UNIT MOUNTED IN A PRESSED-STEEL FRAME

29 shows a drum-type reverse switch intended for high torque, polyphase, squirrel-cage induction motors. This really is nothing but a three-pole switch and the motor is thrown directly on the line. This type should be used only where the maximum rating does not exceed 5 hp. at 110 volts or $7\frac{1}{2}$ hp. at 220 to 550 volts and only when the starting current does not exceed two and one-half to three times the full-load current. This switch disconnects all three lines of a three-phase circuit, while on a two-phase, four-wire circuit, one lead is to be permanently connected to the motor. Manual operation may be by a hand lever or sprocket suited for rope or chain pulls.

For motors up to 20 or 25 hp. at 440 volts, similar switches, oil-immersed, can be used, provided that it is permissible to connect motors of this size directly to the line. This switch is provided with a low-voltage release magnet and is designed for one direction of rotation only. There are three sets of fingers, which engage with contacts on the drum to make proper connections. Reversing switches of similar construction are on the market for use with motors required to operate in either direction of rotation.

Star-Delta Starters

Squirrel-cage motors up to about 20 hp. capacity are frequently started by a so-called star-delta switch. For small capacities, this switch is sometimes built as a knife switch, but the drum-type, oil-immersed construction, Fig. 30, is preferable. The action of the star-delta switch is based upon the fact that the three phases of the primary winding of a squirrel-cage motor may be connected in star, Fig. 31, or in delta, Fig. 32. In the star connection the phase voltage equals line voltage divided by 1.732, and in the delta connection the phase voltage and the line voltage are identical. In other words, the current entering at *A*, in Fig. 31, passes through *phase 1* and then *phase 2*, in series; while, in Fig. 32, the current at *A* is divided into two branches, *phase 1* and *phase 2*, in parallel. The line voltage, between *A* and *B* includes two phases; in Fig. 31, connected together in the star-point *O*, while in Fig. 32, the ends of each phase are connected directly between the points *A*, *B* and *C*.

Starting on a star connection and running on a delta connection reduces the starting voltage in the ratio of 1 to 1.732, or 58 per cent., while in the running position each phase has the full-line voltage impressed upon it. The primary winding of the motor must of course be arranged for this change in connections and the switches are designed so as to make it impossible to go directly into the running position when starting. It is necessary to pass through the starting position to reach the running position and when stopping, on the other hand, provision is made for passing directly to the "off" position.

Alternating-current motors of the slip-ring type, on account of their high starting torque, are particularly adapted for crane and hoist service. A reversible or a non-reversible, drum-type controller, similar to Fig. 33, is used for this service which requires frequent starting and stopping of the motor. The three-phase or three-wire, two-phase controller provides a double-pole primary combined line and reversing switch. With two-phase, four-wire controllers, a single-pole primary switch is added for handling the second phase of the motor. All these drum controllers contain contacts for the secondary starting and regulating resistors. The resistors, Fig. 34, are cast grids mounted in a sheet-steel frame and are customarily designed for intermittent duty not exceeding 150 per cent. of the motor rating for both primary and secondary circuits, and are proportioned to reduce the speed 50 per cent. under half-load conditions. To select the resistors properly, it is necessary to know in addition to the usual data on horsepower, voltage, frequency, phase and character of load, the maximum full-load rotor current per ring, and the maximum open-circuit voltage between slip-rings at stand still.

The hand lever may again be replaced by rope or chain drive as mentioned for other controllers to suit operating conditions.

Roughing-Out Bevel Gears on a Shaping Machine

By W. H. Addis

A very unusual sight is a 16-in. crank shaping machine engaged in automatically gashing bevel gears, and that at a high rate of production. This is done in the jobbing shop of the Indianapolis Tool and Manufacturing Co.

In order to accomplish this task on a shaping machine, the following cycle of functions must be provided for:

1. An automatic downfeed for the toolslide.
2. An automatic release for the toolslide permitting the tool to clear the gash while indexing.

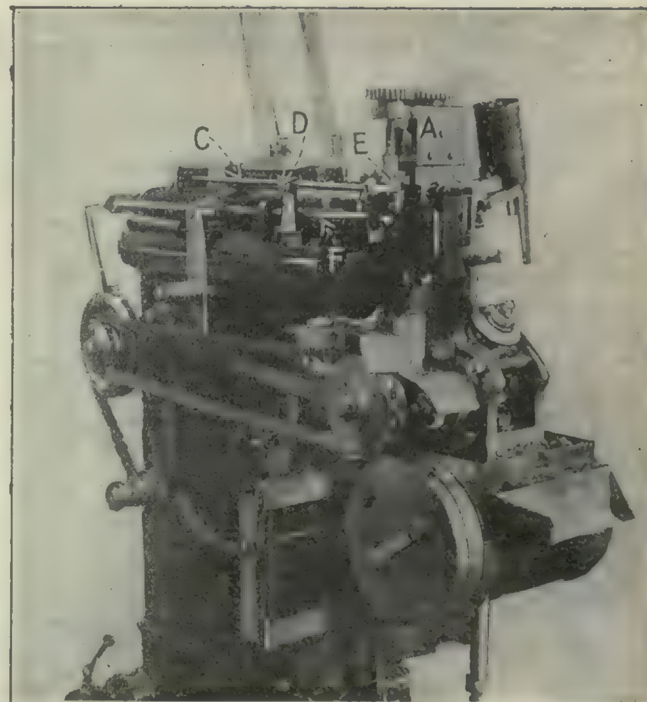


FIG. 1. A MODIFIED SHAPING MACHINE FOR GASHING BEVEL GEARS

3. An indexing device which will automatically function in unison with all other members.

It was first necessary to remove the feed screw from the toolslide. The cast-iron angle plate *A*, shown in Fig. 1, was then bored to form a housing for the timing gears and attached to the toolslide by three capscrews. Directly beneath the large timing gear on the toolslide a pair of face cams with $\frac{5}{16}$ in. rise and fall every 120 deg. of revolution of the gear, serve to impart the downfeed and release to the tool. In Fig. 2, a strong spring which

lifts the toolslide as the cam falls will be seen at B behind the toolslide.

It will be seen in Fig. 1 that the large gear on the toolslide is driven by the small gear. The latter is keyed to a shaft, which has its lower bearing in an angle plate screwed to the machine body. This shaft is actuated by a ratchet feed so designed that it is impossible for it to move more than one tooth at a time. The purpose of this is to prevent the tool being fed into the gear blank more than a determined depth at a cut. The clever part of this device is the method that is used to feed the ratchet. In Fig. 2 the ratchet-feed shaft C, which is made of ½-in. cold-rolled steel, will be seen having its bearing in the stuffing box D, mounted on a stud attached to the gib plate. Now it is evident that as the shaper ram moves in a reciprocating manner, the ratchet E which is on the head of the ram, will cause the ratchet shaft to reciprocate with the ram. Therefore by simply tightening the stuffing box to the point where its resistance is sufficiently great to overcome the resistance opposed to it by the mechanism above described in moving the ratchet forward one tooth, the reciprocating movement of the ram will cause the ratchet to feed forward carrying the driver gear with it and turning the driven gear a sufficient amount to cause the cam which is attached to its under side to feed the tool the required depth. This action is repeated every stroke of the ram.

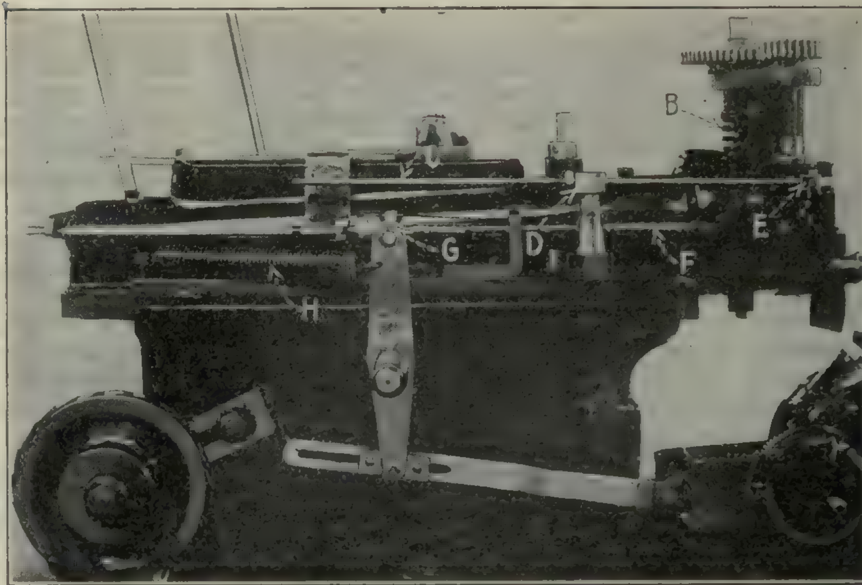


FIG. 2. A SIDE VIEW OF THE SHAPING MACHINE

Timing the Index

In both Figs. 1 and 2, a ¾-in. cold-rolled timing shaft F will be seen parallel with, and directly beneath the ratchet-feed shaft. This shaft is operated by the shaft of the driver gear through a pair of miter gears. The gashing operation is so timed that one revolution of the driver gear cuts the full depth gash. Now as the driver-gear shaft makes one revolution, so does the ¾-in. timing shaft. Taking advantage of this a dog is keyed to the timing shaft, so that a projecting lug which it carries on its surface will be struck by the trip which is clamped in position directly back of the stroke lever. In Fig. 2, the trip and timing dog are shown in position of contact at G ready to trip the rocker-arm. This will release the index pin, thus permitting the automatic index to operate. A study of Fig. 1 will show how power is transmitted from the drive shaft of the shaping machine to the countershaft and thence direct to the index head. Flanged pulleys and a special non-slip belt are used. Fig. 3 shows a close-up view of the indexing mechanism with the drive pulley removed. This drive pulley contains an internal ratchet which idles past the pivoted pawl when the index pin is in position. In Fig. 3 the index pin is shown removed. As the motion of the internal-ratchet drive pulley is clock-wise, it will be seen that the pivoted pawl with its spring tension serves to keep the index plate firmly against the pin while the gashing operation is being accomplished, but the instant that the timing dog strikes the rocker-arm and the index pin is released, restraint is removed from the drive pulley, and there is sufficient tension against the internal ratchet to index the gear blank. Only one stroke of the ram is required to actuate the rocker-arm so that by the time the indexing operation is complete the index pin has returned to its place, due to the pull of the large coil spring H which pulls the rocker-arm back in the position shown in Fig. 2.

The expense of special machines is usually excessive, but here is a most practical and highly efficient adaptation of the shaping machine that is neither extravagant in cost nor difficult to make.

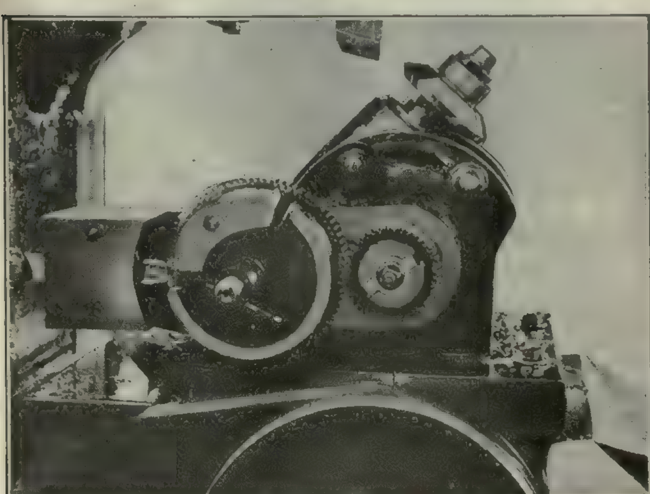


FIG. 3. OPERATING GEARS OF THE INDEXING HEAD

Repairs on Pump Valves

By W. F. Johnson

We had been having trouble with our duplex pumps by reason of the valve seats, which were threaded into the openings in the deck, working loose and destroying the threads.

It was impossible to re-thread the openings because of their being so close to the side walls, so I reamed them out to a slight taper, made valve seats to fit them, and forced the latter into place, facing them off afterward.

The first two valves were repaired in this manner in February, 1919, and upon recent examination were found to be tight and in good condition.

"Caterpillars" and Their Construction—V

By K. H. CONDIT
Managing Editor, *American Machinist*

"Caterpillars" have been field-tested by our Army in Texas, Hawaii and Mexico, by the British on four fighting fronts, by the French on one and by the makers in this and 45 other countries. Factory tests cannot be expected to duplicate all these conditions but they are strenuous enough to develop any hidden weakness.

(Part IV was printed in last week's issue.)

PUTTING together something over 13 tons of tractor is considerable of a job and keeps the traveling crane operators on the jump. The big shop, Fig. 39, where the "120's" are assembled is no place for the unwary bystander for he is likely to have almost anything from a tote-box to a whole tractor dropped on his neck if he fails to heed the warning of the crane man's Klaxon horn.

FIG. 39. OLD ASSEMBLING SHOP

The railroad track in the center of Fig. 39 runs out of the front of the picture to the stockroom; the machine-shop door is at the right and the foundry at the left. Parts from these departments arrive by electric truck and are quickly swallowed up in the assembly stream, one branch of which starts at the far end of the shop on the left and the other about half way down on the right under the gallery. In the right-hand gallery the radiators and sheet-metal parts are put together while the left-hand gallery is devoted to engine assembly. At the far end on the right are the test blocks and stands where the motors and completed tractors are given their initial runs.

The two cranes, one of 15 tons capacity and the other of 10, have something in the air most of the time and their efforts are supplemented by various chain blocks and air hoists scattered about the floor.

The blacksmith shop is opposite the test blocks and just this side of it are the bull dozers, punch presses, shears and riveting machines which form the frames of the big tractors. In many respects this part of the building is like a bridge shop, and with reason, for the frame, Fig. 40, is largely a structural steel job. Here, too, the front wheel, Fig. 41, which is much the same sort of a proposition, is put together ready to go into its round turntable in the frame.

There is good reason for the massive construction of the tractor skeleton in the treatment that is likely to be accorded to it. They tell a story of a western rancher who took a chance on a weak bridge and dropped himself and his "75" 14 ft. into a shallow river. The service station heard of the accident that afternoon and started a rush inventory of spare parts for which an urgent call was anticipated.

AUTOMOTIVE CONSTRUCTION

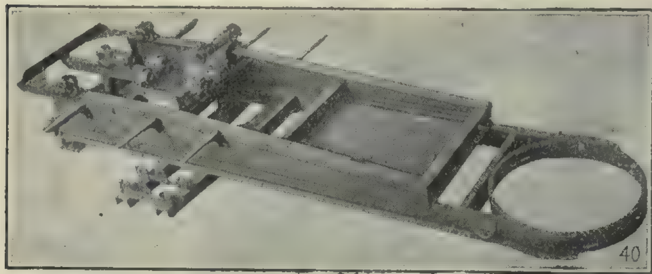


FIG. 40. FRAME OF 120-HP. TRACTOR

Nothing was heard from the rancher until the next morning when he telephoned in to say that his engine wasn't working very well and he couldn't get a spark plug where he was, and wouldn't they please send him one as soon as possible. The astounded dealer got his breath long enough to inquire about the episode at the bridge and the extent of the damage, and was informed that the canopy top had been bent a little but that everything else was all right.

The finished frame is brought by crane to the right foreground of Fig. 39 where the main assembly really begins. The first job on the frame is the layout for the location of transmission gear case and main friction-shaft bearings. Holes for the hold-down bolts are then drilled with a Ryerson radial drilling machine and these parts fastened in place. The babbitting jig, a drawing of which appears in Fig. 42, is then put in place as shown in Fig. 43 and the babbitt for the transmission and friction-shaft bearings is poured. The bearings are then reamed with the pneumatic reamer shown in action in Fig. 44 and finally handscraped as illustrated in Fig. 45.

In the meantime the various unit assemblies have been completed at their stations under the galleries. The pinion shaft, belt shaft and countershaft have been made ready for the transmission, the master clutch has been assembled on its shaft, the roller frame and main drive shaft are ready, the frictions are located in the friction wheels and the first-motion driving chains are ready to link up.

Just beyond the main frames on the right-hand side of the shop are long, heavy planks supported on horses. Here the proper number of track links for one track are laid end to end, the track pins connecting them are driven into place and the track-pin keepers are inserted and bent over to hold the pins. The track shoes and grousers are then laid on and their bolts driven in. A crane picks up the track by one end, turns it over and lays it down again other side up so that the nuts can be screwed on the track-shoe bolts. Fig. 46 shows the track undergoing the last-mentioned operation on its tables.

Up in the engine gallery the crankshafts come over from finish-grinding and the six connecting-rods are fitted to the crankpins and run in for 2 or 3 hr. in the fixture shown in Fig. 47 which is simply an old crank case with one side cut out and crosshead guides bolted on in place of cylinders. A good feature of the fixture is the quick action of the front plates of the crossheads which have inclined slots sliding on two guide screws and are locked in position by clamp nuts.

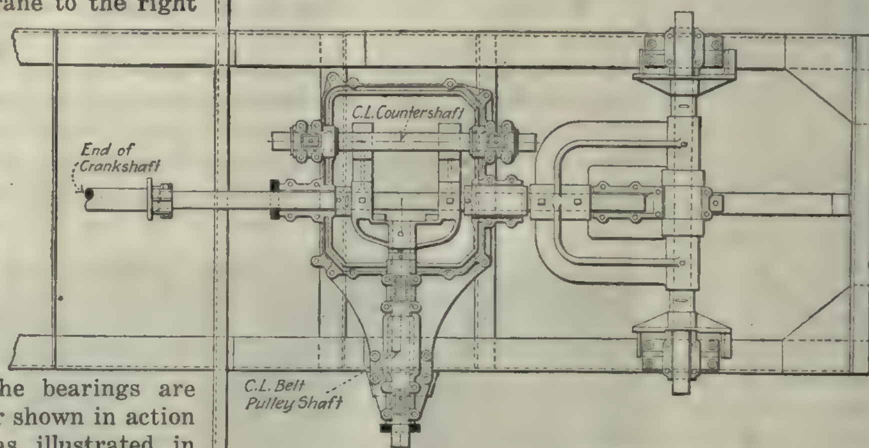


FIG. 42. BABBITTING FIXTURE

The crank case is carefully cleaned and painted white inside and the crankshaft is then put in and spotted down on the bearings. This usually takes about two days and the bearings are then run in for from 8 to 16 hr. An 85-per cent. bearing surface is required.

The next step is to assemble the cylinders, rods and pistons which takes about two hr. and is followed by a further running in of 1½ to 2 hr. The rod bearings

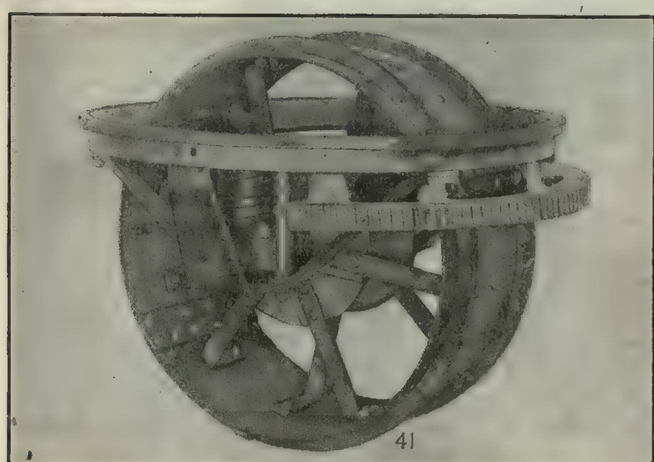


FIG. 41. FRONT WHEEL

FIG. 43. POURING THE BABBITT

AUTOMOTIVE CONSTRUCTION

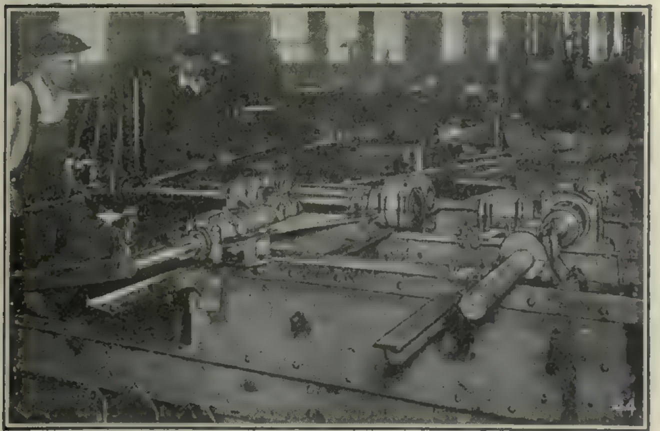


FIG. 44. REAMING THE BEARINGS

are then inspected for bearing surface which must also be 85 per cent. This inspection passed, the motor goes on to final assembly where the camshaft and gears, pushrods, manifolds, carburetor, magneto, etc., are installed.

The finished motor is pushed out on the pulpit which is dimly visible near the back of the shop on the left in Fig. 39, and picked up by the crane to be dropped on the test block near the door. Here it is given dynamometer test run of 8 hours.

At the conclusion of the test run the motor is taken to the partly assembled tractor and lined up. It rests on a rigid cross-member at the rear but the front end is carried on a cross-piece which is pivoted so that it can rock transversely thus providing three-point support. The pivoted support is drilled for the motor hold-down bolts and these are dropped in place and remain until the rear holes have been spotted. The motor is then returned to the block for inspection and the holes in the rear cross-member are drilled.

While waiting for the motor to finish its test the tracks have been put on, the platform mounted and holes drilled for the bolts which hold it, and the various gears and shafts put in place and fastened down. With the motor in position the master clutch can be assembled to connect motor and transmission, the frictions, drive chains and controls connected up and steering wheel and radiator and water pump mounted. When the fuel and water tanks have been added, the tractor is taken down to the test blocks where it is mounted on heavy horses with its tracks free to revolve and run for 8 hr. at about 300 r.p.m. to smooth out the rough spots and make adjustments.

After the block test the transmission cover is put on and fastened down and the machine is turned over to the field tester for 16 hr. of punishment, of which there is more later.

In a newer part of the plant they are assembling the 10-ton artillery tractor. Fig. 48 shows this shop with progressive assembly on trucks proceeding at the right of the picture. One difference here that strikes the observer at once is the use of a one-piece frame made of cast steel instead of the riveted structural type. Fig. 49 shows this frame with two side extensions in place. The very low percentage of rejections, less than 1 per cent., in these castings was rather remarkable. A special wheeled carriage for radial drilling operations on this frame is shown in Fig. 50.

In this shop, as in the older one, unit assemblies proceed in the side bays and join the main stream as needed. The finished machines are run in on horses near the far door and driven outside for further testing.

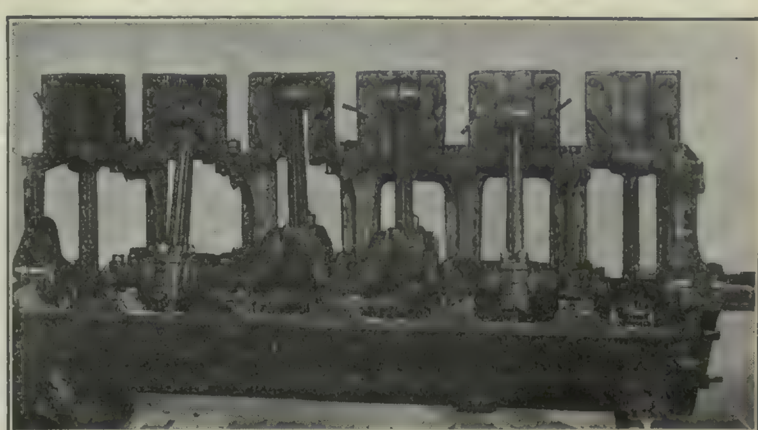


FIG. 47. CRANKSHAFT RUNNING-IN FIXTURE

Originally this testing was conducted in the factory test field which is one of the roughest and most unpleasant looking places for pleasure driving imaginable. Here they were driven round and round until they had

FIG. 45. HAND-SCRAPING THE BEARINGS

FIG. 46. FINISHING THE TRACK ASSEMBLY

AUTOMOTIVE CONSTRUCTION

FIG. 51. FRONT VIEW OF 10-TON ARTILLERY TRACTORS ON TEST

FIG. 48. NEW ASSEMBLING SHOP

made their 20 mi. and if it rained it was almost as much of a job to clean the tester as it was to wash the tractor. Besides, the difficulty of making adjustments to mud-encrusted tracks and friction clutches was enough to daunt any but the most conscientious tester, and things sometimes got by as "good enough" which might have been better.

Then some ingenious individual hit upon the testing device illustrated in Figs. 51 and 52. It consists of a heavy timber frame with a well-braced end piece to which the tractor is chained so that it can't get away without breaking something. The grousers are taken off and the smooth tracks travel around on ordinary heavy planks. Of course they chew up the planks every

FIG. 52. REAR VIEW OF ARTILLERY TRACTORS ON TEST

FIG. 53. A DRY DAY IN THE TEST FIELD

AUTOMOTIVE CONSTRUCTION

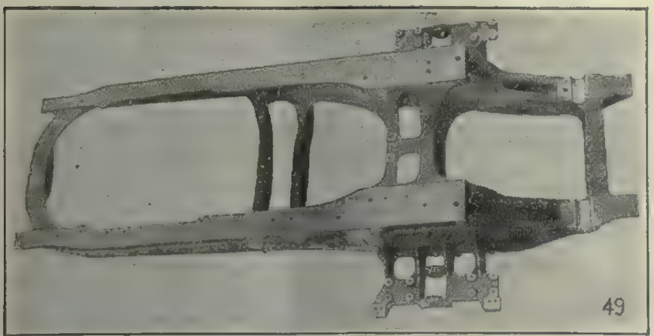


FIG. 49. CAST-STEEL FRAME OF 10-TON ARTILLERY TRACTOR

little while and new ones have to be put in, but this expense is infinitesimal compared with the saving in labor, for two men can take care of 10 test stands and get better results than the old system, with one man to each machine, ever did. They do their 20 miles standing still and stay perfectly clean while they are doing it, and the tester can get right down alongside and watch the tracks go round. He can thus make his adjustments more intelligently and far more accurately than he could with two inches of mud over everything.

Since these pictures were taken a very simple safety device has been added to the test frame. An upright is nailed to the end piece and from it a piece of wire leads to the ignition switch so that, should the tractor break loose, the wire would cut the switch and stop the machine before it went through any buildings, which was not unlikely.

To make sure that these machines are still able to navigate bad country, about one in every 10 is taken to the test field and put through the regular stunts which all the "120's" have to do. Fig. 53 shows one of the big fellows out on the test field on a dry day, a little uneven, but not bad going. Fig. 54 shows the same place on a day which was not so dry and portrays some of the joys of tractor testing.

FIG. 54. DAMP WEATHER IN THE FIELD

Testing at the factory is not confined to the test field, however, as will be seen in Fig. 55, which shows some hill work not very far from the factory. This same Nigger Hill, as it is called, has been the scene of many crucial tests. Beyond Nigger Hill is a stretch of highway which the Holt people have adopted and dubbed the "Caterpillar Trail." They keep it in condition and in so doing try out their tractors on road-building work.

One of the most spectacular tests pulled off near the factory occurred during the heavy blizzard of 1918, which blocked traffic all over the country. The account written by a reporter for one of the Peoria papers gives a good picture of the performance:

"The Holt Manufacturing Co.'s 3-ton Packard trucks used for freight transportation clogged down in the

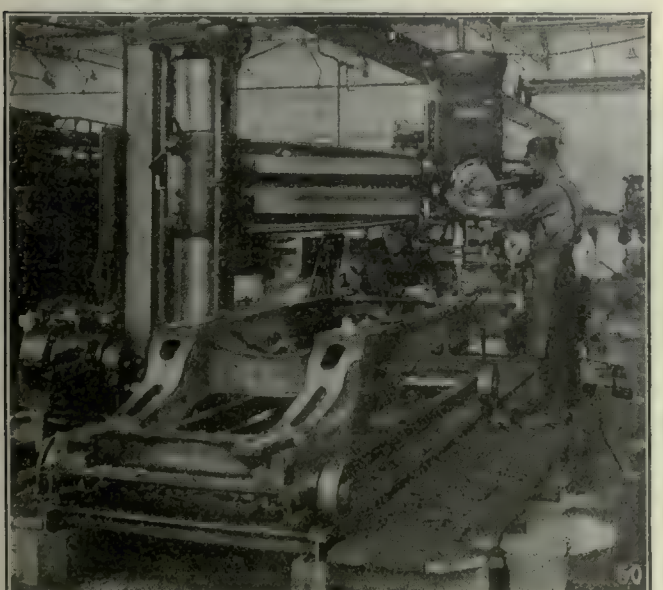
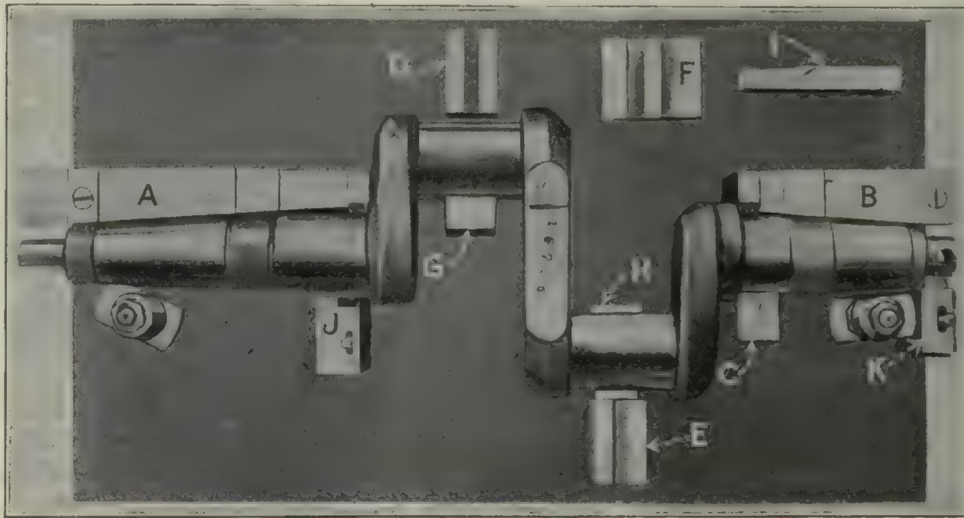


FIG. 50. DRILLING OPERATION ON STEEL FRAME

FIG. 55. TESTING CLIMBING ABILITY

snow yesterday afternoon. The rear wheels spun around but no progress could be made. An appeal for help to the factory brought out a 75-hp. tractor and two 16-ton 'Caterpillar' trailers. Over the top of the light snow went the heavy, unwieldy - looking machinery, packing it down only slightly. The Packards were unloaded and their loads put in the trailers. Then the big tractor took the two trailers in tow, hitched the trucks on behind and chug-chugged its way solemnly back to the factory. 'Some tractor,' remarked a soldier who had watched the performance."



CRANKSHAFT INSPECTION GAGE

"Some tractor" is pretty nearly right, and now that their war work is finished they can go back to their regular jobs of pulling farm machinery over the fields of the world and drawing the produce to market, stopping in the meantime to act as power plants for the harvesters and threshing machines.

Crankshaft Inspection Gage

By Fred H. Colvin

After the crankshaft has been finished and before it goes to final inspection it is placed in the gage shown in the illustration, and the general dimensions checked over by the inspector. The gage consists of the large flat plate on which are mounted supports for the crankshaft, and also blocks to be used in connection with some of the various gages. One of the supporting blocks is shown at *C* and there is a corresponding block under the outside of the corresponding crank at the other end.

The shaft is pushed up against the blocks *A* and *B*, which show the taper of the ends, the shoulders at the ends of the bearings, the length of thread, as well as the overall dimensions.

The blocks *J* and *K* are sliding gages which contact with the diameters shown, and measurement is determined by the "feel" at the end of the block. At *D* and *E* are two locating points, both of which receive the block *F*, positioning it by means of the tongue and groove shown. This block gages the length of both crankpin bearings and the radius of the fillet at the ends.

The crankpin diameters are gaged by means of the bar *I*, which has three checks, as will be noted. This bar is slid under the crankpin at either *G* or *H*, and determines the high or low limits and the permissible diameter in each case. The position of the bar shows whether it is a high- or low-limit crankpin, and in the same way rejects those which are either too large or too small, or otherwise unsuited.

Taken all together, this forms a very complete gage of simple design, and has been found very satisfactory for the work it was designed to perform.

Contracts and Contractual Relations—III

BY CHESLA C. SHERLOCK

Legality is certainly an important element of contracts. Never from the earliest times has the law enforced or upheld contracts which were illegal. While parties may consent to a thing, it must be remembered that a contract derives its force from the sanction of the law and not from the consent of the parties.

(Part II ended in our Jan. 29, 1920 issue.)

IF THE parties to a contract were permitted to set up their consent as being the controlling element, they would be enabled to defeat the whole purpose of the law. They could, by the medium of an agreement, commit offenses against the law which would not be tolerated under other circumstances.

In a Federal case, it was pointed out that the whole doctrine relating to illegal contracts was founded upon a regard for the public welfare. It has come to be recognized by the courts that a fundamental principle of the law of contracts is that a contract, in order to be valid, must have a lawful purpose, and that any transaction in violation of the law cannot be made the subject matter of a valid contract.

Very often the illegal feature of the contract is the consideration, but nine times out of ten the matter to which the courts object is the end to be accomplished by the contract. If that end is illegal or contrary to the law of the land, no matter how reasonable the other provisions of the contract may be, it will not be enforced by the courts.

WHAT CONSTITUTES AN ILLEGAL CONTRACT

It should be remembered, however, that the intention of the parties has a great deal to do with the legality of the contract, as it does in other phases of contract making. While the law will not construe a contract unlawful merely because some third party may make an unlawful use of the subject matter of the contract, still, where the intention of the parties is clearly to contravene some statute in fraud of the public, the contract will be deemed vicious and without effect.

In Michigan it has been said that agreements which are lawful in themselves, but which are merely steps in accomplishing an unlawful end, will not be enforced as being against public policy. And in Florida it has been said that if the effect of the contract is to reach an unlawful end, that it will be declared unlawful regardless of the actual intention of the parties. The law will no more permit the parties to blunder into a violation than it will permit them to achieve that purpose through design and planning.

The courts have attempted to state concisely just what contracts were illegal, and the result of an examination of the leading decisions shows that a contract is illegal when it is contrary to law, morality or public policy.

A valid contract may be entered into, but if it cannot be performed without violating the law, it is null and void whether the parties knew the law or not at the time they entered into the agreement.

It has been said that where a contract can be performed in both a legal manner and in an illegal manner that it will not be declared void, because the law will not impute bad motives to any man where fair and honest intentions are sufficient to account for his conduct.

And in Tennessee it was announced, as a rule, that where a contract can be performed in a lawful manner, it will not be declared void merely because it was performed in an illegal manner, but where a contract is entered into with an intent to violate the law, it is illegal, even though the parties in performing it may actually depart from it sufficiently so as not to transgress the law.

It is also well to bear in mind that there is a distinction in the degree of intent necessary to defeat a contract. The mere fact that one of the parties intended to perform the contract in an illegal manner will not operate to render it void. The illegal intent must have been the common purpose of both parties to the agreement. And it has been said in both Iowa and Montana that the mere fact that one party was actuated by evil motives while the other was blameless will not permit the first party to escape liability in an action brought by the latter for breach of its terms.

EXAMPLE OF ILLEGAL CONTRACTS

As to the manner in which the contract may be illegal, there are a number of common instances which should be within the experience of every person who has had much to do with contracts.

In the first place, we have contracts which are in violation of statutes. If the contract seeks to achieve a purpose which is clearly within the prohibition of the statute, it is absolutely void from the beginning. The statute itself is the best evidence of what the legislaure was intending to do, and if the contract is clearly in violation of the prohibitions set down by the statute, it cannot survive before the courts.

Then, again, we have contracts which are in opposition to public policy. This often amounts to a vague term, and even the courts have not successfully defined just what is meant by public policy. However, the definition given by an English jurist many years ago has been looked upon with favor by many of the authorities. He stated it to be the principle which declares that no man will be permitted lawfully to do that which has a tendency to be injurious to the public welfare. In New Jersey it has been pointed out that public policy is constantly changing with new laws and that it will constantly require a new application of old principles.

Contracts involving a wrongful act or omission are generally held to be illegal. Among this class of contracts would be those aiding a public enemy, inducing the commission of a crime, an immoral act, inducing a breach of trust or confidence, or in fraud, or relating to negligence, generally.

Contracts affecting the public service are generally looked upon as illegal; that is, if one attempts to contract with a public official in regard to his duties in any way. It has been said that a public officer cannot enter into a contract to perform his duty, because he is already required by law to do that; and that he cannot enter into a contract to refain from performing his duty, because he is prohibited from doing that. Such a contract is null and void from the beginning and is of no effect whatever.

The same may be said in regard to contracts which

affect or interfere with the administration of justice. This not only looks to tampering with judges and jury, but also where an attempt is made to conceal evidence or testimony, interference with justice or the enforcment of the law, concealment of crime, or attempting to procure a mitigation of the punishment or a pardon.

Gambling Contracts

Gambling or wagering contracts, if not prohibited by statute, are generally held to be contrary to public policy and will not be enforced. The contract probably is good so long as it is voluntarily carried out by the parties themselves, but the courts will never attempt to adjust rights between parties to a wagering contract. It will leave them where it found them, just as soon as the wagering character of the agreement is apparent.

Contracts in regard to the marital relation, while probably not illegal in every instance, are frowned upon by the courts and in most instances are found to be illegal.

Contracts in restraint of trade have already been considered at some length in these columns. They fall under the class of contracts ordinarily held to be illegal by the courts.

Contracts to suppress bidding at a sale or auction are not looked upon with favor by the courts. To suppress bidding at a public sale is a fraud on the public as well as it is at a private sale, and an agreement in regard to bidding for public work is so vicious that it can never hope to receive any consideration at the hands of the courts.

Contracts may be illegal in part and legal in the remainder of their provisions. While there is a disagreement among the authorities as to whether a contract illegal in part is unenforceable in whole, it seems to be generally conceded that if a contract illegal in part and legal in the remainder can be severed into its legal and illegal portions that it will be enforced as to the part that is legal and ignored as to its illegal portions. But if it is so interwoven as to be incapable of severance, it is void as to the whole.

It is a general rule of law that no action can be based upon an illegal contract, and such a contract cannot be enforced by one party against another. The effect of illegality in contracts is generally as to enforceability.

While the interpretation of contracts is largely controlled by purely technical considerations at the hands of the courts, it is well for business men to know something about these considerations in order that they might know what will happen to the contracts which they chance to enter into.

In fact, the most important thing to know about a contract is to know what the courts will do to it if they have an opportunity to consider it. A learned judge of my acquaintance once said that he had never seen a contract that he could not drive a team of horses through. But we are either not all as brilliant as my friend or else the disposition of the courts is changing, for no such theory holds true in the recent decisions of the courts.

In the interpretation of contracts, the courts will first attempt to ascertain the intention of the parties, and, having done that, they will apply the remedy in the direction that it should be applied. It must be remembered that the courts will not ask the parties what their intention was, but that it will look to the contract itself for evidence of that intention.

It is obligatory, then, for the parties to exert care and caution in drawing up their agreement, and be sure that it clearly expresses their intention and agreement. Do not leave several items out and have them understood between yourselves, for if the matter ever comes to court only those items entered in the written instrument will be considered. And to have the contract exactly express the intention of the parties should be the goal of every contract maker.

The court will look to the nature, the subject matter and the purpose of the contract. It will examine the consideration and it will be controlled by the principles which we have already discussed in this series of articles.

Where it is possible for the courts, due to an uncertain expression of the intention of the parties to the contract, to give it a construction which would show it to be illegal as well as a construction to show it to be legal, the courts will construe the contract as being legal and valid, for it will never impute a bad intention to the parties. There is a presumption that, other things being equal, the parties intended to do the right thing.

In Illinois, Pennsylvania, Vermont and Wisconsin it has been said that the contract must receive a reasonable interpretation, according to the intention of the parties at the time of executing it, if that intention can be ascertained from their language. So the courts will not put an unreasonable construction on the contract, unless it is so ambiguous as to be impossible for the court to reasonably discover the intention of the parties.

Language Subject to Natural Construction

The language of the contract largely controls and it will be interpreted according to its usual meaning as used in the community. Words capable of two or three constructions will not be given an unnatural construction, but a natural construction according to the common usage in the locality or in the trade in which the parties are engaged, or to their relation to the subject matter of the contract.

If, from the acts of the parties, it is possible to determine what construction the parties themselves have given to the contract, the courts will generally follow that construction, for the parties are presumed to know more about the purpose of the agreement than anyone else.

The courts generally are given the opportunity to examine contracts through the efforts of the parties, or one of them to secure some relief.

The usual remedies for breach of contract are either for an action of damages in a law court or for specific performance in a court of equity.

In case of an action for damages, the party injured seeks to recover from the other party the value of the damage which has been done by reason of the failure of such party to perform his agreement as expressed in the contract. Oftentimes the amount of the damage is expressly agreed upon in advance in the contract by the parties. Then, again, it is a matter entirely for the court and jury to determine.

In case of specific performance the aggrieved party does not seek damages, but he seeks to compel the other party to perform his portion of the agreement. The contract may be of such a nature that damages would never compensate him if the other party fails to carry out his agreement.

While the remedies sought in the two cases must of necessity come up in different courts, they will not apply different rules of construction or interpretation to the contracts, but will be largely governed by the same rules.

It is true that the courts will never permit the introduction of parol testimony to vary the terms of a written contract, but in certain instances they will take parol testimony in order to reform the terms of the written instrument, so as to make it express the actual intention of the parties.

For instance, if the parties find that the written contract which they have signed does not express their actual intention at the time, they can apply to a court of equity to reform the contract so as to make it express their intention. The parties may agree that it did not express the intention, but disagree as to what that intention was. It is then a matter for the court to decide.

Keep in mind at all times that it is the "meeting of the minds" of the parties that controls and their intention at the time. If the written instrument fails to express the agreement, it is not a true expression of that agreement. So oral testimony does not here change the terms of a written contract, but merely changes it to express the contract correctly. The written instrument is not the contract, anyway, and never was. It is only evidence of the contract.

If business men will keep these pointers in mind when they are about their daily business, it should serve to give them a better understanding of the contract relation.

Weight Chart for Bar Stock Articles

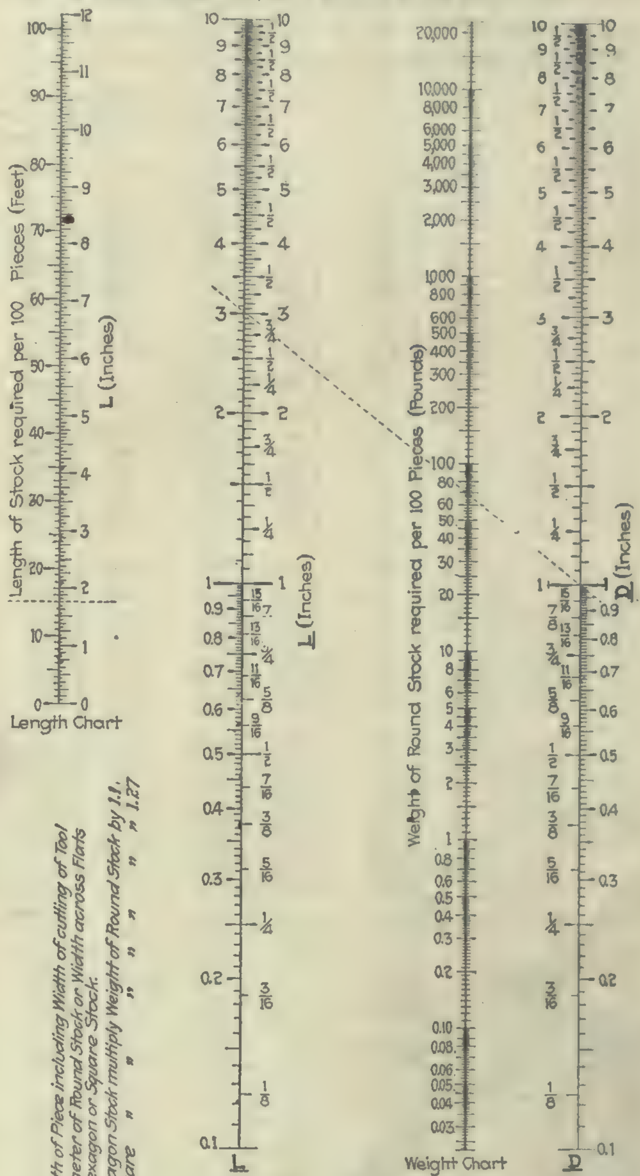
By Hans Ernst

When making drawings of parts manufactured in large quantities from bar stock, it is customary to specify on the drawing the weight of stock required to make 100 pieces. Where a large number of such drawings are made, this causes much extra work for the draftsmen and considerable worry for the checker on account of the frequent errors. To eliminate much of this, the accompanying chart was designed and a copy given to each draftsman. The method of using the chart is as follows:

Find on the scale *D* the point representing the diameter of the stock from which the piece is made, and on the scale *L*, the length of the piece plus the width of cutting-off tool used; connect these points by a straight line and, where this line crosses weight chart, read the weight of steel bar stock required to produce 100 pieces. The example illustrated on the chart is for a piece 2⅞ in. long, requiring stock 1-in. diameter, the cutting-off tool used being ⅛ in. wide. The length of piece plus the width of cutting-off tool therefore equals 3 in., and the straight line joining 3 in. on the *L* scale with 1 in. on the *D* scale crosses the weight scale at 68; consequently, the weight of stock required to produce 100 of these pieces is 68 pounds.

Weights thus obtained from the chart include an allowance of 2 per cent for waste. The chart is designed for steel, but the weight for any other material may be determined by multiplying the weight obtained from the chart by the factor for the desired material as given in the table, this factor being the ratio of the specific gravity of that material to the specific gravity of steel.

If desired, the chart may be arranged to give the weight directly for any of the above materials or sections by moving the weight scale up or down accordingly. The small chart to the left of the *L* chart gives the length of stock required to produce 100 pieces, and is useful when determining the weight of sections other than circular, square or hexagonal. For example: if the length of the piece, including the cutter, is 1¾ in., the length of stock to make 100 pieces is 15 ft.



DIAMETER OF STOCK	WIDTH OF CUTTING OFF TOOL
Less than ½" Diam.	1/16" (0.063)
½" Diam. to 1 5/16 Diam.	3/32" (0.094)
1" " " 1 7/16 "	1/8" (0.125)
1½" " " 1 15/16 "	5/32" (0.156)
2" " and larger	3/16" (0.188)

CHART FOR DETERMINING LENGTH AND WEIGHT OF ROUND STOCK

RATIOS OF WEIGHTS OF METALS TO STEEL

Material	Cast Iron	Wrought Iron	Yellow Brass	Phosphor Bronze	Tobin Bronze	Monel Metal	Copper	Aluminum
Factor	0.90	0.98	1.06	1.13	1.07	1.13	1.12	0.34

For hexagonal stock multiply weight of round stock by 1.1.
For square stock multiply weight of round stock by 1.27.

The chart has now been in constant use here for over 18 months and has resulted in a very considerable saving of time, relieving the draftsmen and checker from much tedious calculating and has practically eliminated errors arising from this source. It is now being adopted in other factories.

A Table of Porcelain Shrinkage Equivalents

BY L. M. CASE

The accompanying table gives the equivalent of dimensions from 0.001 in. to 1.000 in. by thousandths, based on an assumed shrinkage of 0.1406 in. per inch for porcelain products. It is presented as a valuable aid in making the calculations for the design of all sorts of clay-working tools.

SHRINKAGE EQUIVALENTS
From 0.001 inch to 1.000 inch — 1.000 inch to 6 inches
1.1406 inches = 1.000 inch

Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent
0.001	0.0011	0.091	0.1037	0.181	0.2064	0.271	0.3091	0.361	0.4117	0.451	0.5144	0.541	0.6170	0.631	0.7197
0.002	0.0022	0.092	0.1049	0.182	0.2075	0.272	0.3102	0.362	0.4128	0.452	0.5155	0.542	0.6182	0.632	0.7208
0.003	0.0034	0.093	0.1060	0.183	0.2087	0.273	0.3113	0.363	0.4140	0.453	0.5166	0.543	0.6193	0.633	0.7219
0.004	0.0045	0.094	0.1072	0.184	0.2098	0.274	0.3125	0.364	0.4151	0.454	0.5178	0.544	0.6204	0.634	0.7231
0.005	0.0057	0.095	0.1083	0.185	0.2110	0.275	0.3136	0.365	0.4163	0.455	0.5189	0.545	0.6216	0.635	0.7242
0.006	0.0068	0.096	0.1094	0.186	0.2121	0.276	0.3148	0.366	0.4174	0.456	0.5201	0.546	0.6227	0.636	0.7254
0.007	0.0079	0.097	0.1106	0.187	0.2132	0.277	0.3159	0.367	0.4185	0.457	0.5212	0.547	0.6239	0.637	0.7265
0.008	0.0091	0.098	0.1117	0.188	0.2144	0.278	0.3170	0.368	0.4197	0.458	0.5223	0.548	0.6250	0.638	0.7277
0.009	0.0102	0.099	0.1129	0.189	0.2155	0.279	0.3182	0.369	0.4208	0.459	0.5235	0.549	0.6261	0.639	0.7288
0.010	0.0114	0.100	0.1140	0.190	0.2167	0.280	0.3193	0.370	0.4220	0.460	0.5246	0.550	0.6273	0.640	0.7299
0.011	0.0125	0.101	0.1152	0.191	0.2178	0.281	0.3205	0.371	0.4231	0.461	0.5258	0.551	0.6284	0.641	0.7311
0.012	0.0136	0.102	0.1163	0.192	0.2189	0.282	0.3216	0.372	0.4243	0.462	0.5269	0.552	0.6296	0.642	0.7322
0.013	0.0148	0.103	0.1174	0.193	0.2201	0.283	0.3227	0.373	0.4254	0.463	0.5280	0.553	0.6307	0.643	0.7334
0.014	0.0159	0.104	0.1186	0.194	0.2212	0.284	0.3239	0.374	0.4265	0.464	0.5292	0.554	0.6318	0.644	0.7345
0.015	0.0171	0.105	0.1197	0.195	0.2224	0.285	0.3250	0.375	0.4277	0.465	0.5303	0.555	0.6330	0.645	0.7356
0.016	0.0182	0.106	0.1209	0.196	0.2235	0.286	0.3262	0.376	0.4288	0.466	0.5315	0.556	0.6341	0.646	0.7368
0.017	0.0193	0.107	0.1220	0.197	0.2246	0.287	0.3273	0.377	0.4300	0.467	0.5326	0.557	0.6353	0.647	0.7379
0.018	0.0205	0.108	0.1231	0.198	0.2258	0.288	0.3284	0.378	0.4311	0.468	0.5338	0.558	0.6364	0.648	0.7391
0.019	0.0216	0.109	0.1243	0.199	0.2269	0.289	0.3296	0.379	0.4322	0.469	0.5349	0.559	0.6375	0.649	0.7402
0.020	0.0228	0.110	0.1254	0.200	0.2281	0.290	0.3307	0.380	0.4334	0.470	0.5360	0.560	0.6387	0.650	0.7413
0.021	0.0239	0.111	0.1266	0.201	0.2292	0.291	0.3319	0.381	0.4345	0.471	0.5372	0.561	0.6398	0.651	0.7425
0.022	0.0250	0.112	0.1277	0.202	0.2304	0.292	0.3330	0.382	0.4357	0.472	0.5383	0.562	0.6410	0.652	0.7436
0.023	0.0262	0.113	0.1288	0.203	0.2315	0.293	0.3341	0.383	0.4368	0.473	0.5395	0.563	0.6421	0.653	0.7448
0.024	0.0273	0.114	0.1300	0.204	0.2326	0.294	0.3353	0.384	0.4379	0.474	0.5406	0.564	0.6432	0.654	0.7459
0.025	0.0285	0.115	0.1311	0.205	0.2338	0.295	0.3364	0.385	0.4391	0.475	0.5417	0.565	0.6444	0.655	0.7470
0.026	0.0296	0.116	0.1323	0.206	0.2349	0.296	0.3376	0.386	0.4402	0.476	0.5429	0.566	0.6455	0.656	0.7482
0.027	0.0307	0.117	0.1334	0.207	0.2361	0.297	0.3387	0.387	0.4414	0.477	0.5440	0.567	0.6467	0.657	0.7493
0.028	0.0319	0.118	0.1345	0.208	0.2372	0.298	0.3398	0.388	0.4425	0.478	0.5452	0.568	0.6478	0.658	0.7505
0.029	0.0330	0.119	0.1357	0.209	0.2384	0.299	0.3410	0.389	0.4436	0.479	0.5463	0.569	0.6490	0.659	0.7516
0.030	0.0342	0.120	0.1368	0.210	0.2395	0.300	0.3421	0.390	0.4448	0.480	0.5475	0.570	0.6501	0.660	0.7527
0.031	0.0353	0.121	0.1380	0.211	0.2407	0.301	0.3433	0.391	0.4459	0.481	0.5486	0.571	0.6512	0.661	0.7539
0.032	0.0364	0.122	0.1391	0.212	0.2418	0.302	0.3444	0.392	0.4471	0.482	0.5497	0.572	0.6524	0.662	0.7550
0.033	0.0376	0.123	0.1402	0.213	0.2429	0.303	0.3456	0.393	0.4482	0.483	0.5509	0.573	0.6535	0.663	0.7562
0.034	0.0387	0.124	0.1414	0.214	0.2441	0.304	0.3467	0.394	0.4493	0.484	0.5520	0.574	0.6547	0.664	0.7573
0.035	0.0399	0.125	0.1425	0.215	0.2452	0.305	0.3478	0.395	0.4505	0.485	0.5531	0.575	0.6558	0.665	0.7584
0.036	0.0410	0.126	0.1437	0.216	0.2464	0.306	0.3490	0.396	0.4516	0.486	0.5543	0.576	0.6569	0.666	0.7596
0.037	0.0422	0.127	0.1448	0.217	0.2475	0.307	0.3501	0.397	0.4528	0.487	0.5554	0.577	0.6581	0.667	0.7607
0.038	0.0433	0.128	0.1459	0.218	0.2486	0.308	0.3513	0.398	0.4539	0.488	0.5566	0.578	0.6592	0.668	0.7619
0.039	0.0444	0.129	0.1471	0.219	0.2498	0.309	0.3524	0.399	0.4550	0.489	0.5577	0.579	0.6604	0.669	0.7630
0.040	0.0456	0.130	0.1482	0.220	0.2509	0.310	0.3535	0.400	0.4562	0.490	0.5588	0.580	0.6616	0.670	0.7642
0.041	0.0467	0.131	0.1494	0.221	0.2521	0.311	0.3547	0.401	0.4573	0.491	0.5600	0.581	0.6626	0.671	0.7653
0.042	0.0479	0.132	0.1505	0.222	0.2532	0.312	0.3558	0.402	0.4585	0.492	0.5611	0.582	0.6638	0.672	0.7664
0.043	0.0490	0.133	0.1516	0.223	0.2543	0.313	0.3570	0.403	0.4596	0.493	0.5623	0.583	0.6649	0.673	0.7676
0.044	0.0501	0.134	0.1528	0.224	0.2555	0.314	0.3581	0.404	0.4608	0.494	0.5634	0.584	0.6661	0.674	0.7687
0.045	0.0513	0.135	0.1539	0.225	0.2566	0.315	0.3592	0.405	0.4619	0.495	0.5645	0.585	0.6672	0.675	0.7699
0.046	0.0524	0.136	0.1551	0.226	0.2578	0.316	0.3604	0.406	0.4630	0.496	0.5657	0.586	0.6683	0.676	0.7710
0.047	0.0536	0.137	0.1562	0.227	0.2589	0.317	0.3615	0.407	0.4642	0.497	0.5668	0.587	0.6695	0.677	0.7721
0.048	0.0547	0.138	0.1574	0.228	0.2600	0.318	0.3627	0.408	0.4653	0.498	0.5680	0.588	0.6706	0.678	0.7733
0.049	0.0558	0.139	0.1585	0.229	0.2612	0.319	0.3638	0.409	0.4665	0.499	0.5691	0.589	0.6718	0.679	0.7744
0.050	0.0570	0.140	0.1596	0.230	0.2623	0.320	0.3649	0.410	0.4676	0.500	0.5703	0.590	0.6729	0.680	0.7756
0.051	0.0581	0.141	0.1608	0.231	0.2634	0.321	0.3661	0.411	0.4687	0.501	0.5714	0.591	0.6740	0.681	0.7767
0.052	0.0593	0.142	0.1619	0.232	0.2645	0.322	0.3672	0.412	0.4699	0.502	0.5726	0.592	0.6752	0.682	0.7778
0.053	0.0604	0.143	0.1631	0.233	0.2657	0.323	0.3684	0.413	0.4710	0.503	0.5737	0.593	0.6763	0.683	0.7790
0.054	0.0615	0.144	0.1642	0.234	0.2668	0.324	0.3695	0.414	0.4722	0.504	0.5748	0.594	0.6775	0.684	0.7801
0.055	0.0627	0.145	0.1653	0.235	0.2679	0.325	0.3706	0.415	0.4733	0.505	0.5760	0.595	0.6786	0.685	0.7813
0.056	0.0638	0.146	0.1665	0.236	0.2690	0.326	0.3718	0.416	0.4744	0.506	0.5771	0.596	0.6797	0.686	0.7824
0.057	0.0650	0.147	0.1676	0.237	0.2702	0.327	0.3729	0.417	0.4756	0.507	0.5782	0.597	0.6809	0.687	0.7835
0.058	0.0661	0.148	0.1688	0.238	0.2713	0.328	0.3741	0.418	0.4767	0.508	0.5794	0.598	0.6820	0.688	0.7847
0.059	0.0672	0.149	0.1699	0.239	0.2725	0.329	0.3752	0.419	0.4779	0.509	0.5805	0.599	0.6832	0.689	0.7858
0.060	0.0684	0.150	0.1710	0.240	0.2737	0.330	0.3763	0.420	0.4790	0.510	0.5817	0.600	0.6843	0.690	0.7870
0.061	0.0695	0.151	0.1722	0.241	0.2748	0.331	0.3775	0.421	0.4801	0.511	0.5828	0.601	0.6855	0.691	0.7881
0.062	0.0707	0.152	0.1733	0.242	0.2760	0.332	0.3786	0.422	0.4813	0.512	0.5839	0.602	0.6866	0.692	0.7892
0.063	0.0718	0.153	0.1745	0.243	0.2771	0.333	0.3798	0.423	0.4824	0.513	0.5851	0.603	0.6877	0.693	0.7904
0.064	0.0729	0.154	0.1756	0.244	0.2783	0.334	0.3809	0.424	0.4836	0.514	0.5862	0.604	0.6889	0.694	0.7915
0.065	0.0741	0.155	0.1767	0.245	0.2794	0.335	0.3821	0.425	0.4847	0.515	0.5874	0.605	0.6900	0.695	0.7927
0.066	0.0752	0.156	0.1779	0.246	0.2805	0.336	0.3832	0.426	0.4858	0.516	0.5885	0.606	0.6912	0.696	0.7938
0.067	0.0764	0.157	0.1790	0.247	0.2817	0.337	0.3843	0.427	0.4870	0.517	0.5896	0.607	0.6923	0.697	0.7949
0.068	0.0775	0.158	0.1802	0.248	0.2828	0.338	0.3855	0.428	0.4881	0.518	0.5908	0.608	0.6934	0.698	0.7961
0.069	0.0787	0.159	0.1813	0.249	0.2840	0.339	0.3866	0.429	0.4893	0.519	0.5919	0.609	0.6946	0.699	0.7972
0.070	0.0798	0.160	0.1824	0.250	0.2851	0.340	0.3878	0.430	0.4904	0.520	0.5931	0.610	0.6957	0.700	0.7984
0.071	0.0809	0.161	0.1836	0.251	0.2862	0.341	0.3889	0.431	0.4915	0.521	0.5942	0.611	0.6969	0.701	0.7995
0.072	0.0821	0.162	0.1847	0.252	0.2874	0.342	0.3900	0.432	0.4927	0.522	0.5953	0.612	0.6980	0.702	0.8007
0.073	0.0832	0.163	0.1859	0.253	0.2885	0.343	0.3912	0.433	0.4938	0.523	0.5965	0.613	0.6991	0.703	0.8018
0.074	0.0844	0.164	0.1870	0.254	0.2897	0.344	0.3923	0.434	0.4950	0.524	0.5976	0.614	0.7003	0.704	0.8029
0.075	0.0855	0.165	0.1881	0.255	0.2908	0.345	0.3935	0.435	0.4961	0.525	0.5988	0.615	0.7014	0.705	0.8041
0.076	0.0866	0.166	0.1893	0.256	0.2919	0.346	0.3946	0.436	0.4973	0.526	0.5999	0.616	0.7026	0.706	0.8052
0.077	0.0878	0.167	0.1904	0.257	0.2931	0.347	0.3957	0.437	0.4984	0.527	0.6010	0.617	0.7037	0.707	0.8064
0.078	0.0889	0.168	0.1916	0.258	0.2942	0.348	0.3969	0.438	0.4995	0.528	0.6022	0.618	0.7048	0.708	0.8075
0.079	0.0901	0.169	0.1927	0.259	0.2954	0.349	0.3980	0.439	0.5007	0.529	0.6033	0.619	0.7060	0.709	0.8086
0.080	0.0912	0.170	0.1939	0.260	0.2965	0.350	0.3992	0.440	0.5018	0.530	0.6045	0.620	0.7071	0.710	0.8098
0.081	0.0923	0.171	0.1950	0.261	0.2976	0.351	0.4003	0.441	0.5030	0.531	0.6056	0.621	0.7083	0.711	0.8109
0.082	0.0935	0.172	0.1961	0.262	0.2988	0.352	0.4014	0.442	0.5041	0.532	0.6067	0.622	0.7094	0.712	0.8121
0.083	0.0946	0.173	0.1973	0.263	0.2999	0.353	0.4026	0.443	0.5052	0.533	0.6079	0.623	0.7105	0.713	0.8132
0.084	0.0958	0.174	0.1984	0.264	0.3011	0.354	0.4037	0.444	0.5064	0.534	0.6090	0.624	0.7117	0.714	0.8143
0.085	0.0969	0.175	0.1996	0.265	0.3022	0.355	0.4049	0.445	0.5075	0.535	0.6102	0.625	0.7128	0.715	0.8155
0.086	0.0980	0.176	0.2007	0.266	0.3033	0.356	0.4060	0.446	0.5087	0.536	0.6113	0.626	0.7140	0.716	0.8166
0.087	0.0992	0.177	0.2018	0.267	0.3045	0.357	0.4071	0.447	0.5098	0.537	0.6125	0.627	0.7151	0.717	0.8178
0.088	0.1003	0.178	0.2030	0.268	0.3056	0.358	0.4083	0.448	0.5109	0.538	0.6136	0.628	0.7162	0.718	0.8189
0.089	0.1015	0.179	0.2041	0.269	0.3068	0.359	0.4094	0.449	0.5121	0.539	0.6147	0.629	0.7174	0.719	0.8200
0.090	0.1026	0.180	0.2053	0.270	0.3079	0.360	0.4106	0.450	0.5132	0.540	0.6159	0.630	0.7185	0.720	0.8212

SHRINKAGE EQUIVALENTS—Continued

From 0.001 inch to 1.000 inch — 1.000 inch to 6 inches

1.1406 inches = 1.000 inch

Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent	Fired Size	Equivalent
0.721	0.8223	0.758	0.8645	0.794	0.9056	0.831	0.9478	0.868	0.9900	0.904	1.0311	0.941	1.0733	0.978	1.1155
0.722	0.8235	0.759	0.8657	0.795	0.9067	0.832	0.9489	0.869	0.9911	0.905	1.0322	0.942	1.0744	0.979	1.1166
0.723	0.8246	0.760	0.8668	0.796	0.9079	0.833	0.9501	0.870	0.9923	0.906	1.0333	0.943	1.0755	0.980	1.1177
0.724	0.8257			0.797	0.9090	0.834	0.9512			0.907	1.0345	0.944	1.0767		
0.725	0.8269	0.761	0.8679	0.798	0.9101	0.835	0.9524	0.871	0.9934	0.908	1.0356	0.945	1.0778	0.981	1.1189
0.726	0.8280	0.762	0.8691	0.799	0.9113	0.836	0.9535	0.872	0.9946	0.909	1.0368	0.946	1.0790	0.982	1.1200
0.727	0.8292	0.763	0.8702	0.800	0.9124	0.837	0.9546	0.873	0.9957	0.910	1.0379	0.947	1.0801	0.983	1.1212
0.728	0.8303	0.764	0.8714			0.838	0.9558	0.874	0.9968			0.948	1.0812	0.984	1.1223
0.729	0.8314	0.765	0.8725	0.801	0.9136	0.839	0.9569	0.875	0.9980	0.911	1.0390	0.949	1.0824	0.985	1.1234
0.730	0.8326	0.766	0.8736	0.802	0.9147	0.840	0.9581	0.876	0.9991	0.912	1.0402	0.950	1.0835	0.986	1.1246
		0.767	0.8748	0.803	0.9159			0.877	1.0003	0.913	1.0413			0.987	1.1257
0.731	0.8337	0.768	0.8759	0.804	0.9170	0.841	0.9592	0.878	1.0014	0.914	1.0425	0.951	1.0847	0.988	1.1269
0.732	0.8349	0.769	0.8771	0.805	0.9181	0.842	0.9603	0.879	1.0025	0.915	1.0436	0.952	1.0858	0.989	1.1280
0.733	0.8360	0.770	0.8782	0.806	0.9193	0.843	0.9615	0.880	1.0037	0.916	1.0447	0.953	1.0869	0.990	1.1291
0.734	0.8371			0.807	0.9204	0.844	0.9626			0.917	1.0459	0.954	1.0881		
0.735	0.8383	0.771	0.8794	0.808	0.9216	0.845	0.9638	0.881	1.0048	0.918	1.0470	0.955	1.0892	0.991	1.1303
0.736	0.8394	0.772	0.8805	0.809	0.9227	0.846	0.9649	0.882	1.0060	0.919	1.0482	0.956	1.0904	0.992	1.1314
0.737	0.8406	0.773	0.8816	0.810	0.9238	0.847	0.9660	0.883	1.0071	0.920	1.0493	0.957	1.0915	0.993	1.1326
0.738	0.8417	0.774	0.8828			0.848	0.9672	0.884	1.0082			0.958	1.0926	0.994	1.1337
0.739	0.8429	0.775	0.8839	0.811	0.9250	0.849	0.9683	0.885	1.0094	0.921	1.0504	0.959	1.0938	0.995	1.1348
0.740	0.8440	0.776	0.8851	0.812	0.9261	0.850	0.9695	0.886	1.0105	0.922	1.0516	0.960	1.0949	0.996	1.1360
		0.777	0.8862	0.813	0.9273			0.887	1.0117	0.923	1.0527			0.997	1.1371
0.741	0.8451	0.778	0.8873	0.814	0.9284	0.851	0.9706	0.888	1.0128	0.924	1.0539	0.961	1.0961	0.998	1.1383
0.742	0.8463	0.779	0.8885	0.815	0.9295	0.852	0.9717	0.889	1.0139	0.925	1.0550	0.962	1.0972	0.999	1.1394
0.743	0.8474	0.780	0.8896	0.816	0.9307	0.853	0.9729	0.890	1.0151	0.926	1.0561	0.963	1.0983	1.000	1.1406
0.744	0.8486			0.817	0.9318	0.854	0.9740			0.927	1.0573	0.964	1.0995		
0.745	0.8497	0.781	0.8908	0.818	0.9330	0.855	0.9752	0.891	1.0162	0.928	1.0584	0.965	1.1006	1.5	1.7109
0.746	0.8508	0.782	0.8919	0.819	0.9341	0.856	0.9763	0.892	1.0174	0.929	1.0596	0.966	1.1018	2.0	2.2812
0.747	0.8520	0.783	0.8930	0.820	0.9352	0.857	0.9774	0.893	1.0185	0.930	1.0607	0.967	1.1029	2.5	2.8515
0.748	0.8531	0.784	0.8942			0.858	0.9786	0.894	1.0196			0.968	1.1041	3.0	3.4218
0.749	0.8543	0.785	0.8953	0.821	0.9364	0.859	0.9797	0.895	1.0208	0.931	1.0618	0.969	1.1052	3.5	3.9922
0.750	0.8554	0.786	0.8965	0.822	0.9375	0.860	0.9809	0.896	1.0219	0.932	1.0630	0.970	1.1063	4.0	4.5624
		0.787	0.8976	0.823	0.9387			0.897	1.0231	0.933	1.0641			4.5	[illegible].1327
0.751	0.8565	0.788	0.8987	0.824	0.9398	0.861	0.9820	0.898	1.0242	0.934	1.0653	0.971	1.1075	5.0	5.7030
0.752	0.8577	0.789	0.8999	0.825	0.9409	0.862	0.9831	0.899	1.0253	0.935	1.0664	0.972	1.1086	5.5	6.2733
0.753	0.8588	0.790	0.9010	0.826	0.9421	0.863	0.9843	0.900	1.0265	0.936	1.0676	0.973	1.1098	6.0	6.8436
0.754	0.8600			0.827	0.9432	0.864	0.9854			0.937	1.0687	0.974	1.1109		
0.755	0.8611	0.791	0.9022	0.828	0.9444	0.865	0.9866	0.901	1.0276	0.938	1.0698	0.975	1.1120		
0.756	0.8622	0.792	0.9033	0.829	0.9455	0.866	0.9877	0.902	1.0288	0.939	1.0710	0.976	1.1132		
0.757	0.8634	0.793	0.9044	0.830	0.4669	0.867	0.9889	0.903	1.0299	0.940	1.0721	0.977	1.1143		

Machine-Tool Nomenclature

BY ENTROPY

We American people are a perverse lot. We like to take liberties with the English language. Our lexicographers are from ten to twenty-five years behind us. Mr. Norton, who wishes us to adopt a new name for the machine which we have called a grinder for a generation, is about ten to twenty-five years ahead of us. What are we going to do about it? Are we going to concede that Mr. Norton, having kept pretty uniformly in the limelight in grinding circles for a long time, has thereby acquired the right to tell us what we shall call his machine and the machines made by his competitors, or are we going to follow our usual course and continue to call them whatever we please?

It, however, brings up the whole question of machine-shop nomenlature, which is a topic of long standing and little progress. We have adopted many names without much thought, and different sections of the country have adopted different names for the same thing, all of which leads to seemingly unnecessary confusion. It seems, however, hardly fair to concede the right to change names to a single person connected with a single firm which has many competitors, some of them large enough so that they may be at least as well able to present ideas as the one who is insisting on this particular name.

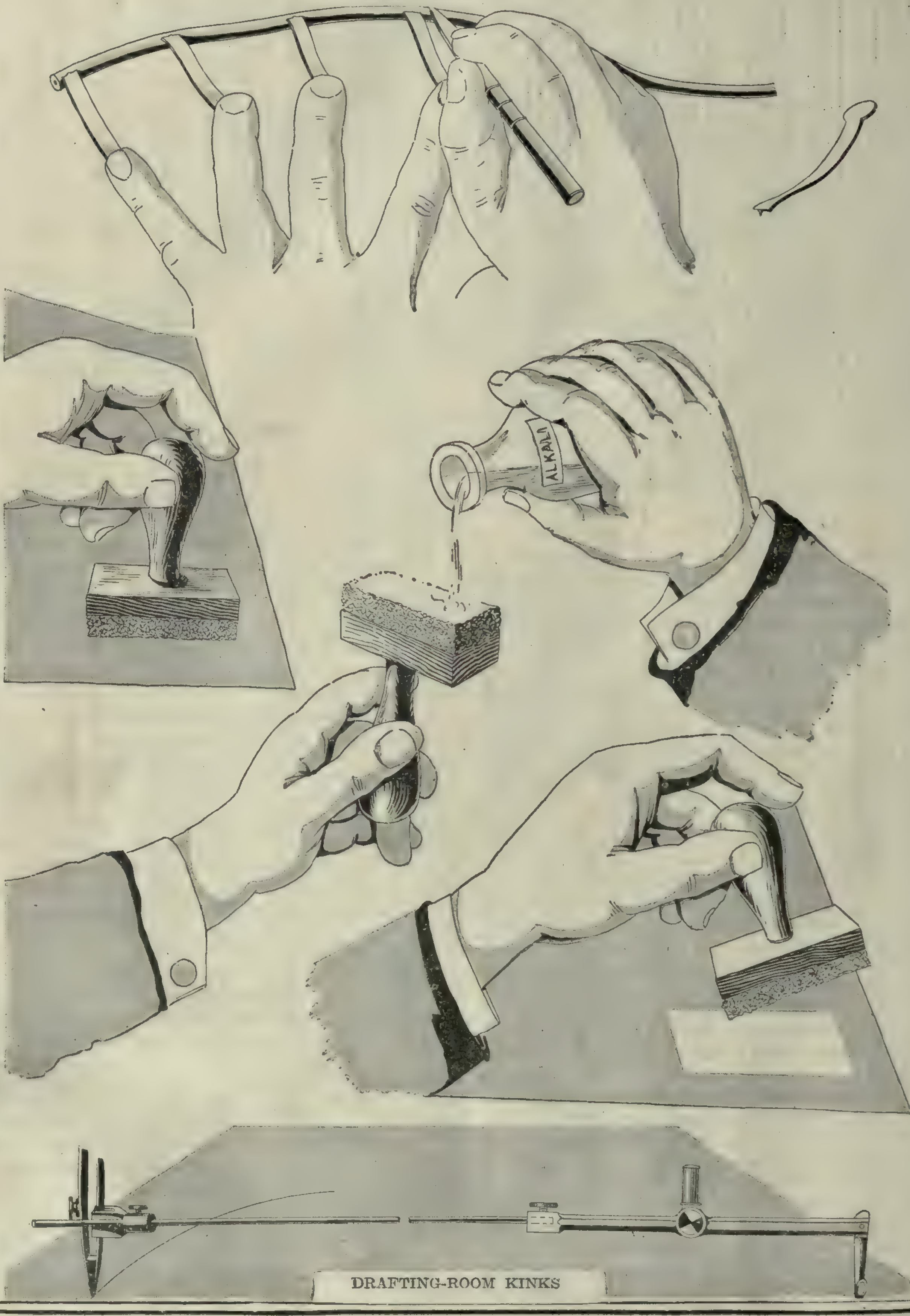
It hardly seems as though any body of less importance than the Machine Tool Builders' Association or the American Society of Mechanical Engineers could pass on this matter and initiate new names with anything like the authority or the prestige that is necessary to accomplish the desired result. Even then, the mere dictum of an association does not appeal to the American people. The only advantage an association has is that it can exert the power of example over a greater area than an individual. Those, in this particular case, who agree with Mr. Norton will try to remember to use the words "grinder" and "grinding machine" as he wishes. No doubt, the publicity department of his own concern feels the same way although it has slipped up at times. It is not easy to change our method of speech unless there is something catchy about the new expression. It took a long while to get even the technical papers straightened out on the distinction between a rule and a scale. Even now the two words are confused in the minds of many who are otherwise good mechanics and law-abiding citizens.

As for the particular question of nomenclature before us, why change? It is not nearly as bad as the confusion over the exact meaning of the word "typewriter" which is still used many times in reference to the typist rather than to the machine. If we were to follow that analogy, we might use the word "grinder" to represent the machine and "grindist" to represent the operator thereof. It would, however, not make the slightest difference as there is not the danger that arises when a man comes home and complains that he had to carry the typewriter across the street. His wife will never be confused as to the meaning of the word "grinder."

There is no doubt but that the expressions "grinding machine" and "grinding-machine operator" are more accurately descriptive than if we use the word "grinder" for both, but why spend time worrying about it when there are so many important things to be done, like straightening out our industrial unrest or getting into or out of the League of Nations? We like to wear ourselves out discussing these trivial and unimportant things, which when they are compared with the big things all around us make us seem small and narrow. Why not leave such matters to some committee of one of the societies and when it has approved some momenclature, wait patiently for people to follow in its wake, as they will surely do if the society has sufficient power of persuasion and keeps using the new terms in its own literature.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



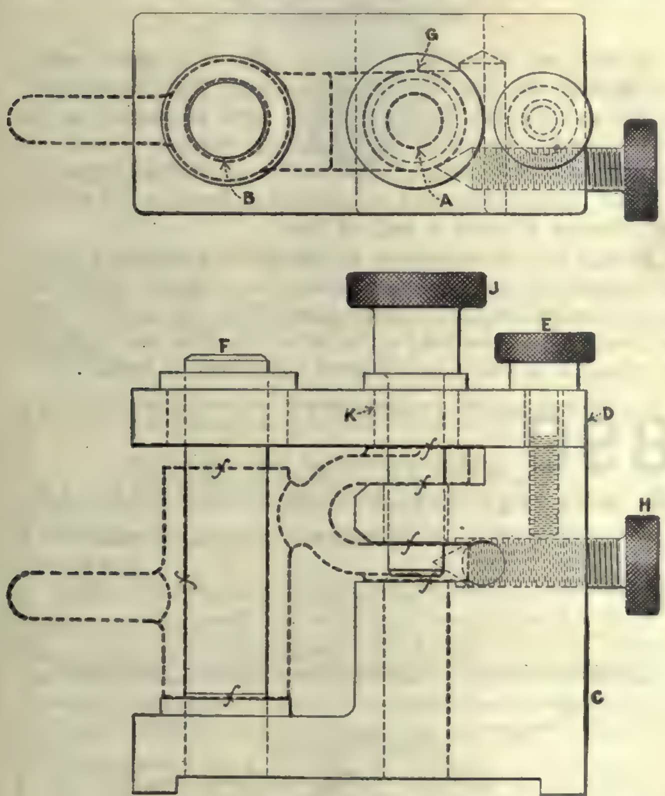
DRAFTING-ROOM KINKS

Reaming Fixture With Locating Plugs

By H. M. Fay

The use of fixtures for reaming purposes, while not by any means common practice, is sometimes resorted to for meeting exacting requirements, and the accompanying illustration shows such a condition.

The work contains two parallel holes. All work except hand-reaming the hole *A* has been completed,



A FIXTURE FOR HAND REAMING

the hole *B* having been reamed by hand to a smooth finish and accurate size, and the hole *A* machine-reamed. The final reaming of this hole is a hand operation to correct slight inaccuracies of size, alignment and finish.

The fixture is held by the body *C* in a vise. The plate *D* is removable from the body of the fixture by taking out the thumb-screw *E*, this screw having a clearance hole for it in the plate *D*. The work is pushed over the post *F* and is located against *G* by means of the thumb-screw *H*, which has a beveled point on it for this purpose.

The plate *D* is then pushed over the post *F* and the pin *J* is pushed through the bushing in the plate and the hole *A* in the work, thereby locating the plate *D* in correct location for reaming. The thumb-screw *E* is now securely tightened in place, thus locking the plate. By removing the pin *J* the hole *A* may be hand-reamed, using bushing *K* to guide the reamer.

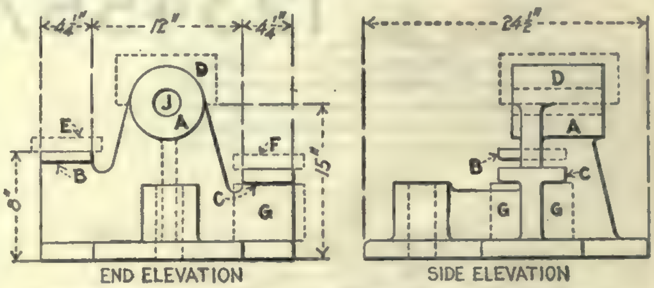
Saving Pattern Work by Using Stock Cores

By M. E. Duggan

Lack of knowledge of molding methods is a serious handicap to the patternmaker who is located some distance from the foundry and who has no one with whom he can consult when a difficult job of patternmaking presents itself.

The combination piece shown in the illustration, which includes a baseplate, journal bearing and vertical brackets, is a simple job of patternmaking and molding to the patternmaker who knows foundry practice. To the man who does not understand molding methods this job is a puzzle.

The first pattern for this piece was made with cores *G* under the plates *B* and *C;* also under the journal bearing *A*. For these cores, coreboxes were made. With



THE WAY IN WHICH THE PATTERN WAS MOLDED

this method, material was wasted and unnecessary labor and time were spent in the making of the pattern; the making of the mold was contrary to good molding practice and a casting that was very unsatisfactory was produced.

The second pattern was a simple and practical job both for the patternmaker and the molder; the patternmaker made it so because he knew molding practice.

The pattern was made with the plates *B* and *C*, and also the journal bearing *A*, loose. No core prints were made on the pattern.

The pattern was sent to the foundry and when the molder was ready to proceed with the making of the mold, he first went to the coreroom and picked out two slab cores (which are usually kept in stock in all foundries) and one core large enough to make the saddle

core *D*. These he cut and filed to the shapes shown at *D*, *E* and *F*. These cores were placed in their respective positions on the pattern as shown in the sketch.

The whole pattern was molded in the "drag" and rammed in the position shown in the sketch.

Sand was filled in up to the top of the cores *E* and *F*. Next the cores *E* and *F* were lifted and the plates *B* and *C* picked out. The cores were then returned to their places in the mold and the filling in of the sand continued up to the top of the saddle core *D*, where the same operation was repeated as with *B* and *C*.

Next the filling in of the sand up to the top of the flask was done and the mold finished, ready to be rolled over to receive the cope flask. As but one casting was wanted no center core was used in the journal bearing *J*.

Standard Title, Lettering and Lines

By George W. Childs

Works Engineer, American Steel Foundries

During my years' of experience as chief draftsman and engineer in various industrial establishments, after starting a new draftsman or tracer to work, I have invariably been questioned as to the style of lettering, lines, specifications, etc., that will be required on the tracings. In order to save time and not be compelled to search the files for tracings and prints for good examples of work to follow, I have made up sheets as shown in the illustration. A good draftsman is generally well informed along these lines, but I have found some who are not, especially those among the young men who have had no particular training or instruction.

I believe if chief draftsmen in general would have sheets made up along the lines in question that they will find them very helpful as well as instructive to those in need of them.

I have shown on the sheet a form for specifications and order, also a bill of material; either of which is suitable and one or the other is generally used in industrial establishments. Too much emphasis cannot be placed on the fact that nowadays tracings are not required to be a work of art, but the lines and figures should be made heavy and distinct in order to produce therefrom a first-class blueprint that can be easily read in the shop. I have often seen men from the shop compelled to stop work and request a draftsman to interpret for them dimensions on a blueprint, which of course costs money and should not be necessary.

When I started as an apprentice draftsman over 30 years ago, tracings were made which had a very artistic appearance; shade and shadow lines as well as a brush were used, but I do not believe a draftsman would last very long on his job if he attempted to produce such work now.

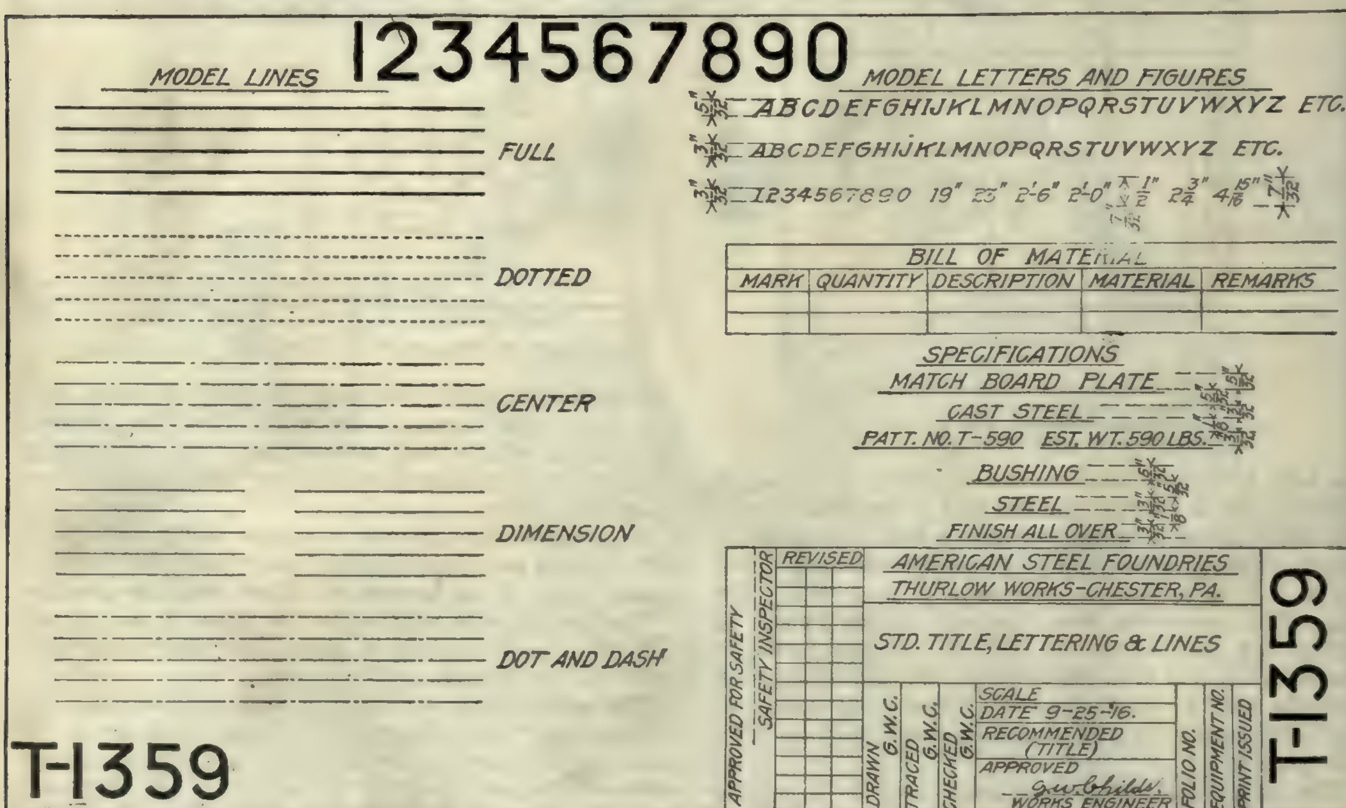
Sheets of tracing cloth can be purchased from drawing material houses with the title, form and border lines printed thereon and it will then only be necessary to fill in the necessary title of the drawing, etc., with freehand lettering.

Setting the Milling-Machine Vise in Alignment

By John A. Grill

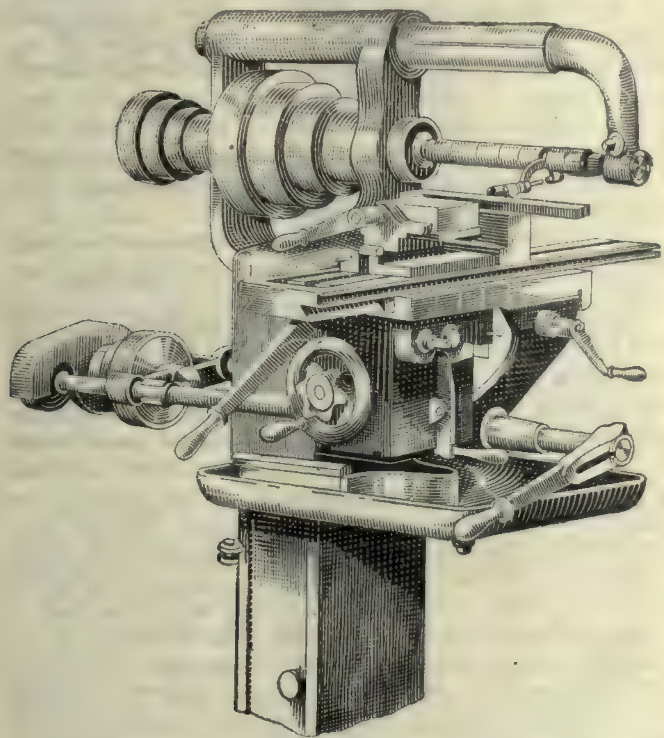
A good way to set a milling-machine vise square with, or parallel to the table is shown in the illustration. After getting the vise as nearly into alignment as is conveniently possible by ordinary means, clamp it tightly enough so that it will not be accidentally moved; but not sufficiently tight to prevent it from being moved by rapping it with a ball of lead.

Hold a 1-in. micrometer on the milling-machine arbor by clamping the bow between two collars with the barrel below the arbor and parallel to the table. The micrometer can be held quite firmly in this way without injuring it in the least if good judgment is used.



SAMPLE SHEET OF LINES, LETTERS AND TITLES

A parallel may now be clamped in the vise and tested for parallelism by moving the table forward and back, or the saddle in and out as the case may be, backing the thimble of the micrometer cut to touch the face of



SETTING THE MILLING-MACHINE VISE

the parallel at each trial and rapping the vise one way or another with the lead ball as the reading indicates until the micrometer reads alike at both ends of the parallel.

A Machine for Molding a Special Gear

By K. J. Van Sickle

The illustration shows a machine for molding the double gears used on agricultural and other rough machinery.

We had heretofore experienced trouble from having these gears more or less elliptical in shape and eccentric as to centers when made from a loose pattern drawn by hand, even though an experienced molder made them. To overcome the trouble I designed a machine to be operated with one lever and be as near fool-proof as possible.

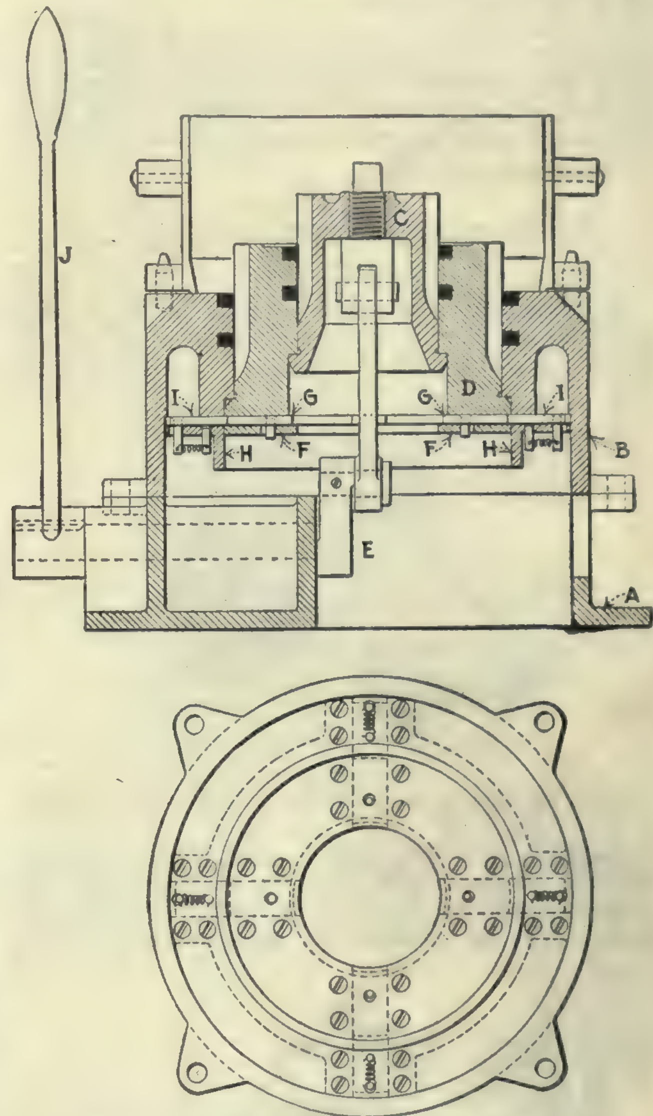
We built three machines for making three different sized gears and have used them now for over two years, with excellent results. An unskilled laborer can produce more and better gears with this machine than could a skilled man by the old method.

The machine is of the stripping-plate type and is composed of a base *A*, a cylinder *B*, and two gear patterns *C* and *D* operating like pistons from the crank and connecting-rod *E*. The outer cylinder is bored and counterbored to a sliding fit for the gear *D*, and the bore of the latter is a sliding fit for the gear *C*.

Two grooves in each bore serve to anchor the lead, babbitt, or other soft metal used for filling between the teeth of the gears. Before pouring the lead the gear patterns are smoked thoroughly and then placed in position. A dam is built up around each outside groove so that the metal will be cast sufficiently above the face of the cylinder and gear respectively to insure filling the teeth. The whole machine should be heated well before pouring and the metal should be very hot to avoid cold shuts.

As soon after pouring as the metal sets, the gears are pushed out by an arbor press, the smoke cleaned off and the soft metal faced off flush with the pattern.

A ring *F* with four slots milled in it to guide the slides *G*, is fastened to the larger gear by means of machine screws, and the ring *H* which has four slots



MACHINE FOR MOLDING DOUBLE GEARS

milled in it for the latches *I*, is similarly fastened to the cylinder.

To operate, the lever *J* is set in the vertical position so that the gears are in the position shown in the illustration. A flask is set on, filled and rammed up in the regular way. Then by pulling the lever *J* down, the gear *C* withdraws from the mold into the gear *D* until it forces the four slides *G* out against the four latches *I*, thereby releasing the larger gear. The smaller gear now bears on the ring *F* and thus draws the larger gear (as well as the smaller one) from the mold into the cylinder.

The drag, now completed, is lifted off, rolled over and placed upon the floor ready for the flat cope which is

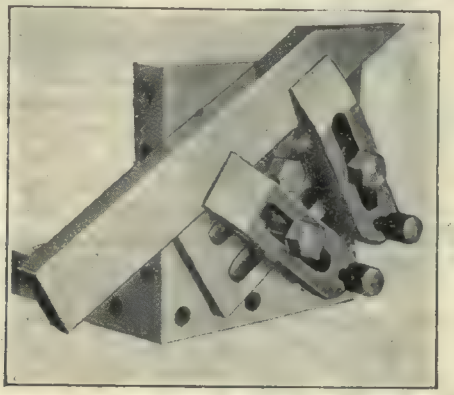
to cover it. All that is required to prepare the machine for the next mold is to raise the lever *J* to a vertical position. This movement first raises the small gear *C* until its flange reaches the shoulder in the large gear, and from that point lifts both gears together until the latches *I* snap into place. The upper edge of the flange on the large gear should be beveled as shown, so as to push back the latches and allow the shoulder to pass by. A similar bevel on the underside of the flange of the smaller gear serves the same purpose in relation to the slides *G* which are in effect but extensions of the latches *I* enabling the inner gear to reach and unlock them at the proper moment.

With this machine any man of average intelligence, when given a few instructions, can turn out better gears and in less time than a molder with years of experience can with a loose pattern. Double gears made on a machine of this kind have no draft on the teeth, and are round and concentric.

A Handy Toolroom Angle Plate

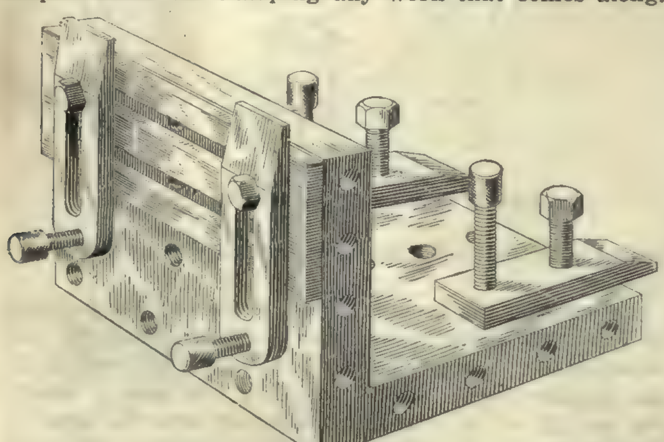
By Joe Peterson

The angle plate shown in the illustrations has come in handy for use in grinding various small pieces used in the making of jig, fixture and cutting-tool parts in the



toolroom of the R. & V. Wagner Ordnance Co., East Moline, Ill.

The angle plate is made of machine steel, carbonized, hardened and ground to square in all directions. The numerous holes tapped to ⅜ in. (16 U.S.S.) provide ample means for clamping any work that comes along.



A parallel strip which can be clamped independently facilitates duplication of set-ups. A set of short and long clamps, each provided with an elongated slot for clamping, and a support screw with knurled head, for the tail end, complete the outfit.

What Is a High-Grade Machine?

By Entropy

This seems like a perfectly simple question to answer. The trouble is that every man puts a different interpretation on the answer. A high-grade machine is a good one. Some people think a good machine is one with a high polish. Others think it is a machine of good design; in other words, such a machine as they would design. Some also think it is a machine that is as nearly accurate as human ingenuity can make it; and still others that it is the machine which will give the greatest possible product.

All of these people are right to some extent and wrong in so far as they limit their views to their one hobby.

This discussion really should not be about the machine and its degree of perfection; but about the inability of production men to see anything else, the inability of the fine mechanic to see the need of production, and so on around the whole circle. The only balanced man around a machine shop seems to be a man who knows so little of mechanics that he cannot criticize the design, the finish or the productivity of the machine, but can only discover its fitness for the work for which it is intended by the way the orders come in and the way the machines stay sold in the shops for which they were intended.

If the shop which turns out the machine is in business, not to make machines but to make money, as one well-known superintendent puts it, then the question of quality of its output depends on, and is indicated by, the measure in which one machine helps to sell another over the period of the natural life of the machine.

The machine may be the most accurate in the world, but if the operators all try to keep away from it because it is awkward to use, the purchasing agent will likely try some other make next time. If it is a great producer, but the tools cannot be depended on to follow their appointed paths and the work coming from it is irregular and does not come within the gage limits, there is no use pretending that the machine is high grade. Every point about the use of the machine must make it the fittest possible for the work it is to do, or it cannot be called high grade.

Followed to the logical conclusion there can be very few high-grade machines under our present system of manufacture. Our machines are designed for a little higher than average conditions. A lathe, built for general use, may have a very poor lead screw and not one customer in a thousand will ever know it. For the benefit of this one customer, most lathe manufacturers try to get pretty good lead screws, and the other nine hundred ninety-nine customers who do not need this refinement, pay extra on that account.

A machine heavy enough to be rigid under certain exacting conditions will be so hard to handle that the design cannot be adapted to the general market. All our machine design is a compromise, and a compromise is never perfect. Even in a machine designed especially for a given job it is necessary to compromise between accuracy, weight, cost and interchangeability, to say nothing of many other things of lesser importance. So possibly we may all be obliged to fall back upon the generally accepted notion that a machine, to be considered high grade, must measure up to the standard set by a successful manufacturer of machines of the same general character.

Shall We Lead Or Follow?

THE United States and England are the two greatest manufacturing and exporting nations today. They both use the English or inch system of measurement.

The World Trade "Club" has for its object the discarding of our present system of measurement and *forcing* us to use the metric system. The metric system was legalized by Congress over fifty years ago. If it were better suited for use in the metal-working industries, it would have been adopted by them years ago—but it isn't.

The changing of our system of measurement would cause endless confusion—**and those who started the World Trade "Club" know it, *but some of their deluded followers do not.***

The World Trade Club was first started under very suspicious circumstances—in fact, one of the first letters received from it practically needed translation, and we called attention to this in an editorial at the time. The German flavor was unmistakable. Now this same "Club" in its literature holds up to the American people the fact that "Germany adopted the Metric System in 1871." ***More German Kultur!***

We will say right here—No one could fight more effectively for the kaiser than to force through a compulsory metric law now. *If such a law is passed we will have lost the war.*

The confusion and expense such a law would cause is clearly shown in the letters that follow—letters from men of standing, and known throughout the manufacturing world—men who are not afraid to come out in the open and ***sign*** their letters!

We wish to call especial attention to the letter from Pratt & Whitney, one of the firms that the World Trade Club claims is in favor of the metric system.

We wish also to call the attention of all to the fact that this "Club" is widely advertising the U. S. American National Manufacturers' Association as in favor of metrics. This is an utterly unknown "organization" and the name has apparently been chosen with the deliberate intent to confuse the reader into thinking it is the National Association of Manufacturers—an organization which has been in existence nearly twenty-five years, and which is opposed to the metric system and has in its ranks some of the best known manufacturers in the world.

The whole output of literature from this so-called club is a cleverly worded lot of misrepresentation. The ***few*** reliable men who have been drawn into backing it are either not manufacturers in any sense of the word or are deluded by the plausible-sounding propaganda.

It is ridiculous for any man to say, as this "Club" claims, that the World War would have been shortened a single day if all the allies had been standardized on metric measurements. The measuring system used has nothing whatever to do with standardization of parts or interchangeability.

Does anyone think for a second that if our 0.30-caliber cartridges had been measured in metrics they would have fitted a British rifle chambered for a 0.303-caliber cartridge? Both France and Germany used metric shell sizes, but would a French 75-mm. shell fit a German 77-mm. gun or vice versa? Even had these shell both been of the same diameter, there is no assurance that they would be of the same taper, length, weight or design of head. Unless they were, they could not be used in the same gun, whether made to inch or to metric measurements.

Isn't it significant that this "Club" should have its headquarters in San Francisco, Calif., and that the Chamber of Commerce of the State of Washington should back the campaign?

The plain answer is that these are non-manufacturing states and easy to persuade, for they have less at stake than the Middle or Eastern States.

Are we, as Americans or as British, going to let people who know absolutely nothing of machine building or real manufacturing problems force us to adopt a system that doesn't fit? The measuring system we now have is all right—to change it will utterly disrupt our machinery makers and upset every industry dependent on them—even the mining industry, lumber industry, and all others of the West that use machinery of any kind.

Are we going to stand for the compulsory metric system and all the chaos it means? Let us all stand up on our hind legs like real he men and say No! It is up to you, gentlemen, to enlighten your representatives in Congress and your Chambers of Commerce as to what is impending.

Are we to follow Germany or lead the World?

Ethan Viall

Editor

Philadelphia, Pa., January 22, 1920.

MR. ETHAN VIALL, EDITOR,
American Machinist,
10th Avenue and 36th Street,
New York, N. Y.

Dear Sir:

We are in receipt of your favor of January 16th, asking our views as to the proposed law for the compulsory introduction of the metric system.

We are absolutely opposed to any attempt to force the use of this system upon the people of this country.

The French units have been legalized by our Government and accurate standards have been prepared for distribution. This, we think, is as far as the Government should go. **If the metric system is much better than our system of weights and measures, as its proponents claim it to be, it will gradually supersede our system without the violent disturbances which would result from an attempt to force the change.**

We have no objection whatever to the use of the metric system by any one who desires it. We, ourselves, found it advantageous when we began the manufacture of the Gifford Injector in 1860, to work to the French drawings and measurements; and we made all of our gages and tools accordingly. We have continued this use in the Injector Department; but have found no such marked advantage that would encourage us to extend the use of the French units into any other branch of our business, as all are equipped with gages and tools based on the inch.

Much stress is laid on the advantages that the adoption of metric measurements would have in extending our foreign trade. This point, in our judgment, has been greatly overstated. In our own business, we are satisfied that not a single sale has been influenced by the fact that our machines are built on the inch basis. It frequently happens that the foreign buyer expresses the desired capacity of the machine in metric dimensions. If so, we quote on our nearest size, expressing the figures in the equivalent French units. It makes absolutely no difference to the buyer what system was used in the construction of the machine; but he occasionally asks that the feed screws should have metric threads or that the machine should be arranged to cut such threads. As a case in point, we recently furnished a number of large boring and turning mills to the French Government for general use, where the question of metric dimensions was not even mentioned.

Manufacturers of this country have been struggling for years toward standardization and much has been accomplished. Large amounts have been expended for tools, gages and other special equipment, which would be rendered useless if our standards were changed; but even if we were willing to incur the considerable expense of new equipment, we could not abandon the old, for we must always be prepared to make replacements. This would involve two kinds of stock and constant confusion. We all know how hard it is to change usage, as is well illustrated in our screw threads; for the old sharp "V" has not yet entirely disappeared, although the U. S. system was recommended in 1864 and adopted by the Navy Department in 1868; nor has entire agreement been reached as to the number of threads per inch for any given diameter.

As a matter of fact, the French themselves have not attained complete uniformity in regard to screw threads, although a standard was formally adopted by an International Congress many years ago.

Any attempt to force the metric system on the country by legislative enactment would have a deplorable immediate effect, without any compensating ultimate advantage.

Yours truly,

WM. SELLERS & CO., Incorporated,
Coleman Sellers, Jr.,
President.

What Real He Men Think of the Compulsory Metric System

January 26, 1920.

Mr. Ethan Viall, Editor,
American Machinist.

Dear Mr. Viall:

The passage of a compulsory metric measurement law by Congress can have but one result, viz:

The Complete Paralysis of Mechanical Industry in America.

The monetary loss connected with the discard of equipment now in use, comprising jigs, fixtures and measuring instruments, mounts into millions. Its total is incalculable. The time loss, both in production and to the millions of men engaged therein, with resultant loss of wages, cannot be figured, as it is no simple matter to change all drawings, replace all discarded equipment and accustom hundreds of thousands of men to a new system of measurement.

America, pre-eminently the leader in mechanical ingenuity and productive capacity, would be set back as if by the devastation of war, and the world, which now depends upon this nation for the equipment required for reconstruction purposes, would be at a standstill.

Any change from present standards would so retard American production of mechanical necessities that the loss to the world would be insufferable.

THE BULLARD MCH. TOOL CO.
Bridgeport, Connecticut.

New York, January 29, 1920.

American Machinist,
Mr. Ethan Viall, Editor.

Dear Sir:

I send you the following in response to the request in your letter of 26th instant.

Since 1866 the use of the metric system in this country has been legal and permissible to all who care to avail of it. Not content with this freedom, the few who use the metric system, and who prefer it to our established system of weights and measures, are seeking legislation whereby all the rest of us, who differ with them on this subject, shall be deprived of our liberty, and compelled to abandon the use of our old standards. The chief argument in favor of this most undemocratic project is that it will bring about *uniformity* of practice with all the so-called "pro-metric" countries, and thereby greatly promote the development of our export trade. "But," said John Quincy Adams in his masterly report of 1828 on this subject, "is your object *uniformity*? Then, before you change any part of your system, such as it is, compare the uniformity that you must lose, with the uniformity that you may gain, by the alteration." We now have uniformity throughout this country, and practically with Great Britain and her Colonies, and this uniformity would be lost under the proposed change, because we should then for a century at least, have both systems in use. To this day France has not yet succeeded in displacing entirely from use her ancient measures of length and volume, while in most of the other so-called "pro-metric" countries the old units persist, and in many cases predominate. Our imports from "pro-metric" countries are not decreased by their use of the metric system, nor would our exports to them be materially affected by our adoption of that system.

Another argument is based on the advantages of the decimal system of notation, but this is not peculiar to the metric system. In surveyors' work, our foot has been decimalized about a hundred years, and in all fine machine work the decimalized inch is in almost universal use. For the every-day transactions of life, vulgar fractions are better than decimal and are universally used, even in "pro-metric" countries. Binary division is natural and simple; decimal division is not, except for calculating and accounting. A child naturally divides an apple into halves and quarters; never into tenths.

Before the people of this country are asked to sanction the proposed change of standards, they should have a clear understanding of all that it would involve. When they have such understanding I predict that they will overwhelmingly refuse to sanction the change. Any attempt to "put over" the change in advance of such understanding should be opposed by all as unfair, unreasonable, and undemocratic.

Yours very truly,
YALE & TOWNE MFG. CO.
Henry R. Towne.

January 29, 1920

American Machinist
Mr. Ethan Viall, Editor,

Dear Sir:

Supplementing our letter of January 19th, we are just advised by Mr. Burlingame that our name has been used by the "World Trade Club," as urging metric standardization.

Such use is entirely without our knowledge or authority and you are at liberty to make the most of the fact that such unauthorized use is being made.

We are writing to the "World Trade Club" in protest, but this protest will, of course, not reach the public who are interested.

Yours very truly,
PRATT & WHITNEY CO.,
B. H. BLOOD,
General Manager.

Hartford, Conn., January 20, 1920.

Mr. Ethan Viall, Editor,
American Machinist.

Dear Mr. Viall:

Replying to your letter of Jan. 16th it would seem as though there was no doubt in the mind of any thinking man, acquainted with the mechanical industry in any of its branches, that the compulsory adoption of the metric system would mean a tremendous loss for a great number of years to every individual member connected with the mechanical industry on account of the fact that every one of their parts and tools and machines are made on the English system; and there would have to be a complete redesigning of all the different articles that enter into mechanical works and a complete re-education of all the men employed in the industry in order to make them familiar enough with the metric system to do the work with the same degree of efficiency as they are now working under the present system.

It seems to me, however, regardless of many opinions to the contrary, that it will be absolutely impossible for our Government to make the metric system compulsory in the true sense of the word; and, regardless of the large amount of money that is being spent by the promoters of the metric system that, when the large amount of evidence is acquired showing the tremendous expense and annoyance and trouble that it will cause, it will not be so easy to adopt as what it might seem at this time.

Yours very truly,
THE HENRY AND WRIGHT MANUFACTURING CO.
R. M. Wright
General Manager.

Cleveland, Ohio, January 22, 1920.

American Machinist.
Attention of Mr. Ethan Viall, Editor.

Gentlemen:

It seems to us that to make the metric system compulsory would be an inconceivable calamity to the machine-tool industry. **The war proved, as it had never been proved before,** how important this industry is to the welfare of the country. Not only would the change be exceedingly expensive, but it would be crippling to many, to say nothing of the upsetting of the industry in general and at a time when it seems to us that it should be maintained at its highest efficiency, on account of the unsettled world conditions, so that it is not at all certain when the full strength of these resources may be required again, **possibly in the not distant future.**

We consider it exceedingly unpatriotic to foist this system on the country, particularly at this time.

Yours very truly,
LUCAS MACHINE TOOL CO.,
J. A. Yost.

Boston, Mass., January 20, 1920.
Ethan Viall, *Editor*,
American Machinist.

Dear Mr. Viall:

In reference to the movement now under way to pass a law through Congress, making the use of the metric system compulsory, we feel that this would work a severe hardship to us and prove a very costly experiment to the machine shops of this country.

We can realize the difficulties in explaining the reasons to the average Congressman or in fact, any man whose training has not embraced actual machine-shop experience.

It would be impossible to calculate with any degree of accuracy the cost to us and to other manufacturers of this change, and, furthermore, we have failed to perceive any appreciable public demand for such compulsory legislation, requiring this change in our standards of measurement.

We have always made large shipments to Europe of our product and only in rare cases have metric measurements been specified.

We sincerely trust this legislation will not be passed.

Very truly yours,
BECKER MILLING MACHINE CO.,
J. P. Lesley,
General Manager.

P.S.—I believe such a law would be unconstitutional.

Worcester, Mass., January 19, 1920.
American Machinist.
Refer to Ethan Viall, Editor

Gentlemen:

In reference to making the metric system compulsory, we are emphatically against such action.

Respectfully yours,
WOODWARD & POWELL PLANER CO.,
E. M. Woodward,
President and Treasurer.

Madison, Wis., January 21, 1920.
Mr. Ethan Viall,
American Machinist.

Dear Sir:

In reply to yours of the 16th would say that we are most decidedly opposed to making the use of the metric system compulsory.

Yours very truly,
GISHOLT MACHINE COMPANY,
C. A. Johnson.

Springfield, Vt., January 20, 1920.
American Machinist.
Attention Mr. Ethan Viall, Editor

Gentlemen:

We are very much against the idea of making the metric system compulsory.

There are so many complications attending this change, in connection with machine-tool manufacturing, that we fail to see enough advantage to offset the difficulties.

The change would surely bring about a serious upset in production, with a tremendous loss both to the manufacturer and to the shop laborers. A large percentage of labor at the present day throughout the country is subject to piece-work basis of some character, and the re-education of the shop men, necessary to read drawings, would surely cause a serious loss to them in their wages. At the present time we surely have labor troubles enough, without adding any new factor of discontent.

Very truly yours,
BRYANT CHUCKING GRINDER CO.,
W. L. Bryant,
President.

New Bedford, Mass., Jan. 26, 1920.
Ethan Viall, Editor,
American Machinist.

Dear Sir:

We think that one of the most serious mistakes that could be made would be to have the next Congress place thereon a law making the use of the metric system compulsory. The investment that would be necessary to make this change is something appalling. Beside that, the inconvenience to the manufacturer of the product in this country and throughout the world would be unmeasurable.

We should deem it a very unwise course to pursue, and unfair to the general manufacturing interests of the country.

Yours truly,
MORSE TWIST DRILL AND MACHINE CO.

> **World Recognized Associations That Are Against The Metric System**
>
> **National Machine Tool Builders' Association**
>
> **National Metal Trades Association**
>
> **National Founders' Association**
>
> **National Association of Manufacturers**

Cleveland, Ohio, January 20, 1920.
Mr. Ethan Viall, Editor,
American Machinist.

Dear Sir:

Without going into the detail of the contemplated change to the metric system would say that this change would be a great mistake and extremely detrimental to all industries. The expense in new equipment and changing of old, coupled with the loss of efficiency during the long period which would be required to educate workmen and designers in the use of a new system, would be a blow to industry from which they could not possibly recover for a long time.

Yours very truly,
THE FOOTE-BURT COMPANY,
G. E. Randles,
President.

Springfield, Ohio, Jan. 28, 1920.
The American Machinist
Attention Ethan Viall, Editor

Gentlemen:

Answering yours of the 26th, in reference to Congress making the use of the metric system compulsory, would say we are against the adoption of the metric system in any form, and have repeatedly written our Congressman, Hon. S. D. Fess, protesting against any such law.

Yours truly,
THE SAFETY EMERY WHEEL CO.
A. G. Spencer,
Vice President & General Manager.

Indianapolis, Ind., Jan. 20, 1920.
American Machinist,
Attention Mr. E. Viall, Editor

Gentlemen:

Replying to your letter of Jan. 16th, we are decidedly against the use of the metric system, as it would not only *create industrial confusion for a long period of time but would cost thousands of dollars* for our company alone to change over, and there would be no advantage in it.

We are very decidedly against the adoption of the metric system.

Yours very truly,
MILLHOLLAND MACHINE CO.
W. K. Millholland,
President.

Grand Rapids, Mich., January 22, 1920.
Mr. Ethan Viall, *Editor*,
American Machinist.

Dear Sir:

I believe that the movement to force compulsory use of the metric system in this country is little short of a crime and the height of economic folly. The fallacy has been well exposed by one of your former editors and we would endorse what he has said in its entirety.

The use of the metric system is now optional and if it were advantageous, the American and British manufacturers and merchants, who are leaders in world trade, would have adopted it. It has been adopted in some lines where the advantage was sufficient and the cost not too excessive but to endeavor to force it upon industries where the cost is excessive and the advantages negligible, is a crime. When we need economy in manufacture and quantity production of goods as we never needed it before in the history of the world, when hours of labor are being shortened and the wages per hour increased, it behooves us to do everything possible to conserve every moment of time. The millions of dollars that would be wasted in trying to change from present standards to metric can only be well understood by those who are in such a basic industry as machine-tool manufacturing.

Machine-tool manufacturers export a considerable percentage of their total manufacture to the markets of the world, to metric and non-metric countries alike. American machine tools made under our present standards stand the highest in the estimation of users in metric as well sa non-metric countries, bringing premium prices of 100 per cent. and more in metric

countries over other machines of similar capacity made exclusively under the metric system. Why then should we change?

Much of the propaganda in favor of metric system seems to me to be pro-German in its basic idea and to partake of the same nature as the proverbial fox, who, having lost his tail, tried to get all the other foxes to cut their tails off too.

If manufacturing under a metric system could be handled so economically, why was not Germany with her lower wages, longer hours and admittedly, in many cases, better trained and educated workmen, able to compete with American manufacturers in a more economical way than she did? The two greatest commercial and manufacturing nations in the world, the United States and Great Britain and the latter with all her colonies, including Canada, Australia, India, South Africa, etc., have no difficulty in doing business with our established system of weights and measures. Why should we join the defeated Central powers and the Bolsheviki of Russia and the, practically speaking, negligible factors in the world's commerce, as represented by the other metric countries, in the effort to force the compulsory use of the metric system.

If, for the sake of argument we admit that the "angel" in San Francisco, who is financially back of a lot of this propaganda in favor of the metric system, is actuated by good intentions, it is only necessary to point out the truth of the old adage that those same good intentions are used as the pavement on the road to the place of future abode that we all hope to escape.

Yours truly,
GRAND RAPIDS GRINDING MACHINE CO.,
S. Owen Livingston,
President.

Worcester, Mass., Jan. 30, 1920.

Mr. Ethan Viall,
Editor American Machinist,
New York, N. Y.
Dear Sir:

In reply to your letter of January 16th with reference to compulsory use of the metric system would say that as I understand it, this system covers weights and measures only, while users of this system still have to use 360 deg. to the circle, 60 min. to the degree, and 60 sec. to the minute. I understand also that they are content to use clocks with the face divided into 12 hours, and with the hour made up of 60 min. to the hour, and 60 sec. to the minute.

Now, WHY under the sun don't the advocates of the metric system make a complete and consistent job of the whole matter and change over the circular measurements to give 100 deg. to the circle, 100 min. to the degree and 100 sec. to the minute?

And, WHY don't they change over their clocks to 100 hr. to the day, 100 min. to the hour, and 100 sec. to the minute?

When they will agree to do that, they can properly ask the rest of us to change over from what we are now doing and have the complete system become universal.

To be consistent, they should not object to having to throw away all their fine watches and clocks and all their handbooks, reference books and data sheets on engineering problems in which time is an element, and they should not object to throwing away all books on engineering problems and give up all reference books and data sheets contained in the records of countless problems worked out in geometry, trigonometry or astronomy, because they are asking us to make just as much of a change in changing the weights and measures as for us to ask them to change records regarding time and areas.

In fact they ought to go one step further and make compulsory the use of the French language so that our commercial and social work shall be as universal as the matter of measurements. In fact, it is a question whether it is not of more importance to be able to sell our neighbor and our foreign friend a typewriter, a meat chopper, or a sewing machine, and arrange the commercial details satisfactorily, than it is to be able to call a bar of iron one meter long as compared with calling it 39 in. long.

Therefore, the writer believes that the idea is fine, only it doesn't go far enough. Not only should the metric system of weights and measures be made compulsory, but also a new system with regard to time, with regard to circular measurements, and with regard to the language we use in dealing with our customers.

Until these theorists with no financial interests at stake are ready to go the whole figure and have a consistent system, they cannot reasonably take exception to other people hesitating to change over and adopt but a part of it when even that involves tremendous expense.

Yours very truly,
JAS. N. HEALD.

Rockford, Ill., January 20, 1920.

American Machinist.
Attention Ethan Viall, Editor.
Gentlemen:

Yours of the 16th received regarding the matter of forcing through a law in the next session of Congress for making use of the metric system compulsory. We are not in favor of the metric system, and only hope that the change will never be made. *We certainly believe that it would be the greatest injustice that was ever put over on not only the users but manufacturers of machinery.*

In the meantime, we remain,

Yours truly,
W. F. & JOHN BARNES CO.

Cincinnati, O., January 19, 1920.

American Machinist,
New York City.
Gentlemen:

Mr. Viall's favor of the 16th, in regard to the metric system, received.

We have threshed this matter out on several occasions, and as far as the R. K. LeBlond Machine Tool Company is concerned, it is absolutely opposed to a change of this kind. While the metric system looks very good from a theoretical standpoint, it does not work out in practice as well as our present system. **The metric thread system is not as good as the United States Standard. Not only this, the nations using the metric system are also using halves and quarters of the decimals of the meter.**

Yours respectfully,
THE R. K. LeBLOND MCH. TOOL CO.

Cincinnati, January 19, 1920.

Mr. Ethan Viall, Editor,
American Machinist.
Dear Sir:

Replying to your favor of the 16th re. a plan to force through Congress a bill making the use of the metric system compulsory, would state that it is about time for manufacturers to "go to the mat" with those who are forcing such a condition. It is a mighty easy thing to talk about the beauties of the metric system, but if the manufacturers are ever forced to use it, I think that such a protest will be made as Congress has never before heard.

I have heard various people discuss it and say how much more simple it would be than our present type of measurement, and perhaps it would be more simple; but so many hundreds of millions of dollars have been spent in this country by manufacturers for measuring instruments, and for jigs, fixtures, tools, etc., made from those instruments, that it seems that those advocating the metric system have no idea whatsoever of this condition and how much it would cost the manufacturers of this country to change from one system to another.

I would suggest that an investigation be made to learn about the people who are back of this movement, and when they are found, that an explanation be demanded in a manner they cannot fail to understand.

May I suggest such a course!

Yours very truly,
THE AMERICAN TOOL WORKS CO.
J. B. Doan,
President and General Manager.

Nashua, N. H., January 27, 1920.

Attention: Mr. Ethan Viall
American Machinist
Gentlemen:

In regard to the compulsory use of the metric system, I can only compare such a course by Congress to a man who voluntarily contracts a malady believing it will make him immune from the disease. It would be a very serious illness to the machine-tool and other machinery industries in this country, and the advantages would be comparatively small. We hope no such measure will pass Congress.

Yours very truly,
THE FLATHER MFG. COMPANY
H. E. Flather,
President.

Dubuque, Ia., January 24, 1920.

American Machinist.
Mr. Ethan Viall:

In reply to your letter to Mr. Eugene Adams, president of the Adams Company, relative to a change to the metric system, would state that all the mechanical men in this company are bitterly opposed to a change from our present linear measure of foot, inch and thousandth thereof.

We believe a compulsory change to the metric system would cause incalculable damage to the machine builders in this country.

THE ADAMS COMPANY,
F. O. Farwell.
Gen'l Supt.

A German's View of the Industrial Situation in Germany

REPORTS from all parts of the metal industry agree in stating that during the past few months there evidently has been a turn for the better. The lowest point of economical decline in Germany has been passed, and one can clearly sense the signs of a powerful rising movement. The output of industrial establishments is increasing; the desire to work harder and better seems to have entered into the minds of the workers—due to the realization that the true value of wages paid lies in the value of work obtained therefor, and that the healthiest and best road to a betterment of wage and working conditions lies in the raising of the buying value of the monetary unit, and this can only be obtained through a concentrated effort on the part of all workers to increase their production.

When we speak of a "desire to work harder and better," we do not mean solely the efforts of the workers. We mean also the desire to work on the part of the employers. This has been at a low ebb during the past few years. The initiative, so long lacking, has returned in a manner which is decidedly gratifying to industry.

Everywhere we find indications of a tremendous increase in work and new enterprises. The difficulties which have to be overcome, are still very great, for the importation of essential raw materials and fuel is still halting and unsatisfactory, and this makes quantity production almost unattainable. But the people have begun to take courage, and have a greater confidence in a brighter future, which helps them overcome the difficulties mentioned. In fact, an incredible and marvelous amount of work has been accomplished in the face of difficulties that have been without parallel, and when the history of German industrial operations shall hereafter be written, the fight during the year 1919, against the heaviest odds, will undoubtedly be notable.

Among industrial branches which have progressed furthest during the past few months the first place belongs without a doubt to iron and steel. One of the surest signs of re-awakened interest in all phases of the steel industry is the condition of the machine-tool industry, and the increase or decrease in the consumption of machine tools has always been considered a sort of barometer for the allied industries. If the demand for machine tools shows a steady increase over a period of months, one may judge with perfect safety that a strong upward movement has started throughout the nation's industries.

One of the most peculiar things to be noted at this time is the complete absence of second-hand machine tools—such as have been thrown on the market in other industrial countries, even in the United States of America, in large quantities. We had been warned, and seemingly rightly, that with the cessation of the manufacture of war materials there would be a large number of used machine tools of all types on the market. Only a very small portion of this dreaded warning has been fulfilled. Each edition of a prominent American trade journal contains about 30 pages of such offerings, and in one particular issue there were counted more than 10,000 such machines. Compared with such quantities, the amount of used machinery and machine tools offered in Germany is infinitesimal. This certainly proves that the factories which have been making munitions and war materials have no intention of going out of business, but have immediately taken up machine-tool and other kinds of industrial work. Everywhere we find new types, new inventions and new apparatus, and the feverish desire to improve on the existing equipment, held in leash so long by war-imposed restraint, shows plainly in all parts of the country.

At the same time it is worthy of note that most of the large factories have gone over their production programs with extreme care, and have eliminated the former policy of scattering efforts. Instead, each firm has laid down a program of concentration and specialization, and it must be admitted that the bitter experiences of the war had their effect in clearing away the cobwebs of ultra-conservatism in production methods. Specialization and multiple production are now considered as the goal to be striven for in all factories, and the indications in all plants of the country are that this policy of multiple production will hereafter be carried out everywhere.

Below is given a review of present activities in a large number of German factories, which make a specialty of machines and machine tools, hand tools and equipment for other factories:

Aerzener Maschinenfabrik G.m.b.H., Aerzen.—Pneumatic hammers.

Ako Werkzeugmaschinen, Dresden, formerly Auerbach & Co.—Lathes, grinding machines.

Armatur und Pumpenfabrik Keller & Co., Chemnitz.—Condensers, steam traps, geared pumps, air pumps, air compressors and wet air pumps. Among its most important products are steam-pressure reducing valves.

E. O. Bartz & Bolle, Berlin S. 42.—This firm is representative for the Palli hardening process in Germany.

Bausch & Sohn, Köln-Bayenthal.—Belting.

A. Bay, Stuttgart.—Metal saw frames.

F. W. Beckmann, G.m.b.H., Solingen.—Universal tool grinding machines, disk grinding machines.

Beling & Lübke, Berlin SW.—Vertical and horizontal milling machines, lathes, grinding machines.

Wilhelm Th. Benning, Düsseldorf.—Machinery and tools for the production of locomotives, cars, switches for railroads, and automobiles.

Paul Blell, Werkzeugmaschinenfabrik, Zeulenroda Thür.—Lathes, radial drilling and planing machines, in small and medium sizes.

Gebr. Böhringer, Werkzeugmaschinenfabrik, Göppingen, Württemberg.—Lathes, planing machines and automatic machines. This firm has been expanded considerably during the past few years. It now employs 1400 men and makes a specialty of the following types of machinery: Turning lathes; turret lathes of various sizes, capable of handling pieces up to 1050 mm. diameter; planing machines of 600 to 2500 mm., planing surface; automatic machines, system Gridley, of 57, 82 and 108 mm.

G. Boley, Werkzeug & Maschinenfabrik, Esslingen a.N.—This firm manufactures milling machines, precision lathes, turret lathes, hand milling machines for precision work and optical work, lathes and tools for jewelers and watchmakers, and small vises. Delivery of these products can usually be accomplished within two to four months.

Boley & Leinen, G.m.b.H., Esslingen.—Turret lathes.

Brüder Boye, Berlin.—Smelting and hardening furnaces.

Franz Braun Akt.-Ges., Zerbst-Anhalt.—Lathes in many sizes and types; high-speed lathes in eight different models; high-speed lathes with constant-speed drive in eight models; heavy ordinary and automatic turret lathes; vertical and radial drilling machines; punching, shaping, and axle-boring machines.

Burkhardt & Weber, Reutlingen-W.—Cold sawing machines for cold steel; saw grinding machines; circular saws, trademark "Perfekt"; boring machines.

Th. Calow & Co., Maschinenfabrik und Eisengiesserei, Bielefeld.—This firm manufactures chiefly presses, milling, pointing and thread cutting machines for the manufacture of screws and bolts; stamping machines for the manufacture of steel balls from cold-drawn steel rods. It agrees to demonstrate to prospective customers any of its products under actual working conditions.

Victor Curstädt Maschinen und Werkzeugmaschinenfabrik, Berlin-Charlottenburg.—This firm makes a specialty of precision grinding machines for high-grade work, according to the Norton system. These machines are especially adapted to the manufacture of small tools and small parts of other machines and range in size up to 90 x 250 mm.

Delfosse, Motorenfabrik G.m.b.H., Cöln-Riehl.—Motors, precision lathes. It can promise delivery immediately or on very short notice.

Wilhelm Dempewolf, Cöln-Ehrenfeld.—Gears.

Deutsche Gussstahlkugel- und Maschinenfabrik A.-G., Schweinfurt.—Ball bearings.

Deutsche Hebezengfabrik, Wilh. Pützer, Düsseldorf.—Chain hoists.

Deutsche Kugellagerfabrik, G.m.b.H. Leipzig-Plagwitz.—Ball bearings.

Deutsche Spiralbohrer- und Werkzeugfabriken, G.m.b.H., Remscheid-Vieringhausen.—This firm has enlarged its capacities considerably during the past years, and is now one of the most important makers of twist-drills in the country. Delivery usually from stock or on short notice.

Deutsch-Luxemburgische Bergwerks und Hütten Aktien-Gesellschaft, Dortmund.—High-price alloy steels, tool steels and construction steels.

Carl Dietlein Maschinenfabrik- und Apparate Bauanstalt, Magdeburg-Neustadt.—Its specialty is the construction of equipment for autogenous welding. Its apparatus is designed and constructed so as to give a maximum of safety in operation. Fifteen different types are produced varying from a carbide capacity of 2 kg. to 100 kg. All the smaller apparatus, up to 10 kg. capacity for a single charge, can be supplied at short notice.

Diskus Werke, Frankfurt a/M. — Surface grinding machines.

Donan-Werk Ernst Krause, Wien.—This well-known wholesale house for machine tools operates its own factory in Wien, and has recently extended its activities into Germany. A branch is maintained in Berlin. The firm recently acquired control of the Werkzeugmaschinenfabrik Brune, Cöln-Ehrenfeld, maker of planing machines.

Oscar Ehrlich, Drehbankfabrik, Chemnitz.—All types of medium and small size lathes, precision lathes, automatic gear cutting machines, and centering machines.

Eikar G.m.b.H. Maschinen und Werkzeugfabrik, Cöln-Braunsfeld.—Large and small vises, of metal and wood. The former can be supplied in one to two months' time; the latter are sold out for the next 18 months

Elektrische Schweissmaschinen, G.m.b.H., Charlottenburg.—Electric welding machines of all types and sizes, ordinary type and automatic, for tin cans, large tins and cans, for small openings and whole seams.

Fichtel & Sachs, Schweinfurt a/M.—Ball bearings.

Max Fischer, Holzwarenfabrik, Marienberg, i/S.—The specialty of this firm is handles and grips for tools, provided with patented metal gripping device, which prevents splitting of handle.

Gama, Otto Eckelt, Berlin N 39.—Gas furnaces for all purposes.

J. Gast, Komm.-Ges. Berlin-Lichtenberg.—Turret lathes.

Richard Grassmann, Chemnitz-Altendorf.—Steel bolts and nuts.

Hahn & Kolb, Werkzeugmaschinenfabrik Index, Oberesslingen a/N.—Machines for straightening crankshafts, smelting and hardening furnaces, grinding machines for all types of tools, automatic screw machines.

Händel & Reibisch, Dresden-A.—High-efficiency saws.

Carl Hasse & Wrede, Berlin N 20.—Turret lathes, automatic machines.

P. W. Hassel & Co., Maschinenfabrik & Eisengiesserei, Hagen i.Westph.—This firm supplies the complete equipment for manufacture of iron and steel products. Its service is in two parts: the laying out and equipping of complete shops of even the largest size, comprising mostly machines made by the same firm, and the equipping of existing shops with single pieces of special machinery for certain purposes. The machines turned out by this firm include complete rolling mills for medium and heavy steel work; cold steel rolling mills; eccentric and friction presses; belt-driven drop hammers and other heavy hammer equipment; wire-drawing machines; special machines for quantity production of car springs, both leaf and spiral, for locomotives, railroad and trolley cars; large and medium screws and bolts for railroad shop work. All this material is kept in stock and shipments can be made on the shortest notice.

Gebrüder Hau, Maschinenfabrik, Offenbach-Bürgel.—Oil centrifugals, screw cutting machines, horizontal boring machines, tool grinding machines.

Heidenreich & Harbeck, Hamburg.—High-speed lathes.

Friedrich Hollmann, Präcisions-Kugellagerfabrik, Wetzlar.—Precision ball bearings and balls for all types of machinery. Able to make delivery of normal sizes in short time.

Huth'sche Eisen & Stahlwerke, Gevelsberg.—Castings of grey iron and steel.

Jaegerstahl G.m.b.H., Mannheim-Waldhof.—Tool steel.

Fr. Aug. Jahn, Gera.—Universal tool grinding machines, boring and milling machines of various types.

Kalthof & Meyer, Milspe i.W.—Screws, bolts, nuts and bed plates for dies.

Fr. Keilpart & Co., Messwerkzeugfabrik, Suhl.—For 40 years specialist in precision measuring instruments, micrometers for inside and outside diameters; depth measuring instruments with dials showing the measurements accurately to 1/100 mm.; compasses, metal triangles and hardened flexible measuring rules. Delivery in two to four months.

Keller & Knappich G.m.b.H., Augsburg.—Autogenous welding and cutting installations, from the smallest to the largest sizes. Acetylene generators built on the principle "carbide into water" and huge underground installations for technical purposes, up to an hourly production of 36.000 liters; all parts of such apparatus, including burners with exchangeable tips; cutting burners for cutting materials up to 800 mm. thickness; carbide testing apparatus; acetylene searchlights. During the war this firm made a specialty of a new type of chain hoist, built on the system "Kuka," with and without automatic brakes. The same firm has announced for the present year an entirely new kind of safety hoist, which lowers the load automatically at a certain pre-arranged speed, without turning the handle, while a single short pull on the chain stops the downward travel of the load at any moment desired. The firm is able to deliver small hoists direct from stock; larger installations in two weeks to two months.

Paul Kellner Maschinenfabrik, Gössnitz (S-A).—Lathes with ball bearings and fitted with a new type of chuck for gripping the material to be worked. These machines are being turned out in mass production, in sizes varying from 1600 to 2000 mm. length, and 225 to 400 mm. swing. They can be ordered from stock for immediate delivery. Another product of this firm is a "parallel vise" capable of taking pieces up to 120 mm., between its jaws.

Karl Krappe, Dresden. Emery wheels.

C. Oswald Liebscher, Dresden-A.—Gear cutting machines, lathes, milling machines.

Walter Loebel, Maschinenfabrik, Leipzig.—Specialties of this firm are high-speed lathes, built in series in several sizes and types. Delivery of small lathes, four weeks; toolroom lathes, four months; and high-speed lathes, seven months.

Ludwig Loewe & Co., Aktien-Gesellschaft, Berlin N.W. 87.—This company has many distinctive branches in its huge establishment. In the division for machine tools it produces nearly every type of lathe, milling and boring machine in existence. In the division for special machine construction the chief product consists of machines for the manufacture of rifles, pistols and ammunition. In the division for tools, the company produces an immense variety of tools, from the simplest merchanic's equipment to the most delicate measuring instruments, and precision tools of the highest type. In still another division it constructs the entire equipment for a modern machine shop. Other divisions make castings of iron, steel, brass and other nonferrous metals, and special alloys. One of its important parts is the famous commercial laboratory for the iron and steel industry maintained by it.

Ernst Löwen, Gesenkschmiederei- und Fabrik für Eisenbahnoedarf, Milspe i/Westf.—This firm makes forgings up to 40 kg. Its specialty is forgings for railroad cars, bumpers, couplings and turnbuckles. The firm is one of the oldest and most capable in its field.

Magdeburger Werkzeugmaschinenfabrik A-G, Magdeburg has become one of the largest manufacturers of turning lathes and turret lathes in Germany. Its products are made in series, by multiple production methods.

Magnetwerke G.m.b.H., Eisenach.—Electromagnets for

lifting and coupling; magnetic separators and protectors.

Mammut Werke, Nürnberg.—Milling machines, universal lathes.

Maschinenfabrik Carl Hurth, München.—Gears of all sizes and types for the manufacture of machinery and automobiles, automobile parts and parts for internal-combustion motors.

Maschinenfabrik Kappel A-G., Chemnitz-Kappel.—Universal milling machines; horizontal and vertical high-speed lathes.

Maschinenfabrik Lorenz, Ettlingen.—Gear cutting machines, milling machines of various types and sizes, worm gears, drop hammers and eccentric presses.

Maschinenfabrik Oberschönweide Akt.-Ges., Berlin-Oberschönweide.—Turret lathes and turning lathes of medium and heavy size, gear cutting and shaping machines, milling machines, hydraulic presses, centrifugal pumps, compressed-air tools of all kinds with complete air-compressor equipment.

Maschinenfabrik Pekrun, Coswig i/Sachsen, near Dresden.—Three manufacturing divisions, comprising heavy milling machines for precision work; reduction gear "Pekrung," helical gears and ordinary cog-wheel drives; axles for automobiles; hardening and smelting furnaces.

Maschinenfabrik Weingarten, vorm. Heinrich Schatz A-G., Weingarten, Württemberger.—Shears for sheet iron, tin, sheet steel; shears for trimming and cutting circles, curves, and angles of all sizes; drawing presses for sheet steel.

Otto Melber, Schnittwerkzeugfabrik, Esslingen.—Dies and cutting tools.

Mikron G.m.b.H., Werkzeug- und Werkzeugmaschinenfabrik, Berlin S. 59, Hasenheide, 5-6.—The specialty of this company is the production of highly sensitive micrometers, for measuring inside and outside diameters, bolt and screw testing calipers.

Mold-Werke Akt.-Ges., Chemnitz.—Electric welding apparatus.

Morsbach Schmirgelwerk, Ohligs, Rheinland.—Buffing and polishing machines for hardware stores and professional polishers. Model A is especially adapted for the polishing of hollow-ground razors and spoons; Model B, for small metal parts for machinery; Model C for hardware stores, etc.

Peter Friedr. Mühlhof, Remscheid.—Twist drills and milling machines.

Pharosfeuerstätten G.m.b.H., Hamburg.—Portable hardening furnaces.

E. Piechatzek, Berlin, N. 65. Hoists and traveling cranes.

Piltz & Sohn, Stuttgart.—Measuring apparatus for inside and outside diameters, depth-measuring devices with dial indicators.

Pscherer & Co., Werkzeugmaschinenfabrik, Leipzig.—Automatic screw machines are the specialty of this firm. The length of the screw thread can be changed and adjusted while the machine is operating. Brass screws are cut, cleaned, sorted, counted and heads properly slotted or milled, at a speed of 500 to 600 per hour.

Pumpenfabrik Urach, Urach, Württemberg.—Pumps for hydraulic presses, boiler-testing pumps, vacuum pumps, air compressors and manometers.

Raboma Maschinenfabrik Hermann Schoening, Berlin Borsigwalde.—Specialty for past 20 years of drilling machines of several types. These machines have been constructed for iron and steel building purposes, for drilling holes in ship plates, locomotive frames, boiler plates, etc.

Paul Radeke, Maschinenfabrik, Berlin, N.W. 87.—Power hammers in three sizes, of 30, 60 and 100 kg. dead weight. These hammers are made in series and can be furnished, even in quantities, on short notice. Delivery usually in four to five weeks.

Wilhelm Reh, Werkzeugmaschinenfabrik m.b.H., Deuben-Niederhäslich bei Dresden.—This firm now specializes in the construction of precision machines on the multiple production system. Its milling machines are especially noteworthy, being constructed solely from the very best raw materials, under strict elimination of all "Ersatz" materials. The spindle is of the best alloy steel, adjustable in both front and rear phosphor bronze bearings, very strong, hardened and ground. The whole machine is strongly and powerfully constructed. Of special interest is the Universal dividing-head which has an attachment for differential indexing. The dividing wheel is larger than usual in such machines, and is of phosphor bronze, which is considered an advantage by that firm. The machine is fitted with an exceptionally large and roomy tool box, which contains, in addition to the usual tools and parts used in different kinds of work, a water tank and a pump for delivering the cooling water to the work. Delivery is promised on short notice.

Hans Reisert G.m.b.H., Cöln-Braunsfeld.—Oil filtering apparatus, lubricating oils and greases.

Riebe Kugellager- und Werkzeugfabrik G.m.b.H., Berlin-Weissensee.—This firm has again taken up the manufacture of its well-known ball bearings, improving its work by the introduction and adaptation of the latest machinery. In addition it manufactures motor plows and stationary internal combustion motors for benzol and similar fuels. In its tool and machine department it manufactures milling machines. One of the new departments deals with the construction of technical apparatus.

Max Rober, Präzisionswerkzeugmaschinenfabrik, Chemnitz.—This firm makes a specially designed gear-cutting and milling machine, capable of cutting any existing type of gear, even the peculiar designs of A. E. G., Bilgram, Fellows and Maag. These machines are for the highest type of precision work, although turned out in series and in quantity. They can be used for cutting internally toothed wheels, without being designed especially for this work. They are built in so compact a way as to be able to trim off even thick layers of material, which is a tremendous saving in time.

Röhm-Gesellschaft, Präzisions-Werkzeugfabrik, Zella-St. Blasil.—Manufactures wrenches, chucks and vises. Deliveries cannot be promised in less than two to three weeks.

Ruthardt & Co., Stuttgart.—Division of measuring instruments. Its specialties are measuring devises fitted with dials, showing inaccuracies of 0.01 mm. The firm calls particular attention to the fact that one of its instruments with dial is far cheaper in actual use than the usual type of permanent gage, because of its wide range and applicability. It will serve to measure a hundred different sizes, while a gage is rarely used for more than one or two sizes. Delivery guaranteed inside four weeks.

Samsonwerk G.m.b.H., Berlin.—Turret lathes, automatic and milling machines, shaping machines and chucks.

Schmirgelwerk Dr. Rudolf Schönherr, Schleifwaren und Spezialmaschinenfabrik, Chemnitz-Furth.—Carborundum and corundum wheels for grinding metals, glass and stone, for cleaning castings, for rough grinding and for automatic polishing of large flat surfaces; honing stones, whetstones for very fine work. The firm also makes a large variety of grinding machines, and can deliver normal sizes and types on short notice.

H. F. Schnicke, Werkzeugfabrik, Chemnitz.—Two divisions are maintained—one for the manufacture of spiral springs, leaf springs, bumper springs, draw and compression springs of various kinds; and the second for the construction of cutting and boring tools for the different types of planing, boring and milling machines. Gimlets, awls and gages are kept in stock in considerable variety, and delivery can be made from stock. Orders for special sizes are filled quickly.

Schuchardt & Schütte, Berlin C 2.—This firm has greatly expanded its manufacturing facilities, without thereby restricting its original business of wholesale dealer in machine tools. Its factories are in Berlin, Neuköln, Guben and Vienna, and can supply practically every known type of machine or tool, either from its own plants, or as a sales representative of other makes.

L. Schuler, Göppingen.—Shears, presses and turning lathes.

Alfred H. Schütte, Köln-Deutz.—This form has greatly extended its scope of manufacturing machines and tools, the wholesale distribution of which was its original business. It has factories in Köln-Deutz, Köln-Ehrenfeld, Berlin, Treptow. To name all the products of this firm would be like printing a list of the machines and machine tools on the market in the whole country, although naturally it makes a specialty of some particular types. Among the late additions to its offerings are high-speed boring machines with electric drive, needle-drawing machines and a large number of automatic machines. It also manufactures machines for all kinds of grinding processes.

Schüttoff & Bässler G.m.b.H., Chemnitz.—Screw cutting machines, turning lathes.

Earl Schwemann, Bohrmaschinenfabrik, Gevelsberg.—High-speed boring machines.

Richard Specht, Coswig i/Sachsen.—Screw cutting machines.

Stahlwerk Kabel, C. Pouplier, Jr., Kabel i/Westf.—Cold-drawn and cold-rolled tool steels, silver steel, high-speed steel, screw cutting machines, gimlets, awls, saws for metal and wood, steel tube and frame steel for automobiles, bicycles, motorcycles and airplanes.

Thielicke & Co., Berlin.—Wholesale house for automatic

screw cutting and boring machines, drop hammers, planing and milling machines, lathes and grinding machines of high-grade materials.

Emil Thuy, Hagen i/Westf.—Transmission parts.

Th. Tielemann, Eisen- und Stahlwerk, Gevelsberg.—Castings in iron, grey iron, steel and tempered steel.

Titania-Werk, Berlin-Schöneberg.—Vertical boring machines, milling machines, tools and gages.

Anton Tureczeck, Berlin.—Micrometers for inside measurements.

Carl Unger, Stuttgart-Hedelfingen.—Grinding machines.

Andreas Veigel, Cannstatt.—Turret lathes.

Vereinigte Flanschen- und Stanzwerke, Hattingen.—Forged flanges for wheels, forged pieces for railroad use, dies and die-holding pieces.

Vereinigte Modellfabriken, Berlin-Landsberg.—Models of wood.

Robert Wagner, Eisenwarenfabrik, Chemnitz.—One of the largest factories in the country for the production of metal furniture and fixtures for machine shops and big factories; lockers for clothes and tools, with safety locks; tables, chairs, stools, tool boxes, etc., all of which are kept in stock, in a great variety of sizes.

H. A. Waldrich, Solingen.—High-speed boring machines.

Wandererwerke, vormals Winklhofer & Janicke A-G., Schönau near Chemnitz.—This company maintains, in addition to its famous automobile, bicycle and typewriter establishments, a department for machines and machine tools. Its specialty in this line are milling machines in various sizes, all of which are built in series, and in large numbers. The company does not undertake to construct such machines to order.

Ferdinand C. Weipert, Heilbronn.—This firm makes a specialty of turning lathes, shaping and planing machines in a number of sizes and types.

J. G. Weisser Söhne, Werkzeug-Maschinenfabrik, St. Georgen.—Several milling types of turning lathes, turret lathes, boring machines and milling machines.

Gebrüder Weissiker, Schleifmaschinenfabrik, Gera-Reuss.—For many years this firm has made a specialty of tool grinding machines and other important machine tools.

Ernst Fr. Weisspflog, Metallschrauben- und Muttern-fabrik, Gera-Reuss.—Makes a specialty of supplying screws, bolts, nuts, taper pins and rivets, as well as plates of iron, steel and brass, in thickness of ¼ to ¾ inches.

Werkzeugmaschinenfabrik Gebrüder Eberle, Schönebeck an der Elbe.—Vertical boring machines of limited variety. Requires from two to three months for delivery.

Werkzeugmaschinenfabrik Gildemeister & Comp. A-G., Bielefeld.—Milling machines, turret lathes and automatic screw machines; all these machines are built in series in large quantities, and are always in stock in many sizes.

Fritz Werner A-G., Maschinen-und Werkzeugfabrik, Berlin-Marienfelde.—This firm has expanded greatly in the last few years. Formerly a specialized manufacturer of machinery for the production of rifles and ammunition, it has now become an important factor in the manufacture of all types of machines and tools, such as milling and grinding machines, turning lathes, boring and centering machines, die-sinking machines, wrenches, vises, monkey-wrenches and other tools. During the war the firm built a new factory in Marienfelde near Berlin, which is one of the finest and most modern in Germany. Delivery of most products in three to six months.

Walter Wessel, Werkzeugmaschinenfabrik, Remscheid.—This firm produces vises for precision work, in four sizes, from 60 to 200 mm. distance between jaws. A number of special types of vises are always in stock, and delivery can be made on short notice.

Wotan-Werke A-G., Leipzig.—Turning lathes, milling and shaping machines.

A Radius and Position Gage Problem

By Carman Guerrera

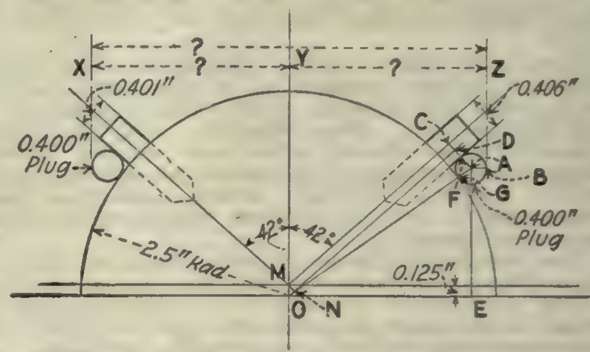
Here is a problem in the determination of a distance by means of radius and position gages which I have been unable to get anyone to solve for me.

The distance to be determined is that across the two 0.400-in. diameter plugs shown in the figure.

[Owing to the difference in diameter of the two arms of the radius gage the required distance must be obtained by two separate but similar calculations, one of which follows:

Draw OD parallel to MC, AC perpendicular to MC, AE perpendicular to OE, AB parallel to OE and connect O and A. Draw MN perpendicular to OD.

Then in triangle MNO, which is a right triangle, we



RADIUS AND POSITION GAGE PROBLEM

know MO which is given as 0.125 in. and the angle MON which is 42 deg. by construction. We want to find MN.

$$\begin{aligned} MN &= MO \sin MON \\ &= 0.125 \sin 42^\circ \\ &= 0.084 \end{aligned}$$

$$MN = CD \text{ (Parallels intercepted between parallels are equal).} \qquad (2)$$

In the right triangle ADO, AD and OA are known. We can find angle AOD.

$$\begin{aligned} AD &= AF + CF - CD \\ &= 0.2 + 0.203 - 0.084 \\ &= 0.319 \end{aligned} \qquad (3)$$

$$\begin{aligned} OA &= OF + FG \\ &= 2.5 + 0.2 \\ &= 2.7 \end{aligned} \qquad (4)$$

$$\begin{aligned} \sin AOD &= \frac{AD}{OA} \\ &\frac{0.319}{2.7} \\ &= 0.11815 \\ AOD &= 6^\circ\ 47' \end{aligned} \qquad (5)$$

In right triangle AOE, OA and angle AOE are known. We can find OE.

$$\begin{aligned} AOE &= 90^\circ - YOD - AOD \\ &= 90^\circ - 42^\circ - 6^\circ\ 47' \\ &= 41^\circ\ 13' \end{aligned} \qquad (6)$$

$$\begin{aligned} OE &= OA \cos AOE \\ &= 2.7 \cos 41^\circ\ 13' \\ &= 2.031 \end{aligned} \qquad (7)$$

$$\begin{aligned} YZ &= OE + AB \\ &= 2.031 + 0.200 \\ &= 2.231 \end{aligned} \qquad (8)$$

XY may be found by a similar calculation. Then $XY + YZ$ is the required distance. EDITOR.]

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and · equipment ·

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs · and equipment ·

Gairing Service Counterbores

The Gairing Tool Co., Inc., Detroit, Mich., is manufacturing a line of interchangeable counterbores of the type shown in the illustration. The cutter is held in position and driven by a steel ball in the body of the holder that engages a slot in the shank of the

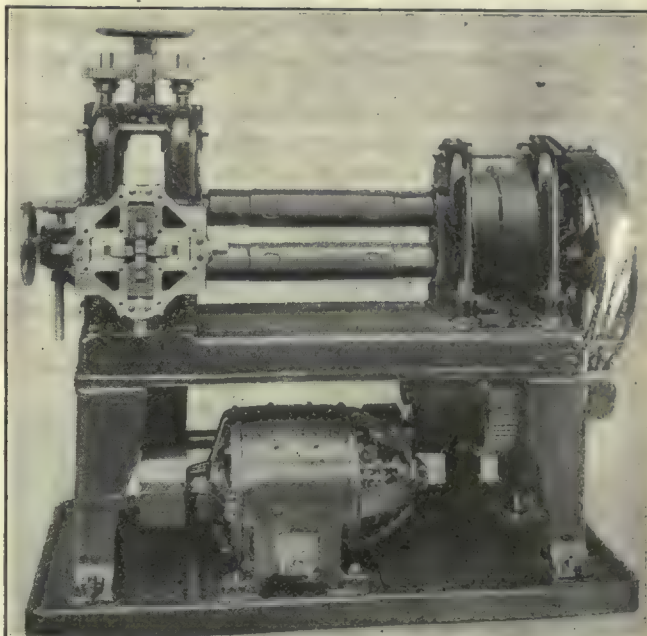
GAIRING SERVICE COUNTERBORES

cutter. The cutter can be removed from the holder by a slight turn to the left which compresses the spring and releases the ball from its seat in the slot. The floating ball with the spring pressure beneath automatically adjusts itself so that the shoulder of the cutter is always squarely against the end of the holder, thus preventing backlash or chatter. The slotted spring nut, holding the pilot in place, seats and locks itself in a 60-deg. pocket in the end of the cutter shank and prevents the pilot from becoming loose. The body of the holder having no projections of any kind, may be threaded to receive a stop collar, an arrangement that will permit a wide range of adjustments. The holders are made in four sizes known as Nos. 1, 2, 3, and 4. They will take any size of cutter from $\frac{1}{4}$ to 3 in. in diameter. Complete sets of these tools are contained in neat boxes having hinged covers. The No. 2 set is known as the fillister- and flat-head screw set, and is suitable for use for all sizes of such screws from $\frac{1}{4}$ to $\frac{7}{8}$ in. The No. 5 set includes two countersinks, fifteen cutters, thirty-eight pilots, three holders, and an assortment of pilot nuts and wrenches for same.

Standard Rolling Mill

A rolling mill designed for the high-speed rolling of wire and thin-gage flat stock is a recent product of the Standard Machinery Co., Auburn, R. I. The rolls are hollow, made of steel, and are hardened and ground. The herringbone pinions that transmit power to the rolls are inclosed in the housings and run in a bath of oil. The housings are made in halves, the joint being of oil-tight packing. Roller bearings are provided for the roll necks. A water-cooling system circulating through the bodies of the rolls keeps the surfaces cool while the machine is running at high speed. Three trains of gears are used to drive the machine. These include three fabroil pinions, one of which is attached to the motor shaft. All of the other gears, including the herringbone pinions, are made of steel and have cut teeth. The power is supplied by a 5-hp. variable-speed motor; the peripheral speed of the rolls ranges from 100 to 225 ft. per minute.

A special feature of the mill is the adjustable draw plate or Turk's head, shown at the rear of the roll housing with its cover removed. The rolls and boxes are



STANDARD ROLLING MILL

easily removable. Adjustments for different thicknesses of stock can be made by means of the four square-headed screws. These are provided with micrometer collars which permit an independent adjustment of 0.001 in. for each of the vertical and horizontal rolls. Lateral adjustment of the Turk's head, permitting the entire surface of the main rolls to be used, is made by the handwheel at the left. The main rolls are 6 in. in diameter and $4\frac{1}{2}$ in. in width, but special rolls are used to suit conditions.

The advantage in placing the Turk's head directly back of the rolls is that in this position it can be used for edge rolling and for sizing special shapes. It can also be used to some extent as a straightener. For edge rolling, the horizontal rolls control the width of the stock and the form and shape of the edges, while the vertical rolls are adjusted downward to control the thickness. The housings on each mill are planed at the front side, as well as at the back, to accommodate the Turk's head in order that the mills can be run in tandem if desired. The adjusting mechanism on top of the main housings is controlled by a single handwheel, the movement of

which operates both adjusting screws simultaneously. By removing the center pinion, the screws may be adjusted independently.

Ferracute Embossing Press

The toggle embossing press shown in Figs. 1 and 2, has recently been built by the Ferracute Machine Company, Bridgeton, N. J. The frame is a one-piece casting, the columns being set close together to minimize all possible spring. Each column is 13-in. square with a vertical 5½-in. cored hole containing a 5-in. steel bar, the combined tensile strength of columns and bars allowing for a large safety factor over the 450-ton pressure—for which the machine has been designed.

The toggles are set in the lower portion of the press and are operated by an eccentric shaft at the back as shown in the rear view, Fig. 2. This shaft obtains its motion from the large gear on its outer end, connection being made by a clutch. Pressure on the treadle causes the press to start and make a stroke, automatically stopping when a complete stroke has been made. If continuous action is desired, the treadle may be locked down.

The ram has a stroke of 2 in. The distance from head to ram, when the latter is in its lowest position, is 20 inches.

A sliding die chuck is given an intermittent horizontal motion of 10 in. by a series of levers connected to the main shaft by means of a cam. This movement causes the chuck to pause during the stroke as the embossing or coining dies come together.

The flywheel, motor pinion, main gear and its pinion are all thoroughly guarded and wire mesh is cast between the arms of the flywheel and gear as an additional safety precaution.

The head is vertically adjusted by means of a wedge

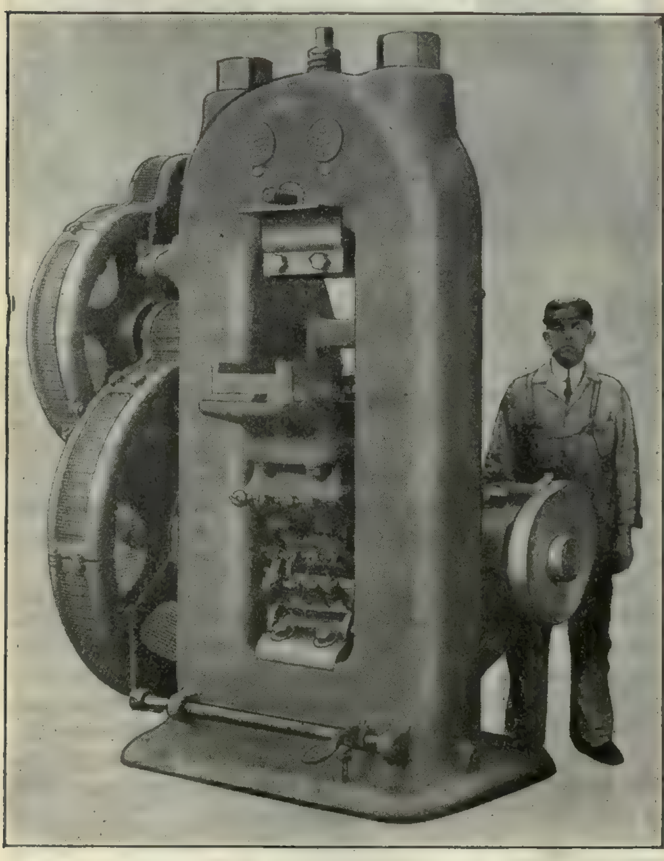


FIG. 1. FERRACUTE EMBOSSING PRESS, FRONT VIEW

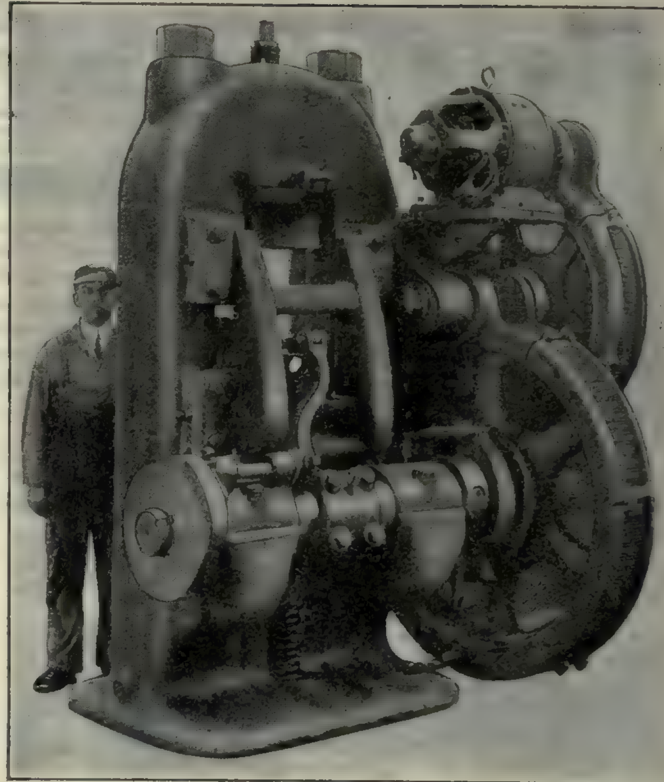


FIG. 2. FERRACUTE EMBOSSING PRESS, REAR VIEW

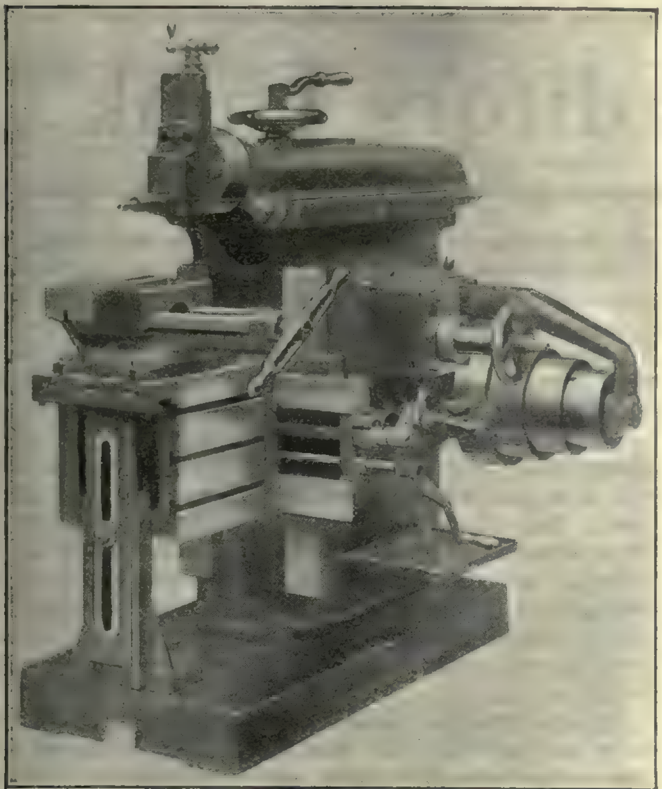
that is moved horizontally, thus permitting the pressure to be transmitted through solid metal. The weight of the head is taken by a helical spring at the top of the press. Thorough lubrication of the toggles so essential in presses of this character, is provided for by numerous oil cups.

The press makes 30 strokes per minute. An electric motor furnishes the drive through a raw-hide pinion engaging teeth that are cut in the rim of the flywheel. The total weight of the machine is about 18,500 pounds.

Davis Cone-Drive Shaping Machine

The shaping machine manufactured by the Davis Machine Tool Co., Inc., Rochester, New York, until recently was made with gear-box drive only, but an additional model, equipped with a four-step cone drive, is now being built.

The new drive through the four-step cone pulley and double back gears, gives eight ram speeds in geometric progression, the range being from 10 to 115. The machine has the same quick-return feature and V-ways with roll oilers as the older model. The base is of heavy design and extended to accommodate the table support. The elevating screw is of the telescopic type. Quick adjustment of the ram is obtained by the handwheel at the top, and the stroke-adjusting mechanism has a dial which indicates the length of stroke set. The head is graduated and swivels through an arc of 120 deg. The down-feed screw is provided with an adjustable micrometer collar. All driving gears are cut from solid steel and are mounted on shafts which are supported at both ends by substantial bearings. The gear change is made by a conveniently located lever that slides one double gear. The regular equipment includes a heavy swivel vise, all necessary wrenches and the countershaft.



DAVIS CONE-DRIVE SHAPING MACHINE

Specifications: Planes, long 16¾ in., wide 21 in.; maximum distance table to ram, 17¼ in.; vise, between jaws, 10 in.; height, floor to ram, 40⅜ in.; power down feed, 6¼ in.; size of box table, 12 x 14 in.; largest cone step, 12 in.; width of drive belt, 3 in.; r.p.m. of countershaft, 290; changes of speed, 8; size of shipping case, 44 x 61 x 68 in.; floor space, 43 x 72 in.

On special order this machine can be equipped with power down feed, swivel box table, tilting table top, circular attachment interchangeable on top of table or vertically on saddle, cone mandrel and index centers.

G. E. 25-Pound Bench-Type Electric Metal Melter

The General Electric Company has developed a new electrically operated device for melting lead, babbit and similar metals, known as the 25-lb. electric metal-melter bench-type pot. This device is designed to eliminate the loss of time and material, and risks of losses by fire, accidents, etc., which attend the melting of metals in a haphazard manner.

This new pot is of durable construction, having four short legs and a flange on the upper rim, so that it may either be stood on a table, or the floor, without fear of upsetting, or lowered into a hole, so as to be flush with the top of the table. It is fitted with a plug and socket fixture that can be attached to any electric-light circuit.

The heating element is a coil, wound around the container from top to bottom, and thoroughly insulated from the outside, thus insuring an even distribution of heat through the contents of the pot, and preventing temperature loss due to radiation.

The automatic regulation, which is the principal feature of the device, has been obtained by constructing the heating element of wire which has a positive temperature coefficient. That is to say, when the temperature of the heating element rises, its resistance rises proportionally, thus limiting the current and, consequently, the heat. When cold metal is put into the

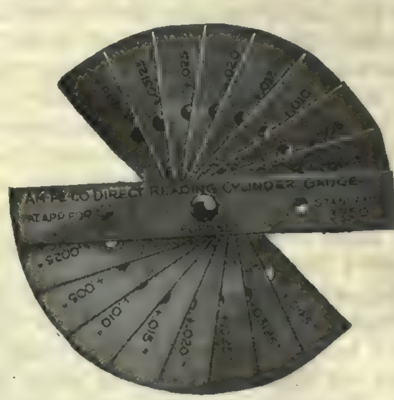
G.E. 25-POUND ELECTRIC BENCH-TYPE METAL MELTER

container, the initial rise of current is enough to melt it quickly, but, after it is melted, the current is automatically reduced to just enough to keep it molten, but not enough to burn it. This does away with the thick scum of oxidized metal around the top.

The operator may go away and leave the pot to itself when necessary without fear of wasting good metal through too much heat, or setting something on fire.

"Am-pe-co" Direct-Reading Cylinder Gage

A cylinder gage, designed particularly for the use of garage mechanics and intended as a substitute for the inside micrometer, has been introduced by the American Machine Products Co., Marshf'ltown, Iowa. It has the



"AM-PE-CO" DIRECT-READING CYLINDER GAGE

advantage of extreme simplicity. When measuring it is merely a matter of finding one of the nine blades to fit the bore and then reading the size that is stamped on that blade. The blade to be used is set at right angles to the others and the cylinder size is determined in the same manner as when calipering. The blades are hardened and ground and the ends ground to a true circle.

What Other Editors Think

Utilizing "White Coal"

FROM *Harvey's Weekly*

A LONG step has at last been taken toward removing one of the greatest industrial reproaches of this nation. The water-power bill which has been enacted by substantial majorities may not be an ideal measure, in all its details. It *is* an ideal measure in its principal purpose, which is to utilize the billions of dollars' worth of energy now running to waste every year. Informed and judicious men estimate that the available water power of the United States at present unutilized is worth, at present prices of fuel, not less than five billion dollars a year. That is more than three times the value of the coal now consumed.

It is a strange thing that throughout most of the country this enormous potentiality of nature's forces has been so largely neglected. In part it has been, no doubt, because of conflicting claims to the use of streams, which needed to be determined by legislation. That is a need which, we may hope, will be sufficiently met by the bill just passed. But there has been another reason, anterior to that; foolish in the extreme, yet undeniably potent. It was the notion that water power was a primitive form of energy, unworthy of an up-to-date people, and that it should be discarded along with the stage-coach and the sailing ship. It is true that it is a very ancient device. But it is also true that in its utilization it employs some of the very latest and most striking inventions of human ingenuity, in turbines and in electric plants for transmission to a distance.

This latter is one of the most important of all considerations. Formerly it was possible to use water power only at the very spot where it was generated, and it was very frequently the case that it was impracticable to use it there. Factories could not be built and operated in the remote places where nature had provided cataracts. And the use of water power for anything more than turning mill wheels was undreamed of. But now, with practicable methods of transmitting power to considerable distances without great loss, a stream in an uninhabited wilderness may drive the machinery of mills many miles away, or run the street cars and lighting plants of a distant city.

In one important respect water power differs from most other natural resources. That is, its inexhaustibleness. If we burn a million tons of coal, it is gone forever, and we shall have just as much less to draw upon. But if we use in one year the 300,000,000 hp. that experts tell us can be developed from streams, we shall have just as much the next year, and the next, and so on forever. In a sense, therefore, there has been no waste in letting the streams flow unutilized. For all the millions of horsepower thus neglected. we are no poorer. We have just as much left. But there has been a great loss from that neglect in the depletion of our coal supply. Had we utilized the water, we should now have hundreds of millions more tons of coal available for those uses—for there are some, of great importance—for which water power cannot be used and coal is indispensable.

Other nations learned the lesson long ago. Italy, having no coal, long ago made use of "white coal" from her mountain streams. Secretary Lane told us the other day that "Far-sighted, purposeful Germany fought four and a half years upon the strength of gear power plants run by the snows of the Alps." She did not, it is true, depend upon that power alone, but used freely the coal from the mines which she had stolen from France. But her use of water power was a very material factor in her prosecution of the war, as it had been in her development of the industries of peace in former years. There is no other large country in the world so well watered as ours, or so well provided with water power.

In any circumstances we should utilize it. We should have done so long ago. But the lessons of the recent coal strike are unmistakable, and were decisive in moving Congress to the long-delayed action which has just been taken. A few weeks ago we were exclaiming in indignation at the spectacle of people suffering from cold and from stoppage of industries, when the coal they needed was lying in the ground at their feet. It is a comparable spectacle to see them thus suffering when the physical energy which would supply their needs is flowing unutilized downstream, past their cities, to the sea. If now the country shall take full advantage of the opportunities afforded by the new law, another coal famine, if ever it occurs, will be robbed of more than half its terrors.

Every Man an Efficiency Engineer

FROM *Power*

JOHN LEITCH in his excellent book, "Man-to-Man, the Story of Industrial Democracy," relates that in one plant at a meeting of the employees the suggestion was made by one that an efficiency engineer be called in to instruct the men in better methods for doing their work, and to increase production. Much discussion followed, and finally one of the men blurted out, "We have 268 efficiency engineers right here now!" (There were 268 employees in the plant, and they were all present at the meeting.)

There is a tremendous amount of sound reasoning and good judgment expressed in that short statement, and it should be true of every plant. When by instruction and co-operation each man is induced to take the interest that he should in the plant in which he is employed, then each man will become an efficiency engineer. It will be unnecessary to call in outside aid to find the weak spots, and to devise better methods of doing things. No man can be as familiar with the workings within a shop as he who spends day after day at his bench, at his lathe, or on whatever his job may be.

Every workman should constantly keep before his mind these three questions:

Am I doing my work in the most economical way for the interests of my employer? (Which, by the way, generally prove to be the employee's interests also.)

Am I eliminating all possible wastes of time, energy and material?

Am I doing everything possible to advance myself in my work, both to my own profit and for the interests of my employer?

If a man can answer "yes" to all these questions, then however humble may be his position, however rough and unskilled may be his labor, that man is an "efficiency engineer," and as such a most valuable asset to his employer. On the other hand, the reverse is true. Any man, no matter how high a position he may hold, who can not answer "yes" to the foregoing questions not only is depriving his employer of services that are his due, but is decreasing production, increasing costs and—what should be of more interest to him—retarding his own development and advancement. And it is such men that make it necessary to bring in efficiency experts from the outside.

The profession of efficiency engineering has been greatly abused, until in many plants an efficiency engineer is looked upon with suspicion by employer and employee alike. The mere use of the words arouses a feeling of hostility at once. This works a hardship upon the great number of men who are qualified by training and ability to give expert advice in matters of cutting costs, increasing production and reducing wastes, and who have made this work their profession.

But if the employees of every plant, large or small, would adopt for their motto the words, "Every Man an Efficiency Engineer," there would be no occasion for outside experts to be called in. Labor and capital would alike benefit thereby, fuel administrators would be unnecessary, and power plants would operate at efficiencies heretofore unheard of.

Stolen Trade Marks

FROM *Automotive Industries*

IT IS interesting to note the interest created among manufacturers of automotive vehicles by a newspaper dispatch printed during the New York show, stating that an enterprising Portuguese automobile tradesman had taken advantage of the trade-mark laws to register in several European countries the trade marks by which forty-three American cars are known. It is probable that this man is patiently waiting for some of the American manufacturers to ask him his price to sell them what should be their own rights.

Some of the makers were amazed at this turn of affairs, but there is little reason why they should be even mildly surprised that they have been robbed of their rights. It certainly was not because they have not been warned. Speaking for *Automotive Industries*, we can say that repeated warnings have been given as to the liability of a copyright to be stolen, and we have told many times of similar, if less extensive, robberies of this kind. Also these columns have pointed out many times the way by which the manufacturer could protect his trade mark at a nominal expense.

The trade-mark specialists have advertised extensively to obtain customers for their service and they have taken very good care of those who became their clients. But there were many manufacturers who were actually selling cars abroad who did not protect their trade marks. Some manufacturers, despite warnings, permitted their agents abroad to register their trade marks and when the occasion arose to change agents, they found that they could not because the smart agent had registered the trade mark as his own. Of course, this involved a settlement and some have been costly.

Just as a word of warning, we might say to any manufacturer who has not registered his trade mark abroad, or whose trade mark has not been stolen: ACT AT ONCE.

[The *American Machinist* also has published numerous articles concerning the use and protection of trade marks.—EDITOR.]

Profit Sharing

FROM *Mechanical World*, ENGLAND

THE significance of the number of profit-sharing schemes which are being launched just now should not be missed, and engineering firms are by no means the least prominent in this movement. The primary idea—indeed, fundamentally, the sole idea—is of course to give the worker that same interest in the business or firm in which he is engaged, as the capitalist and the shareholder. Profit sharing has had a somewhat chequered career, in which outstanding successes and outstanding failures appear. At root, the principle is the right one, and only prejudice has prevented its more rapid expansion.

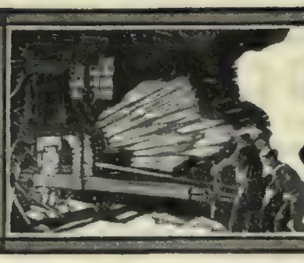
The attitude now being taken by employers seems to be to outline a scheme which in the first place provides for the payment of full trade-union rates of wages. That should essentially sweep away trade-union prejudice, on the ground that the share in profits is offered in lieu of wages. That objection has often been made, although we are not aware of any scheme of which that is a principle.

The employers in recent schemes, therefore, are, so to speak, unconcerned as to what attitude the unions take, for if a workman, after receiving his recognized wages, is offered something more as a share of profits, he may refuse it if he likes. Schemes on this basis are likely to meet with the approval of the more level-headed of workmen, although there is the drawback that the man who does not put himself out to do more than a minimum amount of work gets the same share of the profits as the man who puts his heart into his work.

Class Privilege

FROM *Harvey's Weekly*

WE BELIEVE that there is nothing more odious in a democracy than class privilege. Wars have been fought to destroy the detested thing, and they have been righteous wars, and successful. There was once a parochial political boss who defied a writ intended to prevent him from corrupting an election, with the cynic sneer, "Injunctions don't go here!" But he himself did speedily go—to prison. There was another, a conspicuous labor leader, who similarly defied injunctions; who is at the present moment serving a long term in the penitentiary. It is a dangerous thing to defy the common law of the land, and to claim for individuals or for classes immunity from the penal code. There is room in the United States for only one system of law and justice, with equal and impartial jurisdiction over all men.



Sparks from the World's

By E.C.Porter,

Navy Offering Surplus Materials for Sale

The United States Navy is offering for sale large quantities of metal bar stock, steel in commercial sizes, copper and brass tubing and bolts and nuts which have been declared surplus for Navy needs. Included in the material available for sale are 16,000 tons of commercial steel. All of the material offered by the Navy has never been used.

The disposal of the steel, copper and brass, and other surplus material of the Navy Department is in charge of Commander C. G. Peterson, director of the Board of Sales, Division of Supplies and Accounts, Washington, D. C.

The surplus supply, which is located at various naval stations, is being offered for sale at current market prices. Detailed information may be obtained from the Washington office or naval stations at the following points: New York, Boston, Philadelphia, Norfolk, Va., Charleston, S. C., and Great Lakes, Ill.

Consolidation of Electric Welding Companies

Associated Welding Companies, Inc., is the name of a new corporation being effected that will include the consolidation of the following companies: Electric Welding Company of America, New York; Electric Welding Company of America, Baltimore; Electric Welding and Shipbuilding Company of Canada, Montreal; Electric Welding Company of America, Portland, Me.; Electric Welding Company of Boston, Boston; Brooklyn Electric Welding Company; New York Electric Welding Company; Electric Welding and Ship Repairing Company of Pennsylvania; Electric Welding Company of America, Norfolk, Va.; Ohio Welding Company, Cleveland; Electric Welding Company of the Argentine, Buenos Aires; Compañia Soldatura Electrica de España, Bilbao, Spain; Brooklyn Ship Repair Company, Brooklyn. The main office of the new corporation will be in Brooklyn.

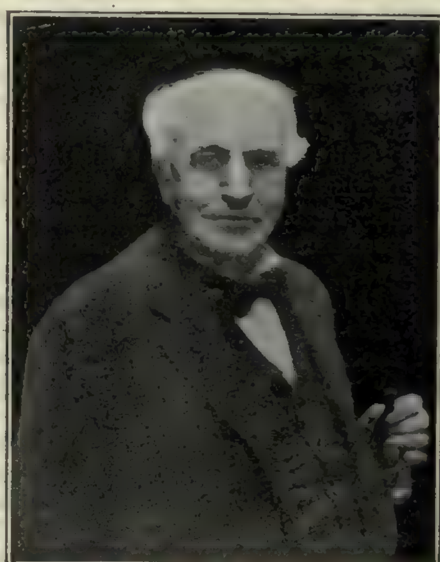
Seventy-Third Birthday of Thomas A. Edison

Yesterday, Feb. 11, 1920, was the seventy-third birthday of Thomas A. Edison, the inventor and pioneer, who has done so much to make this the greatest electrical period in history.

Mr. Edison started his electrical career as a plug operator sixty years ago and today his great achievements are shown by about 1,500 United States patents of which 500 at least have been "master" or remain "controlling."

It is impossible to estimate the total contribution to the wealth, happiness and prosperity of the world of this great American electrical engineer who is the inventor of the phonograph, the founder of the motion picture industry and a leader in domains so widely apart as chemistry and cement making.

At the outbreak of the world war Mr. Edison patriotically offered his services and was appointed head of the Naval Consulting Board. He devoted himself quite largely to military and naval problems such as those connected with the suppression of the submarine boat.



THOMAS A. EDISON

Mr. Edison has received innumerable degrees and marks of recognition, the latter including the Albert gold medal of the Royal Society of Arts of England and the John Fritz gold medal of the four national engineering societies of America. The Edison gold medal was founded in the American Institute of Electrical Engineers in 1904 and has since been awarded to several great electrical engineers and scientists. Various organizations bear his name, notably the Association of Edison Illuminating Companies. In 1918, on his birthday, the Edison Pioneers, whose membership is composed of men associated with him in his work and enterprises up to 1885, was founded. Mr. Edison is a member—honorary in several instances—of a great number of societies, and though in no sense a club man, is an honorary member of the Engineers' Club of New York.

Koehring Company Opens Three Southern Offices

The Koehring Machine Company, of Milwaukee, it is understood, will open offices in Atlanta, Jacksonville and New Orleans under the name of the Atlantic Equipment Company.

The Atlanta branch will handle the Koehring line of concrete pavers, mixers, loaders and sifters, together with other lines of concrete equipment. A service department will be maintained, which will keep in stock repair parts and machinery.

N. A. Coulter has been named manager of the sales department and will be actively in charge with headquarters in Atlanta. The New Orleans office will be represented by Tom E. Foster and Warren Shankle. S. P. Galley and W. S. Ansley, Jr., will have charge of the Jacksonville office.

Steinmetz Motor-Car Corporation

The Steinmetz Motor Car Corporation, with executive and sales offices in the Ziegler Building, 512 Fifth Ave., New York, has been chartered under the laws of the State of Maryland with a capital of $2,000,000 to manufacture a new type of light-weight electric delivery truck and an improved electric industrial car for use in manufacturing plants. Both cars are the invention of Dr. Charles P. Steinmetz, chief consulting engineer for the General Electric Company, Schenectady, N. Y. Dr. Steinmetz will act as consulting engineer to the Steinmetz Motor Car Corporation and is a member of its board of directors. The company has acquired a manufacturing plant at Baltimore, Maryland.

The officers of the corporation are: A. Robert Elmore, president; J. P. Story, Jr., vice president; Nelson H. Truett, secretary and treasurer. The board of directors includes: Herbert A. Wagner, president Consolidated Gas, Electric Light and Power Co., Baltimore, Md.; William F. Ham, president Washington Railway and Electric Co., Washington, D. C.; Lindsay Hopkins, banker, director American Hide and Leather Co., vice president and director Santa Cecelia Sugar Co.; A. Robert Elmore, banker, of Moorehead & Elmore, Washington, D. C., members New York Stock Exchange and president Universal Body Co.; Guy Scott, president Continental Trust Co., Washington, D. C.; J. P. Story, Jr., of Story & Cobb, Washington, D. C., director American Hide and Leather Co., director Commercial National Bank, Washington, D. C., and Charles P. Steinmetz.

Industrial Forge

News Editor

Progress of the American Engineering Standards Committee

After three years of painstaking investigation and discussion by the engineering fraternity, and under the guidance of Prof. Comfort A. Adams as chairman, the revised constitution of the American Engineering Standards Committee, along with the by-laws and rules of procedure, has been adopted, and has been ratified by the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, and the three Government departments — Commerce, Navy and War. Each of these interests has three representatives, and although the committee as it exists today consists of twenty-four members, the new committee is of very wide scope and allows the direct or indirect participation of anyone interested in standardization.

On account of other affairs, Professor Adams has given up the chairmanship, but he will give the committee his full support as a member.

A. A. Stevenson, the newly elected chairman, is a past president of the American Society for Testing Materials, and has been officially and actively interested in standardization work for many years.

C. B. LePage, who volunteered to act as secretary during the organization period, was unable to continue the work and has resigned, and Dr. P. G. Agnew, formerly of the United States Bureau of Standards, is now permanent secretary with headquarters at the Engineering Societies' Building, 29 West Thirty-ninth St., New York.

Objects of the Committee

The American Engineering Standards Committee makes it possible to give an international status to approved American engineering standards and to co-operate with similar organizations in other countries. Similar organizations are now functioning in Great Britain, France, Switzerland, Holland and Canada.

Through the new committee the methods of arriving at engineering standards will be unified and simplified, and by co-operation the duplication of standardization work will be prevented. Standards will not be created without giving all interested an opportunity to participate.

The "approval" of a standard by the American Engineering Standards Committee does not mean that the committee has itself worked over and approved each detail, but rather that the work has been carried out by a sectional committee adequately representing the industry concerned, and sponsored by one or more bodies of ability, experience and standing, so that the result may stand for what is best in American engineering practice.

What the Committee Is Doing

The American Engineering Standards Committee is not only ready for business, but it has made considerable practical headway. It has approved specifications for standard pipe threads, for which the American Society of Mechanical Engineers and the American Gas Association are sponsors, and are representing America on this subject at an international conference in Paris. Co-operation is in progress with the National Screw Thread Commission, authorized by Congress and composed of representatives of the various technical societies, looking forward to standard screw threads. Through this arrangement, direct co-operative work with the British, which is not possible by the official commission, is being carried out. The committee is also in active co-operation with the Canadians on bridge specifications, with the British on specifications for machine tools, and with the Swiss on specifications for ball bearings. In each case the detailed work is being carried out by sponsor bodies by means of sectional committees.

A large conference, in which are practically all national organizations interested in industrial safety, has unanimously voted that all industrial safety codes should be prepared under the auspices of the American Engineering Standards Committee.

Now that the organization of the committee has assumed such definite and precise form, no doubt its activities will be greatly extended and accelerated.

Incorporation of Automobile and Motor-Car Concern

The Dusenberg Automobile and Motor Car Co. has incorporated under Ohio laws for $15,000,000.

Officers of the new concern are L. M. Rankin of Kansas City, Mo.; Newton Van Zandt of Revere, Ind.; and the Dusenberg brothers, Fred and Otto, who designed the motor bearing their name.

Cleveland capital is interested in the enterprise, and it is reported that a plant will be constructed in East Cleveland to turn out 1,500 cars yearly.

Trade Currents From New York, Cleveland and Milwaukee

New York Letter

Increased activity in many lines has strengthened the tone of the local machine-tool market in contrast to the quietness prevailing during the past week.

Heavy equipment is booking up after a somewhat inactive movement. Machine-tool men report a constantly increasing demand for the larger units, but state that no falling off in the sales of small equipment is noticeable in consequence.

The demand for wood-working machinery still continues heavy with a promise of becoming even more so. In used-tool circles, trade is exceptionally brisk, but new equipment is restricted in sales volume only by delivery.

Deliveries quoted last week at 30, 60 and 90 days have been set back to June and July, with a large number of orders scheduled for delivery during the last quarter of the year. It looked as though deliveries would ease up considerably, but latest reports seem to dispel whatever hopes machine-tool men may have had of quoting their customers early delivery dates.

Industrial building in and around New York is running largely to activities that use machine tools extensively with New York as their source of supply.

The Excelsior Motors Corporation at Orange, N. J., is to engage in a general automobile manufacturing business with an initial capital of $125,000.

Newark gains four new plants with a combined capital of over two and one-half million dollars. The National Auto Products Company, with a capital of $2,000,000, heads the list. It will manufacture a general line of auto parts and accessories.

The Cutlery Specialty Company, with a capital of $100,000, will operate a plant for the production of high-grade cutlery, and the Bender Manufacturing Company will locate in Newark with a plant capitalized at $250,000 to produce iron and steel products.

Coal-gas producers will be manufactured by the Gas Producer and Engineering Corporation which has filed capitalization figures of $200,000.

These industries will buy in the New York machine-tool market.

As March 1 approaches, the machine-tool trade is anticipating an influx of large orders, but until these materialize, business will continue on a basis of small sales in large numbers.

Cleveland Letter

A change for the better has manifested itself in the northern Ohio machine-tool situation.

Although orders are limited, generally, a large number has resulted from inquiries placed some time back. The sales volume has increased to some extent, and this is taken as an indication that general manufacturing interests and the automotive industry are about to carry out expansion programs planned in the latter part of 1919.

The increased demand for machine tools has been sufficiently sudden to cause uneasiness among dealers as to deliveries. Consumers have taken lightly the warnings of the machinery men that deliveries will be slow and uncertain, and are inclined to think that thirty- to sixty-day deliveries will prevail. When it is impressed on the consumer that June and July are really favorable delivery dates, confusion is bound to result to the annoyance of all concerned.

Skilled and unskilled labor is scarce in machine-tool plants of the northern Ohio district. One large concern states that it needs at least 300 more men to keep up to schedule. This has its effect on deliveries.

Two large orders for special machine tools, $100,000 and $200,000, respectively, were encouraging features of the week. From appearances, sufficient business has been booked by manufacturers to warrant heavy expenditures for new equipment.

Prices here, as elsewhere, have gone up an average of 10 per cent all around, and this, also, is a factor in influencing sales before further rises.

As usual, the bulk of machine-tool orders is drawn from northern Ohio industries and Detroit, but a significant hint of expansion comes in the shape of an order from Mexico for $10,000 worth of glass-molding machinery.

Milwaukee Letter

The general prosperity in the machine-tool industry continues. Buying has been active for some of the new plants which will be located in Milwaukee and nearby. Dealers are having increasing difficulty in obtaining satisfactory delivery from sources of supply. Dates promised on many of the larger machines will be in the neighborhood of six months for the earliest delivery.

The automobile industry will have a large accession when the new Milwaukee plant of the Nash Motors Co. is completed. The work on this plant is progressing and the company expects to begin making delivery of finished cars in the early summer. Purchases of tools and equipment for this plant are rapidly being made. Other automotive plants are said to be planning to locate in this vicinity in the near future.

One of the large machine-tool builders of this district has just announced an increase of approximately 14 per cent in the price of his machines. This is one further instance in answer to those who thought that the prices of machine tools had been unduly inflated by the war conditions, and that after times had become more normal there would be a big slump in prices. While the present prosperity is adding its share to the profits of the industry, it is probable that the ease in doing and getting new business is at present holding down the overhead expenses to such an extent that no more price increases can be expected.

The Machinery Outlook at New Orleans

Machine-tool and general-machinery business in the New Orleans district is reported good, with every prospect of continuing for months if not years to come. This district it must be remembered reaches into the Texas oil fields as well as eastward to Mobile and its shipping. While, as yet, there are no large machine manufacturing plants as we know them in the North, the diversified interests make a steady demand in what may be called staple markets of the world—sugar, cotton and rice. All of these are seasonal; yet they constitute a trade which may be depended on year after year.

Add to these the development of the oil industry in northern Louisiana and Texas, the huge shipping trade of New Orleans—claimed to be the second port in the U. S. A.—and you have a market that is diversified enough to remain fairly stable.

Here is built much of the sugar machinery, not only for this district but for the Cuban sugar fields. The Dibert, Ross & Bancroft Company, of New Orleans, has recently supplied one of the largest sugar grinding mills ever built to a huge sugar plantation in Cuba. This will represent a shipment of over a million pounds and has a capacity of over 3,000 tons of cane per day.

Other and smaller shops make various parts of sugar equipment such as extractors, pumps, etc. These shops have comparatively little equipment in the way of machinery, but are well supplied with the mechanics who know how to get out work without special machinery. Those who only keep in touch with our highly organized and specialized shops, such as we find in the automobile, gun and typewriter industries, should visit this section and see what is accomplished with comparatively few machines and with improvised tools and methods.

The question of skilled men becomes vital, however, in the rush season, when large sugar-mill machinery has to be built in time for the next season. Then it becomes necessary to recruit additional labor from other industries, such as the shipyards or ship-repair shops and the railroads—for this work requires all-round mechanics who can handle almost any kind of work. The operator who may be skilled on only one machine is of little use. The shortage of skilled men is felt here as elsewhere, all agreeing that we have not trained enough good mechanics during the past ten years.

Here, too, we find the question of insufficient production, of the failure to secure the full co-operation which can alone give us the production we need. This only emphasizes what has already been pointed out in various ways. Production, or the lack of it, is not so much a matter of geography or the kind of work as it is the way in which the matter of personnel relations is handled by the management. It is the growing belief that we have neglected this, the most important element in production, while devoting all our efforts at improvement toward the mechanical end.

Machinery dealers in the New Orleans section consider that this district has a most promising and stable future, even without the establishment of large manufacturing plants.

Bill Will Give Protection of Trade Marks and Commercial Names

Ratification of the Pan-American trade-mark and trade-name convention by the House makes it practically certain that this convention will be authorized in the very near future since an identical bill was passed by the Senate at the last Congress.

This convention makes it possible on the payment of a $50 fee for American manufacturers to secure protection for their trade marks and commercial names in all Latin-American countries. At present, it is necessary for American manufacturers to register their trade-marks in each country separately, entailing large expense.

The discussion of the bill in the House brought out that further patent legislation looking to greater efficiency in the handling of patents, and establishing a court of patent appeals, is about to be reported out of committee.

Tool Companies Merge

The Williams Tool Corporation, organized under the laws of Delaware, has acquired the business, plant and manufacturing assets of the Williams Tool Company, Erie, Pa. The principal product of the latter company has been for eighteen years the Williams' pipe-threading machine.

Portable Engine Cranker

A portable engine cranker designed and built under the supervision of the Equipment Section, Engineering Division, McCook Field, Dayton, Ohio, was successfully demonstrated recently. The design allows for the cranking of engines mounted in various airplanes, ranging from the Curtiss training plane to the Martin bombing types, on rough and uneven ground. The outstanding feature of this cranker, it is reported, is that it will accommodate all right-hand engines fitted with a standard hub, not mounting a spinner. It develops a starting torque 50 per cent greater than that necessary to turn over a cold Liberty "12."

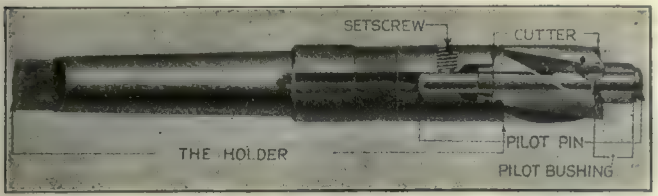
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Counterbore, Cost-Cut

The Cost-Cut Counterbore Co., 74-78 Fort St., East, Detroit, Mich.

American Machinist, Dec. 18, 1919

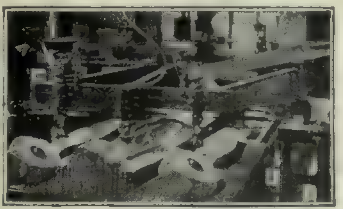


This tool is made up from the five following pieces: holder, cutter, pilot pin, pilot bushing and setscrew. Holders are made in five sizes with a selection of taper shanks for each and will carry cutters ranging in size as follows: No. 1 holder—Morse taper Nos. 1 or 2; range of cutters, $\frac{1}{4}$ to $\frac{11}{16}$ in. No. 2 holder—Morse taper Nos. 2 or 3; range of cutters, $\frac{3}{4}$ to $1\frac{1}{16}$ in. No. 3 holder—Morse taper Nos. 2 or 3; range of cutters, $1\frac{1}{8}$ to $1\frac{9}{16}$ in. No. 4 holder—Morse taper Nos. 3 or 4; range of cutters, $1\frac{9}{16}$ to $2\frac{1}{16}$ in. No. 5 holder—Morse taper Nos. 3, 4 or 5; range of cutters, $2\frac{1}{8}$ to 3 in. or over.

Shaping Machine, for Propellers

Keller Mechanical Engraving Co., Brooklyn, N. Y.

American Machinist, Dec. 18, 1919

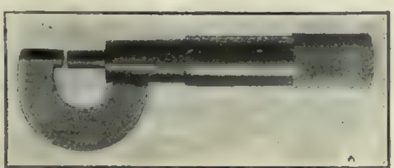


This machine has cut to size from the rough fifty propellers in $8\frac{1}{2}$ hr. One blade of each propeller is being worked on and when these are finished the propellers are given half a revolution, presenting the other blades to the cutters. For finishing the other sides of the blades, the propellers will be turned over. At the rear is an extra fixture on which a model and one propeller are mounted. When the propellers on which the machine is working are finished, the work table will be shifted along to bring the fixture at the rear into the working position and the fixture with the finished propellers will be unloaded and again loaded while the machine is at work.

Micrometer, Lindquist Ten-Thousandth

The Lindquist Engineering Works, Portland, Conn.

American Machinist, Dec. 18, 1919



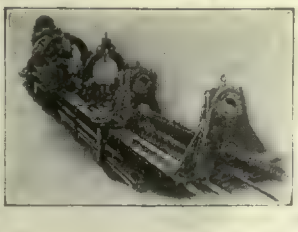
The barrel is graduated forty divisions to the inch for a distance of $1\frac{1}{4}$ in. The extension is threaded, 40 pitch. Beveled edge of the thimble is graduated to fifty divisions.

Measuring spindle is splined to frame. Its outer end is threaded fifty pitch and screws into an inner sleeve which turns with the thimble. When thimble is turned forward one full turn it advances 1/40 or 0.025 in. and at the same time withdraws the measuring spindle into inner sleeve 1/50 or 0.020 in., leaving an actual advance of spindle equal to the difference in pitch, or 0.005 in. One division of the thimble equals 0.0001 in. Total range of each tool is $\frac{1}{2}$ in. Made in all sizes from $\frac{1}{4}$ to 6 in.

Lathe, Stamets Gun-Boring

Wm. K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa.

American Machinist, Dec. 25, 1919

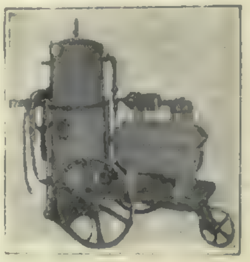


The lathe is provided with a boring-bar unit instead of a boring bench, common to lathes of this type. A rack and pawl provide means to resist the thrust of the boring tool. Motors are controlled by handwheels. The machine as shown, is 100 ft. in length and weighs 1,700 lb. per foot. The drive motor is 35 hp.; quick-traverse motor, 10 hp.; circulating pump motor, 5 hp. Other approximate specifications are: Swing, 55 in.; width, 8 ft.; height, 9 ft.; approximate weight (100-ft. bed), 85 tons; extra weight per foot of bed, 1,500 lb.

Compressor, Electric Air

Black & Decker Manufacturing Co., Baltimore, Md.

American Machinist, Dec. 18, 1919



Has a capacity of 6 cu.ft. per minute at a pressure of 200 lb. The motor, engine, gearing, etc., are completely inclosed in a single housing, which is removable in three sections. The machine is air-cooled, and it is said to run 24 hr. continuously against 150-lb. pressure. The electric equipment can be furnished for direct current at 110 or 220 volts, or for alternating current, two- or three-phase, at 220 volts. Another outfit with a larger engine but the same design, known as No. 412, has a capacity of 12 cu.ft. per minute at 75-lb. pressure. This outfit is recommended by the makers as especially suitable for pneumatic tools, paint-spraying machinery, blowing flame work, etc.

Boxes for Carbonizing and Annealing

The Quigley Furnace Specialty Co., 26 Cortlandt St., New York.

American Machinist, Dec. 18, 1919

A line of steel boxes for carbonizing and annealing. It is claimed that these boxes are made of special analysis steel, known as Q-steel, which gives maximum resistance to oxidation coupled with minimum cost per heat hour of service.

Grinding Machine, Plain

Wadkin Mills & Co., Ltd., Nottingham, England

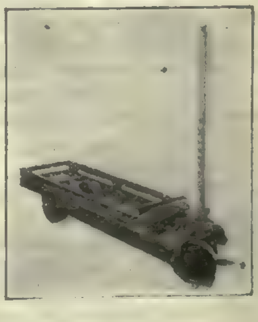
American Machinist (English Edition), Dec. 13, 1919

Swing, 6 in. in diameter as a maximum, or 4 in. in diameter over the steady, by 20 in. long. The crossfeed is 5 in., the five table speeds ranging from 27 to 166 in. a minute and the five work speeds from 51 to 316 r.p.m. The grinding wheel is 12 in. in diameter by 1 in. wide by 5 in. hole, and will wear down to 7 in. in diameter; its speed is 1,900 r.p.m. Also the table swivels to an included angle of 10 deg. While the maximum diameters are as stated, the machine is thought to be specially suitable for finishing work up to about 3 in. in diameter by 18 in. long. If specially ordered a variable-change speed device can be fitted, giving all the intermediate speeds and travels within the range of the machine, the change being affected by handwheel, while a dial shows the speed of the work and the travel of the table. The floor space occupied is about 82 x 49 in., and the machine weighs 21 cwt.

Truck, Combination Lift and Trailer

Barrett-Cravens Co., 169-73 Ann St., Chicago, Ill.

American Machinist, Dec. 25, 1919



These trailer trucks are built in all models in which lift-trucks are supplied, have capacities of 2,000, 3,000 and 5,000 lb. with carrying frames ranging in size from $17\frac{5}{8}$ to 27 in. in width and from 30 to 72 in. in length. When in use as a trailer, the handle of each truck is automatically locked in an upright position. The front link will turn through an angle of 180 deg. and in no way interferes with the full turning radius of the front wheel. On account of the rigidity of the coupling links there is no possibility of collision between trailer trucks and no chance of piling up when the power truck stops suddenly. For the same reason the train may be started smoothly.

Clip, paste on 3 x 5-in. cards and file as desired

Business Items

The R. E. Ellis Engineering Company has opened a Milwaukee office at 1417 Majestic Building with Leslie E. Johnson as branch manager.

The Toledo Tool Engineering Co., Toledo, Ohio, has been chartered with a capital of $10,000 by E. E. LaFrance, E. R. Carroll, D. M. Grimm, F. H. Wells and D. Ray Rowe.

The Holt Manufacturing Co., Peoria, Ill., announces that it has placed its advertising account with Cleland, Inc., 48 East 41st St., New York. All inquiries are referred to this concern which will handle the entire publicity campaign.

The McCrosky Tool Corporation has opened two new branch offices: one at 621 West Washington Boulevard, and the other office at 1417 Majestic Building, Milwaukee, Wis. Frederick Fisher is in charge of both offices.

J. E. Poorman, manufacturer of machinery, has lately acquired a 76 x 114-ft. piece of property at 1820-24 Bristol St., Philadelphia, Pa., where it is expected a large machine shop will be erected, in connection with his present plant at 1825 Bristol St.

George W. Childs has opened an office in Room 701, Crozer Building, Chester, Pa. He will act as consulting engineer on power transmission, rolling mill, cotton mill and dredging machinery, machine tools, jigs and fixtures, artillery and ship construction and foundry equipment problems.

Raymond B. Jones and Eugene E. Hart, both formerly with the Dale-Brewster Machinery Co., Chicago, Ill., have formed a company to specialize in the sale of cutting tools. This company will be known as the Industrial and Railway Supply Co., with headquarters at 114 North Desplaines St., Chicago, Ill.

The General Tractors, Inc., Paulsboro, N. J., would be pleased to get in touch with concerns doing machine work, who might be interested in the manufacture of tractor parts in quantities. The company is also in the market for the purchase of materials and supplies used in connection with the manufacture of tractors.

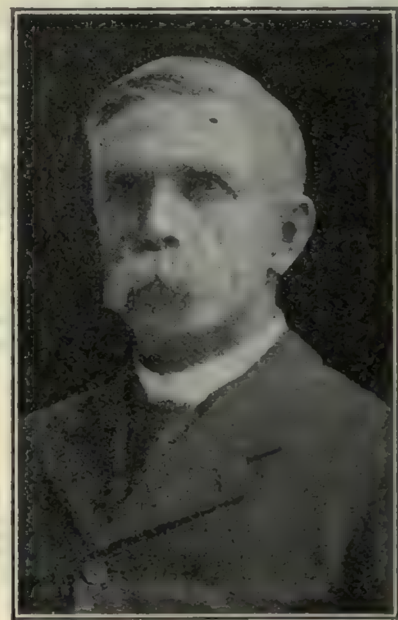
The Black & Decker Manufacturing Co., Baltimore, Md., has opened a branch office at 6523 Euclid Ave., Cleveland, Ohio, with Garth A. Dodge in charge. Mr. Dodge was formerly connected with the Austin Co., Cleveland, Ohio, and has recently joined this company to act as branch manager for the States of Ohio and Indiana.

The Dart Truck and Tractor Corporation, Waterloo, Iowa, held its annual meeting recently and elected the following officers: W. H. Johnson, M. D. Herron, vice presidents; E. L. Stover, secretary and treasurer; and S. Y. Eggert. It was voted by the stockholders to increase the equipment and assembly space of the factory.

Rimmon Colton Fay

Rimmon Colton Fay, inventor of the Fay automatic lathe, died at his home in Fox Chase, Philadelphia, on Jan. 16, 1920, in his seventy-second year after a short illness.

Mr. Fay was employed as a machinist, draftsman and contractor for Colts Arms Company, Hartford, Conn., from



RIMMON COLTON FAY

1868 to 1873, two years of that time working on the gatling gun.

Since then he has held positions as contractor or superintendent with the Fales & Jenks Machine Company, Pawtucket, R. I.; the Draper Corporation, Hopedale, Mass.; Pratt & Whitney, Hartford, Conn.; Remington Arms Company, Ilion, N. Y.; Thomas Manufacturing Company, Springfield, Ohio; Mossberg and Granville Manufacturing Company, Providence, R. I., and Schaum & Uhlinger, Philadelphia.

In addition to being the inventor of the Fay automatic lathe, Mr. Fay was well known as an inventor of textile machinery, firearms, bicycles, machine parts, and automatic drilling and tapping machinery. He was born in Ludlow, Mass.; and is survived by four sons and two daughters: Arthur C. Fay, of Brooklyn, N. Y.; Major Frank H. Fay, of New York City; George L. Fay and Rimmon W. Fay, of Philadelphia; Mrs. Howard H. Wright and Miss Elsie F. Fay, of Philadelphia.

The William H. Forbes Construction Co., Cleveland, Ohio, has been chartered with a capital of $30,000 by C. A. Alexander, John H. Schultz, Quay H. Findley, K. T. Liddall and M. I. Buelow.

The National Industrial Engineering Co., Cincinnati, Ohio, announces that C. U. Carpenter, M. E., has assumed the offices of president and general manager. Richard Smethurst, C. P. A., has been appointed to the office of vice president of the company.

Personals

C. U. CARPENTER has recently been appointed vice president and general manager of the Western Appraisal Co., Cincinnati, Ohio.

CHARLES EISLER, formerly connected with the Westinghouse Lamp Co., has been made consulting engineer and vice president of the Newark Engineering and Tool Co., Newark, N. J.

G. C. COOK, general sales manager of Warner & Swasey Co., has left for a five weeks' trip through the South and to the Pacific Coast. He expects to visit about fifty cities and towns before returning.

WALTER R. DRAY, for the last two years general manager and vice president of the Hart-Parr Co., Charles City, Iowa, has resigned and will be succeeded by M. W. Ellis. Mr. Ellis was formerly president of the Security Trust and Savings Bank, Charles City, Iowa.

C. E. LAVERENZ has been appointed special railroad representative to assist the manager of western railroad sales of the Chicago Pneumatic Tool Co., Chicago, Ill. Mr. Laverenz for several years was an inspector in the Ordnance Department of the U. S. Navy and previously held a position as foreman of the Chicago and Northwestern and Illinois Central R.R.

EDW. A. WOODWORTH has been appointed special railroad representative of western railroad sales of the Chicago Pneumatic Tool Co., Chicago, Ill. Mr. Woodworth has been for several years secretary of the Committee on Standards, Washington, D. C., and previously was chief clerk to general mechanical superintendent of the Chicago, Rock Island and Pacific R.R.

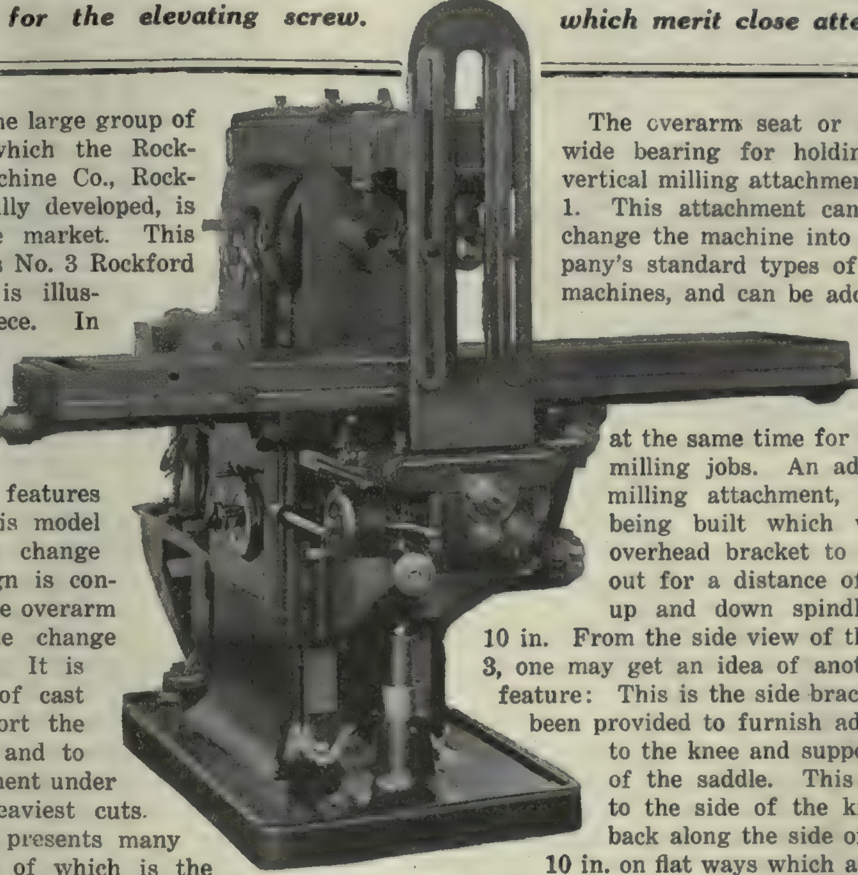
Obituary

E. T. CLARAGE, president and founder of the Columbia Tool Steel Co., Chicago Heights, Ill., died suddenly at his Chicago residence early Thursday morning, Jan. 29, 1920, from pneumonia. Mr. Clarage has been well known in the steel trade for a number of years, and particularly in the tool-steel line. He was born in Kalamazoo, Mich., in 1862, and started in the tool-steel business at the age of eighteen years with the Crescent Steel Co., Chicago. Later he was sales manager for the Sanderson Steel Co. in its Chicago district. Following this, he had charge of the Crucible Steel Co.'s combined interests in the West upon the formation of that organization. In 1904, Mr. Clarage organized and built the Columbia Tool Steel Co.'s mill at Chicago Heights, Ill. He had lived in Chicago for forty years, and is survived by a widow and two children.

Rockford Number Three Milling Machine

By J. V. HUNTER
Western Editor, *American Machinist*

The points of this machine which will first catch the eye of the reader, are the rectangular overarm, the saddle support and the reinforced base for the elevating screw. However, careful inspection of the text and illustrations of this article will reveal numerous other features of this machine which merit close attention.



AN ADDITION to the large group of machine tools which the Rockford Milling Machine Co., Rockford, Ill., has successfully developed, is now being put on the market. This machine is known as its No. 3 Rockford Milling Machine and is illustrated in the headpiece. In general, the milling machine is thought to be fairly well standardized in design, but some features have been added to this model which exemplify the change that machine-tool design is constantly undergoing. The overarm is the most noticeable change from common practice. It is a rectangular section of cast iron designed to support the arbor brackets rigidly and to keep the arbor in alignment under the stresses of the heaviest cuts. This form of overarm presents many desirable features, one of which is the possibility of setting up work by measuring or leveling up from its broad lower surface with a precision practically equal to working direct from the surface of the table. The mechanic will find this especially serviceable when it is difficult to measure the height of inside portions of the work with a surface gage used in the ordinary way.

The overarm seat or slide provides a wide bearing for holding in place the vertical milling attachment shown in Fig. 1. This attachment can be supplied to change the machine into one of the company's standard types of vertical milling machines, and can be added at any time. With this device in place it is possible to use two cutters at the same time for side and vertical milling jobs. An adjustable vertical milling attachment, Fig. 2, is also being built which will permit the overhead bracket to be moved in or out for a distance of 16 in., and an up and down spindle movement of 10 in. From the side view of the machine, Fig. 3, one may get an idea of another outstanding feature: This is the side bracket *A* which has been provided to furnish additional rigidity to the knee and support the overhang of the saddle. This is fitted solidly to the side of the knee and extends back along the side of the column for 10 in. on flat ways which are provided with T-slots and clamping bolts. Its use is optional with the operator and depends upon the character of the work.

The boss or base bracket, holding the nut for the elevating screw, is connected to the column, as shown at *B*. This heavy added section aids in resisting the down thrust of the elevating screw and adds to the

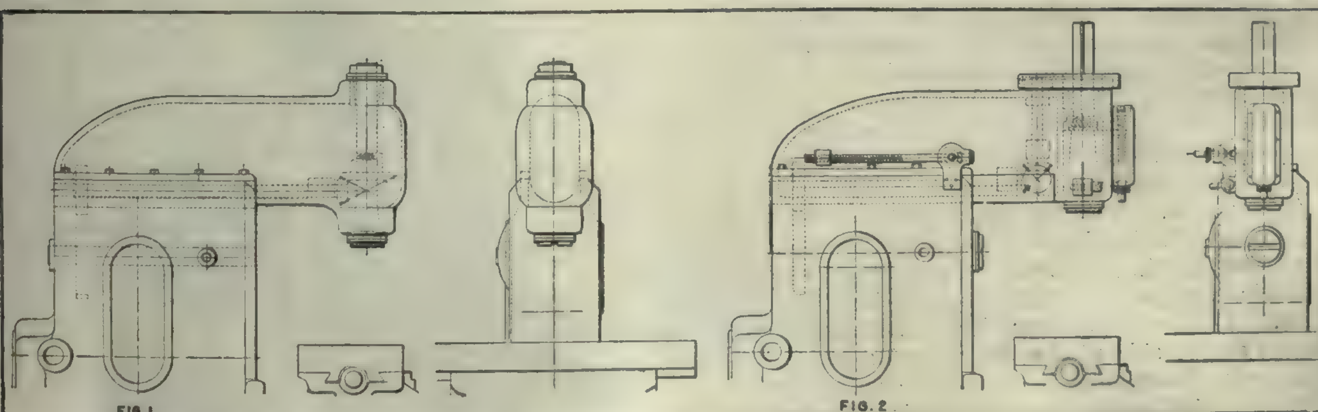


FIG. 1. STATIONARY VERTICAL MILLING ATTACHMENT. FIG. 2. VERTICAL ATTACHMENT WITH HORIZONTAL AND VERTICAL ADJUSTMENT

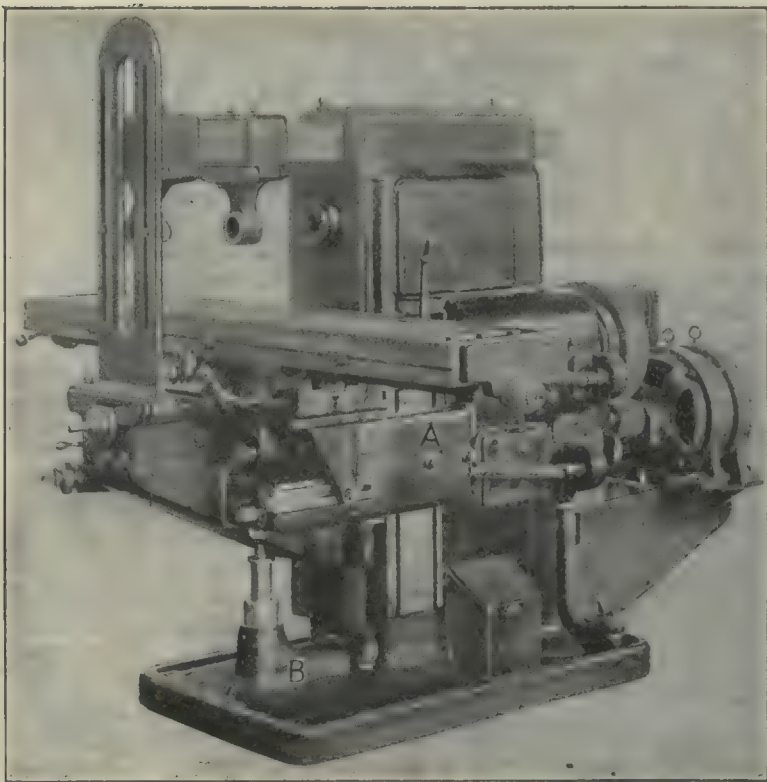


FIG. 3. RIGHT-HAND SIDE OF MACHINE

rigidity of the knee. It also adds greatly to the ease of obtaining fine adjustments, since the base web is not so apt to spring downward under its load.

The gearing is designed so that all shafts are supported by bearings on the outside of the gears, thus avoiding the necessity of carrying any of these on outboard ends or studs. All drive shafts are carried on high-duty roller bearings oiled by forced lubrication from a geared oil pump. This pump draws its supply from a reservoir in the base and floods it down from inside the top of the machine over all bearings. The column is built as an oil-tight case and has two reservoirs in its base, one for the lubricating oil and the other for the coolant. The speed changes of the machine are controlled from the side of the column, Fig. 4. The gear tumbler bracket is not shifted endwise but is merely rocked up and down, as the different speeds desired are selected by the other controls. Two intermediate gears are shifted endwise by the plug lever to correspond with speed gears on the tumbler, and in this the operator is guided by the speed diagram fastened to the column of the machine above this lever. The lower or selective gear lever is kept in neutral position while the others are being adjusted and it is then moved around until it reaches a positive stop. This fixes its position as it is entirely selective in its action. Eighteen speed changes, in geometric progression, are available, ranging in speed from 15 to 360 r.p.m. The reverse lever is conveniently located on the side of the column and serves to reverse the spindle rotation at all speeds.

The crossfeed screw for the saddle is located in the center of the top of the knee. This eliminates any tendency of the saddle to twist or bind on the ways. Both this and the table and vertical screws are provided with large ball-thrust bearings.

The compact feed box gives a range of fourteen feeds varying from ½ to 16 in. per minute. The feed changes are controlled somewhat similar to those for speed, using two shifting levers and a selective tumbler. The feed reverse lever is conveniently located on the side of the knee and it will reverse the feed of either the table, the saddle or the knee, whichever may happen to be in operation. All gears and shafts are made of hardened and heat-treated special steel.

The feeds in either direction are automatic and are controlled by a feed-trip mechanism which is positive in its action. This trip mechanism is very sensitive, its quick action being obtained by connecting a high-speed clutch to the gear-feed mechanism where the ratio is four to one, instead of tripping with a clutch directly connected to the feed screw. The big advantage is that when working with very slow feeds the operator need not wait so long for the teeth of the drive mechanism to line up in order to throw them into mesh.

The table has a quick-return mechanism which can be operated in either direction, and is controlled by a lever on each side of the saddle.

An oil-tight pocket is provided in the middle of the saddle in which the gearing is located. Oil is put into this pocket to a height slightly above the bottom of the table screw. This permits both the gearing and the screw to run in a constant bath of oil and insures full lubrication of these parts. The oil bath is supplied through a duct extending to the outside of the table where it is handy for the operator.

The spindle is of a special grade of hammered steel, ground to size, and runs in adjustable bronze bearings. The spindle nose is provided with keys for driving face-mills which are held in place by a draw-in rod that passes through the spindle. These keys can also be used for driving a flanged arbor with keyways cut in the face of the flange.

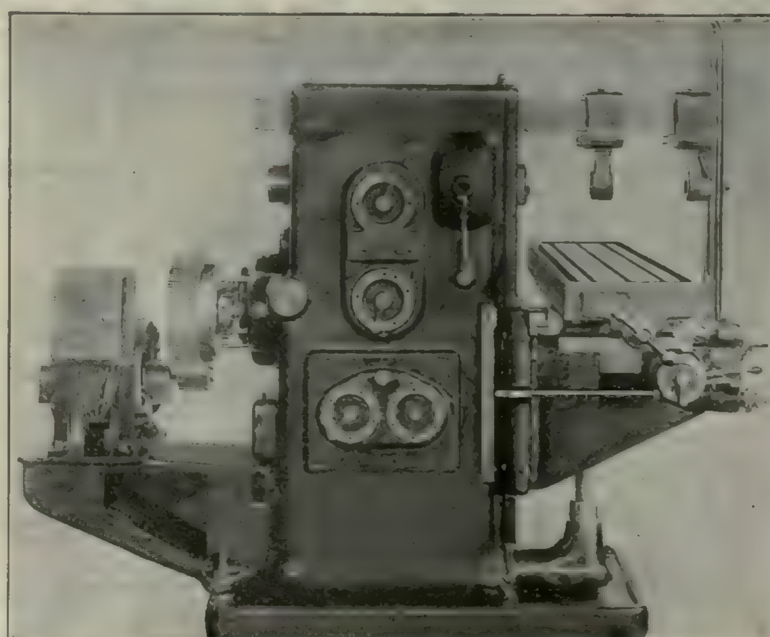


FIG. 4. SIDE VIEW SHOWING SPEED AND FEED CONTROLS

As has been stated, a reservoir has been provided in the base of the column for the coolant. The filling spout *A*, Fig. 5, is so constructed that chips and sediment may be removed from the bottom of the reservoir.

The power drive is through a friction clutch located on the main drive shaft at the rear of the machine. This is operated by convenient levers located on both

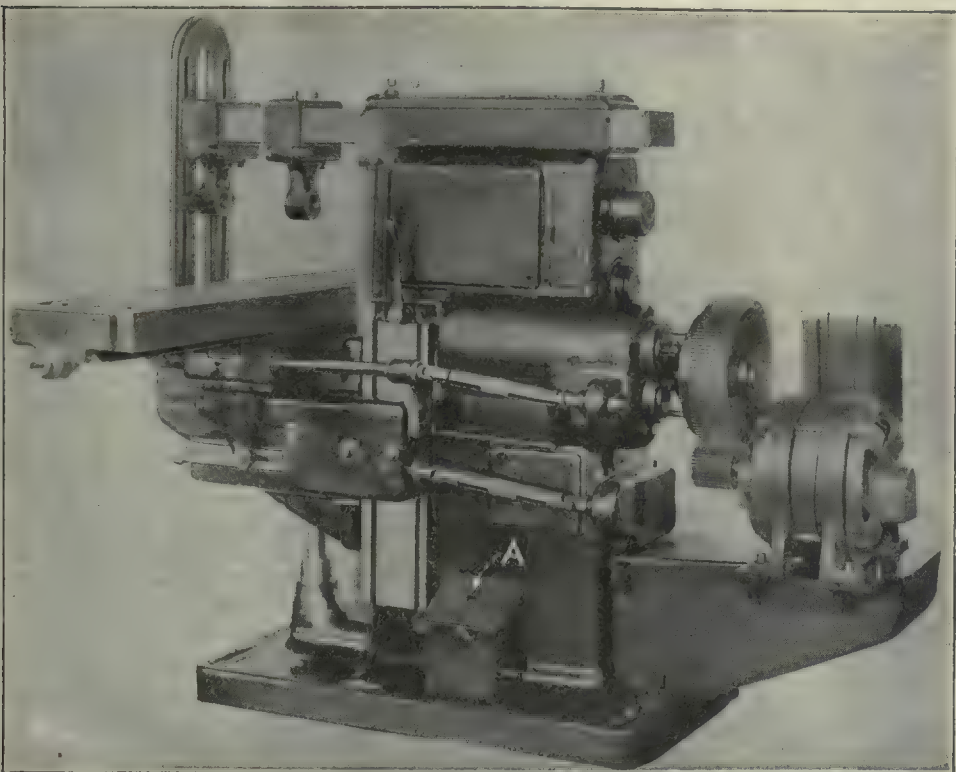


FIG. 5. REAR OF MACHINE WITH DIRECT-CONNECTED MOTOR

Specifications: Table feed automatic, 34 in.; crossfeed automatic 12 in.; vertical feed, automatic, 20¾ in.; working surface of table, 15 x 62 in.; overarm, 4½ x 9½ in.; number of arbor supports, 2; center of spindle to bottom of overarm, 7¾ in.; B. & S. taper hole, No. 11; hole through spindle, ⅞ in.; index center swing, 12 in.; index centers take in length, 40 in.; three-jaw universal chuck, 9 in.; width of vise jaws, 7½ in.; depth of vise jaws, 2¼ in.; vise opens with steel jaws, 6 in.; number of speed changes, 18; range of speed (r.p.m.), 15 to 360; number of feed changes, 14; range of feed (in inches per minute), ½ to 16; diameter of driving pulley, 16 in.; width of belt, 4 in.; speed of driving pulley (r.p.m.), 320; horsepower of electric motor, 10; net weight (in pounds) approximate, 7,200.

sides of the column. When built for belt drive the outside ring of this clutch constitutes the belt pulley. For motor drive the motor is mounted on a heavy cast-iron bracket bolted to the rear of the column. A fabroil pinion on the motor shaft meshes direct with teeth cut in the main clutch ring.

Finding the Age of Machine Tools

By L. L. Thwing

It sometimes happens that there is a dispute in the shop about the age of a machine that has stood on the floor so long that the date of its installation is a matter of tradition, rather than history. If the machine has a serial number, the question generally may be easily settled, but machines twenty years old do not always have serial numbers, in which case the only recourse is an examination of the machine for certain features of design that were standard with its maker between certain dates. Anyone having a complete file of the catalogs of this particular manufacturer can readily settle these questions, provided catalogs are dated, but few appear to have been interested enough to save them. One other source of information is the files of the *American Machinist*.

In an attempt to settle a question concerning the age of machine tools with gear boxes, the writer spent an interesting afternoon in a library which is fortunate enough to have files of the *American Machinist* beginning with Vol. 6 (1883). The advertising as well as the editorial sections are retained in the older volumes though at that time the advertising columns were not as extensive as they are today and included three-fourths of the last page only. The first use of any improvement is sure to be local and unadvertised, and the use of gear boxes may have antedated 1891, but this is the date of the first advertising of this device. The first gear boxes were not part of an all-geared feed, but were driven by belt.

The Garvin Machine Co. advertised in 1890 its No. 3 milling machine as having twenty-four feeds for each spindle speed. This was accomplished through loose change gears, but it indicates the demand for greater flexibility of feeds. In 1891 Flather & Co. advertised a new model lathe having a three-speed, slip-key, belt-driven gear box, and, with New England honesty said, "We are aware that this device has been used before." In the same year the Gisholt turret lathe appeared with a four-speed gear box.

The first all-geared feed with gear box the writer has been able to find, was on the 1893 model of the Hendey-Norton lathe and is apparently the same as is furnished today on that make of lathe. It is not improbable that some one may be able to furnish further information on this subject, but the above information settled the particular question involved, and may not be uninteresting to others.

It may not be out of place to mention that gear boxes and other improvements were introduced ten to twenty years before they came into general use. Double back gears for engine lathes were advertised by Prentice Bros. as early as 1891, but it is only recently that they have become at all common. Helical gears are slowly finding an accepted place in machine-tool design, but the writer recalls seeing in a small machine shop in Brockton, Mass., an engine lathe probably thirty years old with back gears of this kind. This suggests that the determination of the age of a machine by its design resolves itself into an investigation of the available records of the particular manufacturer who made the machine.

[The author must have gotten hold of an 1883 volume of the *American Machinist*, in which all the advertising pages were not included in the binding. The advertisements of that year covered almost seven pages.—Editor.]

JAMES WARING SEE died at his residence in Hamilton, Ohio, Jan. 31, 1920, in the seventieth year of his age.

Mr. See was better known to the readers of mechanical journals as "Chordal," a pen name used by him for much of his writing.

About 1880 he began a series of articles in the *American Machinist*, then a struggling young paper, under the title of "Extracts from Chordal's Letters." These articles were of the shop by a shop man and their popularity contributed greatly to the success of the *American Machinist*. They attracted widespread interest, and through their influence more than one young man has been inspired to do better and greater things.

Mr. See was born in New York City on May 19, 1850, and was the only child of George C. and Sarah See. Both his parents, while natives of New York, were descendants of sturdy and vigorous ancestry of Huguenot origin.

Mr. See received his earliest education in a country school at Rutland, N. Y., though he later attended schools at St. Louis, Arcadia, and Springfield, all in Missouri. In the latter place he got himself into trouble by teaching some darkies how to read. Though he did not know it, this was contrary to the law, and his father was waited upon by a committee and told that such proceedings would have to be stopped.

At the outbreak of the Civil War young See was employed in the Springfield military hospital as an assistant in the dispensary and in the operating ward. After the battle of Carthage he was made telegraph messenger to the Federal forces in and around Springfield.

Upon the ending of hostilities Mr. See served an apprenticeship as machinist at the Springfield Iron Works and it was there he laid the foundation for his future career. At the completion of his apprenticeship he found employment in various shops located from St. Louis to Yanktown, S. D., eventually settling at Omaha, Neb., where he started a shop of his own.

The story is told of him that being disappointed in a lathe he bought from the Niles Tool Works he wrote to that firm to the effect that if he could not design a better lathe he would eat it. Alexander Gordon, head of the Niles Works, testily replied that if he was able to design a better lathe than the one in question he wished he would come to Hamilton and do it.

Long after Mr. Gordon had forgotten the incident there appeared in his office a tall, lanky individual who said with a drawl, "My name is See and I came up here to design that lathe for you." He was put off with one excuse after another until in disgust he appropriated an empty drawing board and did design a lathe that made Mr. Gordon sit up and take notice.

Yours Truly
James W. See.

He was at once employed by the Niles Works, filling positions as foreman, chief draftsman and chief engineer respectively.

In 1876 Mr. See opened an office in Hamilton as a consulting mechanical engineer and his keen insight into mechanical matters soon brought him a wide practice in connection with some of the largest machine establishments in the United States and Europe.

With the invention of the telephone Mr. See became greatly interested in its practical workings and was the inventor of several valuable devices connected with central-station apparatus. In recognition for his work he was made an honorary member of the Telephone Exchange Association. For a time he was editor of the *Telephone Exchange Reporter*. He built the first telephone line in Hamilton. Also, in connection with Alexander Gordon and James K. Cullen, he built an electric-light plant at the Niles Tool Works, the first in Hamilton.

As Mr. See's business increased he became a patent attorney and as such developed an enviable reputation as an expert in patent litigation. He has been called upon to give expert testimony in more than three hundred cases, among which was the litigation involving the validity of the patents issued for the original McCormick reaping machine.

He took great interest in airplane development and was counsel for Wright Brothers in their litigation with the Curtiss company.

By appointment of Governor Campbell, Mr. See acted as one of the commissioners for Ohio to the World's Fair held at Chicago in 1893.

Perhaps we cannot pay a better tribute to the memory of Mr. See than that contained in the following telegram from James K. Cullen, president Niles, Bement, Pond Company, to one of the Hamilton papers:

New York, Feb. 2, 1920

Hamilton Daily News: In the death of James W. See, Hamilton has lost a most exemplary, gentle and kindly gentleman, and an able and widely known engineer. His interest in the welfare of the city was always manifested and he lent liberally of his time, his money, and his ability to enhance its reputation and improve its condition.

While modest and unassuming to a marked degree, his knowledge of mechanical and industrial affairs brought him in touch with many of the largest manufacturing concerns, and a large number of eminent engineers who greatly admired his talent and appreciated his advice. His literary productions were read and favorably received by employers and employees engaged in mechanical pursuits throughout the country, and brought prominently before the people, not only the man, but the city of which he was a resident.

Honest and honorable, he was trusted implicitly in all business transactions, and socially, while of a retiring disposition, he endeared himself to a large circle of admiring friends who will sadly miss him in the years to come.

JAMES K. CULLEN.

On June 1, 1881, Mr. See was united in marriage to Miss Hester R. Rose, of Forestville, Ohio, by whom he is survived, together with three sons and one daughter: Robert M., of Chicago, Ill.; Willard and Howard, of Atlanta, Ga.; and Mrs. Thomas A. Allen, of Evanston, Ill.

Mr. See was a charter member of the American Society of Mechanical Engineers, a member of the Franklin Institute, the Hamilton Club and the Union League Club of Chicago.

Modern Ford ENGINE Repairing

By L. M. MANLEY

During the war when new cars were not available, repair shops and service stations looked about for labor-saving machinery for overhauling and rebuilding used cars. The success of their efforts is manifested in the complete line of such devices now on the market for Ford service stations and described in this article.

BACK in the good old days when people traveled afoot or on horseback, there lived in a small Midwestern city a man who, according to his sign, was known as John Wilson, "general machinist, gas- and steam-engine repairing a specialty." There were a few "horseless carriages" in this town, and their constant recurring need of repairs and adjustment prompted Wilson, with an eye to the future, to add to his shingle the legend, "Automobile Garage."

The author recalls many hours spent in Wilson's shop in boyish wonderment and admiration, as grease-besmeared Mr. Wilson knowingly made this or that adjustment. He has also vivid recollections of the first tourist, whose car had sustained a broken connecting-rod while attempting to negotiate a sandy stretch of road known as "The Mile Hill." It took about 10 days to replace that rod, as it was necessary to make a forging, machine it, and fit it to place, for interchangeable parts and quick-repair service were in an embryonic state at that time. There had been considerable publicity given the work, so that when the car was ready for a trial run, the whole town turned out to witness the performance. To everyone's surprise the engine ran, and Mr. Wilson's first real job of automobile repairing was successful.

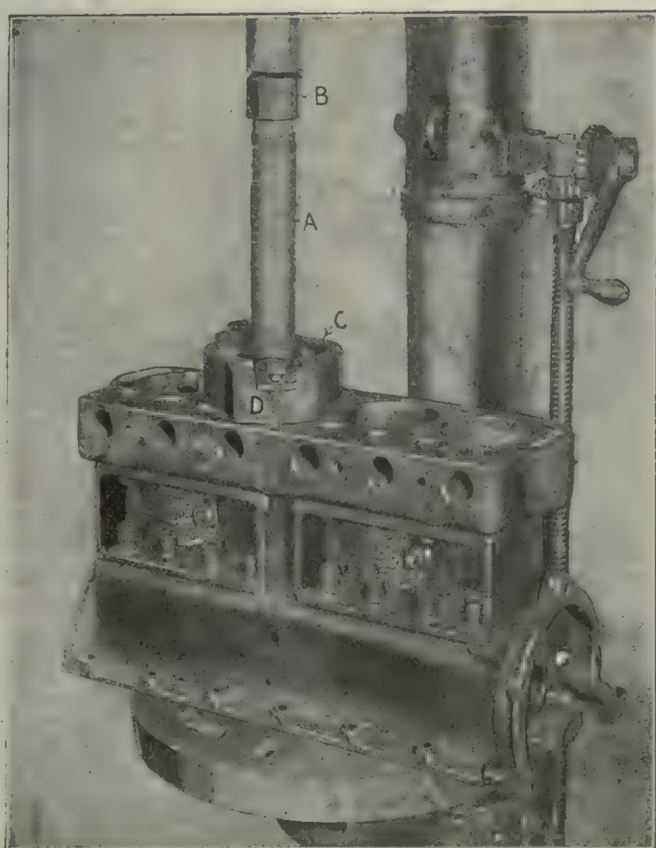


FIG. 1. THE CYLINDER-REBORING MACHINE

This repair was made on one of the first cars built by Henry Ford, and is in striking comparison with the present-day repair and replacement equipment which is now the complement of the Ford car. Today, a car owner can leave his car at any first-class service station on his way to work in the morning, and, if the occasion demands, he can get it in the evening completely overhauled and practically as good as new. That this service is possible is due to large quantities of spare parts kept in stock in the service station and the recent adaptation of manufacturing methods and equipment to repair work, modified, of course, to suit conditions.

Realizing the need for such labor-saving machinery, the Fairbanks Co., after considering the situation from all angles, has assembled, and is marketing a line of special machinery and devices for Ford and Fordson service stations. This company has also established schools in its principal branch houses where instruction courses are given in the use of the machinery and in service-station organization. This equipment duplicates to a marked degree the machinery, tools and fixtures used by the Ford Motor Co., and is of considerable interest to anyone having to do with motor cars, trucks, or tractors.

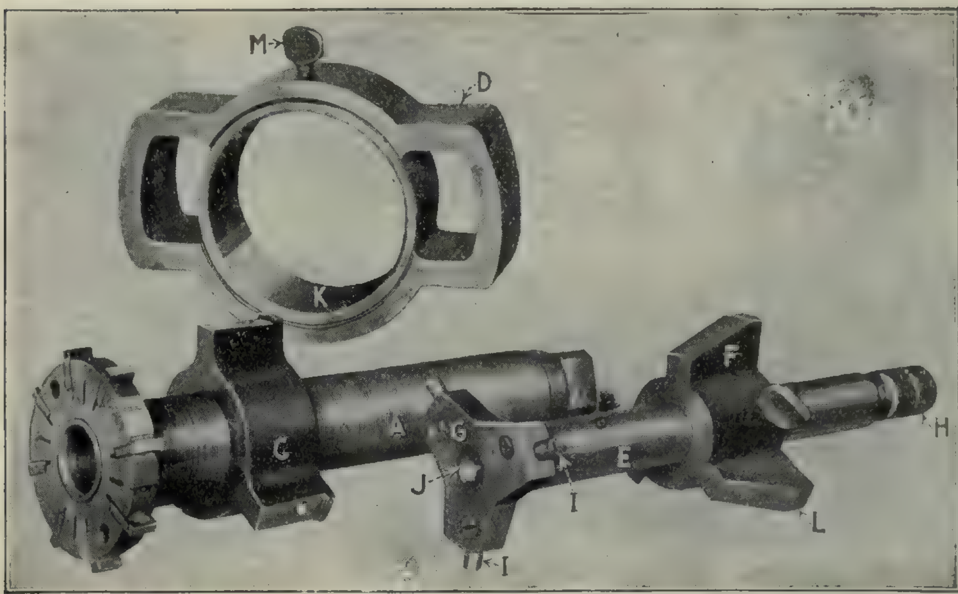


FIG. 2. THE DETAILS OF THE CYLINDER-REBORING MACHINE

In modern service stations, there is a sequence of operations which is rigidly followed in a complete overhauling of a car. There are mechanics or groups of mechanics who are responsible for certain details of this sequence; such as the radiator and body work, the engine, the transmission and chassis, the ignition and all the electrical parts, the assembly and final testing.

As soon as the engine is removed from the car it is dismantled and the cylinder block placed in a drilling machine ready for reboring the cylinders. This operation, shown in Fig. 1, is accomplished by means of a special boring tool. An inserted-tooth cutter, which can be set for any standard oversize piston, is held by the threaded feed bar *A*, which is turned by the chuck *B* on the drililng-machine spindle. The bar is partly guided by the nut *C* held in the collar *D*, which is clamped to the cylinder block. This reboring tool is shown in greater detail in Figs. 2 and 3. The pilot bar *E*, together with the centering gage *F*, is inserted into the cylinder with the inclined surfaces of the gage resting on the top edge of the cylinder bore. The bar is then lowered until a witness mark on the bar coincides with the top surface of the gage. The thumb screw is then set which positions the bottom gage *G*; while turning the knurled nut *H* expands the spring stops *I* at *J*, thus accurately centering the pilot bar. The collar *D* is slipped over the gage *F* and is positioned by the bushing *K* and the surfaces *L*. The collar is then clamped to the cylinder block, after which the gage *E* is removed and the threaded cutter bar assembly inserted and held by the threaded nut *C* in the collar *D*, the thumb screw *M* preventing the nut from

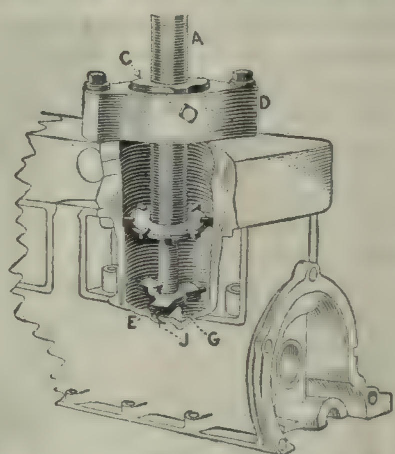


FIG. 3. ANOTHER VIEW OF THE REBORING MACHINE

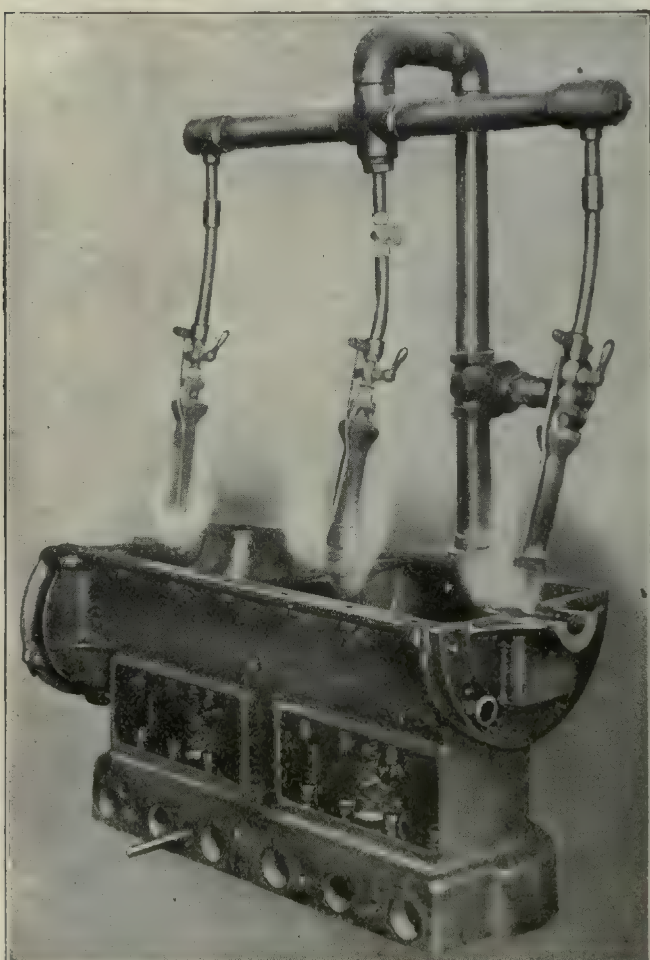


FIG. 4. MELTING THE BABBITT FROM THE CRANKSHAFT BEARINGS

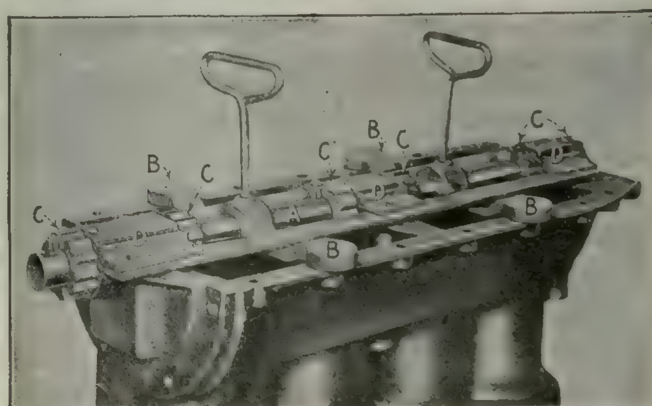


FIG. 5. A JIG FOR REBABBITTING THE CRANKSHAFT BEARINGS

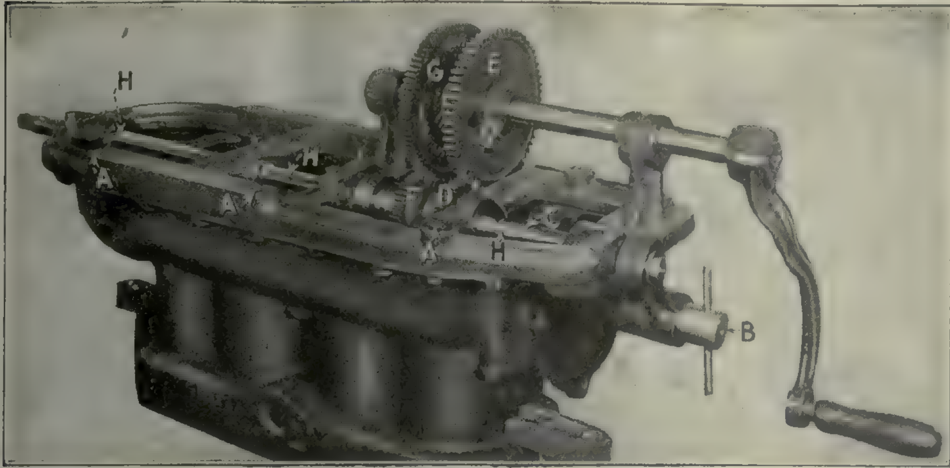


FIG. 6. HOW THE BEARINGS ARE BORED

turning during the boring operation. The accuracy and smoothness of the cylinder bore produced by the cutter is such that subsequent boring or rolling is not required. About 20 min. are required for reboring all four cylinders.

After the cylinders are rebored, the next operation is the rebabbitting of the main crankshaft bearings. The babbitt is melted from the cylinder block by gas torches, Fig. 4, which also preheat, at the same time, the cylinder casting to the proper temperature for babbitting. A rather unique jig which insures correct alignment of the bearings has been designed for the rebabbitting operation. The babbitting mandrel *A*, Fig. 5, is positioned by the pin stops *B* inserted in the crank-case-mounting screw holes as shown. The mandrel is then clamped in position by means of the eccentric lock blocks *C*, which also prevent any leakage of the babbitt metal. The babbitt is poured through the ports *D*, and after the metal has set the jig is removed by means of the handles. The bearings are next rebored by the main-bearing boring machine shown in Fig. 6. The machine is accurately located on the cylinder block by pins passing through the holes *A* into the crank-case-mounting screw holes and by two centering pins *B* which fit the camshaft bearings. The boring bar *C* is turned by the pinion *D* which is driven by the master gear *E*, while the feed is accomplished by a special feed screw driven by the pinion *F* and the master gear *G*. The boring is done by the cutting tools *H* held in proper position by setscrews. Special gages are provided for correctly setting the cutting tools to meet the diameter of the crankshaft bearings. The time consumed in the babbitting operations is about 30 minutes.

After the crankshaft has been thoroughly overhauled and all bearing surfaces trued up as required, it is fitted and lined up in the cylinder block and the bearing caps fitted with a slight rock and the bolts drawn down as tightly as possible. In modern service stations, the bearing caps are rarely rebabbitted as new caps ready for assembling can be purchased for less than the labor cost of rebabbitting the old caps. The cylinder block is now mounted lined up in the bearing burning-in machine shown in Fig. 7. The machine, which is run at approximately 200 r.p.m., is started and the bearing surfaces of the babbitt are burnished or burned-in. In this way a 100 per cent bearing surface is obtained in less than 1½ min., against the old system of scraping the bearings, which usually takes from 5 to 7 hr. and results in only 40 to 50 per cent.

While the foregoing operation is in progress the connecting-rods are being overhauled and tested for alignment in the novel fixture shown in Fig. 8, the operation of which is apparent from the illustration. An efficient device for holding the piston while reaming the wrist-pin bushing and for assembling the connecting-rod is shown in Fig. 9.

After the burning-in operation on the crankshaft bearings is completed, the pistons and connecting-rods can be installed or fitted in the position shown in Fig. 7, without removing the block from the machine. The burning-in of connecting-rod bearings is similar to the

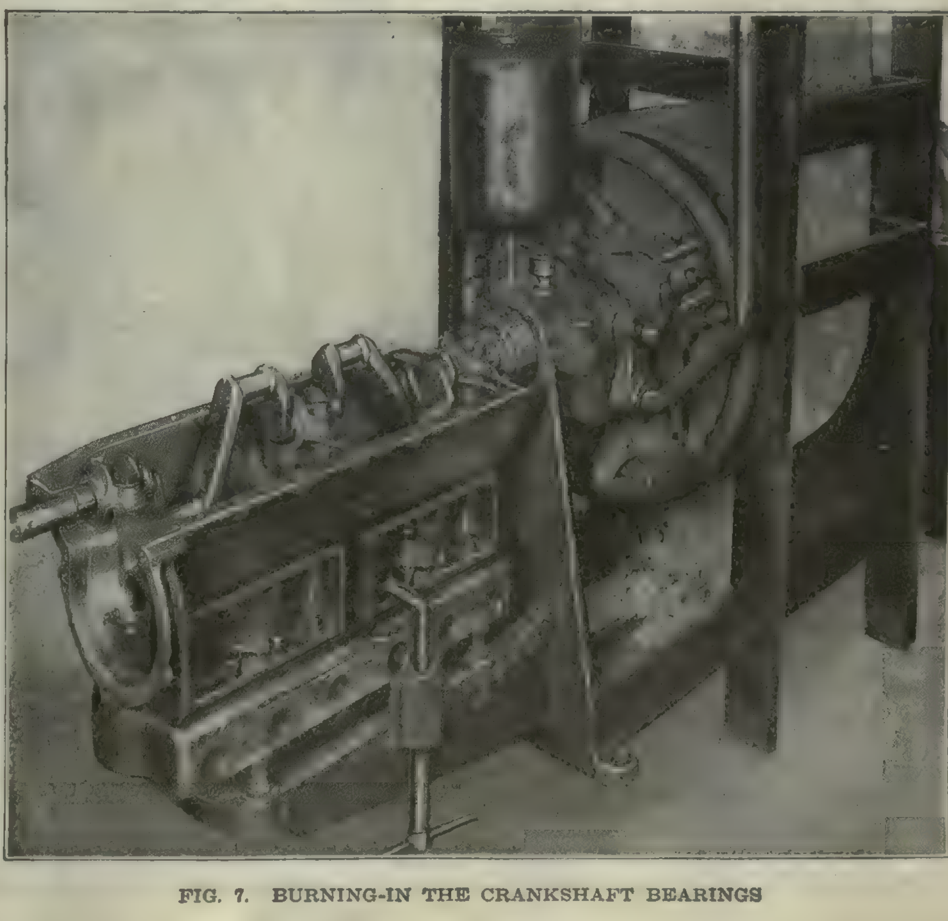


FIG. 7. BURNING-IN THE CRANKSHAFT BEARINGS

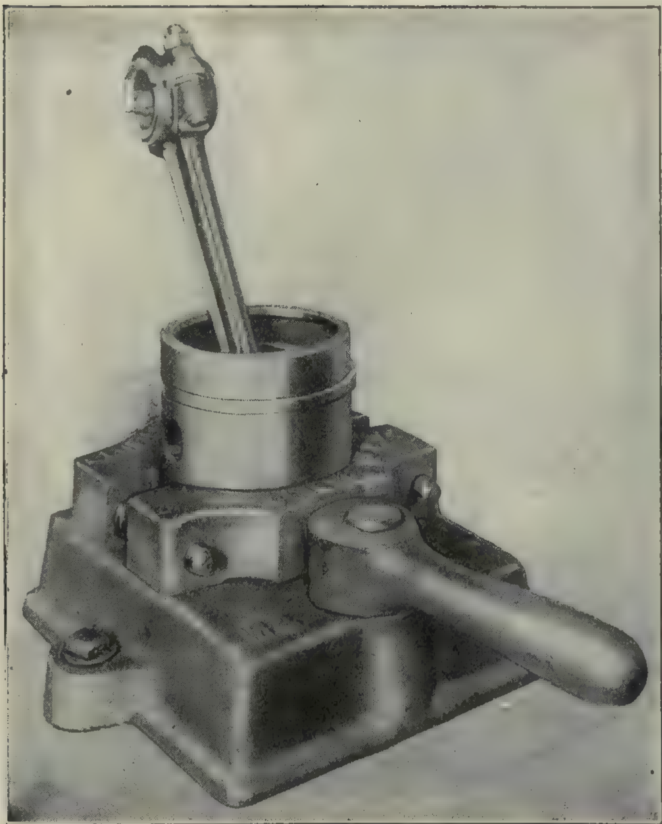


FIG. 9. A NOVEL PISTON CLAMP

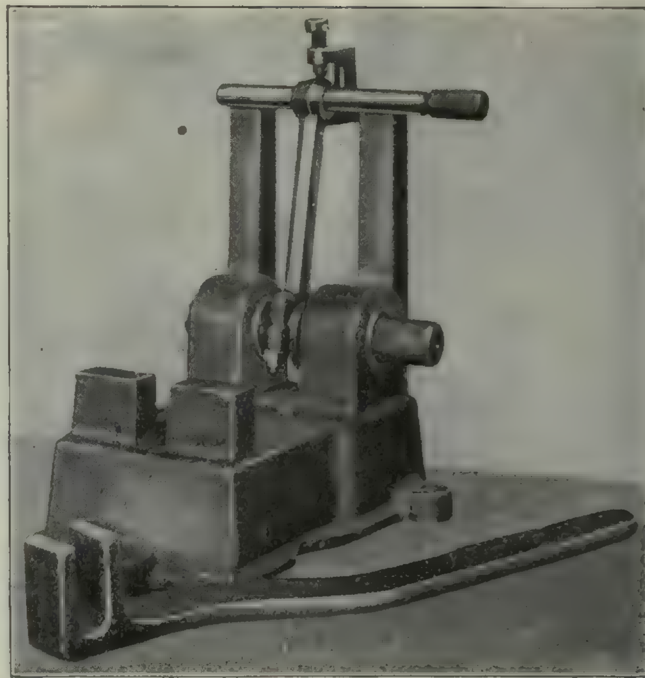


FIG 8. CONNECTING-ROD ALIGNMENT JIG

detected and corrected. Similarly, special equipment has been designed for overhauling the transmission, front and rear axle, crankshafts and camshafts, and, in fact, every detail of the car, so that after the final assembly there is little left for the final testers to do.

operation just described under the caption of "burning in," except that the main bearings now run in oil, and it is during this operation that the stiffness of the motor and bearings can be determined without removing the unit from the machine. The machines for burning-in and running-in are made in various sizes and designs to meet the individual requirements of the service station. However, the one illustrated is a double-end machine. By referring to Fig. 10 it will be seen that the engine block with the transmission unit which has been previously overhauled, is mounted in the position shown. The camshaft, timing gears, and the valves are assembled and given a running test. Incidentally, during this last test it is possible to grind-in the valves, as the revolving camshaft imparts the correct vertical motion required for valve grinding. Finally the complete engine unit is assembled and the motor is run-in and limbered up. During this time a thorough test of the valves, timing, and ignition can be made and it is obvious that the expense of making adjustments during this time will be much less than if the motor were placed in a chassis before testing.

When the motor is sufficiently limbered up with oil, which is done at about 600 r.p.m., it is started under its own power so that all oil leaks, noisy gears, timing magneto and carbureter trouble can immediately be

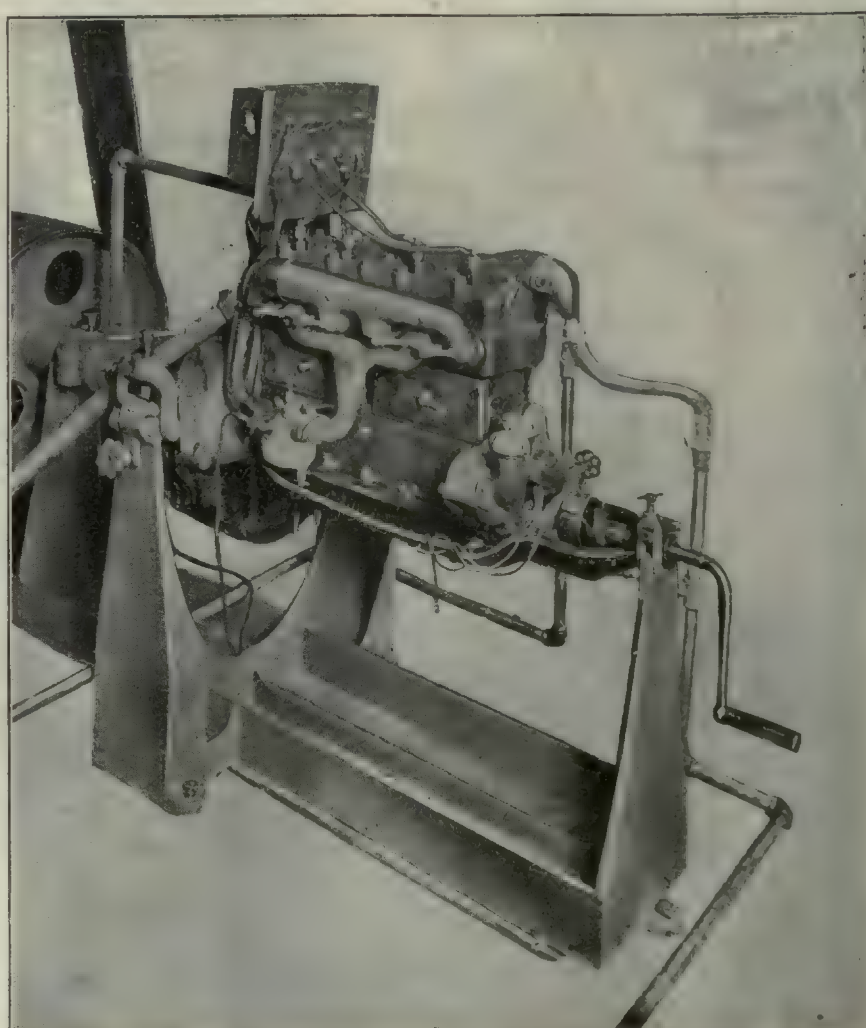


FIG. 10. RUNNING-IN STAND FOR FINAL ASSEMBLY OF MOTOR UNIT

Some Functions of the Employees' Magazine

BY JOHN T. BARTLETT

The shop or employees' magazine has, of late years, been recognized as a factor in industrial administration. Men like to read intimate items about their work and to see their names in print. The author tells something about a certain shop magazine and its editor. He also gives some pointers as to messages to the men through the medium of such a paper.

ARCHIE BEEMAN had knocked about in one occupation and another, and, when he suddenly blossomed out as a full-fledged newspaperman, he still retained much of the viewpoint of the man who works with his hands for wages. He was a good newspaperman, too, and friends deplored it, when, losing his berth on the "Morning Beacon," he started to work in a local shipyard where he could earn more money. Archie is democratic, and earned his pay, as "No. 1107," with the best of them, week in and week out.

The shipbuilding company saw the business advisability, after a time, of an industrial-relations department. This new department was quickly knocked together, but it was no less efficient. It comprised a superintendent, who was a member of the company; a general assistant; the safety engineer; the employment office head, and the editor of the plant publication —the editor of which was Archie Beeman. It was a case of somebody picking the right man for a particularly exacting job. I know—because I am acquainted with Archie's work with this new kind of publication which is no less important because it often comes out in humble dress.

Picture to yourself a clean-cut, rather slender young Scotchman in his thirties, a family man with kiddies of his own, a good mixer who remembers and is remembered by everybody he meets, an intelligent fellow with a grasp of business principles, a man who gets the viewpoint of the company without losing that of the men—and you have Archie.

We are considering some problems and functions of the employees' magazine, and Archie Beeman's well-conceived publication, "The Proper Job"—not the actual name, but it will do—furnishes some good examples of how definite and very significant things are done. The point which must not be forgotten is that in some ways it is infinitely easier to do these things wrong than right—unless the editor is just the right man; no mere talent in word-stringing will do. The editor of the plant publication must have ability of a high order, else the publication will likely do more harm than good.

Every individual industrial enterprise, whatever the product, gathers to itself an atmosphere distinctly its own, and this atmosphere, correlated with a tangible "shop spirit," is an offshoot largely of the relations between employer and employees. Under former conditions, this spirit more or less just happened. We are beginning to understand the importance of deliberately, carefully cultivating it. That is where the employees' magazine fits in. We have begun to appreciate the cash value of cheerful, contented working spirit; a year-in and year-out joining together of employer and employees.

The employees' magazine is a poor little orphan in the plant where employer and employees fence with one another, with distrust and suspicion on both sides, and with each holding "cards up their sleeves."

In the initial issue of the Acme plant publication, John M. Stead, the plant manager, in a signed message headed, "To All Acme Employees," touched on the company's biggest problem, but only to tie it up with the general matter of relations between employee and employer. There was possibly a thousand words in this talk by the plant manager. A photograph of John M. Stead accompanied the article.

We cannot quote Mr. Stead's message in full, but the following extracts will suffice to indicate the fine spirit which permeated it and its general character.

"There is no keener competition in the industrial world today than is found in the shipbuilding business, and the plant which will continue to exist and offer employment to a large body of shipbuilders is the one where waste time and waste material are eliminated and where the employer and employee feel that they are getting value received.

"We feel that it is not only the desire but the intention of each individual in the Acme plant to place that plant where it will be on a firm competitive basis, and will continue for years to come. Success for the firm can only be measured through the combined success of the individual employees.

"The management which exacts service on the part of its employees and fails to give service in return is definitely at fault, and cannot hope for success. With this in mind the management of the Acme plant is, through the planning of work, the proper location of machinery, and the placing of service stations as near the work as is possible, endeavoring to place the employees in the position where they do not waste their energy and where every effort counts toward the actual production of ships. In this manner we feel sure that the mechanical problems will be handled with satisfaction—if we have the benefit of the recommendations of every thinking man in the plant.

"With the mechanical problems in hand and in a fair way to being satisfactorily solved, we still have even greater problems of the individual employee as to his working conditions, his pay, and his means of presenting these problems to the management. To my mind there are none better fitted to study or present the problems of the employees of this plant than those employees themselves. Problems in regard to working conditions will be with us as long as we exist as a plant, but it is not necessary that they shall be the cause for dissatisfaction or dissension on the part of any individual or group of men.

"If we co-operate in spirit as well as in letter, we can eliminate our troubles by eliminating the causes, and it is with this in view that we most heartily desire definite representation for the employees in the form of shop committee which can handle these problems at their inception."

Mr. Stead then outlined a clean-cut, workable plan,

utterly devoid of red tape, whereby problems—call them complaints or grievances, if you like—could be settled to the employees' satisfaction. It was expected that the shop committee, made up of employees of the plant, would settle at least nine out of ten problems which arose. When this direct treatment did not suffice, the matter was to be taken up by a shop-committee member with the department superintendent and the industrial relations department. If no satisfactory agreement was reached at this stage, the case would be presented to the shop committee as a whole in conference with the plant management. Where the matter was of trade-community scope, the shop committee and plant management would confer with the metal trades council.

The Paper's Vital Relation to Company Policies

Mr. Stead's message to the men, which we have quoted, will illustrate a point or two. The man-to-man, above-board, straight-from-the-shoulder style was admirable. We might as well get this side of the employer-employee relation right at the beginning, because it is of fundamental importance. "Talking down" to the employees is absolutely wrong. The message does not need to be "adapted" to them, in the sense of a presumption that they are beings of inferior intelligence. They should be talked to as equals. Mr. Stead talked in that way. And he meant what he said.

The plant publication should be a pleasant, cheerful, happy little sheet, touching on many subjects in a light, even jovial, way. But all the time it should be serious, mighty serious, underneath. Its definite editorial policy, handled by a tactful, intelligent editor, should always stay in line with a real, tangible spirit of co-operation between company and men.

Archie Beeman surely understood his job. One of his creations was, "Sayings of Shipyard Sam." Sam was a semi-humorous character done into cartoon by the yard artist, J. Sheds, Archie's close ally. Here is a sample of Shipyard Sam's philosophy.

"Say, pard, have you seen that guy Rumor Monger? I told you what I did to him last week, but he's still at it, and if I get another chance at him he'll be fit for the hospital. The new yarn he is spinning is a hot one. He's passin' the word aroun' that we pieceworkers are going to get a cut. Where he got that dope from is more than I can fathom, but he's got a lot of poor fish worried; some of them are even slowin' down on the job to keep their production small.

"Why, I was talking to the Big Chief myself, and he says, 'Sam, I want you to tell the boys for me that we are doing big things in a big way at Acme, and when we get good men we want to hold onto them, and furthermore, we are willing to pay them, and pay them well. Production is what we want. A well-paid, efficient organization is far more economical than a moderately or poorly paid, less productive organization. We prefer the former, Sam, and I can guarantee you there is no cut in the wages, either time or piecework, contemplated by the management here.'

"Now fellows, that's official, and if you meet this Rumor Monger, hold him and send for me. I'd like to make a short address and farewell to him."

Sam was depicted in argumentative posture delivering his talk.

In what more effective way could uneasiness over wages have been banished? Of course, the management might have handed Archie Beeman a signed statement to use, but Shipyard Sam was an infinitely better device. He stood as a symbol of the above-board, open policy between company and men, and because he was Shipyard Sam, he could use language which would drive the thing home, and drive it well. The whole added effectively to the familiar atmosphere of the plant publication.

In contrast to the "Shipyard Sam" way of treating a subject without gloves, the writer recalls an example of the wrong way to endeavor to correct an abuse. This appeared in an employees' magazine of a coal-mining company. It had to do with smoking in a gaseous mine—a criminal offense. In the straight newspaper manner this publication commented on a criminal conviction and caustically used "miserable hides," and other strong expressions in connection with a discourse on the subject.

This was tactless, though every word of the diatribe was absolute truth. The mistake was in letting the company say severe things to employees in the form used, when some such device as "Shipyard Sam" would have run no risk whatever of offending, though language twice as harsh and highly colored within quotes was used. The strategic angle from which to approach the problem was the standpoint of the conscientious employee, to whom really the matter was of most consequence, inasmuch as the flagrant carelessness of others endangered his life. We know the typical happening when an outsider starts to tell the bald truth about a member of our family. We may know he tells the truth, but he antagonizes us.

Archie Beeman's Way of Correcting Wasteful Practices

To get across, the employees' magazine must be a genuine friend of the men, must treat things in a friendly way, must fairly radiate a spirit of fellowship.

It's just a case of the personal relation being exalted to print. The editor of a good employees' magazine can accomplish the result, just as Archie Beeman has done, right from the first.

Archie had ability to turn to account that spirit of fair play innate in a majority of us. "I'm doing my part—now do yours!" is the straight-from-the-shoulder appeal in several masterpieces of little articles by Archie which I have beside my typewriter. He talks in a man-to-man way in these articles. They could offend nobody. They were so patently fair-and-square, that they were sure to have a good influence. Another sort of editor would have "preached," "harangued," or "scored," and would have failed. Listen to Archie. His little article is headed, "Rivet Heaters, Attention!" It goes on:

"Have you noticed that when you come in in the mornings your fire pot has been all cleared out for you, your coke box is full and frequently you find kindling lying 'on the job' all ready for you to light up? Have you noticed that no more do you have to pack across a sackful of coke on your shoulder or lug a boxful of rivets half across the yard? Sure you have.

"These things have all been done for your convenience. Here's one way in which you can help wipe off the score:

"Pull out all rivets from your fire before you quit for lunch and before you hit the road for home and mama at 4:30, and be sure to turn the air off.

"Every afternoon when the service squad goes its rounds of the fire pots it finds a number of rivets absolutely ruined by being left in the pot with the

air turned on. Of course, the turning off of the air only delays the burning of the rivets a little; the only way to make sure they won't be spoiled it to take them out before you quit.

"D' you know that an average size rivet costs the firm about three cents? Suppose you allow half a dozen at noon and half a dozen at 4:30 to be burned; that means you have cost the firm 36 cents where there should have been no expense a-tall. Assuming there are 60 heaters in the yard and they are all careless about their rivets, they will waste $21.60 worth of rivets per day, or about $120 worth per week or over $6,000 in a year.

"Rivet heating is one of the first jobs a youth strikes in the yard and many may not realize that a share of the future of the yard lies in their hands. Yet, the above will show where they can cut down the costs considerably and every useless expenditure of a dollar cut out will enable the firm to compete for new orders on more equal terms with our competitors."

The Good Workman Respects His Job

Such articles are fundamentally compatible with the proper policy of an employees' magazine—which is one reason why the employees' magazine is potentially a powerful institution for good. The good workman respects his job. He takes pride in it, if he does it well; and, if he doesn't do it well, he knows he ought to, or there is something wrong with him. This presupposes, of course, that working conditions satisfy him. If he believes the employer is "doing" him he begins to lose efficiency and works in an atmosphere that is radically wrong. At Acme, the company was actively pursuing a policy of a square deal for every worker. It was paying high wages, and it let the employees know that it was paying them gladly. In return it frankly expected good, conscientious work. It let the employees know that conditions in the shipbuilding industry were such that without high efficiency the plant would not remain permanently in business.

Beside a snapshot of "Service Reilly" smoking a pipe at noon, "The Proper Job" carried this message, headed, "Are You Getting It?—Service":

"Riveters and bolters up. Are you getting it?—Service.

"When you take your wife or sweetheart to the show we have sometimes heard you beef about the street-car service. Also sometimes after the show when the big feed is on, or should be on, you frequently grunt out, 'Rotten service!' And we also have sometimes heard the same expression in the yard!

"In the last few years, there is hardly a word in the English language which has been studied or digested more by business men of all classes than the word, 'service.' Whether it is running an ice-cream parlor, department store or a shipyard, this new science, 'service,' has come to be demanded.

"In these days of keen competition this firm realizes that having what you want, where you want it and when you want it, is going to be one of the big factors in the success or failure of its future plans.

"Boys, our Service Department is open at all times for suggestions for its improvement. We believe we have improved somewhat, but we are not yet satisfied. We want to be able to shoot your wants in bolts, nuts, and rivets through the wicket in the service stations with the same dispatch as you get your favorite tobacco over the counter of an up-to-date cigar store. But we must have your co-operation to make it the success we wish. You can sure help out by cutting down all possible waste both of material and labor; the material by the large quantity of rivets which are needlessly burned; the bolts by the large number which are needlessly stripped and the labor by only taking as many rivets and bolts away from the service stations as you think you will use. Otherwise, large quantities are left lying around at night which the cleaners have to pick up and send to the salvage department where they are separated, the good from the bad.

"Boys, we have been making a record during the past months in the way of cutting waste, and with your co-operation we can still greatly improve this standard. Help us to show the firm we appreciate the expenditures they have made for Service."

A Clever Cartoon and Acrostic

Such material as the foregoing is only one kind of several which should go to make up an employees' magazine. A super-abundance of it would tire the employees and defeat its own purpose. But it is in the handling of such material possibly more than in any other that the employees' magazine editor is likely to "fall down." Though he consult at length with the management, though he obtain O.K. for all material before publication and hedge himself about with a dozen precautions—he must possess ability or he will surely fail. It is writing "work" that calls for talent of a high order.

The ingenious editor finds various ways of hammering away at wasteful practices. We have given some actual work by Archie Beeman. Here is a good example from the employees' magazine of one of the leading railroads.

The amateur cartoonist among the employees is a first-class ally of the editor. Not only is the cartoon in itself particularly effective, conveying a big point in an instant which a column of type might fail to drive home, but the fact that an employee draws the cartoon is a strong feature. The cartoon done in a good-natured way by an employee is taken in the same spirit by those who can profit by it.

The railroad-paper editor referred to, used in the summer a telling cartoon entitled, "The Blower On and the Pop Up," depicting a locomotive in that situation, and there was the further label, "This Is a Careless Engine Crew. They Are Wasting 20 Lb. of Coal a Minute," drawn in by the cartoonist.

Two or three issues later, the editor republished the cartoon, and below it an acrostic which it had suggested to another employee. Below the cartoon, and a caption, "Don't Advertise Yourself This Way—Save The Coal," was the following:

The POP tells the tale of
How much COAL YOU WASTE on
Engines in your charge, by
Popping in the ENGINE TERMINAL,
On the READY TRACKS, or
Popping on the LINE OF ROAD.
It never works unless YOU MAKE IT WORK, and then it
Shows up your lack of interest and care in your work,
And costs at the rate of TWO DOLLARS AN HOUR for the
Twenty pounds of COAL YOU WASTE
Every minute the POP IS UP.
Let ENGINEERS AND FIREMEN,

Let ROUNDHOUSE FOREMEN, ENGINE WATCHERS, HOSTLERS, and all concerned,
Take a real interest in KEEPING THE POP DOWN
And see that all who work with you
Learn to SAVE COAL and not to waste it on the
Engines YOU HANDLE.

In connection with all such employees' magazine methods to improve morale and raise standards—and the methods have application to big and little industries of every kind—is the basic principle which makes them practical and is what has been termed, "the spirit of the good workman." Whatever the job we do, whether high or low, it is worth doing well. The employer who has a contempt for the sort of work his employees do had quickly better cultivate a different attitude. It may be paradoxical, but the best guarantee an employee doing humble work has that some day he will be many rungs higher up the ladder, is that he love that humble job, study it from day to day and develop maximum efficiency at it. That is the spirit of the good workman. Whatever the job is, it is worthy of the best that is in him.

"Jack of All Trades, Master of None" Not a Modern Proverb

The first men to raise good workmanship to genuine idealism were not employers, the guiding heads of great industries. They were plain working men who took pride in doing a job not passing well, but exceptionally well. The disposition to do this is rooted deep in human nature. Rather than being a new thing, it is a heritage of the centuries. The spirit of the good workman has come down through the ages. "Jack-of-all trades, master of none!" is not a modern proverb, a product of this age of extreme specialization. It was first aptly said in the days when all work was done by hand, slowly. It had its birth in that great belief of humanity, that the job is worthy of the laborer's best skill.

Archie Beeman's tactful articles, mixed in with much of another nature, fostered this spirit with sympathetic touch. So did the cartoon of the engine which was burning superfluous coal. So did the acrostic which was added, "The Pop Is a Telltale." So can the employees' magazine of a thousand and one individual industrial enterprises. While exerting a steady influence for more efficient production, thereby gladdening the employer's heart, the interests of the employees are furthered to an equal degree.

Out of a recognition of mutual interests the employees' magazine grows into a business institution well-nigh indispensable.

A Man's Pay Should Equal the Value of His Production

By John F. Clark

The article under the above title, by John S. Watts on page 43 of the *American Machinist*, gives some good suggestions and would, if followed, go a long way toward the solution of the present unrest and dissatisfaction, provided the relative values of production could be fairly and accurately determined.

An instance is given where a foreman, by his superior knowledge, is able to increase production, and the value of the increase of production of all the men under his supervision is accredited to him. This, no doubt, sounds quite fair, but who is to determine whether the foreman is entitled to all the credit, or whether he did not gather some of his ideas from the workmen?

Many cases have been known where valuable improvements on certain machines were made possible in the first place by the suggestion of some workman, but in how many instances has the credit been placed where it should be? If the improvements have been the means of increased productive value and thus greater profits, should not a share, at least, belong to the one who made the first suggestion?

To illustrate the impossibility of determining just where to place credit for increased skill and production, the writer has in mind a certain case which recently came under his observation and which is typical of everyday happenings.

A Typical Case

A man was transferred from a manufacturing department where he had worked for a number of years, to the experimental and tool department in the same factory. His mechanical skill was limited to the operation of screw machines, and though he was an intelligent man he had had no opportunity of acquiring knowledge of the operation of machines in general.

He was placed next to a man who had many years' experience on high-class work and who was considered the most skillful and able man on the job.

This man, by virtue of his knowledge and skill, was able to instruct his neighbor and give him many valuable hints, so that in course of a year or so the new man had developed into a valuable man, and his pay had come up to within about a dollar a week of that of his instructor. He was highly appreciated by the foreman, who of course took a good deal of credit to himself for his development.

If Mr. Watt's theory should be worked out in this case, would it not mean that some of the credit for this man's increased usefulness should belong to his workmate and that his workmate's pay envelope should show it?

Another thing I have noticed in this particular department is that many times tool designers seek information from some workman concerning methods used and temporary tools made for the production of some particular part, and make use of this information in the designing of permanent tools.

Who Should Get the Credit?

Should this not mean that some of the credit for the increased production made possible by the use of these tools belongs to the workman who gave the helpful suggestions.

To my mind these things are so complex and intermingled that it is practically impossible to determine who shall have the credit for the ideas necessary to increase production, but I do believe that everyone who does his or her best and conscientiously perform their duties are entitled to some appreciation that will make them feel a little more than merely part of a machine.

I see no satisfactory solution for the unrest in the world except, as so often suggested by the *American Machinist*, the operation of the "Golden Rule," and this can only be when men realize the necessity of observing the first and second commandments.

The Evolution of the Workshop—IV

By H. H. MANCHESTER

Developments of the sixteenth century that are of immediate interest in the machine-tool field, were the introduction of printed books on machine tools, refinements in guild organizations and further adaptations of water and animal power for operating trip hammers, bellows, and machinery of all kinds.

(Part III appeared in our Jan. 29 issue.)

ALTHOUGH printing was invented before the middle of the sixteenth century, our knowledge of the conditions in the workshop in the first part of this century is derived chiefly from manuscript sources. A single exception seems to be an engraving of an armory shop by Hans Brugmair, which appears in the life of Maximilian the First of Austria.

This cut, which we reproduced some time ago in an article on ancient helmet making, is of importance in illustrating the various tools of the craft, especially a pair of large shears set in a block very much in the same way as the modern tool would be mounted.

Some of the first manuscript records of the century have already been touched upon in dealing with the work of Leonardo Da Vinci, which for the sake of unity was treated all together, although the last of his designs were produced in the first years of the sixteenth century. Another manuscript which we find belongs to the beginning of this period, or about 1505, is the "Codex Picturatus" of Bem, which included pictures of a number of trades at Cracow, an important Polish City. Among these illustrations is one of a sword maker and an even more interesting one is of a nail maker. This picture is shown in Fig. 25. An important detail in the latter indicates how the nails were headed with the aid of a die in the anvil.

FIG. 25. A CUTLERY- AND NAIL-MAKING SHOP FROM BEM'S "CODEX PICTURATUS," 1505

About 1510, Landauer established a foundation at Nuremberg for old members of the guilds similar to the home founded by Mendel 130 years before. As in the Mendel foundation, various portraits were preserved of craftsmen at work which are today of great interest in the history of industry. One of these pictures dating about 1526 is of an auger-maker. This is probably the first picture showing this occupation as a distinct trade.

It is at this point we leave the age of manuscripts for that of printed books

which were now becoming quite common, as a source of information. The first of these books which included subjects relating to the workshop is the Pirotechnia of Biringucci, which was published in 1540. While this deals particularly with munitions of war, it includes a few pictures which are very important from our point of view. It shows water power applied to bellows, to the boring of cannon, and to the drawing of wire and iron rods. Thus this work may be said definitely to mark the date of the first representations showing the actual use of water power in connection with

FIG. 28. A SMITHY OF 1556

the heavy work of the smith. At the same time, Biringucci shows the processes being carried out by hand, as shown in Fig. 26, so that the two methods were evidently used side by side.

Such application of water power had probably spread throughout western Europe, for there is a note by Ebanus Hessus of a mill at Nuremburg which succeeded in both rolling and cutting iron.

Our first definite notice of a universal joint seems to be in 1545, when such a joint was invented by Hieronymus Cardamus to be applied to the compass. In 1552 we find notice of a second rolling mill being put into operation by Antoine Bruler in France. Another picture, Fig. 27, showing the application of water power to metal work appears in the "History of

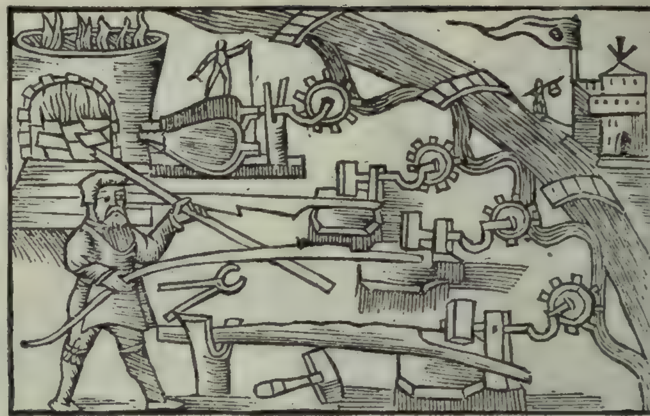


FIG. 27. WATER POWER AS APPLIED TO TRIP HAMMERS AND BELLOWS, FROM THE "HISTORY OF THE NORTHERN PEOPLES," BY OLAUS MAGNUS, 1555

the Northern Peoples," written in Latin by Olaus Magnus, Archbishop of Upsala, and published in 1555. This is a very quaint scene of the interior of a shop in which the bellows and, what is particularly noticeable, three hammers, are operated by little water wheels. This seems to be the earliest picture in which the application of the waterwheel is definitely shown, although this method had undoubtedly been known for some time.

While the work of George Agricola, "De Re Metallica," which was first published in 1556, deals mostly with mining and metallurgy, it contains a few pictures and facts of interest pertaining to the workshop. In Fig. 28 water power is shown in use for blowing a furnace and for operating trip hammers. There is also a rather important picture of the vertical stamp

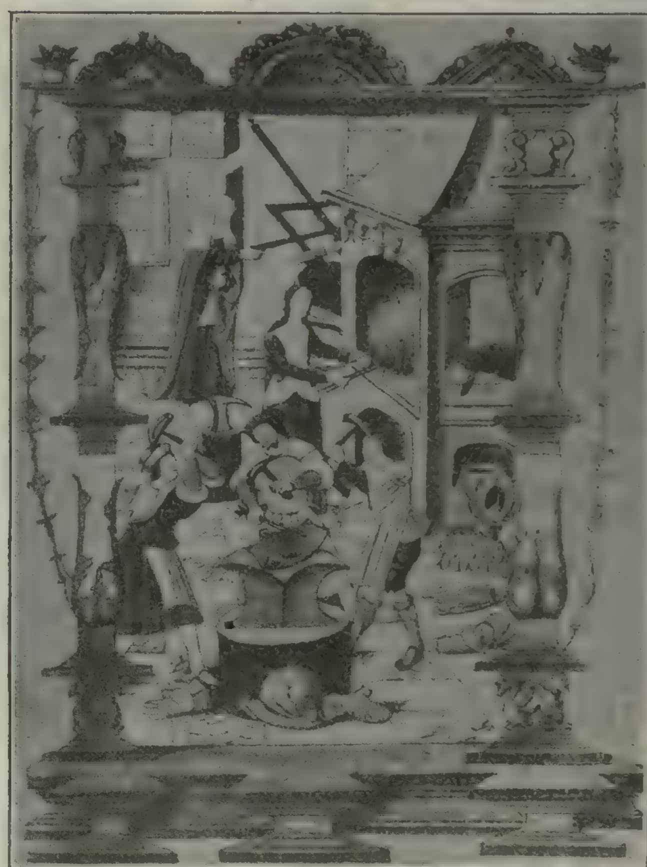


FIG. 26. ARMORERS, WITH WOMEN ASSISTANTS, ABOUT 1520

mill run by water power, but it is probable that this was used on ores rather than on the metal itself. He also notes that animal power was extensively used for driving various machines.

While we have already noted the introduction of several power-driven machines, it must not be supposed that they were as yet in common use throughout the various guilds of metal workers. This is made perfectly evident from the manuscript cuts of the Dutch engraver, Jost Amman, who made a faithful effort to represent the work of the guilds. These cuts are significant from several points of view. In the first place, they give an idea of the tools and operations which were employed, and, secondly, indicate how the guilds were splitting up more and more into separate trades.

FIG. 29. LOCK AND KEY MAKING IN 1568

FIG. 30. EARLY METAL SPINNING

One invention of which we have heard very little so far is the vise. The first notice of this tool seems to come from the previous century, but in Amman's time it was evidently in common use, for he pictures it as employed by the locksmith, cutler, spurrier, and other metal workers. The file seems to have been another very useful tool, as it is pictured in many of the shops. It is rather interesting to note that the locksmith seems to be cutting and punching out his wares with tools similar to those of our present blacksmith. This picture is shown in Fig. 29. Perhaps the most important addition to our knowledge of shop practices, however, is Amman's picture of the hollow-ware maker shown in Fig. 30. This shows that the lathe was already applied to metal working. The large wheel at the side would seem to indicate that the lathe was run by a belt connecting with this wheel, which was turned by hand. If this is correct, it is perhaps the first picture of a belt in actual use in a shop.

An interesting sidelight on the times is the fact that one of Amman's guild masters seems to be employed exclusively in making thimbles, which he stamped out by hand.

The extreme subdivision of guilds may be judged from the fact that Amman gives separate pictures for the plain-armor maker, chain-armor maker, and helmet maker as well as for the sword maker and cutler. Still other subdivisions were the gun maker, the gun-barrel maker and the pistol maker. Horse shoes were made by one craftsman, nails by another and spurs by still another.

This minute subdivision of the guilds had its counterpart in a division of labor which tended to increase the skill applied to a particular product. This skill in craftsmanship was also increased by the system of apprenticeship by which a boy received seven years' training in a shop before he became a journeyman and was allowed to change his working place. On the other hand, since this guild was given a monopoly of its own trade, no matter how small, such minute subdivision was a barrier against extension and was destined to be broken through with the introduction of power-driven machinery and the establishment of larger shops.

There is no doubt that the illustrations of Jost Amman marked, in general, the greatest development of the hand trades, because from this time we find more illustrations of machines as applied to industry. Curious old books devoted entirely to machinery have been found. One good illustration of the growing use of machinery is given by the engraving by Stradanus, dated about 1570, which was reproduced in the article on "Ancient Helmet Making." In this engraving a number of grindstones were shown mounted

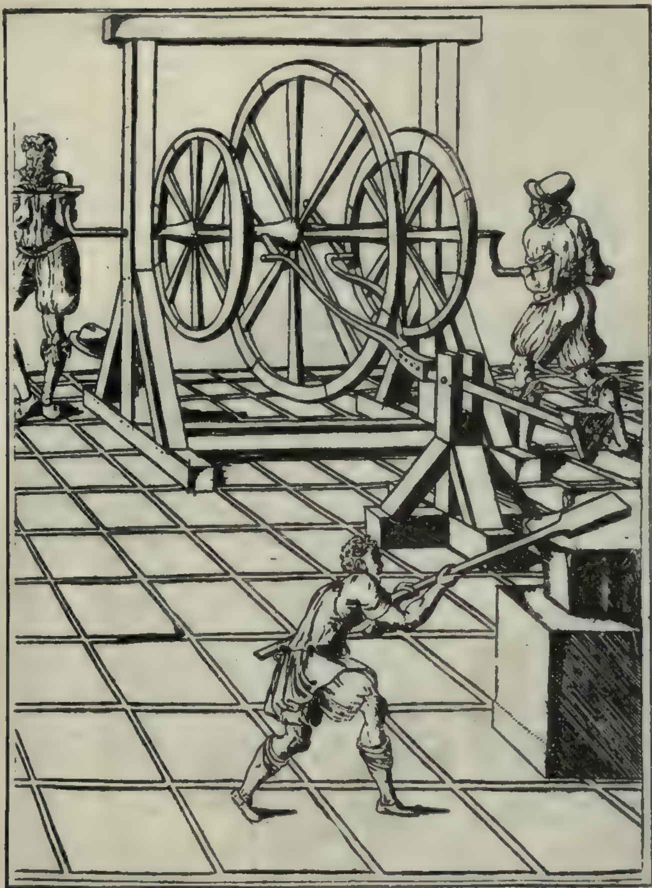


FIG. 31. A TRIP HAMMER OPERATED BY HAND POWER

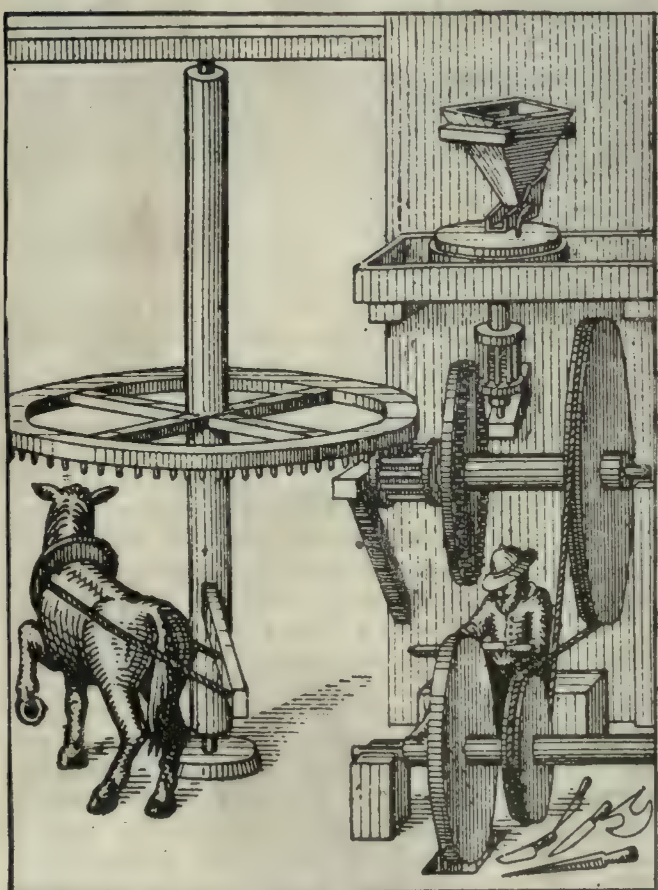


FIG. 32. AN INTERESTING INSTALLATION OF A HORSE POWER, LANTERN PINION AND ROPE DRIVE

on one shaft which was turned by a lantern pinion. This picture may be found on page 507, Vol. 49, of *American Machinist*.

What may be considered as the first printed book on the subject of machine tools was written by Jaques Bessen, and published in 1578. It was entitled "Theatrum Instrumentorium," or Theater of Mechanics, a title which was later employed for a number of such books.

In a way, Bessen's book covers an intermediate step between hand and machine work, for in it the majority of machines depicted are run by foot power or hand power. The foot power was usually applied by means of a treadle, while hand machines were driven from a flywheel that was turned with a crank.

Fig. 31 shows an application of the flywheel and crank for operating a trip hammer.

An interesting picture is found in the work of Jacob De Strada, who died about 1588. The illustration. Fig. 32, shows a grindstone and a mill driven through the medium of a rope belt and a system of lantern pinions, the whole being operated by a horse power.

A book of the engineer, Ramelli, "Del Artificiose Machine," which was published in 1588, includes many machines for engineering purposes, but only a few were applicable to shop work. These machines represent the application of water power to sawing and bellows blowing. In addition Ramelli's work shows many details which would be of interest in a more complete survey. Among these are heavy pliers and wrenches, a machine turned on roller bearings, and various sorts of gears and valves.

To sum up roughly for the century, it may be seen that power machinery was practically applied in the metal industry to boring, to wire- and bar-drawing, hammering and probably the turning and cutting of the softer metals. A more rapid development of power-driven machine tools was to take place in the next century.

Elements of Gage Making

Referring to the article under the above title in the *American Machinist*, Vol. 51, page 1033, the author recommends a flux for soldering steel composed of chloride of zinc, glycerine and alcohol, but fails to give the proportions of each.

He says that alcohol and glycerine in equal parts are to be mixed with chloride of zinc. How much chloride of zinc? Then he says, "Enough alcohol should be left in the bottle to make a clear flowing mixture." That would seem to indicate that after the chloride of zinc has been dissolved more alcohol should be added.

I think for the benefit of your readers who may decide to try the flux in question, the composition should be more clearly defined. J. R. WEMLINGER.

The flux referred to should be a super-saturated solution of chloride of zinc in glycerine and enough of the chloride should be added from time to time to insure the formation of a deposit at the bottom of the bottle after standing.

Sufficient alcohol should be added to make the solution flow readily, and alcohol should be added occasionally to replace the loss by evaporation. The mixture should be shaken well and often.

The alcohol referred to is grain alcohol. I have had no experience with wood alcohol. C. A. MACREADY.

FIG. 1. A HOLLAND MACHINE SHOP

FIG. 2. THE FOUNDRY

Business Conditions in Europe

By GEORGE R. WOODS
Manager New York Office, R. S. Stokvis & Zonen

The deductions in this article are from the careful observation of one closely connected with the machine-tool business in the principal countries of Europe. They deal particularly with the conditions which affect this industry and which are likely to play an important part in our future foreign-trade dealings.

IN Holland, Belgium, France and England, manufacturers, well aware of the opportunities before them, are desirous of quickly seizing the chance to resume or to enlarge their business, and are in nearly all cases thinking of the future instead of complaining of their present condition or of discussing a newer and better order of things generally. In each of these countries there are impediments, interferences, and difficulties of various kinds which retard business, but in general the business men are eager and anxious to see commerce functioning more smoothly.

Shipbuilding in Holland

In Holland there is exceptional activity in shipbuilding, ranging from the small yards where 100-ft. to 200-ft. steel barges are being made almost as a household industry, up to the new large shipyards where 10,000-ton steamers are seen on the ways. Fairly large ships are built in the interior and brought down through the canals, which, in fact, limit their size.

Locomotive and railroad shops of all kinds, both government and privately owned, are exceedingly busy, and the manufacturing of articles in general is quite active. There is a shortage of many things which people would like, ranging from bicycles, motor-cycles, and automobiles, up to houses in which to live. The automobile situation is somewhat different from the other countries, from the fact that Holland has no special automobile industry as we know it in America.

Holland has however some interesting industries, one of the most attractive shops being shown in Figs. 1, 2 and 3, which show the Automatic Screw Works at Nymegen. Fig. 1 is the end of the main works with the office at the left. Fig. 2 is the brass foundry, where faucets and similar parts are cast, while Fig. 3 gives an end view of the foundry, which is very different from the average foundry building in the United States. Fig. 4 shows the workmen's homes, located near the brass foundry.

FIG. 3. END VIEW OF FOUNDRY

The large number of German and Scandinavian machine tools shipped to Holland during the war, the large stocks of these tools that are being sold there now, the low value of the German mark, and the shortage of skilled labor, are all factors which count against the sale of American products. Large machine tools, particularly, are being bought freely in Germany because of the long deliveries from America and the low value of the German mark. The American machine tools which sell best now are those which are highly developed and made by well-established American firms with an international reputation.

Danger of Fuel Shortage

Holland is ambitious for a greater share of the world's trade, is desirous of being more self-contained economically and is looking forward to prosperous times. The shortage of fuel is the principal danger which threatens to diminish the nation's business.

The industrial leaders of Belgium are taking the same courageous attitude that the Belgium army took throughout the war. Nowhere is there any depression or bewailing of present conditions, even though manufacturers realize that they can never be compensated for their losses. After viewing the destruction in some of the large plants and learning the amount of indemnity that has been awarded, one soon realizes that the amount to be received by these manufacturers will be only nominal compensation for their losses.

The building shown in Fig. 5 is the Charleroi Electric Works, Charleroi, Belgium, the equipment of which

FIG. 4. WORKMEN'S HOUSES

was used by the Germans during the war. Nearly all of the original equipment has been returned and is now in service. Figs. 6 and 7 are groups of machine tools in the shop of Carrel Freres in Ghent, Belgium, which have just been received from Germany. This firm manufactures Diesel engines and similar machinery.

Probably the largest and most modern machine-manufacturing plant in Belgium is that of the Fabrique Nacional de Armes de Guerre, at Herstal, Belgium. Fig. 8 shows the entrance to this plant and gives some idea of its size and construction. This plant is now gradually resuming operations, using some tools returned from Germany and others that have been purchased new from various sources.

The largest automobile plant which makes the best-known Belgian automobile is the Minerva Automobile Works at Antwerp. Some idea of this is shown in Fig. 9, which is typical of the construction of all the buildings of this plant. Its product is entirely passenger cars, and American machine tools predominate throughout the plant. New tools are being bought and are replacing those taken by the Germans.

There is no reluctance anywhere toward purchasing machinery or equipment from Germany. In fact, in one of the largest enterprises, the officials stated that the low value of the German mark, the greater familiarity which the Belgian workmen had with German materials, the long American deliveries, the premium on the dollar, and the high ocean freight rates, all combined to bring them to the conclusion that they would furnish their plant entirely with German equipment.

One discouraging feature of the situation is the necessity which forces many Belgium firms to again install old and in many cases obsolete machines which were removed to Germany and which are now being returned

FIG. 5. CHARLEROI ELECTRIC WORKS

in wretched condition. So great is the necessity for starting the factories at once that even these old machines, now badly rusted and in frightful condition, are being cleaned up and put back on the old foundations. Under these conditions, the production per hour will be about the same as ten or fifteen years ago. No one can visit a dozen or more plants in Belgium without being amazed at the energy, resourcefulness and progressive attitude of the managers and executives. There is much to be done in the rebuilding of the railroads and their re-equipment. At the present time much of the equipment, both cars and locomotives, is of German make.

Belgium has made up her mind to re-establish herself quickly and in better shape than ever before, and is now carrying out her resolution to the best of her ability.

FRANCE

An observer who has only a limited amount of time in which to survey conditions in France, even though making a tour of the important cities, is apt to conclude that France's problem is more complex than that of Belgium and possibly that of England. A readjustment of the national economic program seems to be in the air. The restoration and rehabilitation of Alsace-

FIG. 6. MACHINES RETURNED FROM GERMANY

Lorraine, the increase in certain industries, the decrease and almost total destruction of others, is a tremendous load for any nation.

Here, too, the railways, as well as the national highways, are in need of much attention in the way of repairs and re-equipment. American locomotives and rolling stock are being used to some extent. There is a decided attempt to put the automobile industry on a firm foundation and on a quantity-production basis, which means something of a reorganization of both plants and personnel.

Throughout France there is abundant evidence of the industrial disturbance caused by the war. As in Belgium, the transportation problem is probably the most serious. Not only is there a shortage of railroad equipment, but the whole transportation system of France seems to be out of balance. A tremendous amount of war material is still clogging the ports. At Havre, for example, some of the largest piers are still filled with British army stores and machine tools. General cargoes are often unloaded over the shipside to the lighters and then towed around the harbor and up the Seine

until some empty place can be found where the cases may be unloaded and often remain in some out-of-the-way place for months. In several instances, brand-new expensive American machines were almost hopelessly covered with rust. The cases were smashed because of the severe handling and the outdoor storage did the rest. Contrasting France and Belgium, it seems as though Belgium has already determined her economic position and is working out her salvation. In France it seems as though there was considerable uncertainty as to what course to pursue.

The transportation difficulties, the premium on the dollar, and the low price of the franc, all impede the sale of American machine tools. There is considerable dealing in second-hand tools, and the gravest point of all is the direct recommendation of the government to purchase everything possible in Germany and as little as may be in England and the United States. A speech to this effect in the Chamber of Deputies was applauded. The officials appeal to the business men of France not

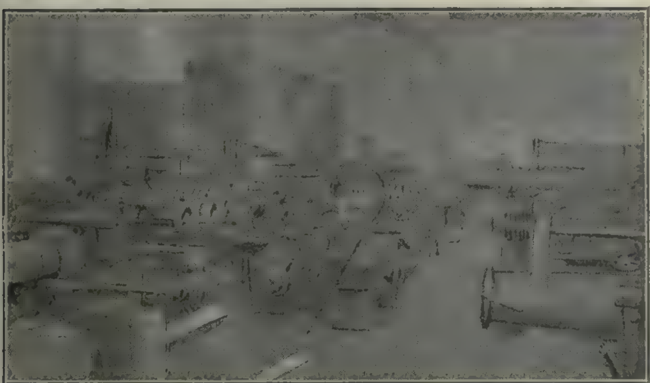


FIG. 7. MACHINES RETURNED FROM GERMANY

to let their prejudices interfere with their business judgment, and urge them to purchase everything possible in Germany because of the low value of the German mark.

ENGLAND

The question of transportation in all its branches is the dominant issue in England as in almost all European countries. In England the government still has some of the most important piers and tidewater warehouses filled with army stores.

The whole industrial life of Britain has been, of course, most seriously disturbed; and their desire to rebuild England on a better basis than ever before, and at the same time to "carry on," is slowing up their recovery. They are trying to build a new house and live in it at the same time. In their eagerness to protect key industries, they propose to prevent importation of precision instruments such as micrometers, etc., claiming that England should not depend on other countries for tools which were needed for the national defense. Programs such as these in the case of a very critical and delicate situation, are interfering with the quick recovery of Britain's industry.

Then, too, there is the natural reaction from five years of being very close to a great war. There is a great demand for automobiles, motor-cycles and motor trucks, in spite of the high price of motor fuels. In none of these lines is it possible to secure prompt deliveries in many cases. The general unrest is, of course, partly responsible for this condition.

FIG. 8. A BELGIAN FACTORY

The means for overcoming the disadvantages under which American exporters operate today have been discussed almost daily in the public press. There appears to be a full realization here of the seriousness of the situation, as well as a desire and an ability to meet it. The impatient attitude of European buyers and their apparent unreasonable demands can possibly be better understood if one considers France, Belgium and England as countries in which every industry and every business has experienced a fire or an earthquake.

ALL ORGANIZATIONS ARE UPSET

Practically every organization is upset and disorganized, and in this condition, with strikes of all kinds pending from week to week, the business men of Europe are trying to rebuild their organizations. Nowhere do you find conditions normal, and it is in a disturbed unsettled and abnormal atmosphere that the agent of the American exporter is endeavoring to sell American products

As the price of German tools descends, the greater is the possible number of buyers for them. There are, however, many firms in Europe who would still buy

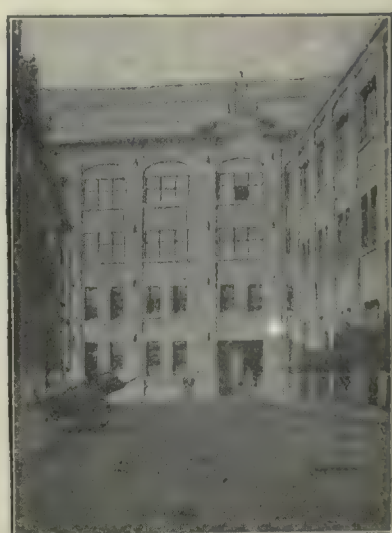


FIG. 9. MINERVA AUTOMOBILE WORKS

American machine tools, even if tools of German make were given to them. And when European buyers display confidence of this nature in American tools, it is a sign of encouragement that warrants American manufacturers in bearing with their European customers in this, the most trying period of European history.

Modern Aviation Engines—I

By K. H. CONDIT
Managing Editor, *American Machinist*

THE development of aviation engines during the last three years has been so startling that a series of sketches of the representative types used by the various air services of the Allies and the Central Powers, as well as some of the recent commercial types, has been prepared in an attempt to place the present situation before the readers of the *American Machinist*. Six pages of these sketches are planned, each to be accompanied by a brief description of the models shown.

No attempt has been made to group the engines according to types except that those with radially arranged cylinders, both stationary and revolving, appear in the same group. The classification of airplane engines can be attacked in so many different ways that it is rather difficult to choose the best one. All of the models shown are of the four-stroke-cycle type. Two-stroke-cycle airplane engines have been built and operated but never with entirely satisfactory results. The air-cooled cylinder is also out of favor just now except for rotary engines where its use is imperative because of the difficulties attendant upon the adaptation of water cooling to rapidly revolving cylinders, and in some of the smaller fixed radial engines.

When the art of flying was in its infancy, the internal-combustion engine had not progressed much beyond the "short-pants" stage and the only reliable power plants were of the four-cylinder vertical variety. Compared with present practice they were heavy, but as they were the best to be had they were used to a certain extent. Several engines of this type were constructed with air-cooled cylinders at an appreciable saving of weight, but about the only valuable feature of these early vertical engines was their economy in fuel consumption.

The rapid advances in the automobile-engine field were reflected in aircraft engines so that at the outbreak of the war there were several reliable and reasonably light vertical water-cooled engines available. Engines of this type are built with four, six and eight cylinders, but by far the greatest number are sixes. One of the latest of these appears on the opposite page; built by the Hall-Scott Motor Co., it combines with their experience the proved features which made the Liberty motor so successful. Vertical engines have a high reputation for reliability, economy and long life, but their weight per horsepower is usually not much below 3.5 to 4 lb. The arrangement of the cylinders is the best possible to reduce head resistance, but of course makes them occupy a good deal of fore-and-aft space in the fuselage, particularly in the eight-cylinder type. In multiple installations this difficulty disappears.

A very few engines of the horizontal-opposed type have been built, but never with sufficiently good results to warrant their adoption, and never with high power.

In order to reduce the length of the bigger engines, the cylinders are arranged in two rows set at an included angle of 45 to 90 deg. and forming what we call the V-type engine. Engines of this type have all the advantages of the vertical engines except the low head resistance, and in addition are characterized by a much lower weight per horsepower. This figure will be approximately 2 lb. for the modern V-type motor. The reduction in length of crankshaft and crank case permits both to be made lighter and stronger and the possibility of locating accessories inside the V makes the design a compact one.

If reduction gearing is used between crankshaft and propeller, the latter may be raised far enough to allow a machine-gun barrel to be mounted on top of the crank case to fire through the hollow propeller hub. Several motors have been built to take the French 37-mm. cannon in this way. This is not quite so simple a problem as it sounds, because of the rapid heating of the barrel of the gun when in action and the difficulty of securing really reliable reduction gearing, but the elimination of the delicate synchronizing gear needed when the gun is to be fired through the propeller blades is a very important advantage.

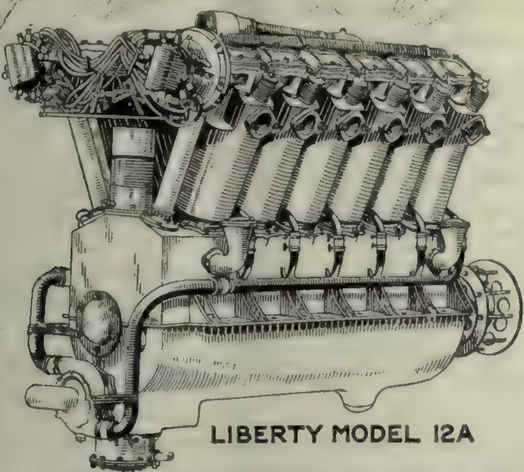
The V-type engines were the backbone of the American, British and French aviation programs as will appear in subsequent installments of this series. Our own air service soon discarded all other types except a few rotary engines for scout training machines, and used Liberty or Hispano-Suiza engines for everything except primary training where the old reliable Curtiss Model OX was unbeatable for the work required. So much has been published concerning the conception, design and manufacture of the Liberty motor both in the *American Machinist* and elsewhere that little new can be said. Built as a high-compression job for the Army and with lower compression for the Navy, it finally silenced its critics by its splendid work in the transatlantic flight of the NC-4 flying boat.

As a factor in the actual fighting on the Western front, its value was probably more potential than actual, but it is quite possible that the information supplied by the German secret-service agents to the high command concerning the rapid strides in production in this country had something to do with their sudden decision to throw up the sponge.

Shortly before the signing of the armistice, the Curtiss Co. brought out its Kirkham 12 which is shown here. It was first mounted in a small combat machine of advanced design and gave an unusual performance at the Army test fields. This motor is quite different from the standardized Liberty. It has four valves per cylinder and drives the propeller through reduction gears, the crankshaft turning at better than 2500 r.p.m. This machine recently broke the official altitude record by exceeding a height of 30,000 ft.

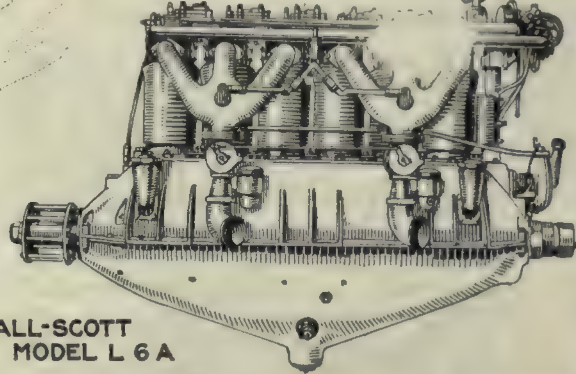
The other motor shown is the small Hispano-Suiza which is credited with having made the famous French Spad possible. In the second year of our participation in the war this motor was used in our advanced training machines with marked success. The other models will be described in more detail in the next paper of this series.

For still higher powers the cylinders have been arranged in three rows to form the W-type engine. The complications multiply to such an extent in this model, however, that it has not met with favor. The most prominent example was the 18-cylinder Sunbeam which had six magnetos, six carburetors and six camshafts. Tuning up such an engine ranks among the high arts.



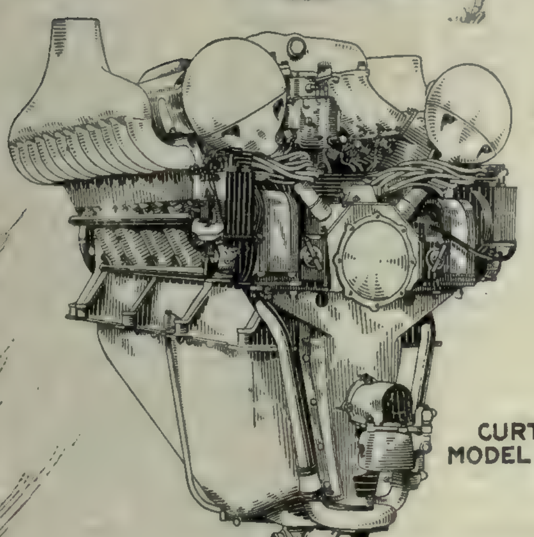
LIBERTY MODEL 12A

Twelve cylinders; bore, 5 in. (127 mm.); stroke, 7 in. (178 mm.); compression ratio, 5.4 to 1 (Army type), 5 to 1 (Navy type); angle between blocks, 45 deg.; rated hp., 410 (Army Type), 330 (Navy type), at 1750 r.p.m.; generator battery ignition; dry weight per hp., 2.11 lb.; fuel consumption, 0.51 lb. per b.hp.-hr.



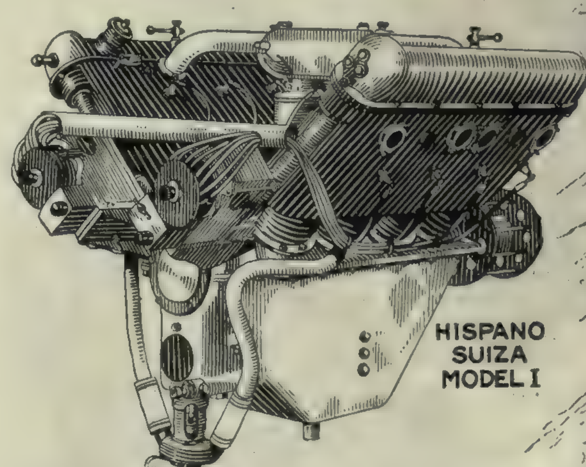
HALL-SCOTT MODEL L 6 A

Six cylinders; bore, 5-½ in. (127 mm.); stroke, 7 in. (178 mm.); compression ratio, 5.5 to 1; rated hp. 200 at 1700 r.p.m.; generator battery ignition; dry weight per hp., 2.2 lb.; fuel consumption, 0.55 lb. per b.hp.-hr.



CURTIS MODEL K-12

Twelve cylinder; bore, 4-½ in. (114 mm.); stroke, 6 in. (152 mm.); compression ratio, 6 to 1; angle between blocks, 60 deg.; rated hp., 400 at 2330 r.p.m.; two-spark magneto ignition; dry weight per hp., 1.65 lb.; fuel consumption, 0.55 lb. per b. hp-hr.



HISPANO SUIZA MODEL I

Eight cylinders; bore, 4.72 in. (120 mm.); stroke, 5.12 in. (130 mm.); compression ratio, 4.8 to 1; angle between blocks, 90 deg.; rated hp., 150 at 1450 r.p.m.; magneto ignition; dry weight per hp., 3.03 lb.; fuel consumption, 0.51 lb. per b. hp.-hr.

-by B. Z. REITER-

There is some question whether it is advisable to put so much power into one unit, and for fighting work where one bullet can put an engine out of action, the tendency is toward increasing the number of engines rather than the power.

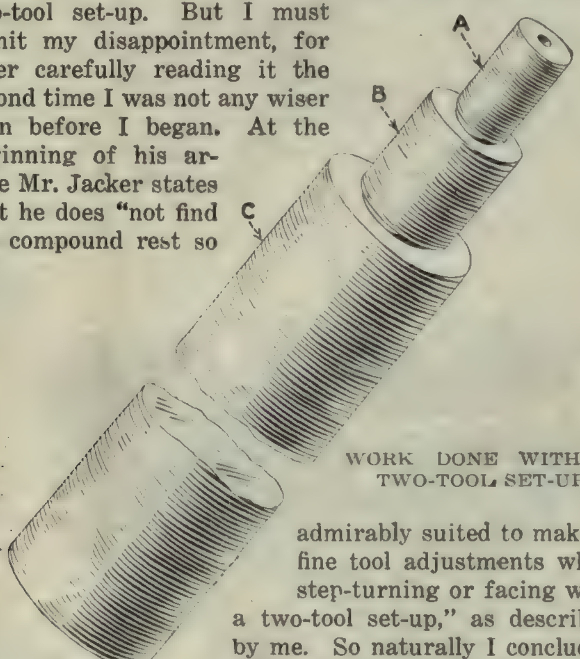
Radially Arranged Cylinders

The final step in reducing engine length is to arrange the cylinders radially like the spokes of a wheel about a drum-shaped crank case. Here the weight per horsepower is very low but the head resistance becomes disproportionately high. Economy is also sacrificed to a certain extent. Two possibilities present themselves in this type of engine; to keep the cylinders stationary as in the other types described and rotate the crankshaft and propeller, or to make the crankshaft the fixed part and let the cylinders and crank case revolve about it. Both of these types are shown in the fourth installment of the series and the peculiarities of their action will be taken up at that time.

Using Two Tools at Once

By H. F. Pusep

When looking over the *American Machinist* I read an article on page 731, Vol. 51, by M. Jacker, criticising the method of the two-tool set-up described by me in an earlier issue. This interested me greatly, and I hoped to enjoy the article and to learn more about the two-tool set-up. But I must admit my disappointment, for after carefully reading it the second time I was not any wiser than before I began. At the beginning of his article Mr. Jacker states that he does "not find the compound rest so admirably suited to making fine tool adjustments when step-turning or facing with a two-tool set-up," as described by me. So naturally I concluded that his article would treat specifically of these subjects. On the contrary, these issues do not appear, but instead a rather elementary treatise on effects of heavy cuts in reproducing inequalities of "rough forgings in miniature upon the finished product." I might say here that the two-tool set-up described by me was not intended as a cure-all for existing mechanical troubles. Mr. Jacker will understand my meaning better if he will try to reduce a hexagon bar of steel in one cut on the sturdiest built lathe on the market.



WORK DONE WITH A TWO-TOOL SET-UP

The average machinist who "sometimes uses a piece of pipe on the wrench" would not be tolerated by any foreman who values his lathe equipment. The toolpost wrenches supplied by the lathe manufacturers are the proper means wherewith to tighten a tool, and if they are not effective I would advise using a heavier lathe rather than ruin the toolpost via the "pipe on the wrench route" as described by Mr. Jacker.

Just why the compound rest is not suitable to making fine tool adjustments is not explained, the nearest to explanation being the assertion that it "would require the tapping of the compound rest from side to side with a piece of lead." This, however, is unnecessary if the swivel nuts are loosened; but should it persist in sticking I would advise that the shop repairman be consulted.

A number of years ago, while working as a journeyman machinist, a large number of shafts similar to the inclosed sketch were being put through the shop. Part *A* was afterward threaded and the part *B* was held to a tolerance of ± 0.002 in. There was also a recess at each shoulder. Several men besides myself were working on this job and as there was a sort of bonus system in the shop, the competition was quite keen. As it was a case of "more production, bigger pay" I did some hard thinking, the result of which was that my bonus averaged about 75 per cent higher by the end of the week than that of the next highest lathe operator. A spare toolpost which I found in the tool crib gave me the idea of a two-tool set-up. Of course, this good luck didn't last very long because the boys got wise to the trick and then the time setter had to set a new rate to suit changing conditions.

The Operations

The operations of these pieces which were made of bar stock, cut to length and centered, were as follows: Diameter *C*, not requiring close limit, was finished in one cut, the operator fixing a dog on a new piece while the lathe was running. This method was followed throughout, performing the same operation on several hundred pieces before changing on to the next one. The diameter *B* was now roughed out in the usual way, leaving enough stock for the final finishing; diameter *A* being then roughed out identically to *B*. The operation following consisted of finish-turning the diameters *A* and *B*, using two tools at once (such a set-up was explained in my previous article).

This operation left radii at the shoulders and so the next operation squared the shoulders at the right distance from the end of the shaft and formed the recess at each shoulder, this being accomplished with a regular cutting-off tool.

It will at once be apparent from the accompanying sketch that if the important diameters *A* and *B* could be finish-turned in the time that it previously took to turn one of them, the saving of time on several hundred pieces would be very considerable. This can be accomplished on any ordinary engine lathe by the aid of the compound-rest swivel. There might be other methods whereby the same results can be obtained without any additional expensive equipment to the standard lathe, but if there are, they have not come to my notice.

In conclusion I agree with Mr. Jacker that there is a certain amount of "maneuvering" as he calls it in setting up the two tools, but then even a most simple set-up requires it more or less. It is my opinion that if the results attained more than justify the small initial time spent in setting up for a given job by a new method, it should be adopted until somebody shows a better way—for by so doing the wheels of progress are kept going in the right direction.

Making or Manufacturing?

By E. A. Dixie

In spite of our boast that we are the greatest manufacturing nation in the world, there is still an enormous amount of "making" as opposed to "manufacturing" even in some of our largest so-called manufactories. There is generally more evidence of this form of inefficiency in long-established plants than there is in the newer ones. The handling of work in jigs and fixtures which hold a number of pieces at a time does not necessarily mean that the work is handled faster than it might be in a simpler jig or fixture which holds but one piece.

SEVERAL years ago a young friend of mine took a job as general superintendent of a large small-arms factory.

He is an exceptionally good man, but was handicapped because he had spent practically all his working life in one shop, and so had not the breadth of experience that drifters acquire in their wanderings.

In the new shop, the men, the tools and the methods were all old; in fact, everything was old except his job, while in the previous shop he had been accustomed to conditions exactly the reverse.

About two weeks after he started I got into town and at once called him on the phone to ask how he liked the new position. Instead of a cheery invitation to see some new trick whereby work was turned out faster than it had ever before been turned out, in a mournful voice he begged me to come down to the shop for half an hour to talk things over, as he was at his wits' end with the new conditions and needed council and advice.

When I got there he had the same expression on his face that I once saw on the face of a man who fell overboard in Sydney Harbor—ask any old sailor man about the sharks in Sydney Harbor, but don't believe anything over 20 ft. He was the picture of despair.

In response to my query as to what was the trouble, he began about as follows:

"Dixie, I'm here to increase production and I don't know where to start. There's not a machine tool in the shop that did not come over in the Mayflower. Whenever I ask for new tools, the boss calls in an antiquarian who has worked here for centuries and has the histories of all the machines tucked away in his head. He knows just what the boss wants him to say so he tells me what fine-paying work was done on the old chain lathe during the war. No! not the Civil War, but the war of 1812. Then he goes on to say that modern tools are no good and to support this statement he tells how the firm bought a new lathe in 1856 which was no good and had to be sold at a loss. Then the boss butts in with the intimation that, father and grandfather always said the shop was the best equipped in the world, and that what is wanted is product and not bills for new equipment. But come out into the shop and see what I'm up against.

"Just look at that frame-milling job. The spindle of the machine is running so slow that unless you chalk one of the teeth of the cutter you can't tell whether it is turning right or left. You are familiar with the last shop I had charge of; pick out any job here and compare the machines and methods with those for the same job in the other shop."

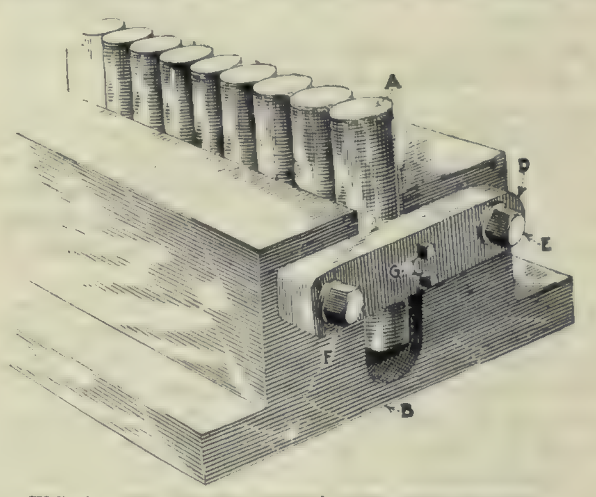


FIG. 2. JIG FOR "MAKING" THE ENDS ROUND

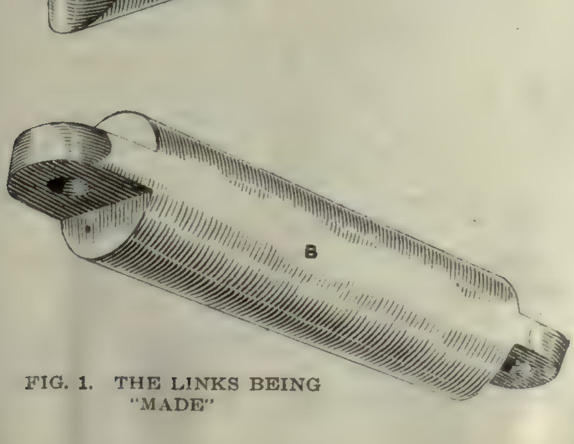


FIG. 1. THE LINKS BEING "MADE"

Fixtures Needed, Not Machines

So I went from job to job and looked things over and the more I looked the more I was convinced that the frame-milling job to which he had called my attention was a typical example of the way work was done in the shop. But the trouble was not with the machines so much as it was with the jigs and fixtures. The more I saw of the jigs and fixtures, the better satisfied I was that he had nothing to worry about, providing the firm would be willing to spend money on accesssories rather than tools. So I asked him the attitude of the firm toward the making of jigs and fixtures; to which he replied that he had a free hand so far as these were concerned, no matter what they cost, because no bills were rendered for them from outside concerns.

"Then," said I, "I don't see what you want with my sympathy. The trouble is not with the power of the machines; it is with the weakness and unhandiness of the fixtures. You tell me you are here to make a record; that you've got to live up to the record you made in the former shop as a producer, and that you can't see your way to do it because the machines, methods and men here are all antiques. Your viewpoint is wrong. You might have something to fuss about if all the machines, methods and men here were up to date and they had in actual operation one of those faultless systems which are found only in books on efficiency. But here with this outfit anything you do will be an improvement; you can't go wrong, a mistake is impossible."

I saw him again about a year later, he had made good and he gave me some credit for giving him the proper viewpoint. The trouble with him was that he was impressed with the size of the new concern. He had been accustomed to manufacturing and he thought the new shop was a manufacturing plant because they said so in their advertising matter. They were *makers* —not *manufacturers*. There are many such, producing many lines of machinery.

Recently, I was called into such a shop "to lower their manufacturing costs," as their letter stated. After looking over the plant and product, the treasurer, a very dignified ladylike old gentleman, who looked like one of the original Daughters of the Revolution, asked me very seriously if I thought it possible to lower their manufacturing costs; to which, I replied:

"No one can lower your manufacturing costs, you have no manufacturing costs; you are not manufacturing, you are merely making. But if you will permit some small changes and order some little jigs and fixtures to be made in the shop (that's what gets them, *made in the shop*), I believe in many instances your output can be doubled, without increasing the payroll."

As the firm is still somewhat sensitive because of what was said about their methods, only one item of their manufacture will be shown as an example of how easy it often is to lower costs of production by the use of suitable jigs.

In Fig. 1, at *A* and *B*, are shown a female and male link of a sort of link belt used in one of the machines made by this concern.

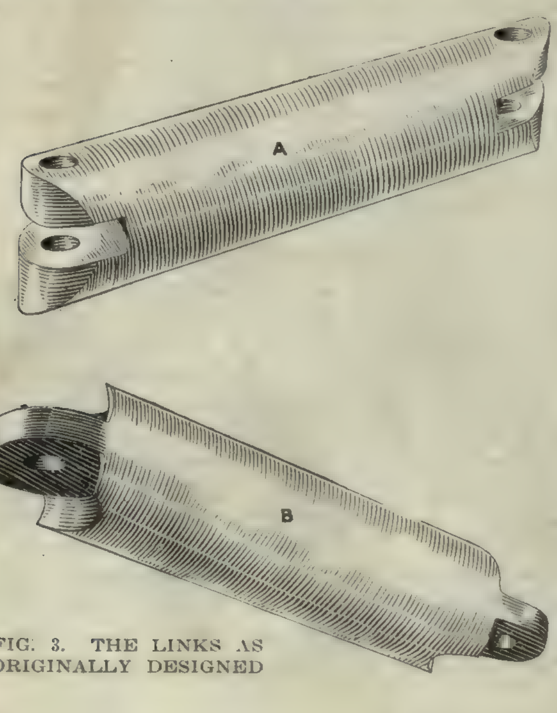


FIG. 3. THE LINKS AS ORIGINALLY DESIGNED

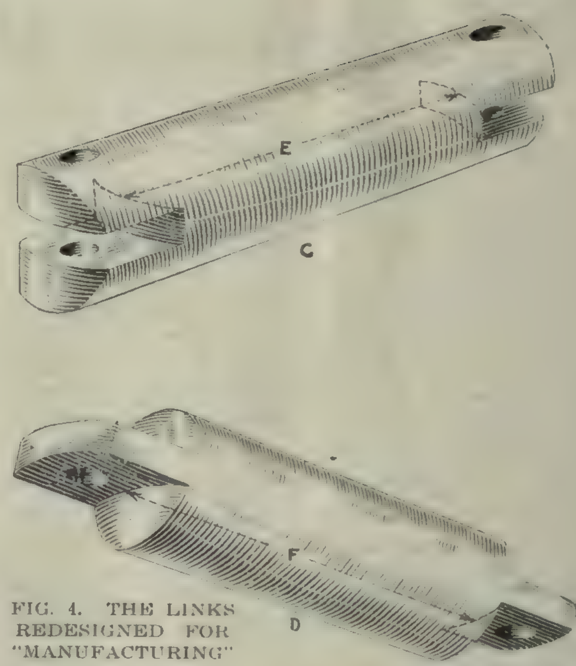


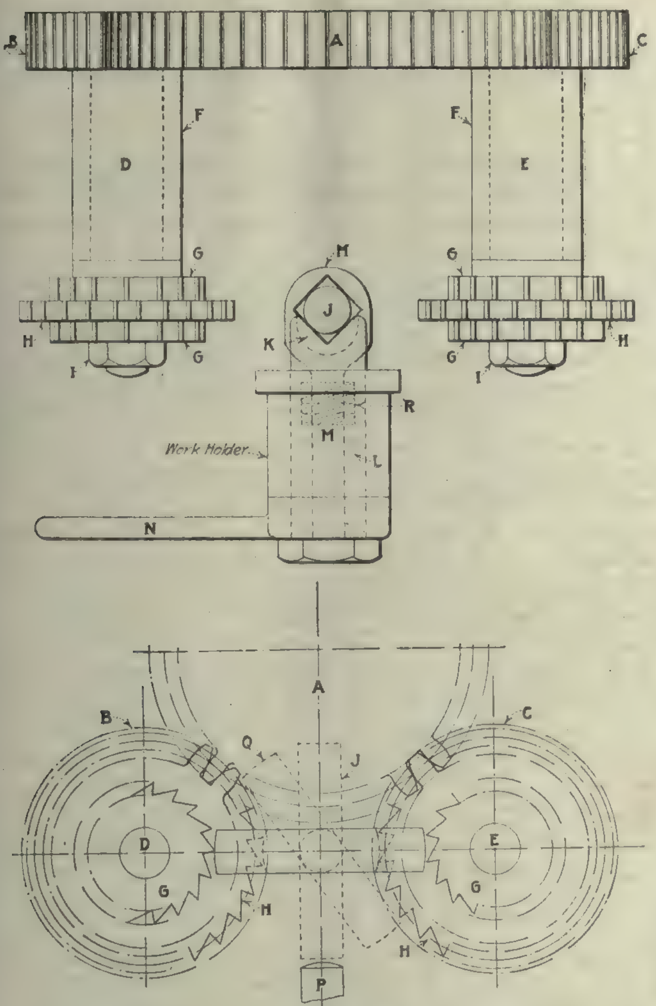
FIG. 4. THE LINKS REDESIGNED FOR "MANUFACTURING"

Sizing Up the Job

The stock is round cold-rolled steel ¾ in. in diameter. Over all, the links measure 3¾ in., and the center to center distance of the pin holes is 3 in. Many thousands of these links are required. Before suggesting a manufacturing method, I saw the link belt in operation and noted that the ¼-in. pins in the holes in the ends were required to carry all the load the links were called upon to carry; also that they were quite strong enough for this duty. I also noted that when in action the links were never inclined more than about 10 deg. from the contiguous links. I had previously watched the method of manufacture which was as follows:

A number of bars of stock were held in the vise of a cold sawing machine and cut to length. The next job was to mill the circular ends. For this the blanks *A* were held in a jig *B*, Fig. 2. The jig *B* is made of cast iron. A ¾-in. slot with a half-round bottom runs from end to end. One end of the slot is permanently closed by a plate fastened with capscrews. The other end is provided with a swinging plate *D*, which pivots on the capscrew *E* and has a slot at the other end for the capscrew *F*. Why the designer of this jig pivoted the plate *D*, I can not see, as the blanks are not put in from the end but from the top. Two setscrews *G* in the plate *D* serve to clamp the blanks when they are located. The jig holds 20 blanks. After a large number of blanks are rounded on one end, the work of rounding the other end begins, and so does trouble, for there is nothing nicer for the retention of chips than that deep ¾-in. slot with its rounded bottom. It only takes one little chip to raise one of the blanks enough to cause it to be spoiled. It is also almost impossible to tell whether the previously rounded end of the blank is seated properly in the rounded bottom of the slot.

The trouble with this fixture is that at first glance it looks like a real fixture and when the office man sees it he thinks the operator is milling 20 pieces every time the milling cutter traverses the full length of the vise. As a matter of fact, it is a rank deception, spoiling as much work as it produces. The work from it is



FIGS. 5 AND 6. ONE OF THE NEW "MANUFACTURING" MILLING FIXTURES

never perfect, the rounded ends are never aligned; and, as the rounded ends serve as locating surfaces for the subsequent operations of drilling the holes, slotting the ends of the female links and milling the tongues of the male links, the holes, slots and tongues are never in perfect alignment.

As the fixtures for milling the slots and tongues, and the drilling jigs for the holes, produced nearly as much scrap as they did passable work, there is nothing to learn from their construction, except what to avoid. They will, therefore, not be shown.

With a knowledge of the duty of the links and how they were made I went to the chief draftsman, who, by the way, was responsible for the design of the links.

From him I elicited the fact that *originally* he designed the joint of the links to take the *thrust* of the load, but, as the link chain is in *tension,* I could hardly see the use of a *thrust* joint. As first designed, they were like Fig. 3; that is to say, somewhat similar to the hinge joint of a "break down" revolver. He said that they had found it impossible to manufacture them in this form, so, as it was the most difficult to make, they changed the female link first to that shown in Fig. 1, at *A*. Then, because of the breakage of counterbores, they changed the male joint to that shown at *B*, Fig. 1. However, while it was of no specific use, they still retained the $\frac{3}{8}$-in. radius on the rounded ends.

With this information I sketched the links shown in Fig. 4, at *C* and *D*. In these links the over-all length and the center to center distance of the pin holes are the same as in the links shown in Fig. 1, but the lengths *E* and *F* are slightly shorter, for clearance, than similar dimensions in Fig. 1.

Balking at "Looks"

When the sketch was completed, it was shown to the chief draftsman for his approval. After fussing around for a couple of hours (during which, unknown to him, the sketches for the manufacturing fixtures were started), all he could find to say against it was: "It does not *look* as good as the original link." He stuck to this objection even after his attention was called to the sheet-steel guard which entirely obscures the link chain in the completed machine.

The new manufacturing fixtures were made as attachments to several old 14-in. lathes which had outlived their usefulness as lathes.

The milling and drilling fixtures were designed first, as the old method of cutting off the bars in the cold saw was for the time being quite good enough. Later on, however, the blanks were sheared off one at a time at the rate of 30 to 40 per minute, there being no objection to the slight change of form at the ends of the blanks due to this method of making them.

The milling fixture is shown in Figs. 5, 6 and 7. The gear *A* is fastened to a faceplate which is screwed on the spindle nose of the lathe. It engages with the two gears *B* and *C*, which are similar in size, and secured to the ends of the spindles *D* and *E*. These spindles run in bearings, mounted in the bracket *F*, secured to the lathe bed, and are so arranged that they can be adjusted to or from each other to compensate for change of size of the milling cutters due to wear and grinding.

By using gears with teeth of very coarse pitch and mounting the driven gears so far below the center of the driving gear considerable latitude of adjustment was obtained without complicating the fixture with universal joints, flexible shafts or other contraptions.

The other ends of the spindles *D* and *E* are provided with gangs of milling cutters *G* and *H* held by the nuts *I*.

The work *J* is seated in a V-block *K*, which is formed on the outer end of the work-holding spindle *L*. This spindle is hollow for the reception of the stem of the yoke *M*. The center of the V-block *K* is cut away for the yoke *M*. At the other end the work-holding spindle

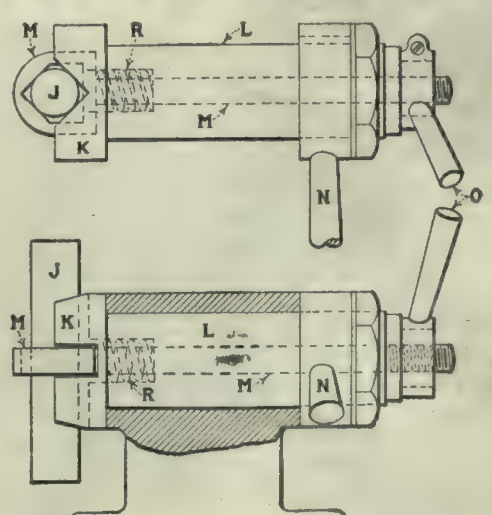


FIG. 7. DETAILS OF THE WORK HOLDER

L is provided with a handle *N*, and beyond the handle a D-washer and locknut are provided to take up wear and end movement.

The end of the work-holding spindle, Fig. 7, projects beyond the locknut sufficiently to afford a seat for the threaded clamping lever *O* which screws on the end of the yoke stem *M*.

In charging position the lever *N* rests on the front V of the lathe bed. A link blank from the cut-off saw is dropped down between the yoke *M* and the *V*-block *K* till it rests on the stop *P*. The yoke lever is now tightened, which draws the work *J* tight into the V-block *K*. It may be as well to mention a small detail of the work-clamping lever *O*, which saves a lot of time.

This lever consists of two parts—a plain cylindrical nut which fits into a cylindrical hole in the head of

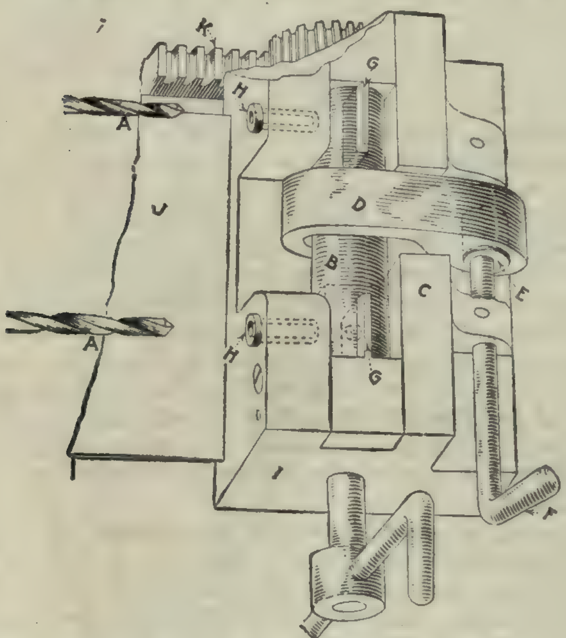


FIG. 8. ONE OF THE "MANUFACTURING" DRILLING JIGS

the lever. The head is split and provided with a clamping screw so that the cylindrical nut can be adjusted within it to clamp the work with the lever in any desired position. This feature was to provide a simple automatic release for the work after it had passed the cutters.

Duplicate Fixture

In the illustrations, Figs. 5, 6 and 7, I have shown the milling of the female links only, because the milling of the male links is done on a duplicate fixture, the only difference being in the substitution of a gang of cutters suitable for the male links.

When the work *J* is securely clamped by the lever *O*, the operator raises the handle *N*, and both ends of the link pass the gangs of cutters at the same time. When the work reaches the position shown at *Q*, the end of the clamping lever *O* comes in contact with a stop fixed to the back V of the lathe. Further movement of the lever *N* causes the stop to release the clamping lever *O* by unscrewing the threaded head from the yoke stem, and the spring *R* forces the yoke *M* into open position. This releases the work which slides by gravity out of the V and yoke and down a chute to a box on the floor. The lever *N* is now returned to starting position on the front V of the lathe and the V *K* is again ready to load with work.

In this way both ends of the link are milled simultaneously at the one setting. The stop *P* is in plain view of the operator before he places the work so that he can see if there are any chips or other obstructions. Small chips on the stop do not affect the quality or length of the work as there is an allowance of about $\frac{1}{16}$ in. at each end for milling, and the total length of the links is controlled by the distance which separates the gangs of cutters.

The Drilling Jig

The drilling jig for the female link is shown in Fig. 8. It also is mounted on a lathe. The drills *A*, Fig. 8, are driven by a geared head just the same as the one used for milling and shown in Figs. 5 and 6, with the exception that the centers are closer, and smaller gears are used; also there is no provision necessary for wear as with the milling cutters.

The work *B* seats in the V *C* and is drawn down securely by the hook clamp *D*, which is operated by the eccentric *E* and lever *F*. The slots in the ends of these links are a snug sliding fit over the hardened tool-steel guides *G*. The tops of these guides are made to a fairly sharp edge, so as to facilitate locating the work in the jig. Holes are provided in the guides, in line with the bushing holes *H*. The bottom of the part *I* has a slide formed on it to permit it to move to and fro on the base *J*, which is secured to the lathe bed. Movement of the sliding *I* and work is obtained by means of a rack *K*, secured to the base *J*, and a pinion and lever mounted in the sliding member *I*.

Some of the Other Components

Some of the other components were handled in new jigs and fixtures to greater advantage than were the links, while with others there was not so great a saving. All of the product was, however, improved and scrap due to faulty *methods* was eliminated.

The original operations on the links were: Cut off; mill round on one end; mill round on other end; slot one end; slot other end; drill one end; drill other end.

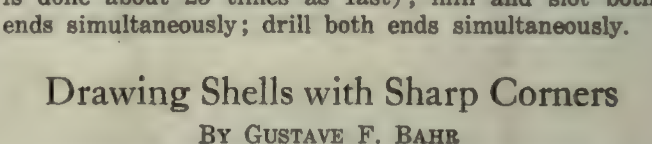
The new operations were: Cut off (in the shear this is done about 25 times as fast); mill and slot both ends simultaneously; drill both ends simultaneously.

Drawing Shells with Sharp Corners

By Gustave F. Bahr

The sketch shows a method of drawing metal shells to a sharp corner, which is quite difficult to do on some work, for the reason that there must be a good radius on the punch and die in order to keep the stock from breaking and have it draw properly.

In the first operation shown at *A*, the blank is drawn to the proper depth with a little extra crown which



DRAWING SHELLS WITH SHARP CORNERS

in the second operation is compressed back into the corner, making the latter sharp.

Care should be taken not to get too much metal in the crown, otherwise there will be too much strain on the tools and they will not stand up well. There should be just enough extra metal to fill out the corner.

US ARMY ORDNANCE NEWS

The Manufacture of Artillery Range Finders—IV

BY GEO. H. THOMAS

Previous articles which have been presented dealt with the theory and use, the tools and processes, and the indexing and engraving methods employed in the manufacture of range finders. This article, the last of the series, tells of the finishing and final inspection of the instruments.

(Part III was published Feb. 5, 1920.)

AFTER the proper association of aprts in the process of assemblies have been made, the parts are ready for the applying of the protective finish. It is important that field-artillery pieces should be finished with the idea of blending the piece into the surrounding landscape, and the color scheme should be in accordance with the latest practices of camouflage. Such is the case with the dull-bronze-finished French artillery pieces which are quite interesting in the distance while the American field pieces, with their soft gray-green finish, are lost to the eye at short range.

THE FRENCH PROCESS

The chemical bronzing process, as employed by M. Schneider et Cie, Paris, produces a soft dull finish by oxidation. The process makes use of the following solutions and the method of application as hereinafter described.

Solution No. 1:	
Bichloride of mercury	50 g.
Ammonium chloride	56 g.
Nitric acid at 36 deg. Baumé	16 c.c.
Alcohol at 90 deg	100 c.c.
Water to make 1 quart	
Solution No. 2:	
Perchloride of iron	60 g.
Sulphate of copper	20 g.
Nitric acid at 36 deg. Baumé	50 c.c.
Alcohol at 90 deg	30 c.c.
Water to make 1 quart	
Solution No. 3:	
Protochloride of iron	30 g.
Perchloride of iron	10 g.
Alcohol at 90 deg	15 c.c.
Nitric acid at 36 deg	10 c.c.
Water to make 1 quart	

The pieces are first scoured and cleaned to remove all trace of grease. After drying, they are given a brushed coat of solution No. 1 and placed on a mesh tray in a drying oven where they are left for 30 min. in a temperature of 140 deg. F. After cooling, they are placed in a sweating boiler for five min. at 112 deg. F. The sweating boiler consists of a galvanized-iron inclosure heated by vapor from a water bath located in the bottom of the boiler. After the sweating process, the parts are again placed in the drying oven until thoroughly dry. The pieces are next submerged in boiling water, after which they are dried and cleaned with steel wool and metal brushes.

The above sequence is repeated with two applications of solution No. 2 and one of solution No. 3. The last two coats, however, are dried at a temperature of 104 deg. F., instead of 140 deg. F. and horse-hair brushes side by side with the French method. The aprts are given a final rubbing with a polishing cloth.

After the last operation, the parts are immersed in a tank of boiling oil for 20 to 30 min. and left to cool in air for 10 hr. All excess oil is then removed and parts are given an application of light oil.

THE AMERICAN PROCESS

The American process of finishing range-finding apparatus is a comparatively simple matter when placed side by side with the French method. The parts are given two coats of olive green japan, baked at a temperature of 250 deg. F. for 4 hr., and a coat of varnish which is baked at 200 deg. F. for 4 hr. The baked varnish presents a peculiar frosted effect. Parts, on which are scales and dials, are finished so that the scale itself is

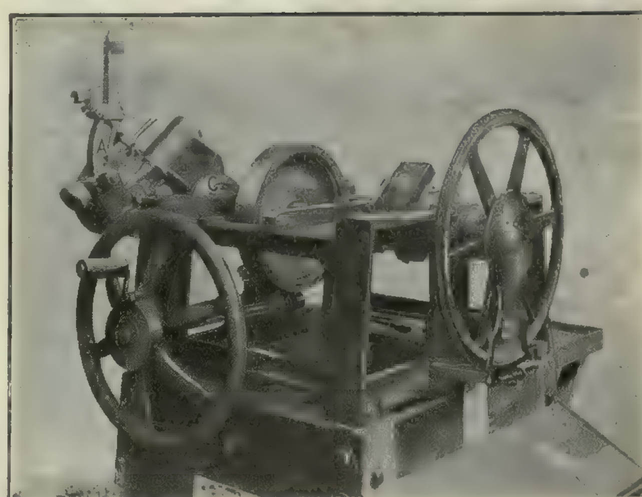


FIG. 36. FIXTURE FOR THE FINAL INSPECTION OF THE RANGE FINDER

rather dark while the graduations are filled in white. This contrast permits a rapid and correct reading of the instrument.

During the manufacture, the component parts of the apparatus undergo rigid process inspection and in spite of this, parts which are slightly defective find their way into the final assembly. Due to the extreme precision of the instrument, a final inspection is necessary to catch the accumulated errors of the final assembly and to determine if the instrument meets the specification requirements.

The inspection scheme follows the actual field use of the gun. The range finder *A*, shown in partial assembly, Fig. 36, is mounted on a false gun carriage which is designed to perform all the functions of the field-piece mechanism. The straight-edge *B* represents the gun barrel to which can be readily attached a gunner's standard quadrant. A gun-sight adapter is provided at *C* while at *D* is a circular vernier. Targets and points of evidence whose relative range values are known complete the testing equipment. The various elements of the gun sight are focussed on the target and the disposition of the piece for the distance made and a careful check is made of the readings of the range finder with those of vernier.

An agreement of the instrument with the vernier throughout the complete compass denotes a perfect instrument.

On Launching an Invention

By JAMES LESLIE LANE

This article contains a few words of encouragement for the man with a good thing and very little money to push it. Some timely advice as to the best way to get it on the market is included.

MANY a young mechanic with an invention that might be made the basis of a comfortable business fails to make use of his opportunity because of discouraging advice from friends, and a lack of confidence in himself. Usually this diffidence is due less to a lack of confidence in the article itself than in his ability to get it on the market successfully. However sure he may be of its merits, from a mechanical point of view, he is deterred from making the plunge through fear of the obstacles in his path.

Forgetting that whole-hearted enthusiasm is a young man's greatest asset in such a venture, well-meaning friends will seek to throw cold water on the project from the start. As a rule they are men who have neither the courage nor initiative to launch out for themselves and they see only the difficulties ahead of him. When he broaches the subject they will perhaps reluctantly admit that it looks all right, and then proceed to show him why it can't be done.

"In the first place," they will assure him, "the chances are that there is something exactly like it on the market already. Practically everything in the machinery field has been tried out and if such a device had any merit someone would have taken it up before." To their unimaginative minds, the fact that no such article is for sale is proof enough that it has no value, and that there is no call for it.

Overconfidence is a bad thing; yet it has done far less damage than the average man's inability to see promise in and to venture on the untried. If the young inventor is not already discouraged, they will point out that not once in a thousand times does the originator of a new product realize any money from it; that nowadays a lot of capital is required to introduce even the simplest of specialties. In the first place he must have a commercial model built—always an expensive proposition. This will eat up his savings for several months and then, should it still look promising, his real troubles are not yet begun.

Patents must next be taken out, covering the thing fully. And, once obtained, one can't be sure they will amount to much. . . . Patent lawyers are a bad lot. They are always leaving loopholes, and anyway it's money that counts. If it happens to be a success and someone wants to infringe on it he will do so regardless of patents. A poor inventor, having spent what little money he possesses on it, cannot hope to fight the case successfully.

Then, lest some spark of his enthusiasm still linger, he is reminded that an inventor is seldom a good business man; that bankers are chary of lending money except where the venture is already established and its potential earning power proved.

By the time all these possible calamities have been enumerated, the mechanic generally feels that he has been living in a fool's paradise. If he is the kind that is easily discouraged he abandons the idea for good and goes back to his bench, satisfied that it is where he belongs.

However true many of these contentions may be there is no need of his being discouraged. That they are not fatal obstacles is easily seen if he will but look about him. In any city of medium size there are dozens, perhaps hundreds, of small businesses that in the beginning started in the same way he had planned. Obstacles are either great or small, depending on the mental caliber of the man meeting them. Things that may seem mountains to one are but ant hills to another who has sufficient energy and determination.

Having first convinced himself that the article has real merit and that the demand for it already exists or can be created, the inventor would do well to turn his back on the pessimistic ones and trust to himself.

In the first place the question of a commercial model should not deter him. Like a car it may be as cheap or expensive as his pocket will allow, and it need not be completed all at once. If the idea is a good one, it will not spoil overnight but can be made piece-meal

as his wages permit. Remembering that the thing is not yet ready for manufacture in quantities, he need not go to an engineer and have a complete set of working drawings made. They would only have to be redrawn later, as new ideas came, and would be a useless expenditure at this stage. All that is necessary at first are rough pencil sketches of the parts required, and these can be filed away as the work progresses, together with notes for the guidance of the draftsman later on.

If he has a bench at home, and a few tools, he can save a considerable amount by doing some of this work himself. Parts that require lathe work can be bought outside, as well as the standard screws and gears. The patterns he can make himself, getting the castings direct from a foundry and saving the profit a machine shop would ask for doing this for him. Where only one piece of a kind is wanted, he can do the necessary facing with a file, afterward marking off, drilling and tapping the various holes with a breast drill and tap. It may not be quite as easy but the saving will be considerable.

For the sake of a finished appearance, he should go over all metal surfaces with a wire brush, afterward applying a coat or two of black enamel. Piece after piece can be worked up in this way during his spare hours, and finally when all are completed he can assemble them himself. This not only saves money but gives him many little ideas in construction that he would not get if he ordered it direct from a model maker.

Tests are next in order and, should they come up to his expectations, he is now ready to take up the question of patents. If his capital is low it would be well to put the machine aside for a time until he can accumulate some, rather than to see how cheaply he can secure these. A patent is good or worthless, depending almost entirely on how much thought is expended upon it. It is far better in the end to wait until he can afford a good attorney, who has had plenty of experience and who will get for him not merely a patent but protection. If he has never had any work of this sort done, it would be well to go to someone who has and ask them to recommend a good man. Nine times out of ten they will not only do this gladly but will give him many little pointers on what it will be apt to cost, how to proceed, and what to expect in a patent.

Possibly it may be more than he had planned and he may be tempted to seek financial aid at this point, but it should not be done if he can avoid it. As yet he has nothing that is definitely his, nothing that he can bargain with, and it is better to wait. The man whose aid he happened to enlist now would not only have to gamble on the commercial value of the idea but on the possibility of not being able to obtain patents at all, and he would expect too much.

Once the patents have been obtained he need no longer worry lest some unscrupulous person seek to appropriate the idea when he tries to interest him. It belongs to him, and is a tangible asset like capital or a piece of property. No one can use it unless he chooses to give it away. It is the thing he will put into the company alongside the financiers money—just as material a thing, and just as capable of earning dividends. Most inventors who lose out do so through seeking to interest others in an idea before it is really their own, when it is still in a formative stage and anyone's property who wishes to claim it.

With these two stages of the work successfully behind him, he is now ready to seek capital for its exploitation. Nor is this as difficult a matter as is commonly supposed. Two courses are open to him; either to consult a banker and induce him to put up the money outright, or to seek a partner. The latter is preferable for several reasons.

To begin with every business may be divided into several branches; buying, manufacturing, advertising and selling. Each of these functions is equally important and the man who can perform all of them is a rarity. A mechanic is generally fitted for buying and manufacturing, but knows little or nothing about advertising or selling the product when finished. Here a partner with such a training comes in handy. Each supplies the quality lacking in the other and together they make a well-rounded and balanced combination. This is one reason why partnerships are, as a rule, so successful.

Even were he capable of handling all these different branches he would not find the time. A part of the work would have to be delegated to someone and it is better to let a partner, who has as much at stake as one's self, assume charge of it.

Contrary to general belief there are plenty of such men. In every city there are thousands of young chaps, industrious and equipped with a good business education, who are just as eager to get in touch with an inventor as he is with them. Constant contact with affairs has shown them how, if the right opportunity offered, the few hundred dollars they have saved might be made the basis of a good business. They possess the training, the ability to advertise and to sell; but without the proper opening, they are as incapable of making use of it as is the inventor with his own product.

The necessary thing is to get into touch with such an individual, and almost any man of middle age who is in business for himself has under him one or more such men whom he would gladly recommend. If the inventor has the right thing, and a little initiative, the matter of finding capital is not difficult. Money is looking for opportunity just as earnestly as he is.

Having secured its aid the inventor is now ready, or rather he and his partner are ready, to begin actual operations. If they happen to be located in a large city so much the better. It enables them to try out the field without any great initial outlay for advertising.

Starting Operations

The preliminary step is to take the original sketches of the product to an engineer and have a complete set of working drawings made, working in such new ideas and changes as may have suggested themselves at the time of building the first model. When these are ready, a half dozen sets of blueprints should be run off and sent to various shops with a request that they quote a price at which they would contract to furnish the article in lots of one hundred or more at a time.

In the course of a week or two these bids should be received. Assuming that the shops quoted on the expectation of making a 20 per cent. profit and taking the average of all the bids, it is fair to assume that with a factory of their own they could produce it at 80 per cent. of this tentative price. Now by adding on the estimated cost of selling (advertising and sales commissions) and the profit they have fixed for them-

selves, they should know with fair accuracy what the article can be offered to the public for, after it has been placed on a going basis a year or so hence.

An order for 100 or more should now be placed with the firm making the lowest bid, and a short descriptive pamphlet with a cut of the machine, a list of its salient advantages, prices for different sizes, etc., should be ordered from the printer. The thing is now out of the inventor's hands for the present.

If the partner possesses a knack of selling he should be the one to go out and try to interest the public. If not, the aid of a salesman should be enlisted. There is no need of engaging one outright at the outset, there being plenty of time for that later, when the business warrants. Someone who handles a product of a similar nature and who could carry it as a side line is sufficient at first. What is wanted is merely to test out the field—to see what the demand for it is likely to be.

This is apt to prove the most trying stage of all—a period of suspense. It may be months before orders come in fast enough to warrant any further financial outlay, and during this time the partner who has chosen the business end should cover the field with his salesman as often as possible. Selling may not be to his taste but he will meet the trade and pick up many little hints that will help him later on.

A few months at most, in normal times, should tell the story. Either the product is a failure or it meets with increasing sales and shows promise.

If the latter proves the case it is now time to take up the question of its manufacture. This should be gone into gradually, for spending too much money on a shop and machinery is apt to reduce the working capital to a dangerous degree. Sales do not always hold up, collection difficulties may be encountered, and if a surplus is not on hand to meet unforeseen emergencies the new venture is liable to go on the rocks before it is well started.

The best plan is to rent a floor in some building that is equipped with power, benches, etc., and to begin by buying the various parts outside and assembling them here. This gives time to build up an organization and to establish a headquarters. Once this has been done the rest is a matter of natural growth.

Through it all the one vital factor, never to be lost sight of, is that enthusiasm and willingness to attempt things will carry one past obstacles and pitfalls that a pessimistic individual would never even attempt.

A Match Plate for Small Pulleys

By Elmer W. Leach

The nature of our product necessitates the making and keeping in stock of several sizes of tight and loose pulleys, ranging in diameter from 2 to 11 in. Recently, when we decided that we had at last standardized our pulleys we felt it was time to have all the patterns made up in some permanent form.

Our first thought was to have aluminum match plates made. With this in view we consulted with a firm that could do this work, but its estimate was so prohibitive that we at once gave up the idea.

Our patternmaker then came forward with a wooden match plate idea. Its good points were so evident that we turned the job over to him for execution.

Fig. 1 illustrates a cross-section of one of our finished pulleys. In Fig. 2 is pictured a cross-section of part of a pattern board, showing in detail how the pattern for this pulley is made and mounted.

The pulley pattern is turned out in one piece, making customary allowances for machined surfaces. To the width of the pulley face is added a width equal to the thickness of the pattern board (in our work this is always 1 in.). On this 1-in. part no taper is turned. The wood around each hub is then cut away to the proper outline, just as though the face of the pattern


Fig. 1

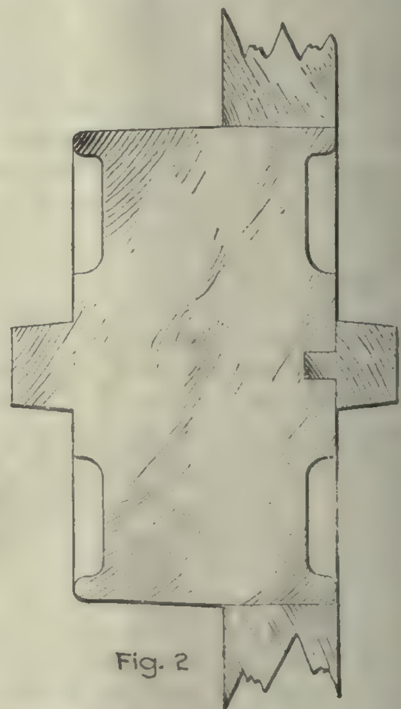


Fig. 2

FIGS. 1 AND 2. CROSS-SECTION OF PULLEY SHOWING PATTERN AND MATCH-BOARD

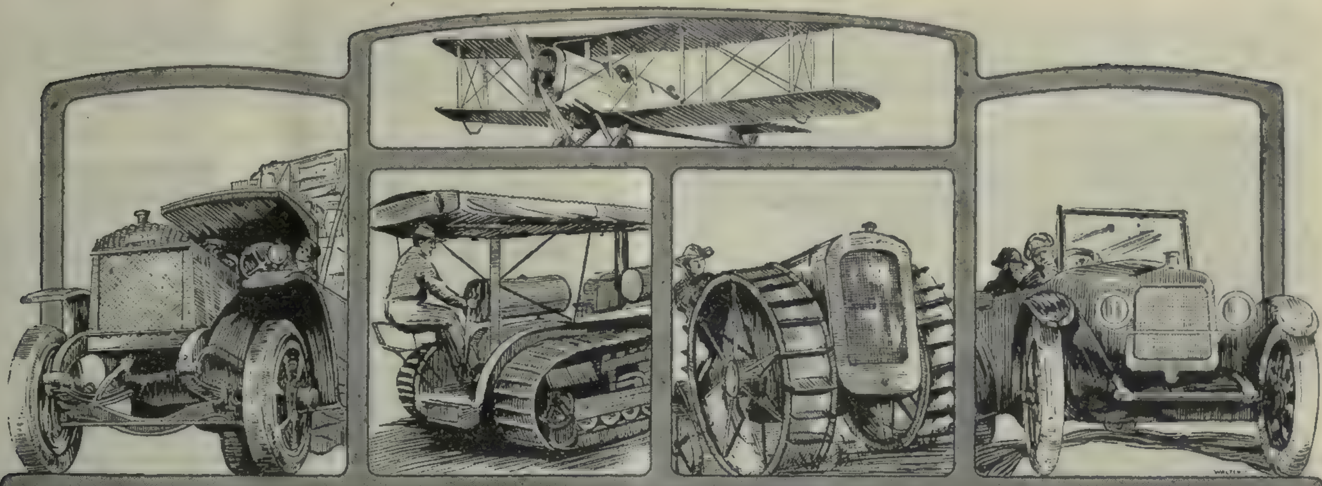
were not 1 in. wider than the actual casting is intended to be.

We have been able to mount from two to ten such patterns on each board. In the board, and through its entire thickness, are bored holes of the same diameter as the outside diameter of the pattern. The patterns are then sunk and fastened into these holes so that the extra 1 in. of the pattern just fills the hole in the board.

When the pattern is mounted in this way, the mold is made practically in the drag. This means less time for making the mold, fewer chances of spoiling the mold (for there is really but one draw) and better assurance that the casting will be free from flaws. Where the mold is wholly in the drag the iron flows naturally and freely down, and one need not fear that it has not gone into all parts of the mold.

By the method I have described, one is assured of a perfect match. The usual way to handle the mounting problem is to make the pattern in two symmetrical halves and mount them on opposite sides of the board. Even if the patternmaker can do this very accurately, his work may be spoiled when it gets into the foundry, for I have seen patterns that had not received any too gentle treatment on the molding floor. But with the method I have explained, there is no chance of producing castings with that small rib around them where the two halves of the mold joined.

Of course, the face of a pulley is usually machined, so the point about the perfect match is not so important in that case. But this method is applicable to any pieces that are circular in outline.



AUTOMOTIVE CONSTRUCTION

Building a Small Track-Laying Tractor

By FRED H. COLVIN
Editor *American Machinist*

The coming of the tractor has brought new machine-shop problems. Solutions naturally depend upon the shop equipment and the quantity to be manufactured. This article shows some of the methods used in building the "Cletrac" tractor, these being particularly interesting on account of the attention which has been given to convenience in handling the various parts.

THE growing demand for small tractors, for industrial plants as well as for agricultural purposes, has reached the point where manufacturing methods are a necessity if the desired output is to be secured.

These illustrations and practices are from the shop of the Cleveland Tractor Co., East Cleveland, Ohio, and it is interesting to note that the personnel includes a number from the automobile industry. The illustrations include drilling, milling and grinding operations, together with special fixtures which should be of service in affording useful suggestions to others in a similar line.

Fig. 1 shows the fixture for drilling the bearing holes in the pads or treads, which go to make up the moving track on each side of the machine. The body of the fixture is a spool, the central portion being cut away to enable the ears on the treads to assume their proper position under the bushings which guide the drills. The clamps are quick acting, swinging from the lower bolt and hooking over the stud at the top. The screw in the center forces the pad into its proper position and at the same time effectually locks the arm against swinging.

Drilling Transmission Housing

A more complicated drilling fixture is shown in Fig. 2, this being for the transmission housing, which will be seen in more detail in a later illustration. For convenience in handling, the base of the multiple-spindle drilling machine has been built up by the two deep beams of I-section. The guide or bushing plate has been

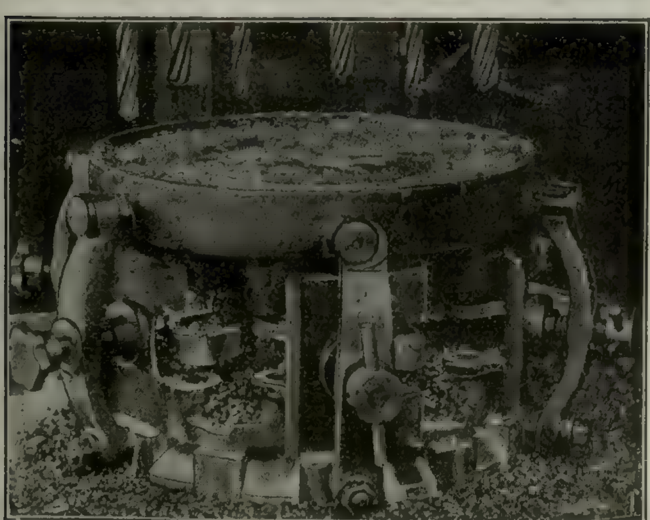


FIG. 1. DRILLING JOINT HOLES IN TRACK PAD

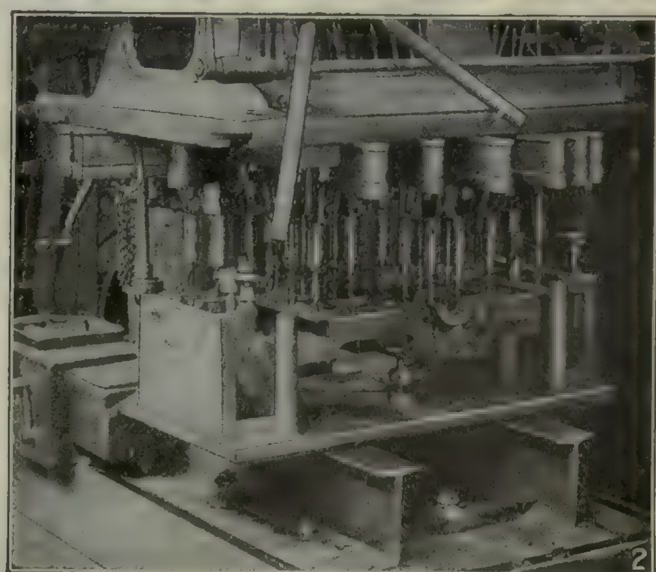


FIG. 2. DRILLING TRANSMISSION HOUSING

AUTOMOTIVE CONSTRUCTION

FIG. 3. DOUBLE MILLING SHAFT ENDS

removed in order to show the drills at work; this plate is located by the cone-pointed studs and held in position by the clamping screw shown.

A somewhat unusual milling fixture is shown in Fig. 3, this being for milling both ends of a transmission shaft at the same time. Two milling cutters are used, properly spaced for the work in hand, and the shafts are held in pairs as shown. The clamping block at the top is pulled down by the bolts shown beneath, which effectually wedge them into the V-slot in the body of the fixture. This gives a practically continuous milling operation, as the shafts can be removed as fast as milled, and their places filled by new work. When the table has reached the end of its travel it is reversed and the process repeated.

The Transmission Case Surfaced on Grinding Machine

The transmission case which is shown in Fig. 2 is surfaced on the large face grinding machine shown in Fig. 4. The piece is held in the special angle plate shown, which makes it an easy matter for the large ring grinding wheel to give the necessary finish to the facing surfaces with a minimum of handling.

Some idea of the kind of driving sprocket used in machines of this kind can be had from Fig. 5, which shows the sprocket mounted in the chuck of a large Gisholt lathe. The internal drive gear has already been fastened in position inside the sprocket, which must now be turned true on the outside, and the hole bored concentric with the steel ring gear. This requires careful setting to insure accuracy in the concentricity of the gear and the sprocket.

Then the sprocket is inspected and moved down a conveyor to the assembling department.

Turntable for Assembling

One of the convenient assembling fixtures is shown in Fig. 6. This fixture is a turntable on which the transmission housing is mounted, while the various bearing caps are assembled. It will be noted that the housing

FIG. 4. SURFACE GRINDING A HOUSING

itself rests on a sort of elevated runway with angular sides. These are a convenience in handling and also allow the housing to be set at the angle shown, in order to make it more convenient for the man to put the bearing caps in place. This, of course, depends considerably on the height of the man. After the caps are all in place (and it will be noted that a substantial shim has been placed between each of the four upper caps and the housing itself), the table is turned so that the inside rails match the rails at the right, and the housing is

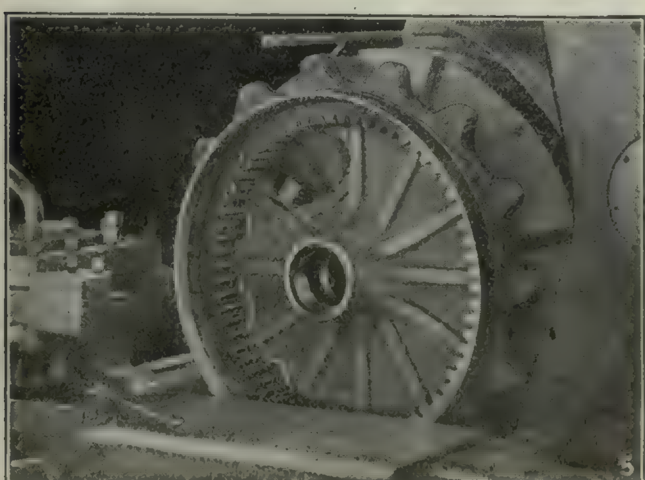


FIG. 5. MACHINING DRIVING SPROCKET

FIG. 6. TURNTABLE ASSEMBLY STAND

AUTOMOTIVE CONSTRUCTION

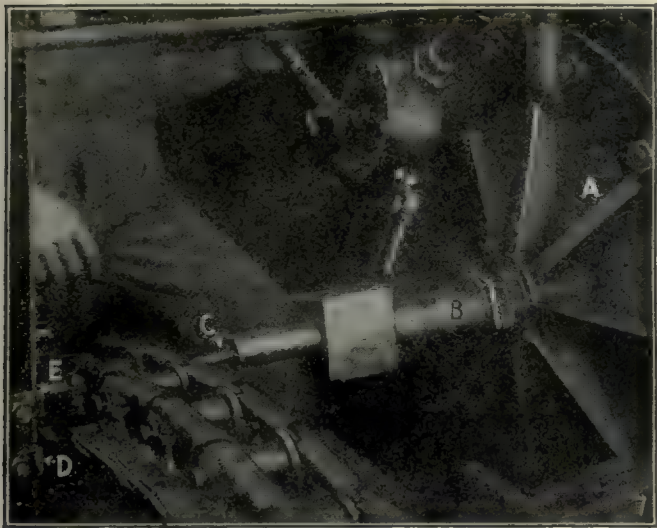


FIG. 7. FORCING PINS IN TRACK BEARINGS

speedily slid from the turntable and down the long rail shown. Both the rails and the turntable are protected with angle iron as shown.

The assembling of the 39 treads which go to make up the complete track is done in an interesting homemade machine shown in Fig. 7. These pins bear in the outside gears while the pads work on the central portion. The assembling is done by a compressed-air cylinder shown at *A*, which, when air is admitted behind the piston, forces out the ram *B* and forces the pin *C* into position in the pad. It will be noted that the pin *C* carries a cross-pin or key by which it is pushed in and which also prevents it being pushed too far. Both ends of the bearing pin are drilled for keys, this being shown in the pins which have already been pushed into place.

Air Is Admitted and Exhausted by a Valve

The treads are moved along the support *D*, while the stop *E* acts as an anvil against the pressure of the air-operated ram. Air is admitted and exhausted by a suitable valve under instant control of the operator. This enables the whole track to be very readily assembled, ready to be placed in position on the tractor and have the final or connecting-pin put into place.

Another subassembly is shown in Fig. 8. These are side frames which carry the idler sprocket as well as the supporting pulleys. The assembling stands are so located with regard to the assembling aisle of the complete tractor that it is an easy matter to slide the completed sides down the inclined rail shown, which places them practically in their proper position for assembly on the completed machine.

Progressive Assembly

In the meantime the transmission is being assembled down the line as shown in Fig. 9. This shows the housing which was being drilled and partly assembled in the previous view, nearly ready for the completed machine. An interesting feature of this transmission is the fact that the steering is done by means of planetary gearing. The two brake bands shown enable the driver to run on either track, fast or slow, and in this way turn the tractor practically in any radius desired. It is a very compact transmission and is shown in place on the chassis in Fig. 10. As will be seen, it is bolted to the end of the side frame, the drawbar with the two clevises being attached to the side frame so as not to impose any strain on the transmission elements. The wheel shown enables the operator to tighten either of the brake bands used for steering; the more he moves the wheel in one direction the shorter the tractor will turn, as in any type of motor-driven vehicle.

The assembling line is shown in Fig. 11, the different

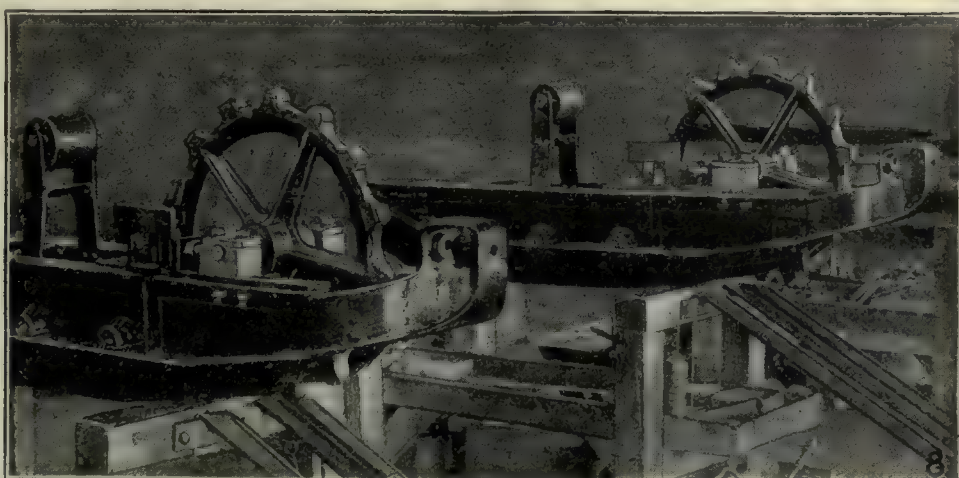


FIG. 8. ASSEMBLING TRACK FRAMES

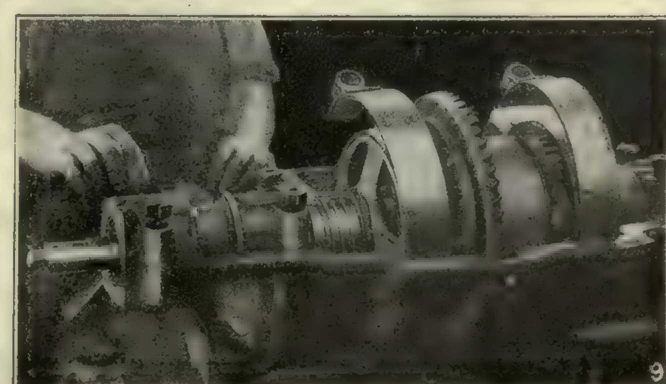


FIG. 9. THE REAR-AXLE TRANSMISSION

AUTOMOTIVE CONSTRUCTION

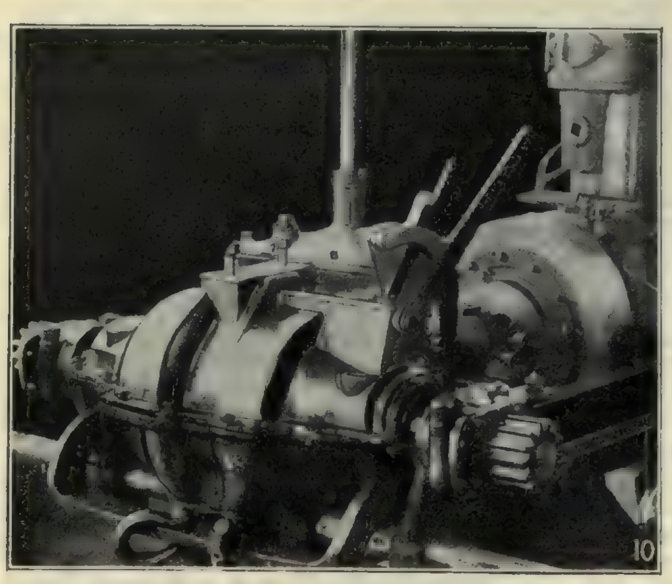


FIG. 10. CHASSIS ASSEMBLY

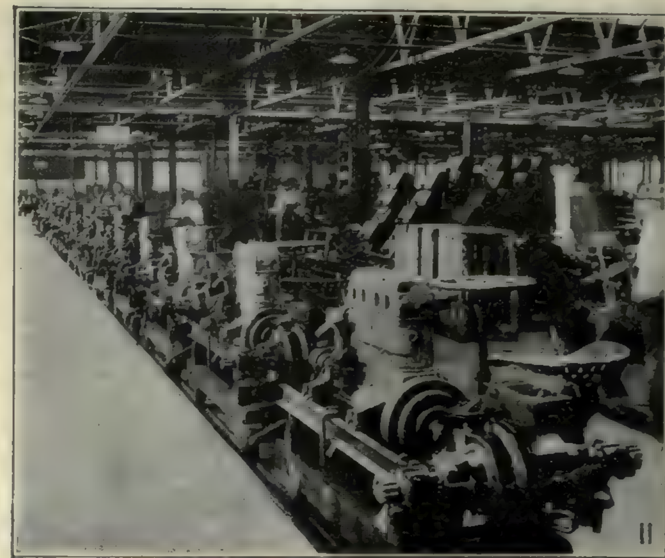


FIG. 11. THE FINAL ASSEMBLY FLOOR

subassemblies coming in from the side at the proper place. When the assemblies shown reach the farther end of the assembling track, the sprockets and the pads of the tracks are put in place. When this is done and the assembling completed, the tractor is driven up an incline each side of the assembling track, raising it completely off the assembling truck shown, and leaving the truck free to be carried back to the other end of the track. The tractor then goes off under its own power, for test or shipment, as the case may be.

Saving in Direct Routing of Work

By H. H. EDGE

General Works Manager, the Locomobile Co. of America, Bridgeport, Conn.

THE importance of direct routing becomes more evident as production increases in quantity, as it not only saves the actual cost of transportation but has its effect on the rapidity with which work moves through the shop, the congestion of the aisles or passageways, and the final output per man. Even the cost of the shop floors must be considered, as there have been cases where excessive trucking from one department to another required constant repairs to the floors in the aisles between the departments.

The lost motion due to indirect routing is shown by the broken lines in the accompanying diagrams while the direct lines show what has been accomplished by rearranging machinery in the sequence of operations, by having the inspection in each department as shown by the "x's" between the circles denoting operations. The general inspection room for parts in process has been abandoned.

These diagrams show what has been accomplished in the plant of the Locomobile Co. of America at Bridgeport and are well worth careful study. Fig. 1 shows the changes which have been made in the machining of motor-car engine cylinders. The circles indicate machine operations; the "x's," inspection operations; the broken lines show the former method, and the solid lines the way in which the work now passes through the manufacturing departments. The column at the left shows the old sequence of operations and includes the central inspection department which necessitated considerable movement of the material, although in some cases it was directly between the two operations.

Reducing Forty Movements to Two

Following the old method it will be seen that the cylinders were moved from the sandblasting department to the inspection room and back to the milling-machine department. Then they were moved to inspection, down to the drilling, back to inspection, to the drilling department and back through inspection to be bored. From here they went to inspection once more, then up to the milling department, back to inspection, and the long jump to the assembling department to be water tested. In this way the whole movement of the cylinder castings can be readily seen and the number of ton-miles moved per month or per year reached an astonishing figure.

By the former method there were 40 transfers from department to department, while by the new routing there are only two, the first from the foundry to the machine shop and the second from the machine department to the assembling floor. The machines are now arranged in the sequence of their operations and require no trucking in order to move them from one to the other.

The machining of the crank case also has two transfers by the new method as against 49 before the change was made. This is shown in Fig. 2.

AUTOMOTIVE CONSTRUCTION

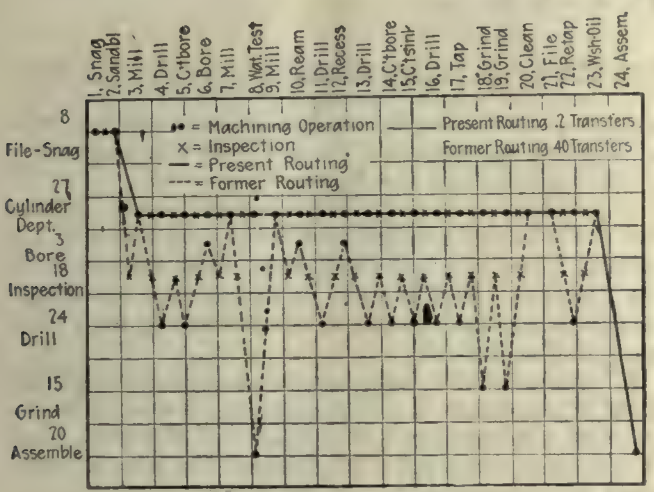


FIG. 1. OPERATION AND ROUTING INSTRUCTIONS FOR CYLINDER

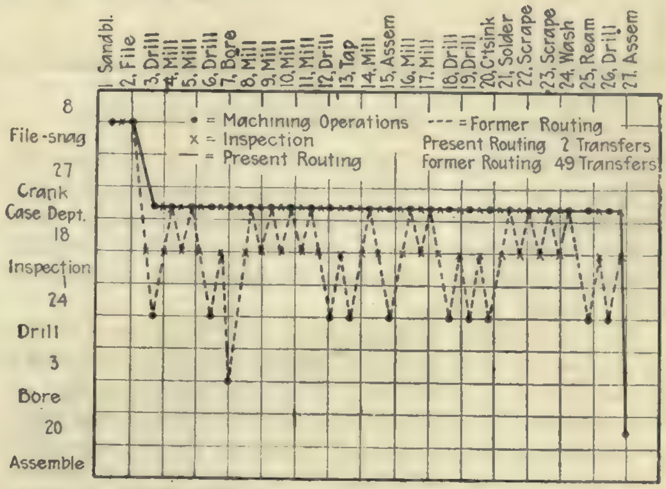


FIG. 2. OPERATION AND ROUTING INSTRUCTIONS FOR CRANK CASE

In handling the crankshaft, Fig. 3 shows four transfers, two of these being necessary on account of the special balancing operation. In order to secure the best results in balancing it is necessary to have the balancing machine in the basement in order to obtain proper rigidity in the foundation, this accounting for the transfer just before the last operation and inspection. As the former method required 56 transfers there remains a clear gain of 52 movements of the crankshaft.

The connecting-rod diagram shown in Fig. 4 indicates that, up to the present, it has not been found practicable to reduce the number of transfers below eight, as against 44 before the change was made. Four of these transfers are required for the forging and heat-treating operations. It will be noted that operation 26 calls for assembling, which means the crank-pin bushing is put in place. This is done in department 20, after which the rod goes back to department 24 for final broaching, operation 27. By placing a broaching machine in the assembling room, the necessity of sending the work back to department 24 would be eliminated.

In addition to saving the cost of handling work in process, this routing of machines for completely machining the most important parts also places the responsibility for production upon one or two department heads instead of dividing it among a great number.

It has been found that the work is much less liable to be delayed where the machining of important parts is segregated, as it is difficult to so schedule work that production will run regularly when various kinds of machines are grouped by kinds, in special departments. One of the main difficulties here is that at certain periods work is liable to accumulate in larger quantities than can be taken care of, and this causes slack periods in other departments where the work does not arrive when it could be worked on to the best advantage.

A careful study of these diagrams can hardly fail to suggest ways in which more direct routing can be applied to various kinds of work in any shop. If in addition to diagrams of this kind a computation can be made as to the number of feet the work is moved, together with the weight of material transferred from one department to another, the advantages of re-arranging machinery to avoid this will become more apparent. This is, perhaps, one of the places where a careful study and comparatively small expenditure may show greater savings in production costs than in almost any other.

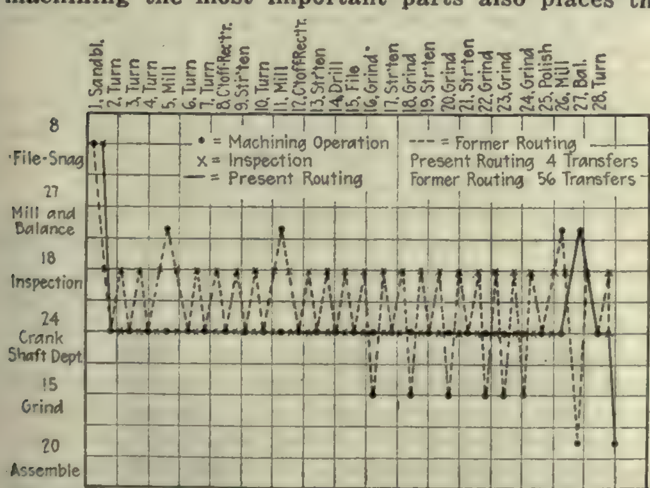


FIG. 3. OPERATION AND ROUTING INSTRUCTIONS FOR CRANKSHAFT

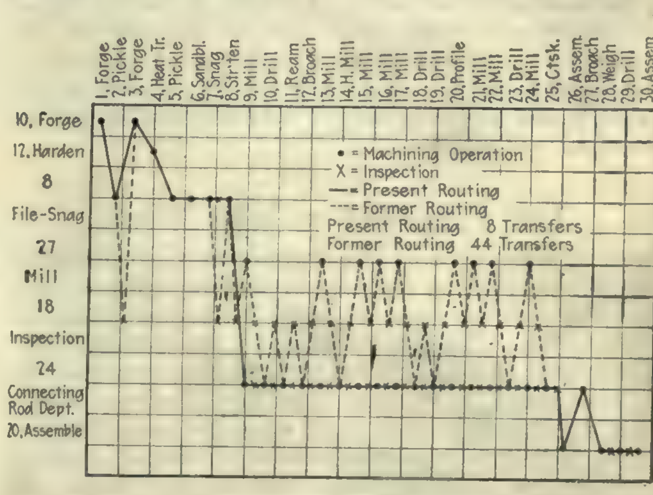


FIG. 4. OPERATION AND ROUTING FOR CONNECTING-ROD

EDITORIALS

Continue the Air Mail Service

ALL WILL agree that real economy in the expenditure of public funds is much to be desired. But the old saying of "penny wise and pound foolish" must not be overlooked and the real development of practical projects must not be made the plaything of political partisanship.

There seems to be little doubt that airplane and airship development depend largely upon governmental encouragement. The Post Office has developed the air mail service to a point where it has become a real institution and is one of the few practical peace-time applications which is rendering a real service to the country. This service has become remarkably reliable and, it is claimed, carries letters almost as cheaply as by rail. While the New York-Washington service does not save very much time, it made excellent training for the longer routes on which time is being saved. The New York-Chicago air mail route, however, saves nearly a day on letters and has become very reliable.

The air mail will do much to encourage the increased use of the airplane along commercial lines. Without it, the development will lag as it did before the war. Every large foreign country, in spite of the huge war debts which confront it, is backing the air service as much as necessary for its development to commercial proportions. Can the United States, the home of the airplane, afford to let its aircraft industry creep along behind all the rest of the world?

No appropriation has been made for a continuance of an air mail service by the Post Office Department, these items having been stricken out of the budget. If this stands, the air mail service ends on June 30, 1920, and the United States becomes the only large country without regular air mail routes.

There were men in Congress who opposed the use of railroads for carrying the mail, demanding that the stage coach and the post rider be continued. The same kind of men are opposing the use of airplanes in mail service. Whether we like the Burleson administration of the mail service or not—and few of us do—we should hold to every advance made and not drop behind the procession. Partisan politics should have no part in determining matters of such grave importance to the industry and to the country. The air mail should be continued and developed.

The Engineer in War Work

THE part played by the engineer in the winning of the war is being resented by certain critics of both the army and the navy of Great Britain, according to *Engineering*. Unusual creations of the engineer such as the tank, the depth mine and the like, were so new, so unorthodox in warfare, that the old-school officers could hardly comprehend their operation or utility.

The necessity for new devices to counteract the lack of shells and of guns forced, for the time being, the relaxation of "the traditional and seemingly inherent opposition of the lawyer and official mind and the work of repelling the menace of the Germans was transferred to the engineer and the factory."

Ours was a somewhat similar experience although the two years which preceded our entry into the war had perhaps paved the way for a more ready acceptance of the engineer. But in spite of this it was not always easy to secure the co-operation which would have made the task less difficult.

We are extremely fortunate, however, in having those high in command of ordnance matters who know the value of the engineer. Major General Williams, Chief of Ordnance, thoroughly appreciates the need of engineers in the development and production of all that goes to make up offensive or defensive armament and is heartily in favor of maintaining contact with the engineering profession through the American Ordnance Association or other channels.

The Navy too appreciates the engineer more than ever and knows how to secure co-operation in most cases. It seems as though we had profited by the mistakes of others in this respect, although it may only be that we have happened to put the right kind of broad-gaged men into the places of authority.

The Question of Fuel

FUEL is the backbone of practically all manufacturing industries and it follows that anything which affects either the price or the prompt supply of fuel is of vital interest to every executive who is responsible for production. This, according to the coal operators, makes the railroad problem of much broader interest than the mere question of shipping their own products. For it is their contention that even if they stored the coal at the mines the railroads lack the capacity to haul it during the seasons when it is most needed.

The problem seems to resolve itself into either greatly increasing the capacity of the coal-carrying railroads, or of storing coal at the industrial centers, the latter apparently being the more feasible.

Why is it not perfectly practicable for the manufacturers in given districts to co-operate in buying such coal as can be stored safely, and having it delivered for storage in the summer months? Storage space can be found in the outskirts of nearly all large cities. But this is such a matter of public welfare that vacant land might even be condemned for such a purpose.

The large motor truck solves the problem of delivery from this local storage yard to any manufacturer and makes it possible to get coal as wanted without congesting the railroads in the least. There are storage yards at present, but these are small affairs for the most part, and handle only domestic coal. Large storage yards might be established by large dealers, but as they have failed to grasp the opportunity, the way lies open for local associations of manufacturers to do a real service not only to their members, but to the community and the coal industry as a whole, which plays such an important part in our welfare.


AMERICAN
MANUFACTURING
INDUSTRY
DOMESTIC
NEEDS
FOREIGN
TRADE


COMPULSORY
WORLD TRADE CLUB
OF
SAN FRANCISCO
METRIC SYSTEM
TRANSPORTATION
TROUBLES
WAR WORK READJUSTMENTS
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LABOR TROUBLES
AMERICAN MACHINIST
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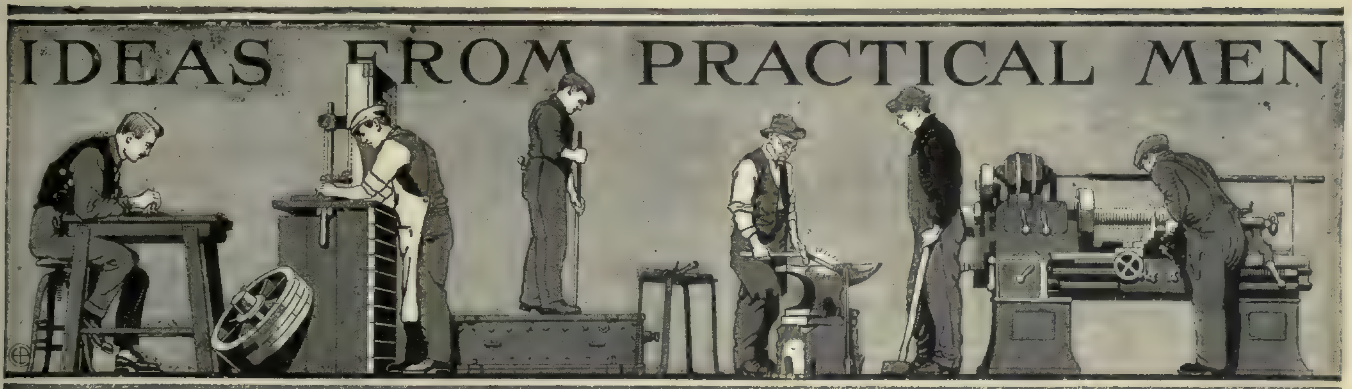
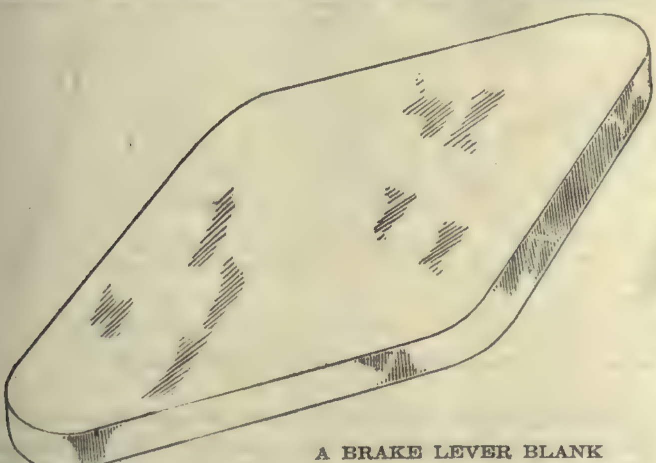


Punches and Dies of Chilled Iron

BY JOHN S. WATTS

For punching or shearing hot steel, chilled-iron castings will make durable cutting tools at a small fraction of the cost of tool steel. The hardness is not affected by contact with the hot metal and thus the chilled iron does



A BRAKE LEVER BLANK

not become dull from softening, or drawing the temper, as is the case when steel tools are used.

The cast-iron tools are simple and inexpensive, requiring only to be ground on the cutting edge. New ones can be made in a few hours when required, once the pattern and chill is made. Their uses are innumerable and a few general examples are given below.

In the making of brake levers such as that shown in the sketch, the pieces can be blanked out from a hot bar of the proper width in one operation. The cost compares favorably, when a reasonable quantity is to be made, with the regular method, which is to shear off the required length of bar, heat and forge the tapers and trim off both ends to a semi-circular shape in a shearing machine.

For large or thick pieces the blanking will have to be done in a hydraulic press because of the high pressure necessary. It makes no difference what the shape to be blanked is, and, for pieces of a shape awkward to form by forging, the saving will be proportionately greater.

Another point is that the pressure required to shear hot steel being only about one-half of that needed for cold steel, the use of chilled dies makes it possible to blank parts on a shearing machine that would otherwise be beyond its capacity. For instance: if we had to shear a number of bars of heavy section (beyond the capacity of our shearing machine) we could use a pair of chilled-iron knives and cut them hot, instead of by the slow process of hacksawing, to which we would otherwise be obliged to resort.

It is frequently possible to design a die for bull-dozer operations so that the bar is trimmed to length (that is, sheared at the ends) on the same stroke of the machine that bends or forms it.

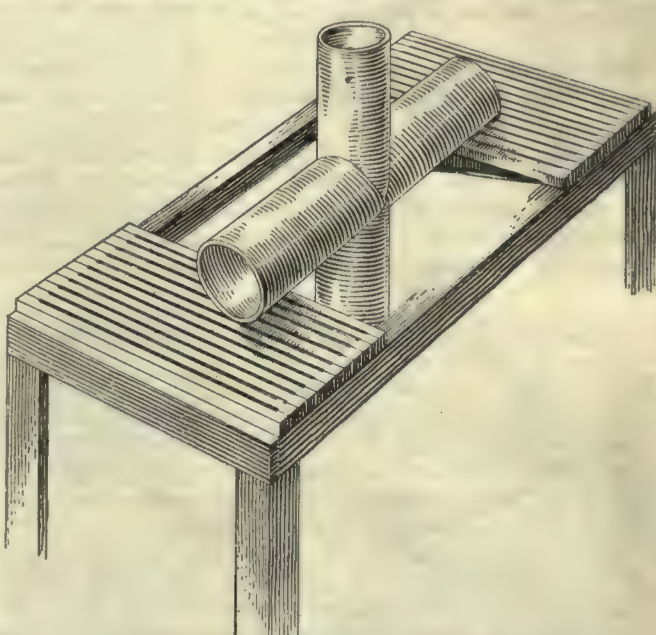
Welding Table Made From Grate Bars

BY CHARLES C. PHELPS

Old grate bars may be used to make a convenient table or bench for electric or gas-welding, brazing, soldering, etc. The support for the grate bars may be made out of a few pieces of angle iron or pipe, and the grate bars are merely placed loosely upon the side bars of the support.

The great advantage of this form of welding table lies in the fact that any of the bars may be easily removed, leaving openings wherever desired for parts to project through, as in the illustration. This often avoids the necessity of building up with bricks to keep a boss, flange, footpiece, hub or other part from resting on the table.

An additional advantage is afforded when it becomes necessary to preheat the work, for it is often possible to place a charcoal fire or oil torch below an opening in the table in order to preheat a part placed on the table. Grate bars placed on either side of curved parts are



WELDING TABLE MADE OF GRATE BARS

convenient for preventing them from turning over and for holding them in any desired position. In the illustration, for example, the piece on the table could be held steadily by placing bars to bridge the opening. The part to be welded may also be tilted by placing the bars in double or triple tiers on one side of the table.

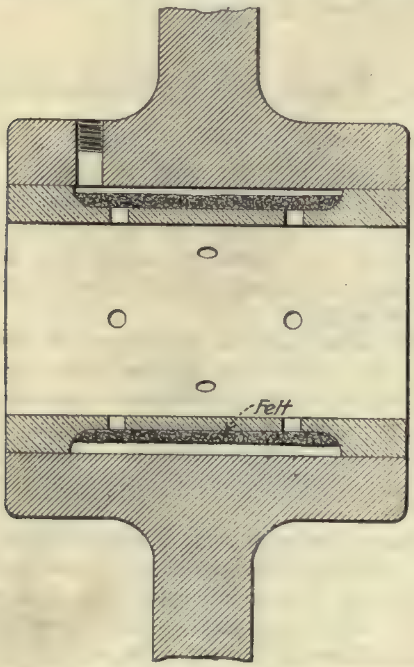
Grate bars are designed to withstand a great deal of heat, which fact makes them ideal for the purpose, especially for oxy-acetylene welding.

An Oil Reservoir in a Loose Pulley

BY JOHN A. SHAND

The loose pulley on a grinding machine had given considerable trouble from lack of oil, and a bushing was made as shown by the subjoined sketch, after which no further trouble was experienced.

The bushing was turned down for a considerable portion of its length both ways from the middle, and the



OILING KINK FOR A LOOSE PULLEY

space thus formed was wound with felt. A number of small holes through the walls of the bushing, under the felt, allowed the oil to get through to the shaft.

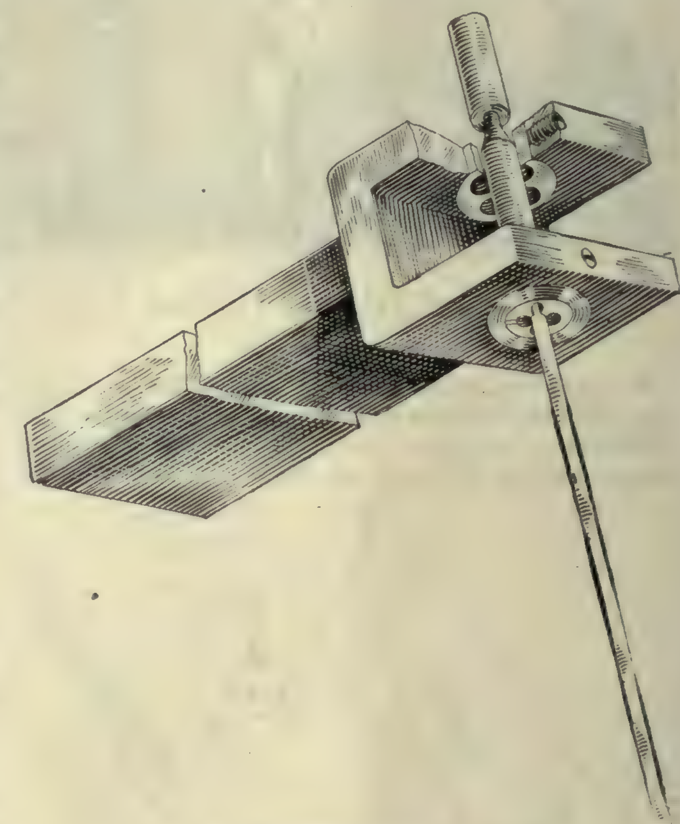
A large hole was made in the hub of the pulley and fitted with a pipe plug. This hole provided for filling the hidden recess between the bushing and the bore of the pulley, and the felt, being saturated with oil, removed the tendency of the pulley to run dry.

Double Turning Tool for Small Work

BY H. M. FAY

A turning tool to be used on a lathe for machining two diameters on long and slender work is shown in the illustration. These parts are made in various lengths on the small diameter which is $\frac{7}{64}$ in., while the $\frac{3}{16}$-in. diameter parts are all of the same length.

The work being so long in comparison to its diameter, is very springy under the cut when turning in the ordinary manner, even though a follow rest is used. To overcome this lack of resistance, two turning dies are employed, which are similar to threading dies except that smooth lands instead of threaded lands are used and the beveled edges of the lands are made to act as cutting edges. Two dies of correct diameter are held in the holder which is in turn held in the toolpost of a lathe in



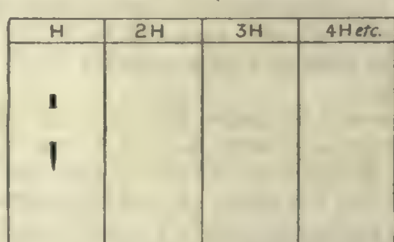
TOOL FOR TURNING SMALL STOCK

the usual manner, care being taken to have the two dies lined up with the spindle of the machine. The carriage of the lathe is then fed forward and the dies turn the work to the shape shown. A little extra length is allowed for gripping these parts in a chuck and this is afterward cut off, leaving the work pointed at the end.

Saving Short Leads for the Compass

BY HARRY H. MORSE

When a pencil gets too short to be used conveniently, split it open, take out the lead and stick it into a piece of drawing paper that has previously been prepared as



A KINK FOR SAVING COMPASS LEADS

shown in the sketch, roll up the paper and put a rubber band around it.

In this way you will be assured of always having compass leads of whatever grade may come within the range of the drawing pencils you use.

What Real He Men Think of the Compulsory Metric System

East Pittsburgh, Pa., Jan. 27, 1920.
Ethan Viall, Editor,
American Machinist.

Dear Sir:

I have your letter of the 23rd and know of the movement under way to force a law making the use of the metric system compulsory.

I believe this is absolutely wrong and detrimental to the interests of the American people. It would entail tremendous expense and difficulties on manufacturers and, I believe, accomplish no useful purpose. In a great many respects the metric system is not so well adapted to use in industry as the system of weights and measures we now employ.

If you will communicate with F. A. Halsey, Commissioner of the American Institute of Weights and Measures in New York, I am sure he will be able to give you all the facts and figures you may need to fully substantiate what I am saying.

I believe every effort should be made to defeat a movement of this sort.

Yours truly,

WESTINGHOUSE ELECTRIC & MFG. CO.
E. M. Herr,
President.

St. Louis, Mo., January 28, 1920.
American Machinist.

Gentlemen:

The adoption of a law to make the use of the metric system of weights and measures compulsory, would in our opinion be not only unwise but thoroughly impracticable.

For various kinds of work and material many standards of measurement are in more or less general use, and it is reasonable to assume that each standard has some advantage for the purpose or it would not be continued in use.

Even though the metric system should be adopted by law, the use of the old standards would be continued in many localities by common consent, and the law practically would be inoperative.

While decimal systems have some advantages, they also have some definite disadvantages. The increments of 1/10 and 1/100 are too greatly different to meet average requirements, and, on decimal systems in use, values of ½ and ¼ and ⅛ of the unit have been found to be practically necessary.

The adoption of the metric system by law would impose unmeasurable difficulty and expense upon every individual and business. There would be a very long period of continual turmoil, and even though all of the theoretical advantages of the metric system could be realized, which is hardly possible, its disadvantages would very largely offset the advantages.

The net results would in our opinion be an appalling loss, and we wish to place ourselves on record as opposing a law to make the metric system the only legal standard.

Yours very truly,

THE EMERSON ELECTRIC MANUFACTURING CO.,
H. I. Finch,
Vice President and Superintendent.

Mr. Ethan Viall, Editor,
American Machinist.

Dear Sir:

If the bill which provides for the compulsory adoption of the metric system of weights and measures in the United States is enacted, industry in this country will suffer losses of billions of dollars and will be thrown into a state of chaos that would result in practical paralysis.

The propaganda which has been directed by proponents of the metric system while insidious and fallacious, has been widespread and successful in so far as it has induced various chambers of commerce and semi-trade bodies to pass resolutions favoring the adoption of the system, and to forward them to Congress. These organizations do not, however, represent the manufacturer who is the one actively concerned in the issue. In fact, it is doubtful whether manufacturers as a whole fully realize that this danger has reached such a menacing status.

Transition from our present standards to those of the metric system would mean the introduction of a dual standard as has been the case in other countries where the change has been made. Results would be exactly the opposite of those claimed by its advocates—complexity instead of simplicity, confusion instead of order, and diversity instead of uniformity. Not only would there be confusion and loss through the necessity of converting from one standard to the other in commercial transactions, but it would require complete new equipment in many forms of measuring equipment, tools, gages and innumerable articles of manufacture, not to speak of changes in designs, plans, etc.

Advocates of the metric system argue on the advantages of a uniform world system, but this disappears in the face of the fact that its adoption has in no country brought about a uniform system in domestic affairs, while in most countries it has been a grotesque failure. The most favorable result has been nothing mo e than a partial change, the old system continuing in use along with the new, and leading to nothing but hopeless complexity, confusion and disorder.

If the metric system had possessed any merit, it would have been put into use in this country long ago, not by force of law but by that of expedience. The very fact that the people of the United States have declined to avail themselves of its principles and to abandon the system to which they are accustomed, should justify the denial of the passage of a law to enforce its adoption.

Whatever the nature and purpose of this metric propaganda that is so effectively making its impression in this country, it behooves every American citizen to realize the influence such an enactment would have upon American life and industry, and to act accordingly lest we learn its results when it is too late, as has been the case with other forms of insidious propaganda.

Very truly yours,

INTERNATIONAL MOTOR CO.,
R. E. Fulton,
Vice President.

Muskegon, Mich., January 28, 1920.
American Machinist.
Attention Mr. Viall, Editor

Gentlemen:

In regard to the compulsory use of the metric system, in our judgment such action on the part of our Government would be a calamity. In our shop, where we produce nothing but camshafts, all of our men are specialists on some one operation. They are not used to the reading of drawings, and as a rule have had very little training in arithmetic. They have become familiar with our present system, but a change to the metric system would make it necessary for us to have all blueprints explained to them.

We certainly would not take very kindly to being compelled to adopt in our shop a system of which we did not approve. It hardly seems to us possible that such a law could be made compulsory. It certainly should not be.

Yours very truly,

MUSKEGON MOTOR SPECIALTIES CO.
F. C. Whitney,
Secretary-Treasurer.

Trenton, N. J., January 28, 1920.
Ethan Viall, Editor,
American Machinist.

Dear Sir:

We are by no means in favor of any law which would make the use of the metric system compulsory. It would mean the sacrifice and destruction of many thousands of dollars in tools, jigs, etc., which are now in use, besides creating a period of confusion which would be very disastrous.

We see no reason whatever why a system based on decimal parts of the inch would not be in every way satisfactory.

Very truly yours,

JOHN A. ROEBLING'S SONS CO.
Karl G. Roebling,
President.

Tiffin, Ohio, February 4, 1920.

Ethan Viall, Editor,
American Machinist.

Dear Sir:

Referring to your article in the *American Machinist*, dated January 22nd, on a compulsory metric system, we inclose copy of a letter which we are sending today to the Committee on Coinage, Weights and Measures, also copies of our letters to our Congressman and Senator.

Until the world adopts the metric system, the United States certainly cannot afford to "play it alone." **Nothing could so boost the export business of Germany as to have the metric system forced upon us by our Government.**

Very respectfully,

THE NATIONAL MACHINERY CO.,
E. R. Frost,
Manager.

Tiffin, Ohio, February 4, 1920.

Hon. Atlee Pomerene,
U. S. Senator,
Washington, D. C.

Dear Sir:

The World Trade Club of San Francisco (which we understand is fathered by a millionaire with a hobby) and also a number of theorists, college professors, etc., are making a desperate effort to have the metric system of weights and measures adopted as the legal standard for this country.

We attach herewith an explanation which shows the extent to which the various screw thread standards are used throughout the world. Of course, the screw thread standards are indicative of the form of measurement used on the balance of machinery and other mechanical measurements. For your own information we suggest that you read the attached letter, as we are in position to supply this information authoritatively because we build screw threading and nut-tapping machinery which is sold all over the world.

The claim can be disregarded that the selfish interests of American machinery builders and other manufacturers prevent them from adopting the metric system on account of the cost of the change. Even if the metric system were adopted, it would still be necessary to build machinery to English dimensions if we attempted to hold any of our export business.

After you have read this letter, you may prefer to pass it to some member of the Committee on Coinage, Weights and Measures.

Very respectfully,

THE NATIONAL MACHINERY CO.,
E. R. Frost,
Manager.

Tiffin, Ohio, February 4, 1920.

Hon. Jas. T. Beggs,
13th District Ohio,
House of Representatives,
Washington, D. C.

Dear Sir:

The World Trade Club of San Francisco (which we understand is fathered by a millionaire with a hobby) and also a number of theorists, college professors, etc., are making a desperate effort to have the metric system of weights and measures adopted as the legal standard for this country.

We attach herewith an explanation which shows the extent to which the various screw-thread standards are used throughout the world. Of course, the screw-thread standards are indicative of the form of measurement used on the balance of machinery and other mechanical measurements. For your own information we suggest that you read the attached letter, as we are in position to supply this information authoritatively because we build screw-threading and nut-tapping machinery which is sold all over the world.

We feel that this information will be of value to the House Committee on Coinage, Weights and Measures, and we will much appreciate it if you will kindly see that this is delivered to the Chairman of this Committee.

Thanking you for your attention to this, we beg to remain

Very respectfully,

THE NATIONAL MACHINERY CO.,
E. R. Frost,
Manager.

Tiffin, Ohio, February 4, 1920.

House Committee on Coinage,
Weights and Measures,
Washington, D. C.

Gentlemen:

In regard to the pending legislation concerning the adoption of the metric system of weights and measures in this country, we are taking the liberty of calling to your attention the fact that we are extensive manufacturers of bolt and screw-threading machinery and nut-tapping machines, and as we have specialized on this class of machinery for a great many years, our machines are sold throughout the world.

Many statements are made by advocates of the metric system that this system is largely used in other countries except the United States. This statement is not only misleading, but is incorrect.

You, of course, readily appreciate that we have exact knowledge in regard to the threads that customers cut upon their bolts and nuts, as we supply the threading dies and taps with our machines, and the customer, of course, advises us just what form of thread is wished. Furthermore, we do a large business in supplying extra dies and taps to these same customers, which constantly shows us the kind of threads they are cutting.

It is patent that a foreign customer who would be using metric measurements in his work would almost from necessity be compelled to use the same metric measurements on screw threads. Many foreign customers send us blueprints showing the work they wish to thread, and it is universally the case that the same standard of measurements used in expressing the dimensions of the threads are applied also to the other general dimensions of the work. Consequently, authentic data in regard to the form of the standard of threads used by various foreign customers on their bolts, nuts and screws is almost conclusive evidence in regard to the extent of the standard of measurement which they use.

The data on standard threads used in the various countries as shown by the orders which we receive are as follows:

In England, Whitworth standard threads (which as you know are measured in inches) are used exclusively. It is rare indeed to either receive a call for metric thread dies or taps from England.

In Norway, Whitworth standard threads are used almost exclusively.

In Denmark, Whitworth standard threads are used almost exclusively.

In Sweden, Whitworth standard threads are used almost exclusively.

In Russia, Whitworth standard threads are used almost exclusively.

In Germany, Whitworth standard threads are used almost exclusively.

In Austria, Whitworth standard threads are used almost exclusively.

In Australia, Whitworth standard threads are used almost exclusively.

In Japan, Whitworth threads are used almost exclusively, although U. S. S. threads are used to some extent.

In South and Central America, U. S. S. threads predominate, although Whitworth threads are also used.

In Mexico, U. S. S. threads are used almost exclusively.

In Canada, U. S. S. threads are used almost exclusively.

In the United States, U. S. S. threads are used almost exclusively, although the S. A. E. pitch of U. S. form of thread is largely used by the automobile people. The use of metric threads in the United States or Canada is exceedingly rare.

In France and Belgium the metric or International form of thread is generally used. However, the Whitworth thread is used also, especially where work is to be exported by manufacturers in France.

In Italy, both the metric and the Whitworth threads are used.

In Switzerland and Portugal, the Whitworth threads predominate; metric threads are also used.

It is evident, hence, that the only extensive use of metric standard threads is in France and Belgium.

Whenever manufacturers in either of these countries are compelled to export their product to other countries they are immediately compelled to supply Whitworth threads. The other exporting nations of the world, such as England, Germany, Austria, Japan and the Scandanavian countries use Whitworth standard threads almost exclusively, except on their export orders to France and Belgium.

Builders of machinery and manufacturers of bolts and nuts in this country are, hence, in infinitely better position to handle export trade by building their machinery to English dimensions, as, of course, both the Whitworth and the U. S. Standard threads are computed in English measurements. When it is necessary to export to France or Belgium, we equip our machines with special attachments and adjustments which enable the metric form of threads to be handled. Consequently, we have every advantage on French export business; and, of course, the average manufacturer of American machinery is able to index the dimensions in the machinery for French consumption, in the metric system. However, to adopt the metric system as a standard in this country, would not only result in untold confusion here, but it would still make it necessary for practically every manufacturer to also build his machinery to English measurements for exportation to practically all countries in

the world, with the exception of France and Belgium.

It seems evident that the demand for the adoption of the metric system in this country must come from people who are not familiar with the situation; or it is an organized effort on the part of Germany to get this country to adopt a form of thread which will cause untold confusion, not only for our own manufacturing plants, but will also practically shut us out from the world markets. At the present time every manufacturer of machinery is in position to supply machines indexed either for U. S. standard, English or metric dimensions; and regardless of what type of legislation is passed in this country, the manufacturer of machinery will still be compelled to furnish U. S. standard and English dimension machines if he has any hope of holding his export trade. Supplying, as we do, threading and tapping machinery to customers in practically every country in the world, we can see the state of chaos which would result if the metric system were forced upon manufacturers in this country. This matter is one of shop practice, and should be handled exclusively as such, and in our opinion suggestions or advice from theorists, college professors or any one not actually engaged in shop work, should be considered noncompetent.

Any further information which our files on this subject set forth is at your command, should you so desire.

Very respectfully,

THE NATIONAL MACHINERY CO.,
E. R. Frost,
Manager.

Worcester, Mass., December 26, 1919.
Hon. Samuel E. Winslow,
House of Representatives,
Washington, D. C.

Greater part of active propaganda now being presented in favor of metric system is based upon misinformation if not actual misrepresentation. Proposed measures are in our opinion utterly chimerical and unnecessary. Their adoption would cost us one hundred thousand dollars per year, and force us out of business. We are now doing active export business to England, France, Spain, Brazil, Argentine, Australia, without least demand or necessity for other than present system. Manufacturers have enough troubles without having to combat any such monstrosity of academic idealism.

BOSTON PRESSED METAL CO.

Barbourville, Ky., February 3, 1920
American Machinist.
Attention Ethan Viall, Editor

Dear Sir:

In relation to the bill making the use of the metric system compulsory, which Congressman Vestal is expected to introduce in a few days, we want to go on record as being unalterably opposed to such legislation.

The metric system was made legal in the United States in 1866, and if it had been of any practical use to manufacturers of the country it would be their standard now.

While our company does not carry the complicated equipment that many others do, it would cost us thousands of dollars to change our system of measurement. It would mean the re-education of all our force from the officials down. It would mean the changing of all our measuring devices, the remaking of all our calculating tables, and be a source of confusion and costly mistakes for years to come. You can readily see what a hardship it would be to us, and how much more to larger companies using immense numbers of special tools, jigs and fixtures.

We will back you to the limit in your fight against this useless disturbance of American industry.

Sincerely yours,
T. W. MINTON & CO.,
N. E. Minton.

Cleveland, Ohio, February 4, 1920.
American Machinist,
Ethan Viall, Editor.

Dear Sir:

With respect to the question of adopting the metric system in the United States, this would cause an absolutely useless economic waste of millions of dollars in discarded tools, machinery and designs, in mistakes due to the change of system and delays caused thereby, and all to no sensible purpose.

There is a far greater proportion of the world using the present English standards adopted in the United States than those who use the metric system, and the change would, therefore, be adopting something in less general use than the system already in use. What this country needs is greater production per man, and any such change would, for a long time, have a most decided effect in reducing individual production and decreasing efficiency.

Yours very truly,

THE BROWN HOISTING MACHINERY COMPANY,
Alexander C. Brown,
President.

Pittsburgh, Pa., Jan. 30, 1920.
Ethan Viall, Editor
American Machinist.

Dear Sir:

I would *not* like to see the metric system made compulsory. As I understand it, the metric system is now legalized for use but not as an exclusive system. It would be a high crime to do away with our present standard and make compulsory the use of the metric only. It would mean chaos, inefficiency and a great decrease in production. Men in shops, salesmen and buyers in all lines of industry and commerce would have to think in a foreign language. It would mean a disturbance and retarding of trade, but above all, it would tend to destroy production to such an extent that it would cause a blight over the whole country. In times like these when we are trying to get back to our old standard of production, which we have not by any means reached, it would be the most disastrous blow that could be laid on American industry. Picture the hundreds of thousands of mechanics and machine-shop hands in our factories alone, engaged in study rather than in production!

I do not think the time should ever come in this country of ours when we should consider the metric system to be the only exclusive system of weights and measures. Now that we are to have a great merchant marine, can not the two English-speaking countries stand by their own system of weights and measures and force its adoption in other countries? It would take years for industry to recover from such a blow as to enforce immediate use of the metric system.

Yours very truly,

GARLAND MANUFACTURING CO.
Robt. Garland,
President.

Pittsburgh, Pa., January 29, 1920.
Ethan Viall, Editor,
American Machinist.

Dear Sir:

As you have asked for a sharp and brief statement of our views in relation to the movement to force through a law at the next session of Congress making the use of the metric system compulsory, I can perhaps make it sharp enough by saying that to me it seems nothing short of criminal. I cannot believe that the people back of this movement are actuated by any other than selfish reasons. Just how they expect to profit I do not know; perhaps they do. The danger is none the less because the metric advocates have many specious arguments which appeal to the unthinking. *The company which I represent has a world wide trade* and even in countries using the metric system our product is now thoroughly understood and established under English measurements and it would perhaps be almost as disastrous to them to readapt themselves to the change as it would be for us to readjust our entire industrial program.

We are having a great deal of compulsion these days and some of it is necessary, but there is a limit to the burdens which can be borne by a long suffering public.

Yours truly,

OIL WELL SUPPLY CO.
Louis C. Sands.
Vice President and General Manager.

South Milwaukee, Wis., Jan. 26, 1920.
Ethan Viall, Editor,
American Machinist.

Dear Sir:

We are definitely opposed to the compulsory adoption of the metric system, believing that the cost to the United States would be incalculable.

Most discussions on the subject lay stress on inconvenience and cost to manufacturing concerns and the workmen employed by them, but it must not be forgotten that every farmer, every tradesman, every workman, every housewife, and in fact every inhabitant of the country would be affected, inconvenienced and subjected to expense.

We are hopeful that Congress will not waste time on this subject.

We consider it remarkable that advocates of the metric system seem to be unacquainted with our Government hearings and reports on the subject of the metric system published in respectively, 1879, 1906 and 1907. We are confident that if new hearings were held at the present time, the weight of evidence against the compulsory adoption of the metric system would be even greater today than it was fourteen years ago and forty years ago. It is not apparent, however, that new hearings should be held, as it is believed

that a brief study of history as shown by these reports is sufficient to convert any metric advocate who is not biased.

Yours very truly,

BUCY RUS COMPANY

W. F. Russell,

Second Vice President.

Pittsburgh, Pa., January 27, 1920.

American Machinist.

Gentlemen:

In reference to the metric system and the effort that is being made to make it compulsory by an act of Congress to use that system of weights and measures, would say that we are very much opposed to any such action and have been using our efforts against it.

At the meeting of the American Gear Manufacturers' Association in Boston in October, 1919, the writer offered a resolution, which was unanimously adopted, against the adoption of the metric system. A copy of the resolution was forwarded to the American Institute of Weights and Measures and your correspondent probably took a record of it at the meeting. Copies were also sent to President Wilson and Hon. Lloyd George.

The decrease in production which would be caused by any change in our system would be enormous and the cost would run into vast sums. We trust that you will use the efforts of the *American Machinist* against any change by Congress.

Yours very truly,

THE SIMONDS MFG. CO.,

Biddle Arthurs,

President.

Brookville, Pa., January 27, 1920.

Honorable Nathan L. Strong,

Congressman,

Washington, D. C.

Dear Mr. Strong:

It seems that this Government is on the verge of breeding a big radical measure when considering seriously the thought of changing the present standard of measure to the metric system. I would, therefore, ask your support to help defeat such a bill for the following reasons:

It will tend to increase, rather than reduce the high cost of living. It will be a back set rather than an uplift to the present generation to make this change, considering how very few people know or care to know what a cubic centimeter is. The present textbooks, purchased at a great outlay of money by states where free textbooks are issued, and also by individuals who will be required to buy new books for their children at school, would all have to be changed at a greater expense due to the present cost of paper.

The educators of today will not take up this new feature and apply it at once without detriment to the education of the pupils. The waste of labor and material that would be involved in hundreds of thousands of forms is not justified. It would no doubt be the forerunner of business failures in hundreds of ways.

We depend upon the manufacturers to provide us with machinery in all forms, and upon this machinery we are dependent to a great extent for our various needs; the manufacturers of the machinery and the users of the machines are not wanting the change, even though they know that the public will pay the bill.

Grave issues of this kind are liable to cause panics which should be avoided, if possible. A few people of these United States in power or influential with the forces have no right to launch a hobby at the cost of the multitude. The Government at the present time is deporting some radicals.

Considering a concrete example, would it be convenient or consistent to tear down the brick house in which you live, for the sole reason that you desire a different size brick used in the construction—the house when completed to be the same size throughout, the same color of brick and no change, except that you have another standard size of brick. Remember at the same time you are tearing down and rebuilding, you must live in the house.

The principle of changing from the present standard, as I see it, is just the same—with the exception that it will require a period of years to make the change, the cost of which would overbalance any gain and the net result would be unnecessary expense and inconvenience to the point of hardship, ruin and the upbuilding of radicalism, a feature which at all times should be guarded against.

Yours respectfully,

P. & S. RAILROAD,

E. L. Frazier, Jr.,

Leading Draftsman and Motive Power Inspector.

Cleveland, Ohio, January 31, 1920.

Ethan Viall, Editor,

American Machinist.

Subject: Metric System.

Dear Sir:

Acknowledging receipt of your letter of January 23, calling attention to a movement now under way to force through the next session of Congress a law making the use of the metric system compulsory.

We are strongly opposed to the passage of any such legislation, and hope that there will be no relaxation in the very effective effort which has been exerted in the past by the *American Machinist* against the compulsory adoption of the metric system.

Yours very truly,

THE GRASSELLI CHEMICAL COMPANY,

J. H. Dunbar,

General Superintendent.

Rochester, N. Y., January 31, 1920.

American Machinist.

Gentlemen:

Regarding the proposed compulsory adoption of the metric system of measurement, we beg to say this is a matter of utmost importance to the manufacturers of this country, and it has received far too little attention on their part.

We cannot understand why our Government should even consider a change without first consulting those who are most vitally interested and upon whom the burden will fall if put into effect.

We have been doing an export business for over twenty-five years, and we have never yet found necessity for changing our present system of measurement in even the slightest degree. The enormous expense and confusion which the change would entail is entirely beyond conception, and why all the manufacturers of this country should be compelled to assume this load simply to gratify the fancy of a few individuals, who, remarkable as it seems, have succeeded in making many people believe that the adoption of the metric system will work some great miracle in our export trade, is beyond comprehension, because we do not know of even a single advantage or benefit it will bring.

Yours very truly,

RITTER DENTAL MANUFACTURING CO., Inc.,

O. H. Pieper.

Brooklyn, N. Y., January 27, 1920.

Hon. John McCrate,

House of Representatives,

Washington, D. C.

My dear Sir:

It has just come to my notice that there is an organized movement, or perhaps a clearer statement is, that a millionaire with a "hobby" is trying to foist on this country a compulsory metric system of weights and measures.

You undoubtedly realize that in hundreds of industries and particularly the machine and tool industry that the cost of a sudden compulsory change from inches to the metric system would cost billions of dollars because of the necessity for scrapping all of our measuring instruments and the most vital parts of our manufacturing machines which are now all graduated to inches.

I understand the metric system and assure you it has its limitations as well as any other system of measurement, particularly in the machine-tool field, because of the wonderful convenience and comprehensive measurement of the inch when divided into 1000 parts as it is most used.

Won't you please use your influence against the unwarranted and pernicious activities of a few people who are trying to force their particular hobbies down the throats of a very patient public and cause untold loss to the business world and throw thousands of people out of work during a compulsory readjustment period which in the writer's estimation would take at least ten years to accomplish.

Most sincerely yours,

EASTERN TUBE AND TOOL CO., Inc.,

Geo. W. Emrick,

Superintendent.

January 14, 1920.

Mr. Robert Garland, *Chairman*,

Trade and Commerce Committee,

Care of Garland Manufacturing Co.,

First National Bank Bldg., Pittsburgh, Pa.

Dear Sir:

Our attention has been called to the fact that a movement is under way to have the Pittsburgh Chamber of Commerce endorse the Meter-Liter-Gram system of weights and measures, and that this movement has come before your committee.

We would like to enter a protest against any such action being taken by the Chamber. There are many arguments both favorable and unfavorable to the decimal system of measures with which, we presume, you are thoroughly familiar and it is therefore not necessary to present these.

The position we take is that *so long as England and the United States adhere to the present system of weights and measures, the*

bulk of the commerce of the world will be done in these units, and that over a long period the old system has proved satisfactory and convenient and in no way interferes with the application of the decimal system for scientific purposes where it is eminently suited.

The particular point which we would call to your attention at the present time is that to adopt a new system of weights and measures will involve an enormous waste of tools and appliances, and require the manufacture of a complete new set of such tools and appliances at a time when all the available labor and production of this country and the world is greatly needed in making up the losses and destruction of the War. To adopt a new system at this time would have the same effect as to stop the entire production of the country for a considerable period of time, because a large number of toolmakers and machinists would be required for a long time in changing over the tool equipment of the various industries of the country, and it will certainly be agreed that at no time is this desirable, and particularly under present conditions.

To give an idea of the significance of such a change, take the case of our own company which, while large in our own line of business, is a very small item in the whole industrial production of the country. We would be compelled to change the lead screws and feed gears for all our lathes, purchase an entire new equipment of taps, dies and drills, as well as complete new equipment of micrometer and other measuring devices.

We have approximately 45,000 drawings, all of which would have to be retraced with changes to adopt them to the new standards of shaft sizes, threads and drills.

Many of our patterns would be useless and a very large equipment of jigs and templets which we use in machining work in the shops would all be discarded.

Without attempting to make any exact estimate of the cost of these changes, we would put them at close to $1,000,000 and every other manufacturer would be put to an expense in like proportion. From this you can see that the cost to the country at large would be an enormous sum of money and that the loss of effective production would be correspondingly great.

We request and sincerely hope that you will use every effort to prevent any action being taken by the Pittsburgh Chamber of Commerce which will, in any way, tend to advance this proposition. We believe that it is fostered by scientists and theorists who do not realize the enormous cost involved.

Very respectfully,

UNITED ENGINEERING & FOUNDRY CO., Pittsburgh, Pa.
(*Signed*) F. C. Biggert, Jr.,
President.

Mansfield, Mass., February 3, 1920.

American Machinist.
Attention Ethan Viall

Gentlemen:

We certainly are entirely opposed to the adoption of the metric system as a standard of measure in this country. As you probably know, we have, for foreign countries, manufactured taps and dies to the metric system for a great many years and we believe that we are without prejudice as regards the adoption of this system. We are sure that the greatest cost to the people in this country would be the cost of getting the people to think in the metric system.

Many years ago the writer endeavored in the shop, on a job where we were making metric tools exclusively, to get the workman to use the metric micrometers, but found the job too big for him.

As you probably know, every manufacturer of tools in this country who makes tools to metric sizes, translates the meter into the decimal equivalent of an inch.

To listen to some people talk about the metric system one would think that all that was necessary would be for Congress to adopt same. I believe if these same people had a fair idea of what it meant for a shop like ours to change over, they would not be any longer advocates of this system.

Yours truly,

S. W. CARD MANUFACTURING CO.,
W. B. McSkimmon,
Treasurer.

American Machinist.
Attention Mr. E. Viall, Editor

Gentlemen:

Replying to your letter of January 16th, we are decidedly against the use of the metric system, as it would not only *create industrial confusion for a long period of time but would cost thousands of dollars* for our company alone to change over, and there would be no advantage in it.

We are very decidedly against the adoption of the metric system.

Yours very truly,

MILLHOLLAND MACHINE CO.,
W. K. Millholland,
President.

New York, January 29, 1920.

Hon. Peter J. Dooling,
15th Congressional District, N. Y.,
House of Representatives,
Washington, D. C.

Dear Sir:

Our attention has been drawn to a well-directed movement now under way to convince members of Congress that there is a real public demand for legislative adoption of the metric system of measurement in place of the English standard now in use. This movement, we understand, either has or shortly will be brought before Congress in the form of a bill to make the adoption of the metric system compulsory.

As manufacturers using machinery and quantities of machine tools in the production of our goods, we are strongly against such a change both from the point of our own interest and that of the entire industrial system, and we are writing to you, our Congressional Representative, to advise you of our attitude and to express the hope that you will do all in your power both officially and personally to defeat any such legislation.

It is probably unnecessary to elaborate details of the objections to a change in this country's system of measurement. Any one familiar at all with the manufacturing industry knows that it is based primarily on the use of machines and machine tools, and that under a legalization of the metric system all those now in use and in process of manufacture will be rendered worthless and the consequent stoppage of production in all lines of industry due to manufacturers being unable to obtain tools and machinery of the new standard would be nothing less than an industrial disaster, and a blow to American business interests, from which it would be the work of many years to recover. The machine-tool business is already overburdened and far behind in their orders, and a change to the metric system, such as proposed, would be an enormous costly proposition, and cripple the machinery builders for years.

We do not believe that there is any general demand for such a change from even a small proportion of the manufacturers of this country, who are after all the ones vitally interested.

From the standpoint of our own problem, the change would mean that an extremely valuable and modern factory equipment would be rendered almost useless, losing at a single stroke much of its value, and would practically wreck an established and prosperous business for at least a term of years; this disaster, of course, also extending to our numerous employees.

We cannot too strongly emphasize our unalterable opposition to any change in the present standards of measurement. We believe the adoption of the metric system, which could only become effective by compulsion, would, through its effect on industry, set the country back at least a decade commercially, and we wish to reiterate our hope that you will give this proposal your careful attention and do all in your power to prevent the metric system becoming standard by law.

Yours very respectfully,

SIMON ZINN, Inc.,
C. W. Hardy.

Brazil, Ind., January 30, 1920.

Hon. James E. Watson,
United States Senate,
Washington, D. C.

Dear Sir:

We have been advised that there is a well-organized movement under way to get a bill through at the next session of Congress making the metric system compulsory. We, as machine-tool builders, are opposed to the metric system for the following reasons:

1. Loss of all gages and working over all fixtures.

2. All drill bushings would have to be changed.

3. Confusion during the change over.

4. It would be necessary for workmen to be re-educated, as they have no conception of the metric system.

5. All micrometers and measuring instruments would be discarded.

6. All drawings would have to be made over.

We also wish to call to your attention that the present-day workmen and their children know absolutely nothing of the metric system and if it should be adopted it would be at least twenty-five years before the average workman could become thoroughly acquainted with the metric system.

In cold facts, we believe that any change in our system of measurement at the present would be such a handicap upon the American people that it would enable Germany to get on her feet again before we could recover from the change.

We can assure you that our employees, from the factory manager down to the

apprentice boy, are all against the adoption of the metric system.

Trusting that you will see that our interests are taken care of and assuring you that you have our co-operation; we beg to remain.

Yours truly,
WOOD TURRET MACHINE CO.,
J. W. Wood,
Secretary.

Rockford, Ill., January 20, 1920.
American Machinist,
Attention Ethan Viall, Editor

Gentlemen:

Your letter of January 16th is received. We will be very decidedly against any movement to make the use of the metric system compulsory. There would be a very large expense in changing our product and equipment therefor in order to accommodate this, and we do not believe that the results which might be expected would be at all commensurate with the cost of making the change.

There is bound to be a *long period of disruption* following an attempted change, which would take many years to overcome, if indeed it could be accomplished at all.

Yours very truly,
THE INGERSOLL MILLING MACHINE CO.
W. C. Sproul,
Secretary.

Hartford, Conn., January 19, 1920.
Mr. Ethan Viall, Editor,
American Machinist.

Dear Sir:

Relative to the existing movement designed to force a law through the next session of Congress, making the use of the metric system compulsory, we use and are familiar with the metric system from perhaps every angle.

During the war, in spite of the urgent requirements for speed, some divisions of the Ordnance Department considered it necessary to translate French drawings into English measurements. Where this was not done, many contractors, including ourselves, found it advisable to re-draw and translate to English measurements before it was considered safe to put the drawings into the shop.

We believe that any law making *compulsory* the use of the metric system in this country would be an economic crime.

Yours very truly,
PRATT & WHITNEY COMPANY,
B. H. Blood,
General Manager

Racine, Wis., February 9, 1920.
Mr. Ethan Viall.
Gentlemen:

Now that the metric system is up for another good airing let us look at it for a moment from the standpoint of a mechanic. What would it mean to the man of moderate wages, who has his tools all bought and perhaps had to pay for some of them on the installment plan? The tool kit of the average machinist is perhaps worth about $60.00 and of an average toolmaker more than double that amount.

In my own case, I have 82 inches in scales and steel rules in the English system and 78 inches of inside and outside micrometers. With the metric system the above mentioned tools would be rendered useless. In addition to that I would have to make an expenditure of close onto $100.00 for the same in the metric system, but with all this accomplished, then comes the transformation, "Oh, my brother machinist, ye must be born again."

Is there any man living with such a far-fetched imagination as to even dream what the confusion would be? For example some four or five years ago the manufacturers of this country changed from the V thread to the U. S. S.; it is needless for me to say how much confusion that caused. The trouble with the ½ inch, 12 and 13 thread is not over yet.

The monkey wrench would be the most prominent tool in use for awhile, so would the "monkey machinist."

In conclusion, I must say that with the compulsory metric system the burdens placed upon the laboring man will be greater than he can bear.

J. A. RAUGHT,
1006 Grand Ave.,
Racine, Wis

Pittsburgh, February 2, 1920.
To the Editor:

In any system of measurements the "Unit of Length" is first chosen and the structure of the system is then built up around it. It is a curious fact that in the eighteenth century, before the advent of the metric system and before the introduction of transportation facilities, countries and even communities which were practically isolated from each other chose, in the overwhelming majority of cases, as their unit of length, "the Foot." True, these expressions of length were all different—some were longer, some were shorter—but they were all in the same catagory of the "foot," showing clearly its handiness.

When the French scientists imposed the "meter," roughly three and a third times as large a unit dimension, is it surprising that the old units show even now such a tenacity for survival?

The meter was supposed to be the 1/40,000,000 part of the earth's meridian circumference; this length being chosen as a fixed and unalterable dimension, which could always be measured again, should the exact length of the meter be lost. We know, of course, that calculations subsequent to the establishment of the meter proved the earlier conclusions to be incorrect, and this is the reason why the argument is no longer heard that the meter is a "logical" and always verifiable dimension of nature.

It would seem that, to be consistent to the metric idea, the French scientists should have divided the earth's meridian circumference by 100 million instead of 40. In that case the length of the meter would have been about 15¾ in. But what they really did was to divide the circumference by the very un-decimal figure 4: i.e., they took the quadrant and divided it by 10,000,000. So the very origin of the meter is not based on the decimal idea.

The metric system was adopted in France by compulsory law in 1793. Nineteen years later, in 1812, Napoleon repealed this law and the old system was used again under the name "Systeme Usuelle" (the usual system). Twenty-five years later, in 1837, the metric system was again made compulsory. Today after eighty-three years it is *not* universally used even in France; the textile industries, for instance, use their own units. All French navigators use the English "Nautical Mile."

What is now called the metric system is but a fragment of that system as devised and understood by the promoters. The French law of 1837 omitted the decimal divisions of the year, of the day and of the circle.

The intrinsic quality which is necessary for any suggestion to be universally adopted is that of "handiness and convenience," because all human efforts follow the path of least resistance. Viewed in this light the metric units are either too large or too small to command general approbation of those who, rule in hand, actually use the system.

In our machine shops the workman using the English system in the building of machines, works to the one-thousandth part of an inch and its multiples as a limit, a dimension as readily and easily used as the inch itself by means of the micrometer.

Now:

(a) 1 mm. = 0.03937 in.
(b) 1/10 mm. = 0.003937 in. about 4/1,000th in.
(c) 1/100 mm. = 0.0003937 in. about 4/10,000th in.

Here again as a unit (b) is too large, while (c) is too small. Of course two and a half times one hundredth mm. is nearly one-thousandth inch, or 0.0009925 in., but what an unhandy unit this is for a man using his micrometer.

Another instance to illustrate the point made is found in the fact that in metric countries like France, Italy and Switzerland we find ½ kg. called a "pound."

The "decimal point" of the metric system, the so-called patent "cure-all" of all our troubles both real and imaginary, is nevertheless a very "shifty" customer, and responsible for many errors. The story ending with: "Damn that decimal point" has unfortunately too many applications.

In foreign trade a machine is sold on its merits; i.e., on its output, accuracy, handiness and first cost. The system of measurements to which it is built does not even play a secondary role.

In the manufacturing sections of "metric Europe" the English inch is as well known as any other dimension, it is reckoned with and made use of.

According to L. D. Burlingame, member National Screw Thread Commission, which met in Paris, France, in 1919, 80 per cent of the screw products of the world are now being manufactured on the inch system. There is very little standardization in this line in the countries using the metric system.

The arguments for the adoption of a new system are based on the assumption that the old units will disappear. As a matter of fact they never do. What is called the "adoption" of a new system is nothing more than its "introduction."

The introduction of a new system means simply the growth of a "dual" system with the perpetual necessity of converting from one to the other, and an inaccurate conversion at that in the majority of cases.

Much has been said in reference to the use of the metric system in the countries of Latin America, where in many of them it was "adopted" by law about sixty years ago. A survey of present-day conditions has shown that the English and Spanish units are still holding their own, with the natural consequence of inevitable confusion.

These few fragmentary notes are presented in the hope that they may stimulate an interest in the study of the subject.

Yours truly,
THE RITTMAN PROCESS CORP.,
C. C. Stutz.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS · A weekly review of modern designs and equipment

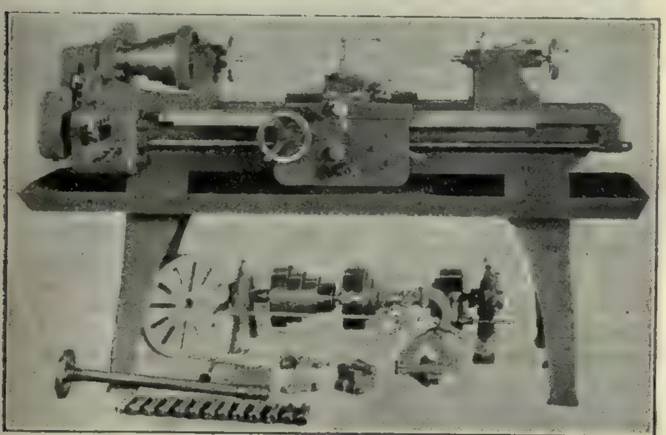
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX A continuous record of modern designs and equipment

Worcester Lathe with Quick Change Feed

Lathes manufactured by the Worcester Lathe Co., 100 Beacon St., Worcester, Mass., are now equipped with quick-change feed devices which are convenient to operate and which provide for twenty-four changes of threads and feeds.

The standard arrangement of gears as furnished will cut all threads from 4 to 30 per inch, except 29, and, in



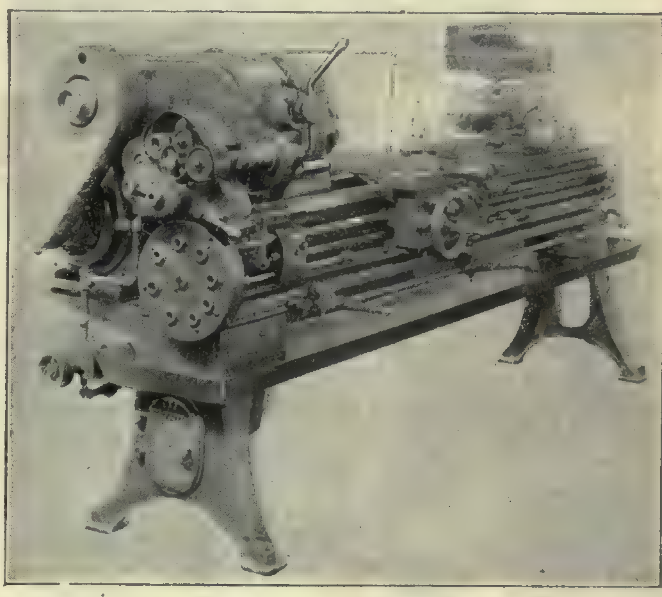
WORCESTER LATHE WITH QUICK-CHANGE FEED

addition, several fractional threads such as 4½, 5½, 6½ and 7½ per inch. Four extra gears are furnished to cut various other threads ranging between 32 and 60 per inch. These gears are also used to cut 3, 11½ and 27 threads per inch. Special transposing gears can be furnished for cutting metric and other threads as required. They can be changed readily, when it is necessary to set up a different combination. The gears that are subject to the most wear are made from heat-treated steel.

"Ideal" Geared-Head Engine Lathe

The 14-in. x 8-ft. "Ideal" lathe illustrated has been greatly improved in design since it was described in Vol. 48 of the *American Machinist*. It is manufactured by the Springfield Machine Tool Company, Springfield, Ohio. It is motor driven and has rapid change gears, relieving attachment, taper attachment, oil pan and pump. A wood cabinet for holding small tools, etc., is a convenient provision.

The geared head is of the selective type having twelve mechanical changes of speed, and is provided with ball bearings throughout, with the exception of the spindle journals, which are adjustable and oiled by means of sight feed oilers. The oil passing through these journals is returned to the interior of the head, as the gears run in oil. The head is provided with two frictions. One of these engages through the back-gear train and the direct-drive gears and is operated by the long handle shown at the front of the headstock. This friction is used on all "Ideal" toolroom lathes, and is said to be of special value in the chasing of threads; as the back gears may be used for the cut and without disengaging the half nuts, the tool may be returned at a



"IDEAL" GEARED-HEAD ENGINE LATHE

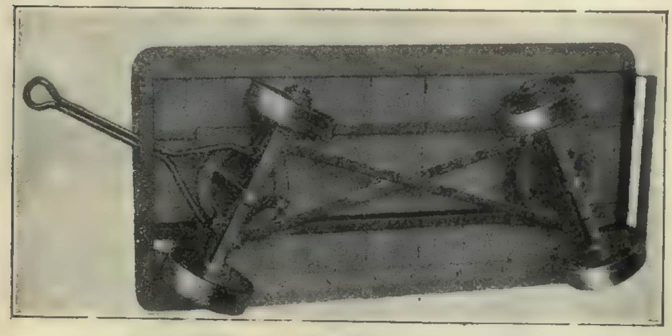
speed ten times as fast as the cutting speed. The second friction is used to start or stop the lathe independently of the running motor. It engages the sprocket that is inside the chain guard, and is controlled from two positions at the front of the lathe—one on the carriage, the other on the bed. The controlling levers may be seen extending forward from the lower lateral rod.

The relieving attachment will cut from two to twenty-six flutes per revolution of the spindle and will relieve right- or left-hand threads both external and internal. The relieving cam is provided with a cone friction in order that the operator may adjust the position of the relief. The rapid-change gear system permits forty changes of feed and the cutting of forty different threads. The upper screw shown is the lead screw and is used only for thread chasing. The rod below is for the feed. The bottom rod is for the automatic stop and reverse which controls both the feed and the lead-screw motions,

by means of adjustable stop collars. The lever at the right-hand side of the carriage pointed directly forward is for the purpose of controlling the right- and left-hand rotation of both lead screw and feed rod. The lubricant is conducted from the pump to the work by means of telescopic brass tubing. The pump may be seen just below the chain guard at the headstock, the reservoir being near by below the bed. The tailstock is of heavier design than formerly and all gears are well guarded.

W. & I. Sixth-Wheel Type Trailer Truck

The Warren & Irrgang Co., Springfield, Mass., has increased its line of industrial trailer trucks by several additional models. The one shown is designed for use in narrow aisles and for turning sharp corners. The bottom view shows the method used to steer with all four wheels. The truck is made in three stock sizes,



W. & I. TRAILER TRUCK

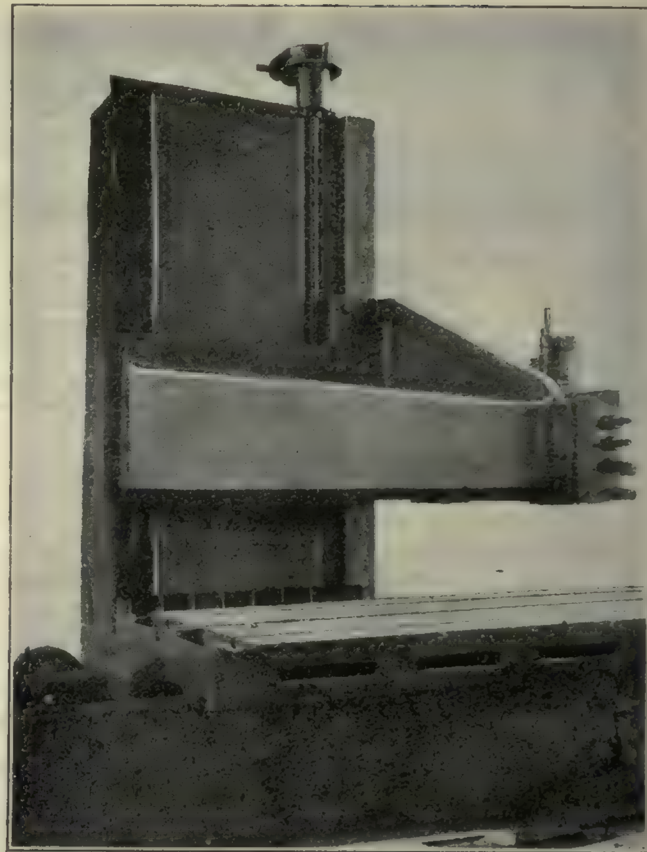
with capacities of two, three and four tons respectively. The 30 x 72-in. size has 12 x 3-in. wheels and will turn in a 4-ft. circle. The 40 x 120-in. size requires a 6-ft. circle to make the turn and has 14 x 3-in. wheels.

The truck is suitable for heavy and bulky materials and for trailing over rough floors and pavements. It can be towed from either end, an advantage when it is necessary to pull it out loaded from congested quarters. The castings throughout are of heavy pattern, and the iron wheels are furnished with or without rubber tires as required. All four wheels are equipped with Hyatt roller bearings.

Patch Open-Side Planing Machine

The F. R. Patch Manufacturing Co., Rutland, Vt., manufacturer of stone-working machinery, has of late years undertaken the manufacture of metal-working planing machines of both the open-side and double housing types. The cut illustrates a late model of the 48-in. open-side type and shows the structure of the crossrail and strut. The crossrail is of heavy box pattern with a bearing of 3 ft. on the front of the post and 2 ft. 3 in. at the rear. A feature in this connection is the corner grip on the housing for the rail brace, this holding the crossrail securely without impairing the alignment in any way.

The table is of the double-deck box type with stake holes drilled through the top deck only, and with openings at the sides for removing the chips. Three T-slots are provided; also four rows of 1-in. stake holes, spaced 1 in. apart each way. The advantage claimed for this type of table is that chips are entirely excluded from the ways. The drive consists of one pair of wide-faced spur gears, which are totally inclosed and submerged in



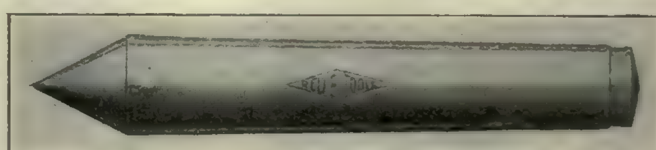
PATCH OPEN-SIDE PLANING MACHINE

Specifications: Planes, width, 48 in.; height, 48 in.; table length over all, 15 ft. 6 in.; width, 44 in.; length of bed, 23 ft. 4 in.; down feed, 9 in.; floor space length, including table travel, 32 ft.; maximum height under rail, 50 in.; horsepower required, 15 to 25; crossrail motor, 2 hp.; net weight of machine, without motor, approximately 40,375 lb.

oil, and one of which is direct connected to the spiral gear that engages the table rack. The entire drive mechanism is confined within the limits of the machine; the thrust bearing is on the outside of the bed and consequently is easily accessible. The spiral-gear bearings and oil reservoir inside the bed are piped to filler connections outside and the table need not be moved when filling them.

"Red E" High-Speed Lathe Centers

Lathe centers pointed with high-speed steel are being marketed by the Ready Tool Co., Bridgeport, Conn. The high-speed-steel point of each center is electrically welded to the nickel-steel body and extends back about one-quarter of the length, which is all that can be used

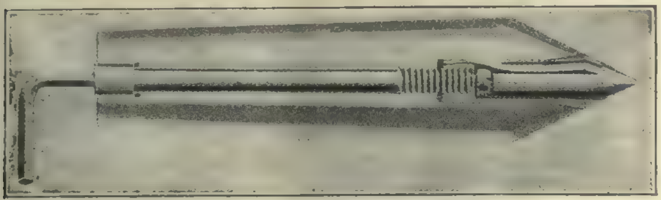


"RED E" HIGH-SPEED LATHE CENTERS

during the life of the center. The advantages claimed for these centers are long life; no tendency to burn or freeze to the work, and that a machine equipped with them can be run faster and more steadily. The center is made in all standard sizes and tapers, suitable for lathes and grinding machines.

Senn Improved Center

The Senn Tool and Machine Co., 90 Shelby St., Detroit, Mich., has introduced a center of the type illustrated that is suitable for a lathe or grinding machine. The body of the center is made from machinery

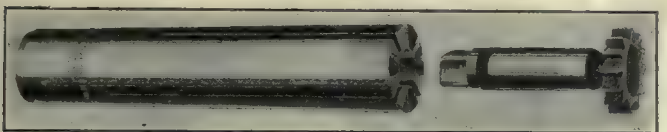


SENN IMPROVED CENTER

steel and is carbonized. The outside taper and collet hole are both ground to size. The collet is made from tool steel and is hardened and ground. The screw is of cold-drawn steel and is cyanided. The center point is of high-speed steel and is heat-treated. A small socket wrench is furnished with each center. The center is manufactured in all standard sizes and tapers, and the parts are said to be interchangeable.

"Wear Ever" Chucks and Cutters for Woodruff Keyways

Scully-Jones & Co., Railway Exchange Bldg., Chicago, Ill., is marketing collet chucks and keyway cutters of the type shown in the illustration. The combination is



"WEAR EVER" CHUCKS AND CUTTERS FOR WOODRUFF KEYWAYS

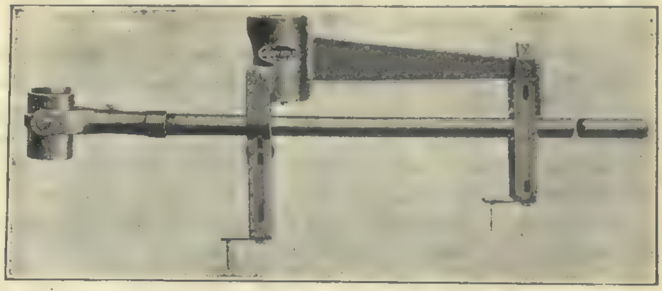
designed especially for the milling of keyways for Woodruff keys. The chucks are hardened and ground and can be furnished to fit all standard tapers. The Woodruff cutters have squared shanks and are furnished in all standard sizes to fit Woodruff keys.

"Liberty" Bottom Riveting Rig

The riveting rig illustrated is a useful accessory to a pneumatic riveter when driving rivets in the bottom of ships. It is a product of the Liberty Tool Co., Munsey Bldg., Baltimore, Md. When used for ship riveting it is attached to the ship's bottom by a single bolt that passes through the center swivel bracket. The riveter is held at the end of the radius arm in the cylinder bracket which is supported in a yoke and adaptable to any make of riveter. When placed in the bracket it is held securely by a neck ring that is fastened by set screws. It rests upon a coil spring that is inside of the bracket, this being for the purpose of holding the riveting hammer against the rivet. The round radius arm is supported at two points upon convex rollers which are mounted in crossheads. These may be screwed up or down by the crank handles at the ends of the brackets.

The operator is not required at any time to support the weight of the riveter, as it will slide the full distance allowed by the radius arm and will cover all parts of a 20-ft. circle. The riveter has a full universal movement; also a vertical adjustment of six inches. The latter is necessary when riveting the keel plate which projects about 1¼ in. below the ship's bottom.

At the sides, stern and bow where the bottom turns up to the shell, the universal adjustment feature allows

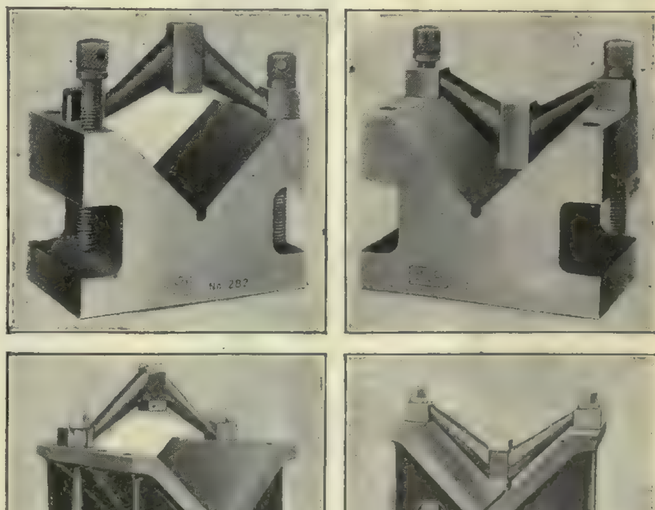


LIBERTY BOTTOM RIVETING RIG

the hammer to be set at the proper angle to drive rivets not on a straight line with the bottom. The device ordinarily works on a radius of 10 ft. and is operated by one man, but another man is of course required on the inside of the ship to hold against the rivet. The yoke on the end of the radius arm is tapped for 1½-in. standard pipe so that it can be equipped with any length of radius arm that may be required between shores under ships. A full-length radius arm is furnished with each rig.

Taft-Peirce V Blocks

The Taft-Peirce Manufacturing Company, Woonsocket, R. I., has introduced a line of V-blocks for machine-shop use. These are made in two styles, as illustrated; the solid type in the 4-in. size and the skele-



TAFT-PEIRCE V-BLOCKS

ton type in the 6- and 8-in. sizes. These three sizes are intended to meet all conditions met in shop practice.

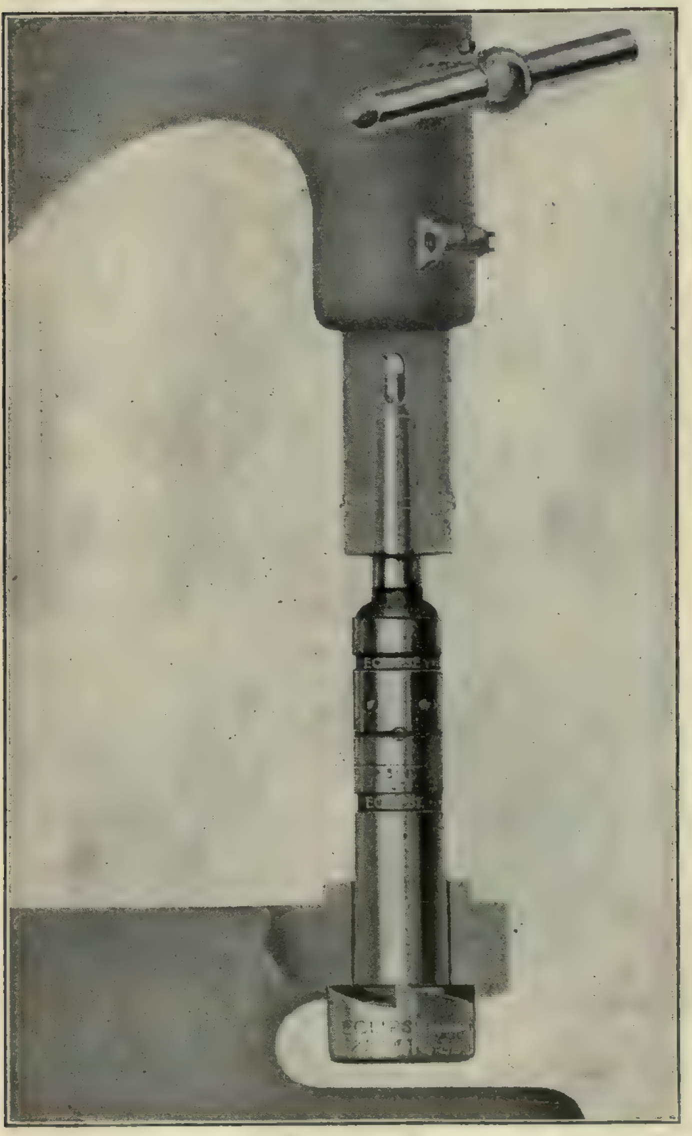
The blocks are furnished in pairs. In each case the

V is central with the sides. The 4-in. block is made of tool steel, hardened and ground on all external surfaces. The sides are undercut in such a way as to permit the use of clamps for holding the blocks in place. The 6- and 8-in. sizes are provided with a slot in one end and in the base, as well as one bolt hole in the base and one in the end, for the purpose of clamping the blocks in place.

Both types of blocks are equipped with clamps of novel design. One end of the clamp is open toward the end while the other end is open toward the side. This permits the clamp to be swung out from under the screw on one end, and then pulled away from the screw on the other end without turning the screw more than a few turns. The clamps are so designed that they may be used either side up, thus giving wider range to the size of work that can be held in the block, as well as decreasing the amount of adjustment necessary with the clamping screws. All blocks are equipped with four clamping screws and two clamps.

"Eclipse" Interchangeable Counterbore

The counterbore illustrated serves a double purpose, as it can be used for either counterboring or back-counterboring. The holder provides means for quickly changing cutters and pilot shanks without removing the holder from the machine. These counterbores are furnished with either straight or taper shanks. The shanks are left soft so they can be fitted to the spindles or chucks of the machines in which they are to be used. The cutters are made of high-speed steel. The pilot shanks are made of machinery steel and are pack-hardened and ground. The lengths of the pilots vary from 3 to 6 in., according to the diameter. The diameter of the pilot section is ground from 0.004 to 0.010 in. under the size stamped on it. The cutters include all standard sizes from ½ to 5 in. and the pilot shanks range in size from ¼ to 2½ in. in diameter. Special sizes are furnished when required. This line of tools is the product of the Eclipse Interchangeable Counterbore Company, Inc., Detroit, Mich.



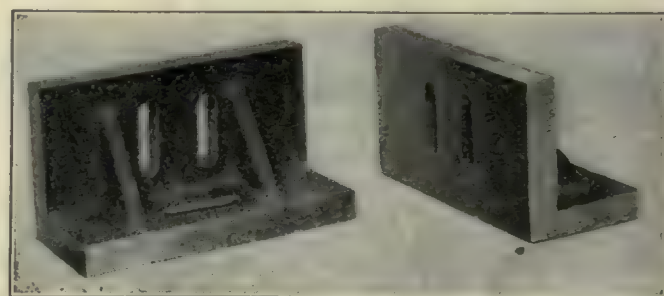
ECLIPSE INTERCHANGEABLE COUNTERBORE

Taft-Peirce Slotted Angle Irons

The Taft-Peirce Manufacturing Company, Woonsocket, R. I., has standardized a set of angle irons for the following series of sizes:

First Angle	Length (Inches)	Second Angle
4	5	5½
6	6	8
4	9	5
8	10	12
5	12	6
9	12	10
12	16	14

These slotted angle irons are especially designed for use on milling, planing, boring, and drilling machines. The combination of dimensions has been selected to meet as wide a range of conditions as possible with a minimum number of sizes.



TAFT-PEIRCE SLOTTED ANGLE IRONS

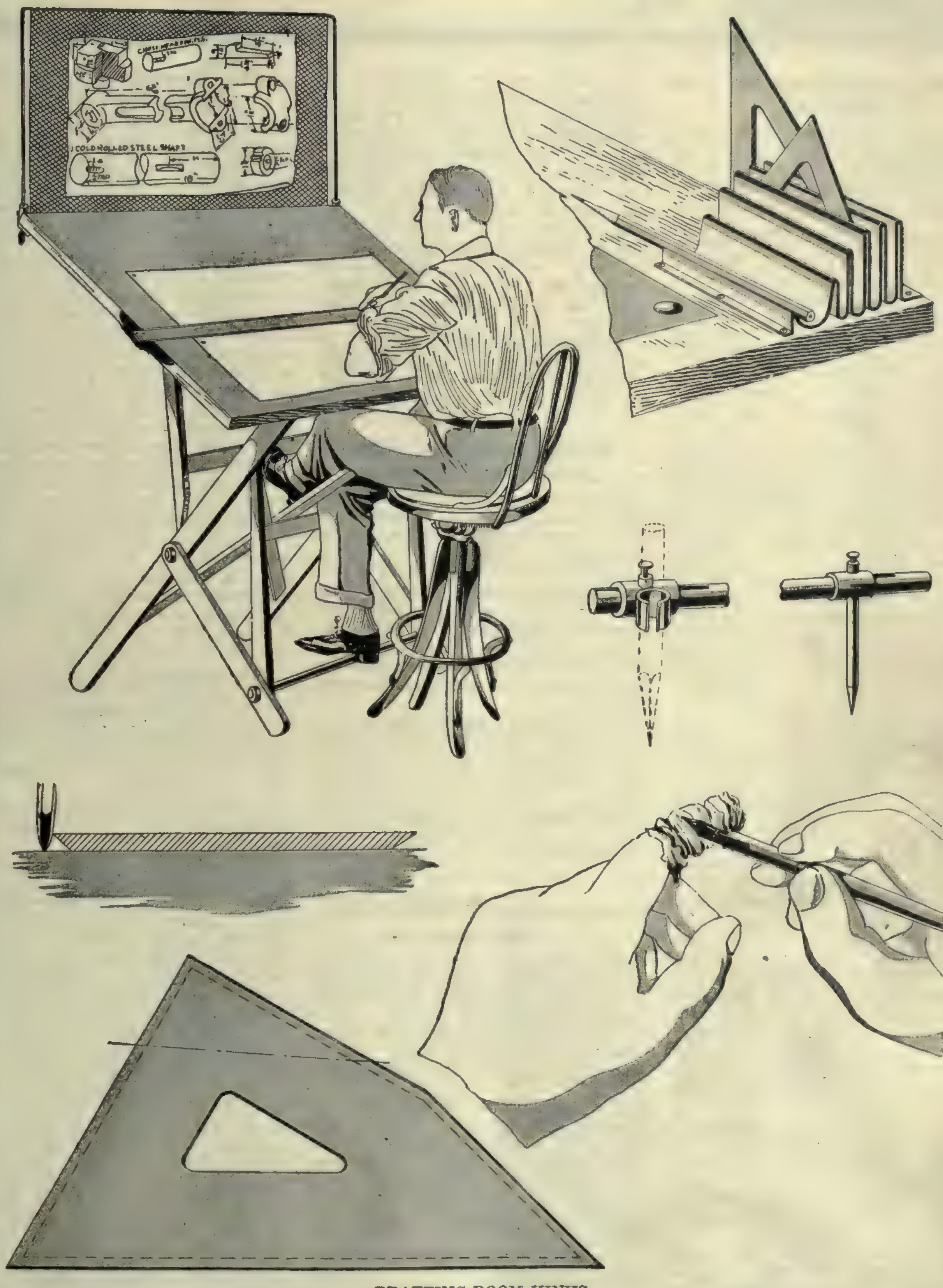
Slots are provided clear through both faces, the slots being located at right angles to one another. The webs are cast well back from the edge, and therefore do not interfere with the use of clamps. The faces are accurately finished so as to be square with each other. In the small sizes the angles are ground and in the large sizes they are planed.

Snow & Petrelli Reversing Gear

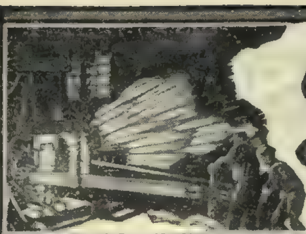
In the article entitled "Snow & Petrelli Reversing Gear," on page 897, Vol. 51, it was incorrectly stated, "the gear is built in four sizes with capacities ranging from 9 to 52 hp., according to size." It should have been "the capacities range from 9 to 52 hp. per 100 r.p.m." This error apeared also in the Condensed Clipping Index, page 268c, Vol. 52. We request all of our readers who intend keeping their copies for reference to make this change.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



DRAFTING-ROOM KINKS



Sparks from the World's

By E. C. Porter,

Mohawk Valley Engineers' Club Organized

On Wednesday evening, Jan. 7, 1920, about 125 engineers, architects and chemists gathered at a dinner at the Hotel Utica, Utica, N. Y., and organized the "Mohawk Valley Engineers' Club."

The membership of this club includes mechanical, civil, chemical, electrical, mining, textile, heating and ventilating, automotive and all technical engineers and architects. The club will have regular monthly meetings on the first Tuesday of each month, and special meetings intermediate between these times will be selected. The officers for the first year are: Byron E. White, president, engineer, Utica Gas and Electric Co.; Hubert E. Collins, first vice president, consulting engineer; Roy F. Hall, second vice president, division engineer, State Highway Department; Horace B. Sweet, third vice president, consulting engineer; Frederick E. Beck, secretary, engineer of Consolidated Water Company; Clifford Lewis, treasurer, civil engineer.

The territory embraced by the activities of the club includes a radius of approximately forty miles from Utica and it is expected that the membership of the club may reach the 200 mark.

Engineering Research Vacancies at the University of Illinois

To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois maintains fourteen research graduate assistantships in the Engineering Experiment Station. Two other such assistantships have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $500 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics, or applied chemistry.

An appointment to the position of research graduate assistant is made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the degree of Master of Science will be conferred.

The Engineering Experiment Station, an organization within the College of Engineering, was established in 1903 for the purpose of conducting investigations in the various branches of engineering, and for the study of problems of importance to engineers and to the manufacturing and industrial interests of the State of Illinois. Research work and graduate study may be undertaken in architecture, architectural engineering, ceramic engineering, chemistry, civil engineering, electrical engineering, mechanical engineering mining engineering, municipal and sanitary engineering, physics, railway engineering, and theoretical and applied mechanics.

Additional information may be obtained by addressing the director, Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Machine Company Building Homes for Employees

The New Britain Machine Company, New Britain, Conn., is contemplating the construction of ten houses on the company's property near the factory being used for the manufacture of shop fixtures. It is probable that work will be started this spring, immediately after the completion of the five homes which were started some months ago. They are two-tenement frame buildings and the additional homes will be on the same plan.

The company's purpose in erecting homes near the factory is to provide rents for the families of the employees. It is the company's intention to rent the homes as soon as they are ready, and if the employees want to purchase their own home they will be allowed to do so on easy terms.

Surplus Material Sold by Navy Department

The sales board of the Navy Department during January, 1920, sold $13,975,272 of surplus material and equipment, according to the monthly report of the chief of the sales section. For the twenty-six working days of January, the sales averaged $499,068 a day.

Included in the transactions for January was the sale of about $27,000 worth of condemned material taken from ex-German ships. In addition, the Navy sold large quantities of scrap iron and steel, steam engines, a number of old destroyers, flying boats and airplane engines.

At the rate the Navy has been selling its surplus material it is expected that the entire supply will be disposed of within a year.

The Frasse Steel Company Reconstructs Its Plant

The Frasse Steel Company has completed plans for the reconstruction of its present plant in Connecticut. This new company took over the business of the Peter A. Frasse Company, Jan. 1. The parent corporation was a New York company while the new concern, which markets the greater part of its products in New England, is incorporated under the laws of Connecticut.

The additions to the plant will comprise an extension of the present shop building, which will be 320 x 25 ft., and a building in front of the present office, the first two stories of which will be 175 x 90 ft., while the third story is to be 75 x 90 ft. On the railroad side of the plant there is now a loading platform 320 x 40 ft., which, under the new plans, will be inclosed to provide more storage space for both raw material and for finished products.

The directors of the new Connecticut corporation are: A. E. Brion, president; R. C. Stacy, vice president; Lester Brion, treasurer; R. K. Newman, secretary; Theodore Hager; Arthur B. Mead, and Fred Becker.

Reorganization of the P-W-V Automatic Machine Corporation

The Springfield Automatic Screw Machine Corporation has been organized under the laws of the State of Delaware with a capital of one million dollars to take over all the assets and liabilities of the P-W-V Automatic Machine Corporation.

The main offices and factory of the new corporation will be located in Springfield, Mass. The construction of a new factory building will be started as soon as the weather will permit. The new corporation will retain its present factory in Fitchburg, Mass., for the manufacture of small parts.

The board of directors of the Springfield Automatic Screw Machine Corporation will consist of the following: M. A. Coolidge, chairman of board of directors; Chas. E. Van Norman, president; Frank H. Page, vice president; L. M. Waite, vice president and sales manager; I. T. McGregor of the Commercial Trust Company, Springfield, Mass.; C. J. Wetsel, secretary and general manager; Arthur H. Skinner, president of Commercial Trust Company; H. Douglas Williams of Watson-Williams Company, Boston, Mass.; Ashton Carr, State St. Trust Company, Boston, Mass.; and Alton F. Tupper, attorney, Boston, Mass.

Industrial Forge

News Editor

Contributes $5,000,000 to Scientific Institutions

The Carnegie Corporation of New York has announced its purpose to give $5,000,000 for the use of the National Academy of Sciences and the National Research Council. It is understood that a portion of the money will be used to erect in Washington a home of suitable architectural dignity for the two beneficiary organizations. The remainder will be placed in the hands of the Academy, which enjoys a Federal charter, to be used as a permanent endowment for the National Research Council.

The council is a democratic organization based upon some forty of the great scientific and engineering societies of the country, which elect delegates to its constituent divisions. It is not supported or controlled by the Government, differing in this respect from other similar organizations established since the beginning of the war in England, Italy, Japan, Canada and Australia.

The council was organized in 1916 as a measure of national preparedness and its efforts during the war were mostly confined to assisting the Government in the solution of pressing war-time problems involving scientific investigation. Reorganized since the war on a peace-time footing, it is now attempting to stimulate and promote scientific research in agriculture, medicine, industry and in every field of pure science.

Joint Meeting on Aluminum

G. M. Rollason of the Aluminum Manufacturers, Inc., read a paper on "Alloyed Aluminum as an Engineering Material," on Tuesday, Feb. 10, before a joint meeting of the American Society of Mechanical Engineers, Metropolitan Section; Society of Automotive Engineers, Metropolitan Section; and the New York Section of the American Institute of Mining Engineers. The paper was illustrated by lantern slides showing charts, microphotographs and a few applications of the alloy to automotive parts.

Among other things brought out were the high tensile strength after heat treatment of the alloy known as "Duralumen," its remarkable resistance to fatigue and its low specific gravity compared to the steel drop forgings which it can replace for certain work.

Lawrence Addicks of the Mining Engineers presided; and, upon the conclusion of the main paper, called upon Mr. Pack, of the Doehler Die-Casting Co., for a few remarks on the die-casting of aluminum, and on Mr. Trewin, of the New Jersey Zinc Co., for information on the alloying of aluminum and zinc. Mr. Pack pointed out the difference between die-casting and casting from permanent molds and remarked that the development of aluminum die-casting dated from the outbreak of the war. He had a number of interesting samples of the work of his company ranging from a Lewis gun part to one for a milk separator.

Mr. Favary of the Automotive Engineers mentioned some of the factors to be taken into account in the design of internal combustion engines using aluminum alloy pistons and connecting rods.

Questions from the floor concerning the welding and soldering of aluminum were answered by Dr. Blau of the Aluminum Company of America. He said that so far as he knew electric welding had not been successful but that gas welding by any of the well-known methods would produce good results after the acquisition of a certain amount of technique by the operator. As to soldering there were several compounds on the market that would stick two pieces of aluminum together but the difficulty was to keep them together as the joint was very susceptible to electrolytic action.

Belgium's Industrial Recovery

In a recent booklet on the subject of Belgium's industrial recovery, D. L. Blount, recently director-general of the Central Office of Information, Ministry of Economics of Belgium, places the following estimates on resumption of industry: Coal mines, 94 per cent normal; refined sugar, 100 per cent; cotton spindles in operation, 75 per cent; cotton looms, 60 per cent; wool products, 75 per cent; shoes, 70 per cent; window glass, 34 per cent; plate glass, 36 per cent; steel mills, 30 per cent, while twelve blast furnaces are now producing 10 per cent of the output of the fifty-four blast furnaces in operation before the war.

Of the machinery taken away during German occupation, 5,069 pieces out of 9,797 have been recovered. The agricultural production in 1919 surpassed the average for the years just preceding the war, the yield of wheat, oats, barley, and rye having been particularly good. In the light of the unfavorable reports current in the newspapers regarding conditions abroad, this showing of Belgium is very encouraging. It warrants the hope that a return to normal will not be so long deferred as we have been led to expect.

First Annual Mechanical Inspection Exhibition

The first annual exhibition of mechanical inspection equipment was held on the Hotel Astor roof, New York City, Feb. 2 to 6, inclusive, 1920. Attendance at a very interesting collection of exhibits was somewhat limited by the severe weather and traffic tie-ups. Those who went, however, were well repaid for their efforts.

Exhibits were presented for inspection by United States Bureau of Standards, American Society of Mechanical Inspectors, William Brewster Company, Inc., Coats Machine Tool Company, Inc., College of the City of New York, Greenfield Tap and Die Corporation, Holz and Company, Incorporated, Inspection Engineering Equipment Company, C. E. Johansson, Incorporated, Arthur Knapp Engineering Corporation, New York Testing Laboratories, Pratt & Whitney Company, Shore Instrument and Manufacturing Company, Inc., The Inspector Publishing Company, The Industrial Press Publishing Company, West & Dodge Manufacturing Company, Wilton Tool and Manufacturing Company, Jones & Lamsen Company.

The Machine Outlook in Mobile

The effect of the increased prices of machine tools has, according to dealers in the Mobile district, almost shut off the demand for them in this locality. There being no machine manufacturing the uses were for the repairing of other machinery such as saw mills and the various kinds of ship repairs.

The large saw mills in many cases had quite complete repair shops for handling their own breakdowns and replacements. A lathe, shaping machine, drilling machine and sometimes a radial drilling machine were to be found in almost all saw mills, while the larger mills added to these an occasional planing machine and perhaps two or more lathes.

This equipment is, however, not being added to at present prices. If their own repair shops cannot handle the breaks, the piece is sent to some repair shop which can—not that these shops have any new equipment, but simply more of it, and the saw-mill man does not know how poor its condition may be. Machine tools never wear out—they get old and loose in the joints (instead of stiff as with a human) and the length of time they can be run depends on the sensitiveness of the user. True, they can be rebuilt and rebushed and this is sometimes done. Usually, how-

ever, they are kept too busy to be repaired or the time never seems to come when it can can be done.

Ship building and ship repair demanded and secured quite an addition to the machine equipment of this section. This leaves the shops engaged in that line of work in good condition to handle the work that is coming from all parts. This includes oil tankers of the various companies which trade in Mexico and Texas; and, at this writing, a Dutch tug with a Chinese crew, all the way from Ceylon, is tied up for extensive overhauling. She towed a barge to Tampico and then ran to Mobile for repairs.

Local dealers do not see much of a market for machine tools in this section as long as present prices prevail, or until the need becomes imperative from various causes. General business, however, is excellent and they see no sign of a let-up during this year at least. As long as the machine-tool men are behind with their orders, the lack from this section, which is small at best, is not likely to prove very serious. The railroad shops in this section are sadly in need of new machinery. But this has been true for so long that it has become a habit and cannot be ascribed to war conditions in any way. Wheel lathes that date back forty years are not just the best equipment to handle the large drivers of the present day.

Automobile repair shops would seem to offer quite a field for a lot of small machinery. But a visit to a few of them soon dispels this illusion. With the exception of the Ford service stations, which require a minimum of repair equipment, the average garage repair shop might almost as well have been in the Garden of Eden.

An oxy-acetylene outfit, which is of course modern, a decrepit drilling machine and a few files and wrenches seem to complete the average outfit. Scored cylinders are filled by the oxy-acetylene torch and after a half-round file gets off most of the surplus metal, an old piston, split so as to expand readily, serves as a lap. The Fairbanks Company has a special department for garage machinery and appliances, which may improve these conditions, but they are not alluring to the average machine builder at the present time.

This is not a country of machine-tool equipment and the field does not promise much expansion in the near future.

Industrial Review of English Conditions

A year ago there seemed a very good prospect of numerous new models of tools which had been lying dormant making their appearance within a measureable time. As a matter of fact very few of them have made their appearance. Machinists were fully occupied as long as they could get castings in trying to overtake the demand for standard tools. The enforced idleness due to the molders' strike, so far from being available for giving concrete form to new ideas, has further postponed developments, for it is not possible to make much progress without the help of the foundry.

The hitches in the negotiations which prevented preparatory work being put in hand at the deserted foundries when the year opened have added seriously to the difficulties of the position. If saner counsels had prevailed when the negotiations were re-opened the foundries might have been in full swing again by this time, but much work remains to be done now before anything like capacity production can be restored. All the normal activities cannot be suspended for four months without involving a great deal of repair work, to say nothing of the preliminaries which in any case are necessary to bring the plant back into operation. Meanwhile the hold-up in dependent industries grows more disastrous. There are a lucky few who have not used up all their stocks, and light castings have been obtainable to a limited extent from the foundries which were not quite closed down by the strike, but it has been impossible to make any general progress. Makers of small machine tools could get heads and sometimes a few beds, but these were not of very much account without the legs and pans. In the same way the automobile factories could get some details, but they could not balance with cylinders and pistons, and though firms persevered in their endeavors to keep down unemployment to the minimum it was a very doubtful advantage from a production point of view, for it will entail uneconomic makeshift expedients till castings are forthcoming to redress the inequalities. Good progress is being made with a further extension of Taylor & Challen's establishment, Birmingham, the large block abutting on Constitution Hill and Henrietta St. now being built upon providing a considerable amount of additional floor space. Buck & Hickman, Ltd., Birmingham, will shortly remove on expiration of lease from the premises it has occupied in Station St. to a site in Newton St. The National Projectile Factory, at Dudley, has been acquired, by private treaty, by the firm of Harper Bean, Ltd., which will equip it for automobile work and general engineering in connection with its scheme for a united system of production embracing almost all departments of automobile construction, from raw material up to the complete machine. The factory with its equipment costs nearly a million pounds. Most of the plant has been disposed of under the hammer. With regard to the National Factory, at Blackheath, for which conditional offers were made by several engineering firms, it is now in contemplation to devote it to training disabled soldiers.

Among the new factories which are being built in Birmingham are several which are to be devoted to the extension of the jewelry industry, and firms like Brown and Ward, Ltd., have a number of orders on hand in this connection, production in certain branches of the jewelry trade being in process of re-organization on new lines in which machinery will play a prominent part.

The Best Land

**If I knew a better land on this glorious world of ours
Where a man gets bigger money and is working shorter hours,
If the Briton or the Frenchman had an easier life than mine,
I'd pack my goods this minute and I'd sail across the brine;
But I notice when an alien wants a land of hope and cheer
And a future for his children he comes out and settles here.**

**Here's the glorious land of Freedom! Here's the milk-and-honey goal
For the peasant out of Russia, for the long-subjected Pole;
It is here the sons of Italy and men of Austria turn
For the comfort of their bodies and the wages they can earn,
And with all that men complain of and with all that goes amiss,
There's no happier, better nation on the world's broad face than this.**

**So I'm thinking when I listen to the wails of discontent
And some foreign disbeliever spreads his evil sentiment
That the breed of hate and envy that is sowing sin and shame
In this glorious land of Freedom should go back from whence it came,
And I hold it is the duty, rich or poor, of every man
Who enjoys this country's bounty to be all American.**

Three Worcester Firms Maintain New York Headquarters

The Reed-Prentice Co. and the Whitcomb-Blaisdell Machine Tool Co. of Worcester, and the Becker Milling Machine Co., Hyde Park, Mass., are maintaining headquarters for their export business at 24 Stone St., New York. The Reed-Prentice Co. is sending abroad its lathes and drilling machines, the Whitcomb-Blaisdell Co. its engine lathes and planing machines, and the Becker Co. its line of milling machines.

Trade Currents From New York and Cleveland

New York Letter

The first two weeks of February ended with all lines of machine tools active, and the dealers enjoying a run of exceptionally good business.

As the machine-tool export center, New York is watching closely the fluctuations of the exchange market. Since the sharp decline of sterling last week, machine-tool exports—except to South America and the Far East—ceased abruptly, and will remain inactive until rates better themselves.

Some exporters see so little hope of improvement in the situation that they are recalling their foreign representatives. Still others are cancelling European agencies, and turning attention to the countries whose exchange is quoted favorably.

With the approach of spring, the shipyards are coming into the market for various tools. Pneumatic equipment leads the inquiries with plate-making equipment second. Most shipyards in the New York district have contracts for all the tonnage they can care for.

The great blizzard last week was a factor in slowing up deliveries of machine tools. This, together with freight embargoes, practically halted machine-tool deliveries in and about New York for over a week.

Some increase in the demand for used machine tools has been noted on the part of consumers who heretofore bought nothing but new equipment. Dealers ascribe this to slow deliveries of new tools, and now state that even slower deliveries will be the rule from now on. Six to nine months is considered good in most lines.

There is no change in the characteristics of orders. Single tools still make up the bulk of the machine-tool business. One concern, however, bought twenty-five tools in one order, and another took fifteen.

The next two weeks promise to have a quiet tone, and a big change in the market has been predicted for the early part of March by dealers who have been closely in touch with the situation.

Cleveland Letter

Markedly unsettled conditions have developed in the Cleveland and Central West machinery trade since official Washington has started the prediction for a slump in prices on commodities. This condition has been augmented still further by the sharp decline in foreign exchange rates, the tightening of credit and the break in stocks.

The result is that the last week finds the machinery interests in a quandary as to what the immediate future will bring forth, and the older members of the trade are disposed to compare present conditions with those that preceeded the financial upheaval in 1907.

The most significant factor making for this contention is that sales representatives both at home and in the field already feel the hesitancy that made its first appearance in this locality late in January. They report that many orders remain unfilled, although there is the consolation that they are not being cancelled. It is admittedly too early to know just what the break in the foreign exchange rates will mean for the machinery industry and all export business, for that matter. Nevertheless in some firms advices have been received from representatives, who have been abroad looking over the European fields, stating that they are coming home, seeing no good in remaining away at this time. The first-handed information they will bring with them is expected to offer a working basis on early future operations here.

Latest figures by the Federal Industrial Census will show that Cleveland leads the world in the production of automobile parts, exceeding even Detroit, and in addition that it is turning out 100,000 completed automobiles each year. A large number of cars are being made in Cleveland and assembled in Detroit, according to Dale Brown, secretary of the Automotive Association of the Cleveland Chamber of Commerce.

V. C. Kylberg Resigns from Machine-Tool Section of War Department

V. C. Kylberg, former assistant chief of the machine-tool section, Office of the Director of Sales, War Department, resigned from that position Feb. 1 to become associated with a large machine-tool concern in an executive capacity.

Coming to the machine-tool section in March, 1919, when it was first organized to dispose of large quantities of machine tools owned by the War Department and which had been declared surplus, Mr. Kylberg was largely responsible for many of the policies and practices adopted by the section which later resulted in large Government sales of machine tools.

At the time of his resignation, he was handling the sale of machine tools to educational institutions as prescribed by the Caldwell Act.

Although Mr. Kylberg's successor has not yet been announced, it is probable that J. M. Bowlby, acting chief of the section during the absence of A. A. Fuller, chief, will be selected to fill the vacant position.

Changes Back to Old Name

The Cleveland Osborn Manufacturing Co., Cleveland, Ohio, manufacturer of industrial brushes, brooms and foundry molding machines, has changed back to its old name, the Osborn Manufacturing Co. The main office and factory are located at 5401 Hamilton Ave., Cleveland, Ohio. Branch offices and warehouses are maintained in New York, Detroit, San Francisco, Milwaukee and Chicago.

Applications for Machine Tools from Educational Institutions

About 800 applications have been received by the Office of the Director of Sales, War Department, from educational institutions in the various states, which are entitled to purchase machine tools from the Government under the Caldwell Act.

Applications have been received from every state, in addition to the District of Columbia and Hawaii. California is leading the states in the number of applications, while New York ranks second and Pennsylvania and Washington are tied for third place.

The number of educational institutions in each state which have already made application to the Director of Sales for machine tools are:

Alabama	13	Nevada	3
Arkansas	10	New Hampshire	7
Arizona	6	New Jersey	21
California	92	New Mexico	11
Colorado	8	New York	74
Connecticut	14	North Carolina	4
Delaware	2	North Dakota	9
Florida	6	Ohio	59
Georgia	9	Oklahoma	7
Idaho	5	Oregon	5
Illinois	21	Pennsylvania	62
Indiana	16	Rhode Island	3
Iowa	13	South Carolina	7
Kansas	28	South Dakota	3
Kentucky	7	Tennessee	10
Louisiana	3	Texas	13
Maine	3	Utah	3
Maryland	3	Vermont	2
Massachusetts	37	Virginia	15
Michigan	30	Washington	62
Minnesota	15	West Virginia	6
Mississippi	2	Wisconsin	25
Missouri	8	Wyoming	6
Montana	7	Dis. of Columbia	11
Nebraska	5	Hawaii	1

A Menace to American Industry

We are doing everything we can think of to bring home the meaning of compulsory metric legislation to the average American. We have commented editorially, we have printed many strong letters from leaders of the machine tool industry and we have sent reprints of these broadcast. In this issue is a cartoon insert which emphasizes the danger in a cruder, more spectacular and perhaps more telling way. We have not bound it in so that it can be put up in a prominent place to spread its message to all beholders.

Westinghouse Opportunities for Technical Graduates

Westinghouse opportunities for technical graduates are explained in an illustrated pamphlet bearing that title, recently issued by the Westinghouse Electric and Manufacturing Company.

This booklet describes the plan which has been developed by this company for the training of the graduates of technical schools at all of its various works. In the booklet is included a list of Westinghouse men who originally entered the company as graduate students, as well as a list of schools from which students have entered the employ of the company.

Copies of the booklet will be sent to anyone interested on application to the educational department of the company at East Pittsburgh.

Business Items

The Risdon Tool and Machine Company, Naugatuck, Conn., has changed its name to the Risdon Manufacturing Company; there is no change in the personnel of the company.

The Lambert & Co., Mexico City, has been appointed representative of the Hart-Parr tractor for Mexico. The Hart-Parr Company recently made a carload shipment of tractors to the Lambert Company.

The Lindstrom Tool, Die and Gage Works, Inc., 50 Silliman Ave., Bridgeport, Conn., has changed its name to the Lindstrom Tool and Toy Co., and will manufacture its tools, gages, dies, etc., in the same plant.

Bennett and Seeley, Inc., Bridgeport, Conn., has been organized to deal in mill and foundry supplies, etc. The incorporators of the new company are F. A. Bennet and E. B. Seeley. The capital of the concern is $50,000.

The Sherritt & Stoer Co. has announced the opening of its new office, storeroom and warehouse at 2006-2008 Market St., Philadelphia, Pa., where it will maintain an exhibition of machine tools, railway and machine-shop equipment.

B. J. McBride, George B. McClennen and Andrew I. Meahan have purchased the business of the Delta Electric Co., Philadelphia, Pa., and will conduct a business of buying, selling and repairing electric motors and generators and will develop departments for new and used boilers and machine tools.

The Fairbanks Co., Broome and Lafayette Sts., New York, has been given the distribution of the Lincoln electric motors for industrial purposes. This line includes alternating-current motors for two- and three-phase circuits in capacities from ½ to 500 hp.; also direct-current motors from ½ to 150 horsepower.

The Tacony Steel Co., Philadelphia, Pa., has announced the opening of a Chicago office which will be located in the Marquette Building. Frank B. Millwick, formerly with the Bethlehem Steel Company and the Crucible Steel Company, will be district sales manager for this branch. Mr. Millwick is a member of the American Steel Treaters' Society.

The Peerless Foundry and Machine Co., of Atlanta, Ga., is moving to Chattanooga, Tenn., where, it is understood, that this company will establish a foundry and machinery plant. The company has rented quarters for the present but makes the announcement that it intends to build a plant of its own in the near future. F. L. Marco is the president of this company.

The Lilliston Harvester Co., Albany, Ga., has been incorporated by J. H. Lilliston, Suffolk, Va.; C. J. Rambo and J. M. Webb, both of Edison, Ga. It is understood that this company will establish a plant at Albany for the manufacture of peanut pickers, and will also operate in connection with this plant a machine shop and foundry. It is announced by the company that it will later manufacture gasoline engines and thrashing machines.

The Road Gripper Tire and Rubber Co. will locate in Mason City, Ia. This company was recently incorporated under the Minnesota State laws by F. W. Bozendahl, president, and Fred. Trahms, secretary. This company will give employment to about 300 men. For the present it will occupy a part of the former Colby motor plant and will manufacture automobile tires, inner tubes and rubber heels.

The Service Engineering Co., 25 Church St., New York City, has been incorporated under the laws of New York State. This company will conduct a general engineering service business and will specialize in the design of tools, jigs, fixtures and methods for interchangeable manufacture of motor cars, motor trucks, typewriters, adding machines, etc. The officers of the new company are: Albert A. Dowd, president; Donald A. Baker, vice president; Fred. E. Rogers, treasurer, and Thomas P. Orchard, secretary.

The J. T. Tractor Co., Cleveland, Ohio, manufacturer of the J. T. Tractor for agricultural and industrial purposes, has completed the first unit of its new factory at 1515 Fairfield Ave., Cleveland, Ohio. A 15,000-sq.ft. assembly plant and other buildings have been completed and a 58,000-sq.ft. machine shop is under construction. The officers of the company are: Fred R. Fuller, president; J. J. Tracy, vice president and chief engineer; C. E. Grove, secretary and sales manager; E. W. Stevens, treasurer; A. B. Saborsky, production manager.

Personals

ROBERT G. PILKINGTON, Chicago, Ill., has been appointed experimental engineer for the Wahl Co., Chicago, Ill.

H. G. STEPHENS has resigned as Eastern manager of the Republic Creosoting Company and has accepted a position with the Alignum Company.

A. S. WINTER, formerly advertising and sales manager for the Wm. Powell Co., has resigned to accept a position with the sales force of the Fairbanks Co., Pittsburgh, Pa., and will represent this company in southern Ohio.

RICHARD J. JACKER has resigned as designing engineer for the Stewart Warner Speedometer Corporation, Chicago, and will associate himself with the American Coke and Chemical Co., as designing mechanical engineer.

JOHN A. RATHBONE, formerly connected with the Wasson Piston Ring Co., Plainfield, N. J., and inventor of the Rathbone multiple molding process is now associated with the H. M. Lane Co., industrial engineers, Detroit, Mich. Mr. Rathbone will assist in general foundry layout work and foundry equipment arrangement.

JOHN CLYDE OSWALD, president of the Oswald Publishing Company and publisher of the *American Printer*, is also associated with the Preston Trading Co., 33 West 42d St., New York City, as vice-president. Mr. Oswald has also been elected president of the National Paper Trades Exchange, a subsidiary company publishing *Paper and Ink*.

A. A. ROELOFS, formerly special representative of the Precision and Thread Grinder Manufacturing Company in the Ohio territory, has been advanced to the position of manager of the Chicago office. The Precision and Thread Grinder Manufacturing Company, Philadelphia, Pa., manufactures of the multi-graduated precision grinding machines.

N. ROCKWELL, formerly Detroit representative of the Republic Creosoting Co., Indianapolis, Ind., has been promoted to the position of Eastern manager of this company and will be located at the Philadelphia office. E. J. Day, of Buffalo, has been placed in charge of the Detroit office and E. E. Bolte has been appointed manager of the Chicago office.

A. R. PETTERSON, formerly with the engineering department of the Osgood Bradley Car Co. of Worcester, Mass., is now acting chief engineer and director of production for the Allen Spindle Corporation, Boston, Mass. Previous to his connection with the Bradley Car Co., Mr. Petterson was president and general manager of the Petterson Engineering and Manufacturing Co., designers and builders of special machinery, tools and jigs.

B. G. KOETHER, after eighteen years of service with the Hyatt Roller Bearing Co., has been promoted to the vice presidency of the organization and will leave Detroit in a short time for Harrison, N. J., where he will have his headquarters, as head of the entire sales and advertising departments of the company. Mr. Koether was assistant sales manager of the company at Harrison, N. J., when he was promoted to sales manager ten years ago and came to Detroit to take up his new duties.

E. I. CHAPIN, for the last few years assistant factory manager for the Brown-Lipe Chapin Company's plant in Syracuse, N. Y., has resigned his position to take active charge of the Chapin & Baker Manufacturing Co., Syracuse, of which he is now manager. Previous to his connection with the Brown-Lipe Chapin Co., Mr. Chapin was with the H. H. Franklin Manufacturing Co., Syracuse. The Chapin & Baker Manufacturing Co., which was organized by Mr. Chapin and his associates some months ago, is manufacturing a line of special tools, including reamers, counterbores, toolholders, etc., and is engaged in jigs, fixture, and general contract work.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

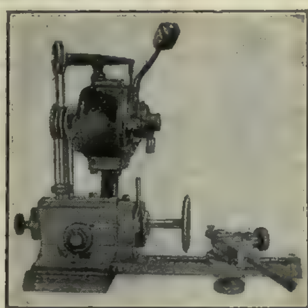
Taper Turning Tool, "Cruban."
Fairbanks Co., Distributors, New York City.
"American Machinist," Jan. 15, 1920.

The tool is designed for use with a hand screw machine, automatic screw machine, or lathe, and is fitted with a straight shank or taper shank as required. It will automatically cut any taper from $\frac{1}{16}$ in. per foot to $\frac{3}{4}$ in. per foot and any length up to 6 in. and it can be furnished to meet greater capacities if desired. The tool is entirely self-contained and is not affected by lost motion in the turret or tailstock.

Pointing Machine, "Namco" Bar.
National Acme Co., Cleveland, Ohio.
"American Machinist," Jan. 15, 1920.

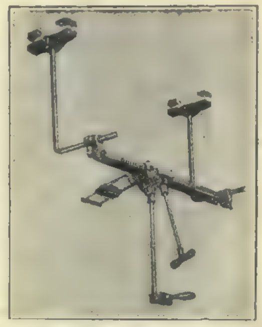
The machine is used to point the ends of bar stock preparatory for screw-machine operations. Being portable, it can be easily removed from place to place where the stock is stored. The revolving cutter head carries a plain cutter that is easily removable for sharpening. A flanged base is provided to prevent the chips from dropping on the floor. When preparing large amounts of stock, two machines operating end to end may be used to advantage; in such a case it would be unnecessary to reverse the bar. The machine is driven by a 1-hp. motor that is complete with switch and all necessary connections. The dimensions of the machine are: length, 4 ft.; width, 2 ft.; height, 4 ft., including motor.

Grinding Attachment, Multi-Graduated Precision.
Precision and Thread Grinder Manufacturing Co., 1932 Arch St., Philadelphia, Pa.
"American Machinist," Jan. 15, 1920.



The wheels are beveled so that they grind on opposite sides of the thread angle. On production work where a large number of duplicate pieces are to be ground, the wheels are set to the thread of the first part. The threads on the following pieces are set to the wheels, provision being made for this by an adjustable dog. After the wheels are once set redressing them does not change their alignment in relation to the thread. A graduated scale is provided for setting the wheel center to the same height as the work center. It is claimed that using two of these machines on thread grinding will result in increased production. In addition to thread grinding a variety of plain grinding, both internal and external, may be done on this machine.

Belt Shifter, Mechanical.
Kremer-Cummins Machine Co., 133 East 55th St., Cleveland, Ohio.
"American Machinist," Jan. 15, 1920.



Designed for use in connection with cone pulleys and operated by means of two handles. Is attached overhead near the cone pulley but is supported by independent brackets that are adjustable to suit conditions. A single piece of channel iron of suitable strength is used to support a sliding carriage that is moved by means of a rack-and-pinion arrangement. The rack is formed by cutting teeth in one leg of the channel, the pinion being attached to the end of a $\frac{1}{2}$-in. shifting rod that can be turned by means of a handle at the lower end. Attached to the carriage is a loop that surrounds the belt. Hence, as the carriage is moved along the channel, the belt is carried with it. A separate shifting rod, made of $\frac{3}{8}$-in. pipe, is used for the belt at the lower pulley.

Steadyrest, Lathe.
Advance Machinery Co., Lower Mosley St., Manchester, England.
"American Machinist" (English Edition), Dec. 27, 1919.

The chief improvement is in the form of the hinge. The cap, instead of being pivoted to the base by projecting lugs, swings on a pin through the medium of an eye-bolt uniform with the front clamping bolt. To enable the cap to be swung over, the rear upper corner of the base is rounded. The cap can be firmly tightened down at the rear as well as at the front, by a simple tightening of the front bolt. After the locknut on the rear bolt is once adjusted by firmly tightening-down the cap with it, no further adjustment is needed until wear takes place. A second improvement consists in the central arrangement of the steady-bars and their nuts. The stresses from the work are resisted directly in the line of force. not by screws disposed at the sides of the bars as is a common construction.

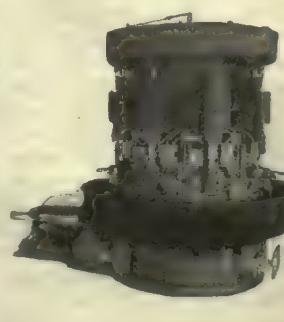
Bender, Hydraulic Plate.
Rice & Co., Ltd., Leeds, England.
"American Machinist" (English Edition), Jan. 3, 1920.

For bending boiler shell plates up to 15 ft. wide by 2 in. thick. The ram cannot be connected direct to the moving beam, owing to unequal thrust, which would occur when a narrow plate was being bent. To give a parallel movement to the moving beam the makers have adopted the lever principle. They claim small fractional loss in the machine, practically the whole power of ram being exerted on plate; power exerted is constant through whole stroke of the beam. Two methods are provided for feeding plates through the dies; one by gripping rollers on the left, the other by revolving drum and wire rope—both actuated by small hydraulic cylinder. Rate of feed is set by a slotted plate connected to cylinder. Feeding is automatic. Stroke of main ram controlled by tappet rod acting on the working valve. Machine is built entirely of steel; has overall length of 22 ft. by 5 ft., is 20 ft. in height.

Drilling and Boring Machine, Continuous.
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," Jan. 22, 1920.

The machine is single-purpose, twelve-spindle and attended by a single operator. The spindles have a vertical adjustment of 8 in., making it possible to take care of the wear on the tools and also to raise the spindle for removal of the tool. Power is furnished to the machine by belt drive to a three-step cone pulley. The spindle head is rotated by a drive from the main shaft through a set of change gears which have further reduction through a worm gear, and this drives a pinion running in an internal gear in the base of the rotating-spindle body. The change gears are provided so that the speed of rotation can be altered if required by the character of the work or the material. The total height of this machine is 8 ft. 6 in. and the diametrical distance from center to center of the work spindles is 48 in., while their chordal center to center distance is $12\frac{1}{2}$ in.

Turning and Facing Machine, Continuous.
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," Jan. 22, 1920.



The machine is single-purpose, has twelve spindles and is attended by a single operator. The machine as set up in the illustration runs with a spindle speed of 75 r.p.m. and has a tool feed of 0.00975 in. per revolution. The spindle speed is judged proper for this particular piece of work and is geared down from a pulley speed of 300 r.p.m. At this speed and feed the total time per cycle of the machine is 3.6 min., or 16.6 revolutions of the spindle head per hour. This gives a rate of machine production equal to 132 completed pieces per hour.

Clip, paste on 3 x 5-in. cards and file as desired

Obituary

MISS KATHRYNE M. HAUN, treasurer of E. F. Houghton & Co., Philadelphia, Pa., engaged in the manufacture of industrial oils and leather goods, died Feb. 9 at her home, 1332 Wagner Ave., Philadelphia, after a short illness from pneumonia. Miss Haun entered the employ of Houghton & Co. to do minor clerical work and when the company was incorporated in 1910 she was appointed treasurer of the company because of her grasp of the company's financial affairs.

HENRY B. BARTLETT, of Bogota, N. J., died Jan. 18, 1920, from pneumonia. Mr. Bartlett was born 1856 in Carbondale, Pa. He began his mechanical experience in 1872 at the old locomotive works in Paterson, N. J., and completed his trade at the Faerel Foundry and Machine Co., Waterbury, Conn. Since that time he has been connected with the Dietrich & Harvey Co., Baltimore, in the manufacture of its open-side planing machines; the Bullard Machine Co., Bridgeport, Conn.; and later with the small-tool department of Pratt & Whitney. In 1896 he went to Berlin, Germany, as general manager of the Ludwig Loewe Co., a large manufacturer of shop tools and machines. Mr. Bartlett returned to America in 1902 and became teacher of tool and machine making at the Hebrew Technical Institute of New York. This position he held for eleven years. At the time of his death Mr. Bartlett was consulting engineer for B. T. Perkins & Sons and their allied paper interests at Holyoke, Mass.

E. FRED. WOOD, formerly vice president of the International Nickel Company, died suddenly on Jan. 5, 1920, in the sixty-second year of his age. Mr. Wood was born in Milwaukee on Aug. 28, 1858. After leaving college he devoted himself assiduously to the study of metallurgy. He entered the employ of the Carnegie Steel Company and rapidly rose to the position of assistant general superintendent of the Homestead plant, which position he filled for a number of years. Upon the organization of the International Nickel Company he became first vice president and a member of the board of directors and of its executive committee. When the United States entered the World War, Mr. Wood resigned his official connection with the International Nickel Company to devote himself to public work, and became a member of the Committee on Production of the War Industries Board, of which committee Samuel Vauclain, president of the Baltimore Locomotive Works, was chairman. Mr. Wood served continuously on this board during the entire period of the war, without compensation. He was a member of the University of Michigan Club, the Automobile Club, the New York Athletic Club, the Society for Electro-Chemical Engineers and of the Railroad Club.

Construction Metallique Representative Returns to Belgium for Two Months

Lieutenant Marc Jeanjean, who has been in Washington for the past six months representing the Societe le Construction Metallique of Brussels, Belgium, in the purchase of large quantities of machine tools from the Government, has left for Belgium.

Lieutenant Jeanjean, according to present plans, will return to this country within two months, and it is expected that he will bring with him additional orders for machine tools and shop equipment.

On his return trip, Lieutenant Jeanjean anticipates making large purchases of machine tools and shop equipment on the open market. The material purchased from the War Department has been entirely satisfactory, but a number of the machine tools desired by the Construction Metallique are not obtainable from among the surplus supply of the War Department.

Foundry and Machine Company Purchases Part of Explosive Plant at Nitro, W. Va.

The Central Foundry and Supply Company, of Columbus, Ohio, with which the Cummings Machine Company, of Minster, Ohio, is consolidated, has just completed negotiations for the purchase from the Charleston Industrial Corporation of five of the large buildings at Nitro, W. Va. These buildings were built and occupied during the war by the United States Government for the manufacture of war equipment.

With the purchase of the five large buildings at Nitro, the Ohio concern acquired 5½ acres of land and a number of smaller buildings. This sale represents the first purchase by an individual concern of any of the industrial buildings at Nitro.

The War Department during the early part of December, 1919, consummated a sale to the Charleston Industrial Corporation of the explosive plants and other facilities owned by the Government at Nitro. The transaction involved an exchange of $8,551,000. Under the terms of the contract, the Charleston Industrial Corporation was not permitted to resell any part of the facilities at Nitro without the approval of the War Department.

The sale to the Central Foundry and Supply Company was approved by the Ordnance Salvage Board at Washington.

The buildings purchased comprise a sheet-metal shop, a brass and iron foundry, a pipe and electric shop, welding shops and a number of small buildings.

It is understood that the intention of the Central Foundry and Supply Company is to establish a branch plant at Nitro, and remodeling of the buildings and the installation of new machinery and equipment are expected to take place immediately.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A firm of engineers in France desires to secure an agency from manufacturers for the sale of factory equipment and machine tools. Correspondence should be in French. Reference. No. 31,633.

Catalogs and estimates are desired by a firm in Cuba for the purchase of 28 kilos of 10-in. and 12-in. cast-iron pipe, universal joints; two steel water tanks, each of 1,000,000 gal. capacity; and rock crushing machinery, capacity about 40 m. daily, with gasoline, crude oil, or steam motive power. Quotations should be given f.o.b. New York. Reference. No. 31,630.

A merchant firm in Ireland desires to purchase general tool supplies, drilling and grinding machinery. Quotations should be given c.i.f. port in Ireland. Payment, cash against documents. Reference. No. 31,813.

A merchant in South Africa desires to purchase general picture-frame-making machinery. Terms, cash. Reference. No. 31,935.

A glass manufacturing concern in India desires to purchase glass-making machinery, for use with coal fuel, of a daily capacity of about five tons, for the manufacture of bottles, sheet glass, chimneys, soda-water bottles, tumblers, etc. Quotations should be given c.i.f. port of India. Payment, cash against documents, or if required, cash with order. References. No. 31,933.

A commercial agent in England desires to purchase direct for consumer, 18-in. cast-iron gas mains, spigot and socket type, in 12-ft. lengths. Full specifications, terms, etc., are required. Quotations should be given delivered on board steamer in English port. Reference. No. 31,929.

A fruit company in Honduras desires to purchase tractors for farm work. Quotations should be given f.o.b. New Orleans. Payment, cash. No. 31,930.

A merchant in France desires to purchase electric appliances. Quotations should be given c.i.f. French port. Payment, cash. Correspondence may be in English. Reference. No. 31,931.

A firm of manufacturers in Spain desires to secure the sole agency on commission for the sale of electrical machinery and supplies, electric flat irons, machinery belting. Correspondence should be in Spanish. References. No. 31,689.

A firm in Spain desires to purchase machine tools, pumps, ventilators, grease cups, tools, elevating machinery, and can-making machinery. Quotations should be given f.o.b. American port. Correspondence may be in English. References. No. 31,755.

A manufacturer in Austria desires to get in touch with manufacurers of machine tools of all kinds, leather belting, and machinery and supplies required by foundries. References. No. 31,751.

A firm specializing in American electrical manufactures in England desires to secure an agency or purchase electrical machinery and control gear, motor and generators, alternating and direct current. Will purchase if agency is unobtainable. Quotations should be given c.i.f. English port. Ref. No. 31,496.

A manufacturing company in India desires to purchase and secure an agency for abrasives, anvils, Babbitt metal, belt fasteners and tighteners, blocks (tackle), blowers, boiler compound and graphite, boiler-room supplies, cement, bolt and nut machinery, and machinery and tools of all kinds. Quotations should be given f.o.b. shipping port. Reference. No. 31,906.

A commercial agent in Morocco desires to secure the representation of the manufacturers and exporters for the sale of galvanized-iron products, hardware, enameled iron, zinc in sheets, building materials, tools, etc. Reference. No. 31,894.

A company in England desires to purchase for resale to clients heavy steel melting scrap, no limit to quantity; billets, blooms, slabs, and ingots for shipbuilding purposes. Quotations desired, c.i.f. Manchester, Liverpool, and Middlesbrough. Terms, payment against documents in England. Reference. No. 31,897.

(Continued on Page 430d)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

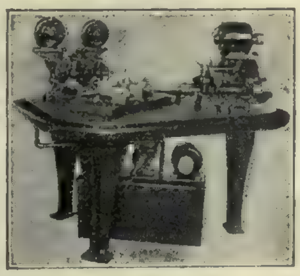
Milling Machine, Two Spindle Spline.
Taylor & Fenn Co., Hartford, Conn.
"American Machinist," Jan. 22, 1920.

This machine is automatic in operation and will simultaneously machine two spline grooves on opposite sides of the same piece, single splines of the same or different dimensions, simultaneously on two pieces, or through slots such as drift-pin slots or cutter slots in boring bars and similar work. Splines of exact duplicate lengths and uniform finish and accuracy can be produced in a minimum period of time, the duration of which, of course, depends on the length, width and depth of the spline and the cutting resistance of the metal being worked. Specifications: Will spline work up to 5 in. in diameter and 6 in. long; longer work may be splined by resetting; spindle speeds, (6) from 302 to 1,885 r.p.m.; table feeds, 10.

Wrench, Hopper Car Safety.
Safety Wrench and Appliance Co., 13th and Cherry Sts., Philadelphia, Pa.
"American Machinist," Jan. 22, 1920.

It is said to have automatic features that protect the workman at all times against injury, when opening the car; also that the car can be opened much quicker than by the usual method. The handle is offset, to permit free movement, and two pawls are provided for the ratchet, one of which is ready to act in case the door should stick. In operation the car dog is held up and the wrench lowered with a quick motion; the pawl will then automatically spring out, allowing the hopper door to drop. If the door does not start, the handle is raised and then pressed down, thus forcing the door open.

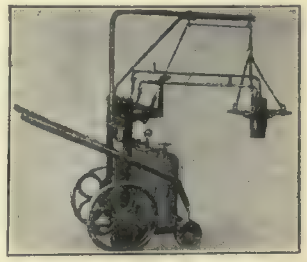
Drilling Machine, Crankshaft Oil-Hole.
Edwin Harrington Son & Co., Inc., Philadelphia, Pa.
"American Machinist," Jan. 22, 1920.



Specifications: Drilling capacity in steel, 5/16-in. holes; distance between spindles, maximum 10½-in., minimum 7⅝-in.; spindle traverse 8-in.; height, spindles above table 4¾-in., table above floor, 31 in.; taper hole in spindles, Morse No. 2; spindle speeds, 1,000 r.p.m.; feeds per revolution of spindle, 0.002, 0.003, 0.004 and 0.005-in.; size of each motor ½ hp.; speed of each motor 1,750 r.p.m.; floor space, 69 x 48 in.; weight, without motors 2,150 lb., with motors 2,415 lb.

Drier, Bull Ladle.
Hauck Manufacturing Co., Brooklyn, N. Y.
"American Machinist," Jan. 22, 1920.

The burner operates with compressed air at a pressure from 20 to 100 lb., burns fuel oil, crude oil or kerosene, and lights instantly. The flame spreads evenly and quickly and is directed downward toward the bottom of the ladle. The drier heats the bottom and sides of the ladle white-hot, if required, and it is claimed to be a more efficient and less expensive method than the use of wood fires.



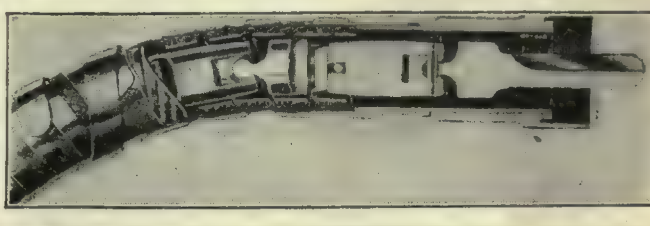
Tipped Tools, Zubar.
Zubar Manufacturing Co., Inc., 5701 McMahon Ave., Philadelphia, Pa.

This line of tools includes all standard shapes and sizes and is furnished in special shapes to suit requirements. The design is intended to combine the advantages of a solid forged tool such as heat conductance, strength, etc., with the economical features of the built-up tool. The material in the shank allows the tool to "give" before it will break and the tip may be rehardened at any time in the usual way. The tools can be tipped with any make of high-speed steel desired by the customer and are furnished ground, ready for use.

Flexible Shaft, "Strand" Link Type.
N. A. Strand & Co., 549 West Washington Boulevard, Chicago, Ill.
"American Machinist," Jan. 22, 1920.

It is said that in shafts of this type the wear on the joints is reduced to the minimum.

Specifications: Standard length, 7 ft.; links, 1 in. in diameter; diameter over casing, 1½ in.; maximum speed, 1,750 r.p.m.; power delivered, 2 hp. at 400 r.p.m.; will operate grinding wheels up to 10 x 1½ inches.

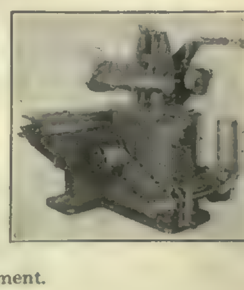


Cherrying Attachment, Jackson Die-Sinking Machine.
Jackson Machine Tool Co., Jackson, Mich.
"American Machinist," Jan. 22, 1920.

Is now being put on the No. 5 and No. 6 Jackson duplex typeless die-sinking machines. This redesign of the attachment has been adapted from a similar attachment which was first brought out for the No. 10 machine. The rotary oscillating motion is provided by means of a connecting-rod attached to the lug on the upper side of the toolholder. The tool housing has a small movement so timed that the cutter is lifted from the cut on its return stroke and again lowered on the cutting stroke. Ample bearing ways and take-up gibs insure it against wearing loose.

Grinding Machine, "Diamond" Surface.
Diamond Machine Co., Providence, R. I.
"American Machinist," Jan. 22, 1920.

Improved automatic surface-grinding machine. One improvement is in the elimination of one motor. In the older type of machine separate motors were used for the spindle and table drives while in the improved type but one motor of 3 hp. is used for both purposes. Power is transmitted to the spindle by chain and belt drive and to the table by chain drive through worm gearing and a belt. The second improvement is in the method of hanging the counterweight. By use of the overhanging arm shown in the illustration, the cable for the counterweight is kept free from contact with any part of the machine, thus preventing wear and assuring its free movement.



Merchants in Scotland desire to purchase acetylene lamps used by miners in coal pits, wire nails, and bar iron and sheets. Quotations should be given c.i.f. Glasgow or Leith. Payment, cash. Reference. No. 31,900.

A manufacturer in Japan desires to purchase machinery for renewing files. Full information regarding capacity of machinery, price lists, etc., are requested. Quotations should be given c.i.f. Japan. Terms, cash. Reference. No. 31,899.

A firm in Sweden doing an import business desires to secure an agency for the sale of cutlery and hardware. Reference. No. 31,843.

An engineer in Spain desires to secure agencies and purchase all kinds of machinery for electric, hydraulic, metallurgic, and chemical industries. Payment, cash against delivery of merchandise. Correspondence should be in Spanish, French or Italian. Reference. No. 31,847.

A rice miller in India desires to purchase one horizontal steam engine, 9-in. cylinder and 16-in. stroke; one vertical boiler of 10 hp., complete with fittings, and chimney, pressure 100 lb.; one tubular boiler, of 10 hp., complete with fittings and chimney, pressure 100 lb., above to be tested to 200 lb. hydraulic pressure, chimneys to be extra long to burn husk fuel; one duplex pump, 3 x 2 x 3 in.; and one screw-cutting gap bed lathe, 10 ft. long, with 3-ft. swing in gap, 9 in. centers (height), or nearest size. Quotations should be given c.i.f. Rangoon. Payment, cash in full with order. Reference. No. 31,857.

A company in England desires to purchase motors for use in the construction of electric vehicles, in quantities of from five to twenty per week, sizes, 4, 6, and 8 hp., and voltage for either sizes of 88 for lead batteries, and 60 for Edison batteries. The motors should be in every way suitable for traction purposes, and be capable of giving three times the normal torque at one-half speed for 10 min. and have the highest possible efficiency from half load to 200 per cent overload, fitted with ball bearings and totally inclosed. Quotations should be given c.i.f. English port. Reference. No. 31,859.

A firm in France desires to secure the agency for machinery and tools, farm implements, etc. Correspondence may be in English. Reference. No. 31,877.

A merchant in Paraguay desires to purchase or secure an agency for all sorts of construction materials, such as steel beams, girders, galvanized zinc, wire, cement, firebricks, forge coal and coke, and roofing materials. Quotations should be given f.o.b. New York. Terms, cash against documents. References. No. 31,878.

The engineer of a cotton mill in India desires to purchase a fully equipped spinning mill of 22,000 ring spindles to spin yarns from 12½s to 16½s, and 16s to 24s; equipment to include steam or oil engine; also fire-extinguishing sprinkler installation and building material, such as cast-iron pillars, H steel beams, angles and tees, expanded metal, etc.; also shafting and gearing. Quotations should be given either c.i.f. Rangoon, or f.o.b. American port. Quotations and specifications must be as detailed as possible. Reference. No. 31,846.

The financial agent of an importing company in Bulgaria desires to receive immediate quotations direct from manufacturers or exporters on 50 metric tons of sheet iron up to 1½ mm. thick; 200 tons of wire; thirty to forty small steam plows of 5 to 6 hp., two without wheels; thirty complete thrashing machines, with 5 tons of belting; 1,000 to 2,000 sewing machines. Reference. No. 31,831.

A manufacturer in France desires to secure an agency for the sale of all kinds of machinery, such as steam engines, pumps, and machinery used in sugar plants. Correspondence may be in English. Reference. No. 31,828.

A firm in Brazil desires to secure the agency for steel manufacturers. Correspondence may be in English. Reference. No. 31,829.

A manufacturer's agent in Australia desires to secure an agency for the sale of hardware and automobile accessories. Reference. No. 31,826.

An importer in Belgium desires to secure an agency on commission or consignment for the sale of ore and cast iron of good quality for high furnace and steel manufactory, zinc ore, lead, and black lead, graphite and crucibles for foundries, aluminum, both in bars and worked, tin, and antimony. Correspondence should be in French. References. No. 31,833.

An importing company in Korea desires to receive catalogs in duplicate, together with terms of export, and all information, such as prices, both with and without bodies, particulars of construction, and terms, for the sale of automobiles in Korea and Manchuria. Reference. No. 31,854.

Trade Catalogs

Micrometers. Reed Small Tool Works, Worcester, Mass. Catalog No. 4, pp. 40, 7¼ x 4¼ in. This bulletin contains forty pages and twenty halftones describing and illustrating the Reed micrometers; also its list prices. Several tables of the metric system and decimal equivalents of millimeters and fractions of millimeters are given in this bulletin.

Furnace Burners. Hauck Manufacturing Co., 101-113 Eleventh St., Brooklyn, N. Y. Bulletin No. 119, pp 16, 9 x 6 in. This bulletin illustrates and describes in detail the different types of oil burners manufactured by this firm. The book also has several illustrations showing the application of the Hauck burners to various types of furnaces.

Grinders. Columbia Manufacturing Co., Belleville, Ill. Catalog No. 26, pp. 21, 6 x 3¾ in. A catalog covering grinding machines, buffers, countershafts and presses for heavy hardware, mill supply and auto trade. A copy of this catalog will be sent upon request.

Sandblast Pamphlet. Pangborn Corporation, Hagerstown, Md. This pamphlet, the title of which is "To See Is to Understand," gives an illustration of the Pangborn Corporation and also illustrations of its staff of engineers, the various officers, the egineering departments, the manufacturing departments both interior and exterior, and equipment manufactured by this company.

Helical Gear. The Fellows Gear Shaper Co., Springfield, Vt. Catalog, pp. 48, 6 x 9 in. This is a treatise covering the application of helical or twisted teeth to gears operating on parallel axes, together with data on design, application and production.

Pyrometer. The Brown Instrument Co., Philadelphia, Pa. Catalog No. 12, pp. 88, 8 x 10¾ in. The first few pages of this catalog contain some illustrations of the shop, testing room, inspecting room and laboratory where the Brown pyrometers are manufactured. Other pages show the construction of the pyrometer and its uses. Charts showing how temperature records are made and tables are given of the melting points of chemical elements. The new catalog is printed in two colors on heavy coated stock and each page presents illustrations and a description of pyrometers for practically every use for measuring temperatures, gaging and time recording.

Valves. Nelson Valve Co., Philadelphia, Pa. Catalog and price list, pp. 156, 5¼ x 7¾ in. This is a cloth-bound catalog and contains many illustrations of bronze, iron and steel valves; gate, globe, check and non-return valves. Besides a brief description of each valve there is also a table giving the sizes, numbers, height, diameter, prices, etc.

Condensing Apparatus. Worthington Pump and Machinery Corporation, 115 Broadway, New York. Catalog No. W. 701, pp. 115, 6 x 9 in. This catalog contains many halftone illustrations of the company's condensers in various machine shops and also some information on condensation. There are also tables on low-pressure steam and two charts showing the friction in surface condenser tubes.

Machinists Tools. Union Tool Co., Orange, Mass. Catalog, pp. 61, 7 x 5 in. This catalog gives the sizes and prices of the products manufactured by this company, such as calipers, dividers, tap wrenches, nail sets, rules, squares, hacksaw frames and toolholders for various machines.

Elevators and Conveyors, Electric Hoist and Overhead Cranes. Link Belt Co., Chicago, Ill. Book No. 380. Book No. 375 contains 108 pages, and each page gives halftone illustrations showing elevators and conveyors in use for a great many purposes. Book No. 380 illustrates and describes the electric hoist and cranes. It contains 100 pages and describes and illustrates the construction of the hoist and the conveyor, and shows their use in different manufacturing plants.

Special Tools for Ford Repair Shops. K. R. Wilson, 10-16 Lock St., Buffalo, N. Y. Catalog, pp. 29, 6 x 3½ in. An illustrated and descriptive catalog of his tools for repairing Ford automobiles, also the list prices.

Whiting Converter. Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 150, pp. 131, 9 x 6 in. This catalog gives a complete description of the Whiting side-blow converter for making small steel castings; also its relations to other processes. Several illustrations are given of the Whiting converter in operation in various machine plants.

Theory and Practice. Issued by the Federal Board for Vocational Education, Washington, D. C. Bulletin No. 52 (Advance Issue), 6 x 9 in., 128 pages. This bulletin gives outlines of instruction in related subjects for the machinist's trade, including general trade subjects for certain other occupations. It is divided into four parts: I Introduction. II Analysis of the machinist's trade and of related general trade subjects. III Suggestions on the organization of material and methods of instruction. IV A suggestive part-time four-year apprentice program.

Screw Jacks. The Duff Manufacturing Co., Pittsburgh, Pa. Bulletin No. 300, 9 x 6 in. A descriptive circular of its new type high-speed ball-bearing jack.

Safety Code. Norton Co., Worcester, Mass. Booklet, pp. 20, 6 x 9 in. This is the third revised edition of this booklet for the use, care and protection of abrasive wheels.

Forthcoming Meetings

The American Institute of Mining and Metallurgical Engineers will hold its annual meeting in New York City, Feb. 16 to 19 inclusive.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of Eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

The Material Handling Machinery Manufacturers' Association will hold its meeting in New York City on Feb. 26 and 27.

The National Motor Boat, Ship and Engine Show will be held in New York City on Feb. 20 to 28.

The National Association of Engine and Boat Manufacturers, Inc., will hold its meeting in New York City on Feb. 26.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Pa., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Second Annual Aëronautical Exposition of the Manufacturers Aircraft Association, Inc., will be held at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, on Mar. 6-13, 1920. S. S. Bradley, 401 Fifth Ave., New York City, is the general manager.

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Converting A Machine Shop to Emergency Production

By Ellsworth Sheldon
Associate Editor, American Machinist

Until the United States entered the war in April, 1917, the country's mechanical resources were rather a subject for conjecture than a matter of statistics. No one knew and few dared to predict the extent of the flood of productive energy that was to be let loose when the absolute necessity for it was disclosed. Concerns that had been loafing comfortably along under the false impression that their resources were strained to the limit, suddenly doubled and trebled their capacity, and that upon work for which, until they were in the midst of it, they did not know they were equipped to handle. The subjoined account tells how one shop met the crisis and, without stopping for preliminary fitting up, plunged into the job of converting machinery to new purposes and evolving new methods of handling unfamiliar work as it went along.

DURING the "great rush" when every shop capable of turning out war material of whatever nature at all suited to its equipment was working feverishly to the limit of its capacity, there were many instances where the native ingenuity of the proprietors or the workmen rendered possible the rapid and efficient production of work that, at first glance, seemed hopelessly alien to the line in which the shop was regularly engaged.

The Schickel Motor Co., of Stamford, Conn., was comfortably busy building motor-cycles for commerce and pleasure, when Uncle Sam was suddenly landed in the turmoil of war, and it became imperative that every shop—big and little—should give prime consideration to the making of something that would render material aid in resolving the sinister menace that threatened the world.

Designing the Tools and Fixtures

From the myriads of small parts that go into the making of various kinds of war material, Mr. Schickel who, incidentally, was his own tool designer, and who later devised all of the tools, jigs and fixtures described in this article, chose among other things the valve rocker-arm of the Liberty motor, shown at the head of the page, as a medium through which to contribute his share of the energy required to put the U. S. A. on a war basis. The reasons for this choice were many, but perhaps the chief consideration was the fact that the part was not so far removed from his regular line of manufacture as some others; and though the adaptation of a factory equipped for the manufacture of a comparatively small number of complete cycle motors to the production of thousands of one small part, involved the design and construction of many special tools as well as the conversion of much machinery to uses other than that for which it was originally intended, this could still be accomplished with less loss of time than would be required to put the factory in shape to manufacture something not so closely related to its original product.

Though the war service of this factory was by no means limited to the single part, the variety of tools and fixtures used in its manufacture and the ingenuity displayed in their conception and design have caused this one part to be singled out for illustration purposes.

The rocker-arms, operating both inlet and exhaust valves of the motor, were of two kinds, designated in the shop as "rights" and "lefts" as a matter of convenience.

They could not be called inlet and exhaust for the reason that a "right" might be operating an inlet valve on one block of cylinders or an exhaust valve on the other. The difference between a right and a left is mainly in the relative position of the cam roller-fork with respect to the length of the piece. There are, of course, one pair of these arms to each cylinder and as an extra pair was sent out with each motor, a Liberty "twelve" required 26 pieces.

The pieces were drop-forged from chrome-nickel steel, were about 5 in. in length and weighed a little over a pound. The sequence of operations is shown in Fig. 1, beginning at the lower right-hand corner with the forging A, which is received at the factory in an annealed condition. A table showing the sequence of operations appears at the end of this article.

Many of the forgings were bent, due, no doubt, to

careless handling in annealing, and the first attention they received after checking in, was to gage them as shown in Fig. 2 and, if necessary, to bend them so that they will clean up in subsequent operations. The bending is done as in Fig. 3 by holding them in a vise and using a piece of pipe to make the arms conform to the gage.

The first machine operation is shown in Fig. 4, and it is performed in a Lincoln type milling machine with a built-up gang of cutters. This machine faces the parts to exact length except for the minute allowance for polishing, besides opening the cam-roller-fork and removing surplus metal from the sides of the latter. A small flat, *b* and *b*, Fig. 1, is milled on the boss at each end of the piece, and these flat spots become the locating points for the next operation.

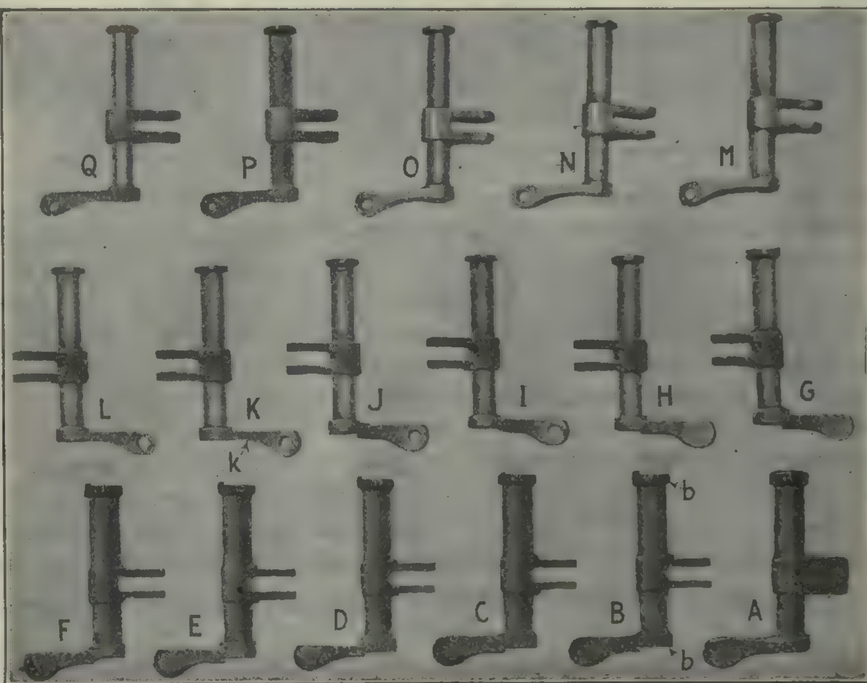


FIG. 1. SEQUENCE OF OPERATIONS

To insure the constant delivery of equal numbers of right- and left-hand parts, many of the tools were arranged to handle the work in pairs, or multiples of pairs. When this was not practicable, machines were operated in pairs, one producing "rights" and the other "lefts."

The holding fixtures are, as far as possible, made on the reciprocating principle; that is, one half of the fixture may be unloaded and reloaded while the cut is going forward on the group of parts held in the other half. This is partly accomplished in the fixture shown in Figs. 4, 5 and 6. It is obvious that to secure proper results, the machine table should always be fed against the action of the cutters—in this case from left to right (see Fig. 6). As soon as the table is run back to its extreme left position at the end of a cut, the right end of the fixture, which will at that time be empty, is loaded and the cut started. While the cutters are occupied on the first four forgings, the operator is removing the milled parts, cleaning the fixture and reloading the left end. As the cutters approach the extreme left end, the right end is unloaded and cleaned preparatory to reloading as soon as the table is run back.

Fig. 5 shows the fixture empty and from it one may observe the principle upon which it is constructed. A base casting *A* is bored to receive two rods (the end of one showing at *B*) which pass clear through it and are clamped in by the draw bolts and their nuts *C*. The jaws *D* are fitted to slide on the bars, being left somewhat loose so that they can in a measure adjust themselves to slight irregularities in the forgings. A forging is put in place between each jaw and the one immediately before it, the following jaw in each case having a 90-deg. angle V-groove across its face to assist in locating the work. The tappet arms rest against the pins *E* to prevent a partial rotation of the work under pressure of the cut. As the pressure of the setscrews *F* is transmitted through each piece and each movable jaw to the central buttress of the main casting *A*, all the parts are held with equal firmness.

Fig. 6 shows one of the machines with the fixture loaded. The pieces to the left have been finished and are ready to take out while the cutters are working on the others. This picture shows also the profile and other gages to which the pieces must conform after this operation.

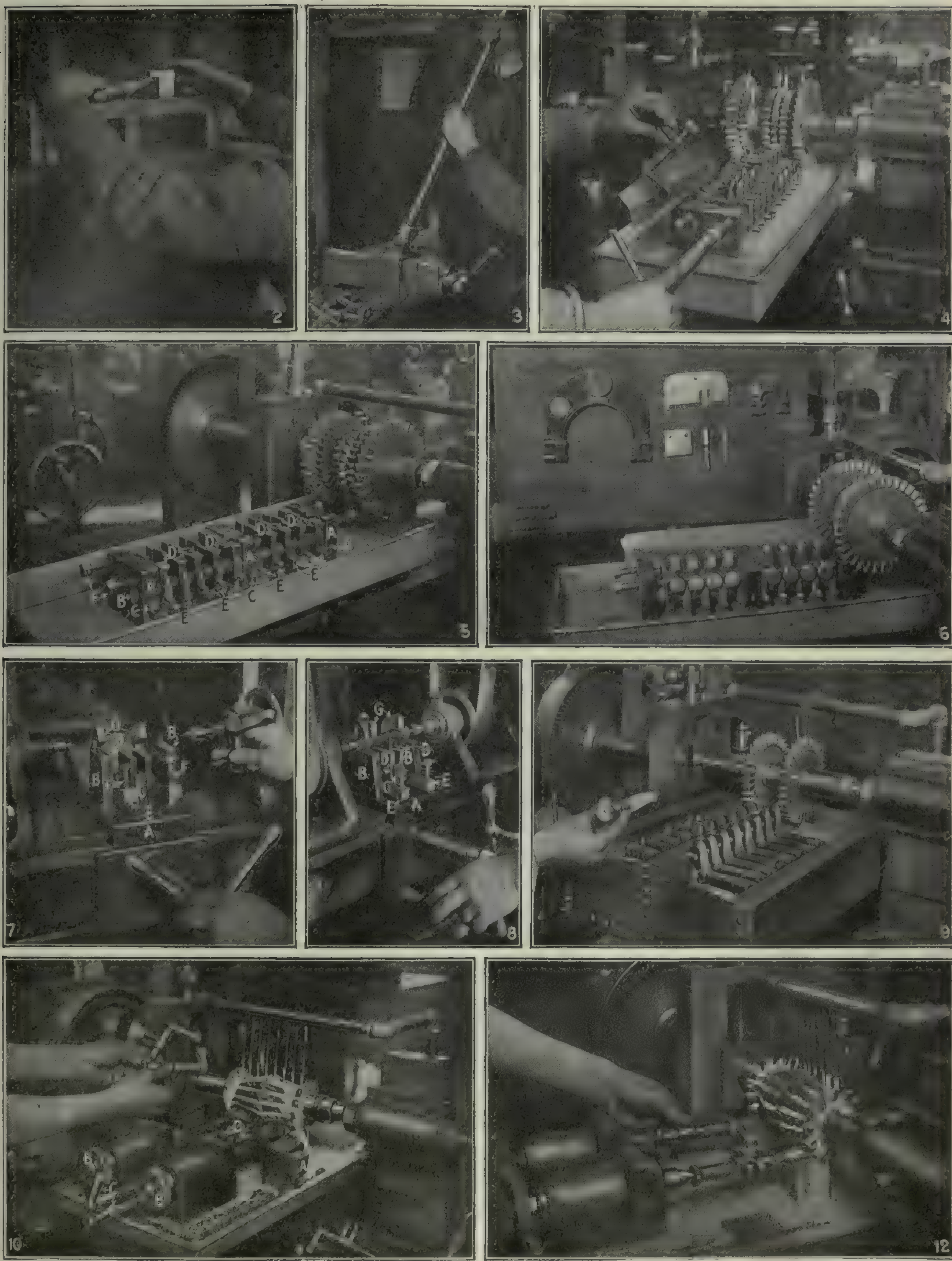
From the milling operation the parts go to the centering machine shown in Figs. 7 and 8. This operation must be very carefully done as by the method followed, the center at the tappet-arm end constitutes the locating point in subsequent operations having to do with the position of the cam-roller-fork and the journals. The depth of the center is held within limits of 0.001 inch.

In this operation the right and left feature receives no consideration, the fixture having two gaging points so placed that the piece automatically selects the one intended for it, so that mixed parts can, if desired, be handled as readily as if previously sorted. A casting *A*, Figs. 7 and 8, having two uprights *B* is gibbed to the bed of the centering machine and when adjusted for position is clamped by means of the gib screws.

The tops of the uprights are planed off to the proper height to support a forging while it is being centered. A shorter boss *C* in the center furnishes a support for the gaging pieces *D* which position the work endwise, and a pin in the top of each upright holds it to center transversely. The forgings rest upon the uprights *B* at the points that were flattened off for that purpose in the first milling operation. Two levers *E*, fulcrumed about midway of their length, have at their front ends the tightening screws *F* bearing upon the base casting, while at the back end the hook-shaped pieces *G* are pivoted in such a way that as the hooks are drawn down by tightening the screws *F*, they are also drawn backward, holding the work against the locating pins. The centering drills are fed forward by hand.

Located From Previously Finished Points

From this point onward the work is handled either on centers, or in jigs or fixtures, the locating points of which bear upon surfaces that are finished on centers. The set-up for milling the inside of the tappet arm is shown in Fig. 9. The fixture is a heavy casting that resembles a square box with a partition through



FIGS. 2 TO 12. SOME OF THE MILLING OPERATIONS ON THE ROCKER ARM, SHOWING THE TYPE OF FIXTURES USED

Fig. 2—Gaging to discover bent forgings. Fig. 3—Straightening bent forgings. Fig. 4—Milling ends, opening and dressing cam-roller-fork and spotting for centering machine. Fig. 5—The milling fixture before loading. Fig. 6—The milling fixture with work in place. Fig. 7—The centering machine. Fig. 8—The centering machine. Fig. 9—Milling inside of tappet arm. Fig. 10—Form-milling top of tappet arm. Fig. 12—Form-milling bottom of tappet arm.

the middle. The ends of this box, however, are merely sheet-metal pieces fastened with small screws and their function is to keep the cutting compound from slopping about on the operator or the floor.

In the central wall of the jig are eight fixed centers with points on both ends. Opposite to these points in each outside wall of the fixture are the corresponding centers which are threaded into the casting and may be advanced by means of a special wrench fitting a socket in the end of each screw. Studs passing through the central wall at the proper place support the tappet arms and take the thrust of the cutters as the inside surface of the tappet arm is milled off. Eight pairs of rockers are operated upon at once with a pair of straddle-mills.

The next operation is to form-mill the top of the tappet arm and is shown in Fig. 10. The work is again located upon centers and is handled in pairs, but as the surface finished is so short in relation to the length of the piece, only one pair is handled at a time.

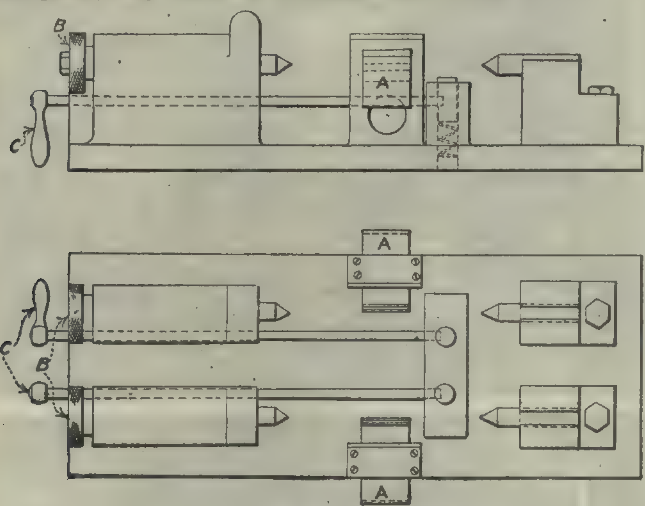


FIG. 11. DIAGRAM OF FIXTURE

A slide *A* at each side of the fixture has a V-groove upon its inner end, and is moved forward by a collar-headed screw below it. This slide bears upon the round end of the cam-roller-fork and brings it to a definite position after the piece has been placed on centers. The tail centers are moved up by the knurled wheels *B*.

A Spring-Adjusted Support

A pair of ingeniously contrived spring plungers located within a boss upon the base casting of the fixture furnish the supports upon which the tappet arm rests while being milled. The slides *A* as before stated bring the pieces to the right position relative to the axis of rotation after the centers are tightened. The spring plunger under the tappet arm resists any such movement, but the tension of the spring is overcome by the action of the slides.

It will be observed that the end of the tappet arm is now supported merely by spring pressure, and to make this foundation solid enough to prevent the springing of the work while under the cut, large screws bearing upon the spring plungers are tightened by means of long extension rods passing lengthwise through the fixture and operated by the handles *C* at the rear. A backstop is provided by the screws *D* which are set up by hand after the pieces are positioned.

Fig. 11 is a line drawing showing the details of this fixture, in which the parts are lettered as in the previous illustration. Fig. 12 shows the operation on the opposite or bottom side of the tappet arm. The fixture used is cast from the same pattern as the previous one, but the locating slides and floating stops are not necessary as the work is now located from an already finished surface.

The lathe work begins at this point with the operation shown in Fig. 13. The pieces are rough-turned in an engine lathe, to remove the scale and dig out the corners that would prove too destructive to the forming tools used in later operations. No size is maintained except to be certain that the work is not made too small to finish. Fig. 13 shows an ordinary high-speed toolbit in use, but a welded stellite tool was later substituted which proved to be longer lived and capable of getting off the stock faster.

A forming operation follows in a Gridley automatic screw machine which reduces the piece to grinding size. The work is placed on centers by hand and the tools fed straight toward the center, cutting a chip the width of which is the length of the journal. Fig. 14 shows the Gridley machine set up for this work. A National-Acme machine was also fitted up to perform the same operation, one machine handling "rights" and the other "lefts."

Figs. 15 and 16 show front and rear views respectively of the set-up in the latter machine. The rear slide has no movement in this set-up, serving only to support a special spider which is fitted with a small lever-operated tail spindle opposite each of the live spindles. The work is all done in the two lower positions of the spindles, leaving the upper positions free for the operator to take out finished pieces and set in others to be operated upon.

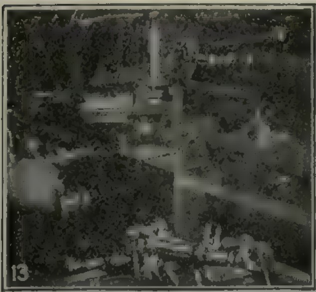
Alternating the Fixtures to Keep Production in Pairs

It was necessary to drill, ream and countersink a hole in both sides of the cam-roller-fork, and to drill and counterbore for broaching the hole in the end of the tappet arm. The jigs shown in Fig. 17 provide for all of these operations, separate jigs being necessary for the right- and the left-hand pieces. In these jigs the work is held upon centers and located for position by the end of the tappet arm.

A latch, shown at *A*, swings over this arm after the work is in place and is clamped by a wing nut and swinging bolt pivoted in the fork *B*. The jig is made to stand in two positions and the work is done in a four-spindle Henry & Wright drilling machine. The tools are guided by the bushing in the fixed bracket *C* and by the adjustable bracket *D*.

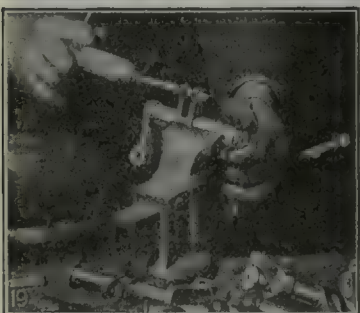
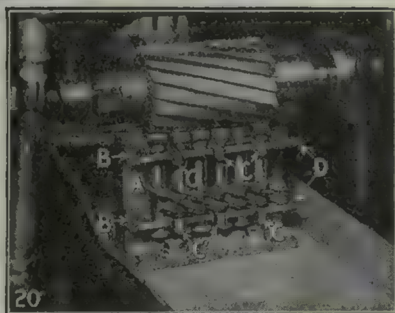
It was necessary in setting the pieces on centers to adjust both centers each time, for the work was located endwise by the gaging bracket *D* in the cam-roller-fork; the distance from this fork to the hole in the tappet arm being an important dimension. The first operator loads a jig, drills and reams the holes in the cam-roller-fork, then pushes the jig and contained piece over to the other operator, receiving in return the other jig which the second operator has unloaded. The second operator drills and counterbores the hole in the tappet arm, unloads the jig and exchanges it for the other one with which the first operator is just finishing. Thus, in this operation the work goes forward in pairs.

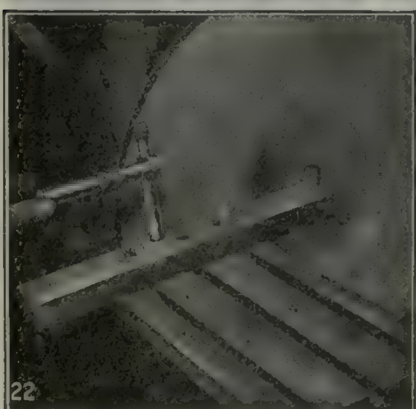
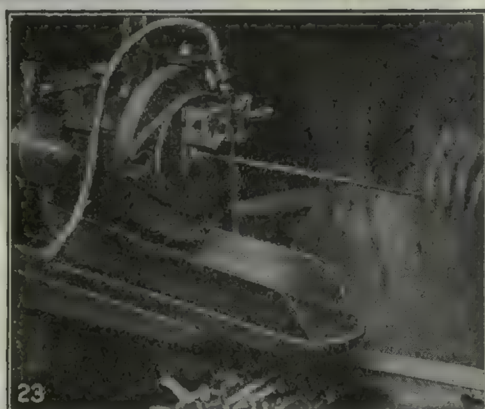
The operation of countersinking the hole in the cam-roller-fork is quite simple; the piece is held by hand, resting upon a parallel clamped to the edge of the table of a sensitive drilling machine as shown in Fig. 18.

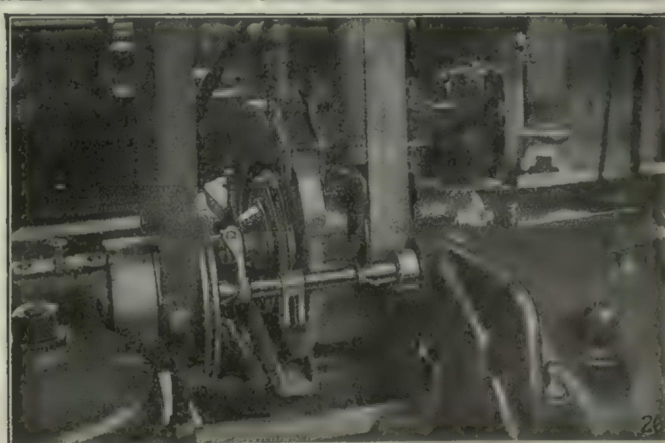






FIGS. 13 TO 26. FURTHER OPERATIONS, SHOWING FIXTURES FOR TURNING, DRILLING AND MILLING, AND THE TEMPERING AND GRINDING OPERATIONS

Fig. 13—Rough-turning. Fig. 14—Automatic finish-turning in Gridley machine. Fig. 15—Automatic finish-turning in National-Acme machine. Fig. 16—Another view of the National-Acme machine. Fig. 17—Drilling and counterboring the holes. Fig. 18—Countersinking. Fig. 19—Hand-reaming. Fig. 20—Milling outside of tappet arm. Fig. 21—Fixture for holding work in operation 11. Fig. 22—Hand-grinding on abrasive disk machine. Fig. 23—Broaching the hole in the tappet arm. Fig. 24—Heat-treating furnace and oven. Fig. 25—Cleaning centers after heat-treating. Fig. 26—The final grinding operation.

This is followed by a hand-reaming operation, Fig. 19. The sequence of this latter operation was later changed as shown by the operation sheet.

A milling operation is shown in Fig. 20 in which the pieces are supported from the turned surfaces. The operation consists of milling the outside contour of the tappet arm as shown at *k* in Fig. 1.

The fixture is an angle-plate casting *A*, upon one face of which two hardened-steel strips *B* are fastened, each having six V-grooves so placed that they form the equivalent of six pairs of V-blocks set to hold round pieces in a vertical position. Three pairs of studs *C* are fitted to slide freely through holes in the casting and are each threaded on one end for a nut, while near the end that projects from the working face of the jig there is in each stud a rectangular hole to take a $\frac{3}{4}$ x $\frac{3}{16}$-in. hardened steel parallel strip *D*.

Six rocker-arms are set in the V-block with the already finished inner face of the tappet arm resting on the planed top of the casting, the parallel pieces are slipped through the rectangular holes in the studs and the latter drawn up by their respective nuts. Thus, while the parts are held tightly in the V-blocks, the pressure of the cut is supported by the top of the main casting and the tappet arms are positioned by studs which are so arranged as to locate properly either right- or left-hand parts, so that it is possible to mill six pieces of one hand or three pairs at one time.

FIG. 27. A CORNER OF THE INSPECTION DEPARTMENT

Fig. 21 shows very plainly the construction of the fixture and also the work to be done. The cutter is an ordinary plain milling cutter with helical flutes, the requisites being that it must be held closely to diameter, only one or two grindings being allowed before substituting a new cutter, and it must be stopped at the right place, upon both of which points the contour of the tappet arm depends.

The outer end of the tappet arm must be finished to a true radius running imperceptibly into the contour of the top and bottom surfaces of the arm, which it will be remembered are finished by the milling operations shown in Figs. 10 and 12 respectively. These two cuts leave a rather awkward place to be finished as the contour to be covered is rather more than a half circle and consequently could not be milled with a concave-faced cutter. Further, any method of milling would have to be very carefully supervised in order to avoid a shoulder at the points of tangency.

A Simple Fixture

Fig. 22 shows how the work was done, the only equipment necessary besides the grinding machine being any piece of iron big enough to strap onto the table of a disk grinding machine, a properly located stud in the piece, and a plug fitting the hole in the tappet arm and also fitting a hole in the end of the stud. The table of the grinding machine, to which the device is bolted, is swung across the face of the disk while the work is turned by hand, back and forth, around the plug. One pass across the face of the disk is sufficient.

The hole through the tappet arm requires a somewhat complicated operation or set of operations to produce. This hole is first made as described and illustrated in Fig. 17 and accompanying text, by drilling a small hole clear through and then counterboring this hole to a larger size for about half its depth. The hole is shown in Fig. 1 from *I* forward. The broaching occurs at *N*.

In the broaching operation shown in Fig. 23, the final shape of the hole is made by a broach, the section of which is a circle with two flat sides. The diameter of the circular section is the same as that of the larger hole in the arm so that, when broached, the hole appears to be of uniform diameter clear through but with the lower part filled in on two sides.

The fixture for holding the pieces consists of a pair of V-blocks attached to a bolster plate, through the center of which is a hardened-steel bushing. The work rests in the Vs, being held thereto by swinging clamps, while the under surface of the tappet arm rests upon the head of the central bushing. This fixture handles either right or left parts, either part being located endwise by the broach itself.

Fig. 24 shows a part of the equipment for heat-treating, both furnace and oven being gas fired and equipped with electric pyrometers for determining the heat. The furnace in the foreground was installed especially for this work, but the large oven graduated from the job of baking enamel on motor-cycle parts. While not ideal in the matter of gas consumption, it had the advantage of being already on the job and as its work consisted of drawing the hardened parts to about 675 deg. F., it served the purpose admirably.

OPERATION SHEET FOR LIBERTY MOTOR PARTS, NOS. 8019 AND 8020

1. Straighten.
2. Milling.
   Gang of seven cutters. Mill ends; mill sides of cam-roller-fork; open slot in cam-roller-fork; spot for centering. Right hand on one machine, left hand on the other.
3. Centering.
   Depth of centers must be held to limit of variation of 0.001 inch.
4. Milling.
   Two cutters, mill inside of tappet arm. Run in pairs.
5. Milling.
   Two special formed cutters. Mill top of tappet arm. Run in pairs.
6. Milling.
   Two special formed cutters. Mill bottom of tappet arm. Run in pairs.
7. Rough-turn.
   Pieces handled separately in engine lathe.
8. Form-turn to grinding size.
   Rights in Gridley automatic; lefts on National-Acme.
9. Drill, ream and counterbore.
   Separate jigs for right and left. Operations go forward in pairs.
10. Countersink holes in cam-roller-fork.
    Pieces handled separately.
11. Milling radius on side of tappet arm; one plain milling cutter. (Do not allow this cutter to become under size.) Run in pairs.
12. Hand-grind contour of end of tappet arm.
    Operation performed individually on disk grinding machine.
13. Rough-polish.
    Hand operation.
14. Broaching.
    Broach hole in tappet arm. Handle right and left consecutively.
15. Reaming.
    Hand-ream hole in cam-roller-fork.
16. Heat-treating.
17. Lapping centers.
18. Finish-grinding.
    Rights on one machine; left on the other.

One feature of the work that is to be finish-ground on centers that cannot receive too much attention, is the cleaning and truing of the centers after hardening. If these are not round, or if they carry particles of grit, it is futile to expect the work to be round after grinding. For this reason the centers in the work under consideration are very carefully lapped and cleaned, the work being done in a sensitive drilling machine with formed metal laps charged with diamond dust. A helper with a pan of gasoline gives the centers a thorough rinsing and wipes them out with a piece of waste several times during the lapping process.

The pieces are ground in two separate operations upon Landis grinding machines as shown in Fig. 26, after which they are ready for the final inspection. A corner of the inspection department is shown in Fig. 27 where the work is tested not only for size and form but for hardness.

Rules of Etiquette for Foremen

By Charles D. Folsom, Jr.

I have had some hearty laughs over the articles on pages 756 and 1026, Vol. 51, by Jack Homewood on "Rules of Etiquette To Be Observed in the Machine Shop." There is truth in those articles, and they were obviously drawn from real life. It seems to me, however, they are a little bit one-sided. I have seen all the antics so cleverly described by Mr. Homewood, and more too, during the "late unpleasantness"; but I have seen something else, both before and after. I refer to the actions of foremen and others in charge of machine shops, and so I should like to propose a few "Rules of Etiquette To Be Observed by Machine Shop Foremen."

When Hiring a Man: Maintain your dignity. Don't let the applicant think you're a human being, because then he will try to take advantage of you. Cover him with a cold and searching glare as though you suspected him of being an escaped convict. This puts him in a genial, confiding mood. Then begin to fire questions. "Where did you work last?" "Why did you leave there?" "Where did you work before that?" "How long did you work in each place?" "How much did they pay you?" "Where did you work before that?" "And before that?" "And before that?" * * * "Can you read a blueprint?" "Do you know how many thousandths there are in an inch?" These time-tried questions are especially recommended. When asked at the rate of twenty-seven or more per minute, the man becomes too frightened to lie and consequently tells the truth, the whole truth, and * * * and then some.

When Breaking in the Man You Have Just Hired: Lead him over to the rickety lathe that the regular men steer shy of, give him a job on which he can prove his ability (or otherwise) and then walk quickly away. Don't go far, however; he might put the lathe in his pocket and make a quick getaway. Hence you should select a point of vantage and spend the morning there, watching him with fatherly care. This is important, because when he realizes the benevolent interest you are taking in him, his ruffled nerves are quieted and he feels at his best.

When You Feel It To Be the Part of Wisdom to Grant the New Man's Demand for a Raise: First sequestrate the happy man where no prying ears may hear the glad tidings. Then with a Santa Claus smile break the news. adding "of course you understand this is not to be mentioned to anybody." "Oh, no!" is the response; at which you are greatly pleased, because you now know that the secret will be well kept—by everybody in the shop.

When a Rush of Work Forces You to Take on a Number of New Men in a Hurry: Don't be finicky. Take what you can get and pay them what they demand. You

should worry; you won't keep them long. Only be sure to impress upon them that their wages are their own business, and not to be discussed with the other men. This makes for a hearty feeling of co-operation and good-fellowship in your shop, especially when one of your "old-timers" finds that a green war-mechanic is getting ten cents an hour more than he.

When the Slump Comes and You Begin to Lay Off Men: Don't let any inkling of the impending cataclysm find its way into the gossip of the shop; it might tend to break down the morale which you have so carefully nurtured. Figure things out to a nicety, and just when the last day's work is going through, spring the news at about 3:30 in the afternoon. Don't make the childish mistake of letting them know beforehand; they probably wouldn't do it for you.

This is my set of rules for the machine shop, and I should like to see it framed and hung over the desk of some foremen I have known. But, speaking seriously, is there not a good deal to be said on both sides, both of criticism and defense? I think that the subject might profitably be discussed by the readers of *American Machinist* in a serious as well as a frivolous vein. Here are a few suggestive questions, which I for one would like to see answered:

What is the practice of the "best shops" in laying men off? Do they give any advance pay? Do they give any notice? And in the latter case, do the employees show themselves worthy of the courtesy?

Is the principle of secrecy in granting increases of wages ethical and expedient?

Should any weight be attached to data given by an applicant for a position relative to his previous employers, wages, experience, etc., until it has been investigated?

Is it cheaper to look up a man's record or to try him out in the shop?

Reboring Motor Cylinders

By E. C. Jones

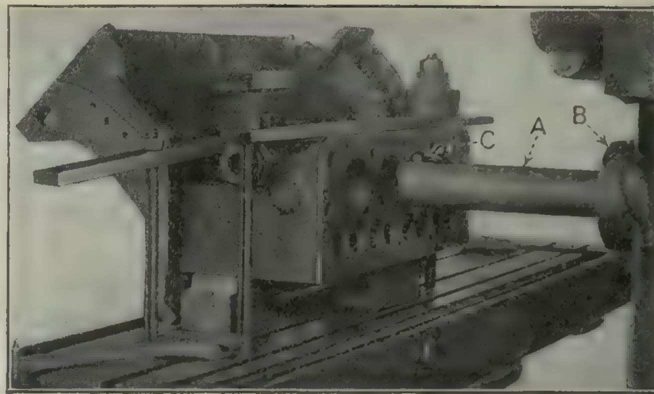
The writer was recently confronted with the fact that the cylinders of his pleasure car were so badly worn out of "round" that it was necessary to have them rebored true.

The only available machine at hand for doing the work with the degree of accuracy required was a 3A Brown & Sharpe milling machine.

The boring bar *A* was made to fit the usual tapered hole in the spindle of the machine, but in addition had a collar turned just in front of the taper shank and integral with it. A cap nut *B* was made to fit closely over the bar and was threaded on the inside to fit the nose of the milling-machine spindle.

The purpose of the slip collar was to press against the collar on the boring bar, causing the bar to be firmly driven home and holding it in place.

The cutting tool used was a single tool inserted into a hole drilled near the end of the boring bar and held in place by means of a setscrew. The tool differed from the usual boring tool in that it was in the form of a wide round-nose tool with a V-shaped cleft made in the cutting edge, thus forming a tool with cutting edges. The forward or front cutting edge of the tool was made about $\frac{1}{16}$ in. wide while the rear edge was $\frac{1}{8}$ in. wide and ground to cut somewhat deeper than the front cutting edge. A back clearance of about 20 deg. was ground on



THE CYLINDER BLOCK MOUNTED FOR REBORING

the tool and 0.010 in. of metal was removed from the cylinder walls in two cuts.

The slowest feed of the milling machine was used. As the work was fed toward the tool in the bar, the cut taken on the cylinder wall described a spiral path, and the rear cutting edge of the tool was made sufficiently wide to enable it to cut the crown of the thread-line surface left by the front cutting edge of the tool.

The bores of the cylinders were finished very smooth and showed little trace of chatter marks.

The Mechanics of the Future

By Thos. W. R. McCabe

On page 70 of the *American Machinist* there was published an article by Joseph T. Taudvin under the above title.

Mr. Taudvin is no doubt correct as to many industrial employers placing men with technical education as superintendents, general foremen, and in various positions of trust, in preference to one of acknowledged skill and experience. The writer has seen many men of this type so placed, and later replaced by the latter class of men, owing to the lack of ability of the former class to instruct and direct those over whom they were placed. I am of the opinion that, at the present time, many industries are prosperous owing to prices and demand for almost all lines of manufactured articles. Managements which in normal times would bankrupt the concerns of which they are the heads are now acclaimed great and wonderful successes. Many hold their present positions owing to their free use of the English language and high-sounding phrases. During the war new high-sounding terms were coined for all kinds of jobs. Jobs are no longer jobs but positions. Skilled men are discredited and called poor workmen because their foremen are unable to judge owing to their own lack of knowledge.

While it is well for all young men to obtain as good an education as possible I am of the opinion that the young man who is now working and gaining that practical experience which is so essential before intelligently directing others, will finally be the man at the top of our industries regardless of his lack of technical knowledge. Technical education is a help though as some advertisements say it is not essential.

Zinc (in the form of zinken) was first used by Paracelsus. In medieval days zinc and bismuth were confused and the word spiauter, the modern spelter, was indiscriminately given to both.

Educating an Entire Personnel

BY MARK H. REASONER
Works Manager, Diamond Chain and Manufacturing Co.

The educational plan described here is unusual in its comprehensiveness, reaching from the lowest-paid employee up to the general manager, and giving to each a course of study and training best suited to increase his ability and prepare for a bigger job. It is encouraging to note the greatly decreased labor turn-over which was one of the byproducts of a scheme intended to make men think and to broaden their viewpoint.

UNTIL recently our country has done little or nothing of consequence to develop the personal efficiencies, knowledge and skill of its craftsmen. It spends millions of dollars annually on general education. It spends several thousands of dollars of public funds on any individual who can afford to devote a suitable length of time to attending a college and becoming a first-rate professional man or woman. It rarely, if ever, spent a single dollar to improve as a mechanic or better the condition of a workman until the war period and reconstruction conditions forced a change.

If every soldier were back on his job today the country would still be short millions of workers, owing to the lessened tide of immigration in former years. Workers are needed everywhere, and we must help by every means possible those now in our employ to do more and to gain through increased production a greater share in the profits.

What then of the waste of human effort and equipment by employing men and women at tasks which they little understand and at which they can only escape condemnation by a plea of carelessness or ignorance?

FORMATION OF AN EDUCATIONAL PLAN

These facts faced the Diamond Chain and Manufacturing Co. in 1918 and caused the formation of an educational plan for training employees. The course outlined was organized in three sections: (1) For factory employees; (2) for foremen; (3) for executives. The courses for factory employees were taken up along vocational training lines. At the request of the company, the work was outlined as vocational and part time, and it was found that it could be legally paid for from the funds on hand derived from tax levy under the Indiana vocational education statutes. The school being duly authorized under the law, the company agreed to furnish facilities and equipment, the school board to furnish the teachers. The women employees from the factory, of all grades except those in the offices, were eligible for the first series of classes. They were paid straight time for all time consumed in class work. The course was divided into four parts or major lines: (1) Common branches and social science; (2) industrial processes, history of material and commercial geography; (3) domestic science, cooking and sewing; (4) first-aid work.

As fast as one class finished the eight weeks of instruction in each section, it automatically graduated into the next division until at least 32 weeks of time had been put in. Classes consisted of from 11 to 15 girls and the schedules for sections one and two were as shown in Table I.

TABLE I. SCHEDULE OF CLASS HOURS FOR WOMEN.

Class "F"	
8:00— 8:45	Arithmetic
8:45— 9:30	Social science
9:30—10:00	Hygiene
10:00—10:20	Physical exercises
Class "G"	
1:00— 1:45	Arithmetic
1:45— 2:30	Social science
2:30— 3:00	Hygiene
3:00— 3:20	Physical exercises
Class "F"	
10:00—10:45	Industrial processes
10:45—11:30	History of Material
11:30—12:00	Commercial Geography
Class "G"	
3:00— 3:45	Industrial processes
3:45— 4:30	History of material
4:30— 5:00	Commercial geography

Taking up the subjects individually, it was found that there was a considerable variance in the previous training and education of the personnel of the school and that many variations and shifts were necessary to bring the classes to a common level.

Form 169 D.C. & Mfg. Co.

CONTINUATION SCHOOL
REPORT CARD

Date Name

Characteristics	Grade	Characteristics	Grade
Attitude		Sense of Organization	
Cooperation		Promptness	
Tractability		Executive Ability	
Common Sense		Results Obtained	
Tact		Drawing	
Energy and Determination		Mathematics	
Initiative		English	
Attention to all Details		Physics	
Analytical Ability		Civics	
		Geography	

100 % Excellent 70 % Fair
90 % Good 65 % Poor
80 % Medium 60 % Unsatisfactory

Description of Action Taken

Made By

REPORT CARD FOR STUDENTS IN ALL CLASSES

When the cooking class was organized, it was found expedient to hold this twice per week at 3 p.m. on Wednesday and Thursday, and to have a six weeks' course instead of eight. The first class carried an enrollment of 28, which was found unwieldy, and subsequent classes were limited to 13 persons. The methods here employed were demonstrations and experiments, and the objects of the lessons were to teach the preparation of cheap and wholesome food with the least expenditure of time, energy and money. Six main points were emphasized: (1) Necessity of buying economically; (2) necessity of buying in advance of needs; (3) necessity of serving well-balanced meals; (4) necessity of using left-overs; (5) necessity of serving food attractively; (6) necessity of taking care of food immediately after the meal, and the care of the kitchen.

The method of conducting the class was a 15-min. lecture on the theory to be employed in the hour following, after which 15 min. were taken for testing and serving, followed by a 30-min. period of dish washing and cleaning up, making a 2-hr. period. Two housekeepers were appointed and these were changed each week. The first class consisted of 10 lessons; the subjects covered were as given in Table II.

TABLE II. FIRST COURSE IN GENERAL COOKERY.

I. Introductory.
- Necessity for food.
  - Building and repairing tissues.
  - Heat and energy.
- Necessity for cooking food.
  - To render it more palatable and digestible. To destroy germs of disease and other parasites.

II. Classification of Food Principles.
1. Water.
2. Mineral matter.
3. Carbohydrates—sugar—starch.
4. Fats and oils.
5. Proteids—Flesh formers and heat givers.
   Food adjuncts—alcohols—acids.

III. Water.

Food value.
1. Solvent power.
2. Heat regulator.
3. Aids chemical changes.
4. Carrier.
5. Keeps parts soft and pliable.

Water boils at 212° F. Freezes 32° F.

IV. Mineral matter.
1. Source.
2. Food value—aids chemical changes.

V. Starch.
1. Food value—heat given.
2. Digestive—stages in cooking of starch.

VI. Foods containing starch.
1. Vegetables—potatoes.
2. Cereals.

Cooking—breaks the starch grains.

VII. Sugars.
1. Source.
2. Composition.
3. Food value—digestion.
4. Conservation.

VIII. Fats and Oils.
1. Source—animal, lard, butter; vegetable, olive oil, nuts, corn.
2. Composition.
3. Food value—heat givers.
4. Cooking.

IX. Proteids.
1. Source.
2. Composition.
3. Food value—flesh formers—also give heat.
4. Cooking—eggs, milk, cheese.

X. Meats.
1. Structure of lean meat
2. Composition.
3. Classification of methods of preparing meats according to their nutritive value.
   1. Extraction—soups, broths, bouillon, beef, tea.
   2. Conservation—roasting, baking, broiling, pan broiling.

Gelatine is obtained from bones and tissues. Easily digested and absorbed.

After this course was finished, these students graduated into the last class—that for first-aid work. This class was conducted by a competent physician under the direction of the school board, and was also thrown open to the attendance solicited from all foremen and executives in the plant. This class was called after hours, or from 5:30 to 6:30 p.m., and all attending were paid straight hourly rates for their presence.

Part-Time Instruction Planned

It was decided that in order to strengthen the organization, the calibre of foremen must be improved and their general understanding and power to think must be stimulated. Therefore, a class in part-time instruction was planned and put into operation in the spring of 1919.

A competent instructor from the Great Lakes Naval Training School was secured. The foremen from the various departments were drawn in two divisions, 17 each, and the course as mapped out consisted of 3 hrs. per day, 5 days per week, for a term of 16 weeks as shown in Table III.

TABLE III. PART-TIME COURSE FOR FOREMEN

Time, 3 hrs. per day, 5 days per week, 16 weeks; total, 240 hrs.
Monday—Morning, 1½ hrs. drawing; afternoon, 1½ hrs., physics.
Tuesday—Morning, mathematics; afternoon, geography.
Wednesday—Morning, drawing; afternoon, mathematics.
Thursday—Morning, English; afternoon, civics.
Friday—Morning, mathematics; afternoon, physics.
Economics may be combined with civics after six weeks.

Mathematics—Belt speeds, gear ratios; percentage of overhead; percentage of labor cost; volume of boxed goods; power transmitted. Fundamentals taught incidentally.

Geography—General geography of the region, the country, and the world; transportation, especially as it relates to products of the factory; products, especially metals.

Economics—Principles of value, elements of cost, balance of costs; money and value.

Physics—Principles of machines, energy, power, elements of electricity, mechanics, elements of heat.

English—Practice in accurate expression, use of punctuation, brief descriptions, letters of application, reports; general suggestions in regard to reading; free use made of trade papers, articles criticized in regard to the English uses.

Civics—General study of city, state and national governments; study local civic activities, political and social.

Mechanical Drawing—The principles of projection, simple sketching, actual drawing of simple machine parts; problems in mechanism, layout of shops, etc.

Shop problems—Discuss with executives various problems of shop management, especially those which involve mechanical difficulties.

In order to bring home the course very thoroughly, this course was supplemented by a series of lectures covering: (a) Necessity for an educational course; (b) lectures covering quality of product; (c) lectures covering principles of supervision.

The first series covered the following:

1. "The Purpose of an Educational Department," by general manager.
2. "The Need of a Quality Product," by sales manager.
3. "The Effects of Perfect Administrtaion," by works manager.
4. "Opportunity Offered by Education," by general manager.
5. "Education as a Means toward Quality Product," by superintendent of vocational education.

The second series, on quality of product, covered the following:

6. "What Is Quality?" by chief engineer.
7. "The Cost of Quality," by general manager.
8. "Quality vs. Production," by works manager.
9. "How Is Quality Secured?" by industrial engineer.

The third series, on supervision, embraced:

10. "Supervising Men and Women," by general manager.
11. "Record of Employees' Performance," by works manager.
12. "Accumulative Progress Records," by industrial engineer.
13. "Records of Complaints and Suggestions," by works manager.

Following this series, a second series on company problems was given, consisting of nine lectures, three on mechanical problems and mechanism, by the chief engineer, and the others on production and production control, and cost accounting procedure as applied to company business, by the production manager and cost accountant.

At the end of each month a report card, as shown in the cuts, is made out for all students in the various classes and is turned in to the works manager in charge of the educational department for inspection. It is then returned to the teacher who retains it after inspection by the student.

Executive Class Organized

Not only is education confined to foremen and operatives, but it is also offered to executives who have the time to spare to better fit themselves for more responsible positions. In the fall of 1918 a class was organized of executives from the general manager down, taking up a standard set of a certain correspondence school's texts, covering the following lines in business administration: Corporate organization management; cost accounting and financing; stocks and bonds; business law and many kindred subjects.

Owing to the pressure on all executives, the time of meeting was placed from 5:10 p.m. to 6:30 p.m., once per week, generally on Thursday. Approximately 160 pages of reading matter were assigned for a two weeks' period. A leader was appointed who made assignments of approximately 10 pages of reading matter to each executive. This necessitated the leader doing a certain amount of his work a week in advance of the rest of the class. The leaders so appointed held office for two meetings in succession and were appointed in rotation.

Discussion

On the convening of the class at 5:10 p.m., the leader called in sequence on the members for a 5-min. report on the sections of the text which had previously been assigned them for preparation. This continued for about 50 min., and the last 30 min. were taken up in a quiz and general discussion based upon the questions in the text and conducted by the leader. This discussion was entirely informal, but it rested upon the leader to see that it was a snappy, well-conducted and logical discussion, and that it led somewhere. Whenever a problem in the lesson occurred it was always solved and handled during this discussion.

This covers the present scope of educational work as carried out in the Diamond Chain and Manufacturing Co. The results to date have been very gratifying and the labor turnover, which has been carefully watched, as a result has shown a most gratifying decline.

A Graphical Method for Finding Accurate Center Distances

By R. Jantsch

This scheme for obtaining center distances with extreme accuracy should prove valuable to the men who have to carry out the details of close-limit work as specified by the modern planning department. It is a whole lot easier to say that a certain distance shall be accurate to a ten-thousandth than it is to measure that distance in a hurry.

THE writer believes the method described in this article, is not generally known, and since it is quick and reliable, it will no doubt be appreciated by the draftsman who is frequently called upon by the shop to figure out in a hurry coördinate measurements for accurate center distances; particularly in cases where the chance of error by figuring is great because of the complicated trigonometrical or analytical solution.

To find the exact coördinate measurements for the distances of a number of points, a layout is made of these points (an actual-size layout is in most cases satisfactory). From this layout the desired measurements are first approximately obtained by scale reading. In this connection it should be mentioned that since the measurements are to be given in decimals, it is preferable to use a scale graduated in 10ths, 20ths, 50ths and 100ths. Using these approximate measurements with the simple trigonometrical formula $c = \frac{a}{\sin A}$, the error of approximation is found and from the latter the exact coördinate measurements by means of the simple method described in what follows:

In Figs. 1, 3 and 5, a and c are fixed points, ab and cd straight lines, the ends b and d of which are supposed to meet at e, but do not because e is not where it should be. The problem is to move e to e'. This is done by drawing arcs be' and de' with centers at a and c respectively. Now if for instance ab is about 3 in. and eb about 0.02 in. and cd and de have similar proportions, the curvature of arcs be' and de' is so infinitely slight compared to the length of the curve that it can be considered zero for all practical purposes. Hence be' and de' can be considered as the tangents of arcs be' and de' at points b and d respectively and point e' the point of intersection of tangents be' and de'.

But in order to determine the minute movement of e to e' graphically, it will be necessary to make a considerably enlarged layout of the points which determine the distance ee'.

In Figs. 2, 4 and 6 these enlarged layouts are shown. An enlargement of 500 to 1 will be found satisfactory in most cases.

If for instance in Fig. 1, $de \doteq 0.0215$ in., then the corresponding distance $d'e$ in the enlarged layout, Fig. 2, would be $0.0215 \times 500 = 10.75$ in. and similarly

$eb = 0.0123$ would be enlarged in Fig. 2 to $eb' = 0.0123 \times 500 = 6.15$ in.

In Fig. 2, we measure $Y = 15.2$ in. and $X = 0.4000$ in. If $\frac{15.2}{500} = 0.0304$ is added to the approximate first scale measurement af in Fig. 1, the exact measurement of af is obtained; and, similarly, if $\frac{X}{500} = \frac{0.400}{500} = 0.0008$ is subtracted from the approximate first scale measurement ef in Fig. 1, the exact measurement of ef is obtained.

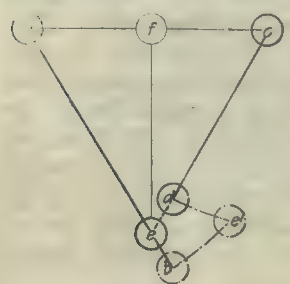


FIG. 1

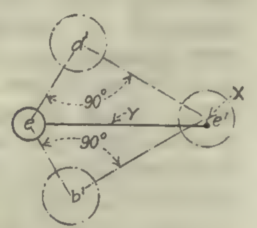


FIG. 2

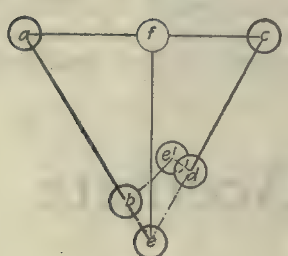


FIG. 3

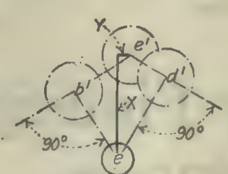


FIG. 4

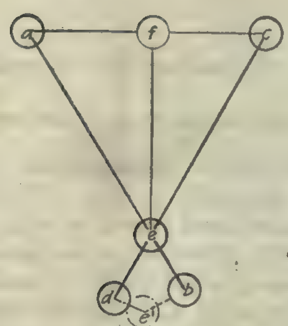


FIG. 5

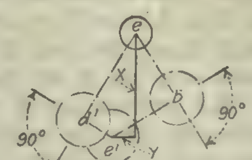


FIG. 6

FIGS. 1 TO 6. LOCATIONS OF POINTS TO STANDARD AND ENLARGED SCALES

Following is a typical example with layout, Fig. 7, which can be solved to advantage by this method:

Example, Fig. 7

Find: ay, cy, ax, bx, ez, fz.

Given: $ab = 3.0003$ in.; $bc = 3.0625$ in.; $cd = 4.9376$ in.; $ac = 4.9373$ in.; $ef = 4.8040$ in.; $fg = 4.8000$ in.

(1) Find ay and cy.

From layout find the approximate measurements: $ay = 3.96$ in.; $cy = (4.37 - 1.4375) = 2.9325$ in.

$$\text{Tan } D = \frac{4.37}{6.2749 - 3.96} = 1.88777$$

From sin table we find $\sin D = 0.88368$.

Then the approximate distance

$$cd = \frac{cy + 1.4375}{\sin D} = \frac{4.37}{0.88368} = 4.9452 \text{ in.}$$

The error of approximation of

$cd = (4.9452 - 4.9376) = +0.0076$ in.

In the same manner we find:

Tan $A = 0.74053$; $\sin A = 0.59512$;

$$ac = \frac{cy}{\sin A} = \frac{2.9325}{0.59512} = 4.92758 \text{ in.}$$

The error of approximation of

$ac = (4.9373 \text{ in.} + 4.92758 \text{ in.}) = -0.0097$ in.

Now we make the enlarged layout:

$cc' = +0.0076 \times 500 = +3.8$ in.; $cc^2 = -0.0097 \times 500 = -4.85$ in.

We measure $cc^4 = 0.75$ in. and $c^3c^4 = 6.54$ in.

Then ay (exact measurement) $= ay$ (approximate) $+ \frac{c^3c^4}{500} = 3.96 \text{ in.} + \frac{6.54}{500} = 3.9731$ in.

And cy (exact measurement) $= cy$ (approximate) $- \frac{cc^4}{500} = 2.9325 - \frac{0.75}{500} = 2.9310$.

Exactly the same procedure is followed for finding ax, bx, and ez, fz.

(2) Find ax and bx.

Approximate measurement: $ax = 0.92$ in.; $bx = 2.84$ in.; tan $B = 3.08695$; sin $B = 0.95133$; $ab = 2.98529$ in.; tan $C = 0.02980$; sin $C = 0.02979$; $bc = 3.0547$.

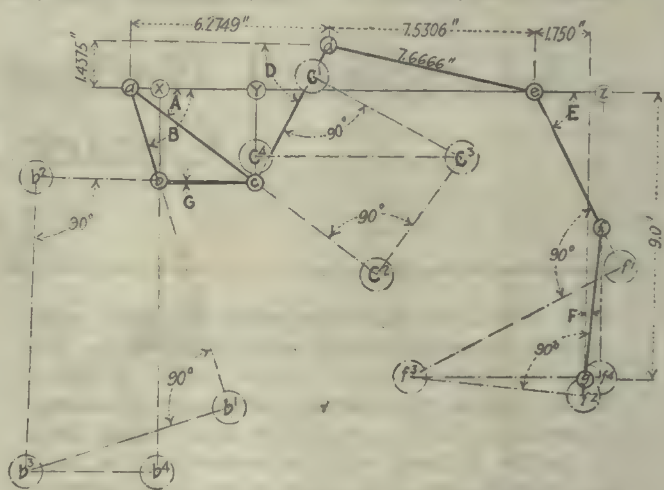


FIG. 7. PROBLEM IN FINDING CENTER DISTANCES

Error $ab = -0.0150$; error $bc = -0.0078$ in.

Enlarged layout $bb' = -0.015 \times 500 = -7.5$ in., $cc' = -0.0078 \times 500 = 3.9$ in., $cc^4 = 9.2$ in., $c^3c^4 = 4.11$

ax (exact) $= 0.92 - \frac{4.11}{500} = 0.91178$; bx (exact) $=$

$$2.84 + \frac{9.2}{500} = 2.8584$$

(3) Find ez and fz

Approximate measurement: $ez = 1.750 + 0.54 = 2.29$ in.; $fz = 4.22$; tan $E = 1.8427$;

sin $E = 0.087894$; $ef = 4.8012$ in.; tan $F = 0.11296$; sin $F = 0.11225$; $fg = 4.81069$.

Error $ef = -0.0028$; error $fg = +0.0107$ in.

Enlarged layout: $ff' = -0.0028 \times 500 = -1.4$ in.; $ff^2 = +0.0107 \times 500 = +5.35$ in.; $ff^4 = 4.75$ in.; $f^3f^4 = 5.95$ in.

ez (exact) $= 2.29 \text{ in.} - \frac{5.95}{500} = 2.2781$; fz (exact) $= 4.22 + \frac{4.75}{500} = 4.2295$ in.

Old English Machine Tools at Soho, Birmingham

By I. W. CHUBB
European Editor, *American Machinist*

In this article some of the machine tools used by Boulton & Watt are illustrated and described. A study of certain of the details will show that the designers of these tools were not so far behind the times as might be imagined. One old lathe is shown with an arrangement for reversing the change gears that might well be the progenitor of the quick-change gears used on lathes of today.

AMONG the historically instructive visits made by the participants in the Watt Centenary celebration, held in the Birmingham district toward the end of September last, the tour of the parts of the works of W. & T. Avery, Ltd., that formed sections of the original Soho Foundry was not the least informative. The foundry has been claimed to be "the first works that the world has ever seen; that is, it was the first works to employ machinery to make machinery." In the minds of some readers of the work of the older British engineers, Soho Foundry is occasionally confused with the Scho Factory. The latter was about a mile away, and was built in 1765 by Boulton, at a cost of £9,000, and was used for the making of small metal ware such as inlaid steel buckles, chains, buttons, etc., and for producing coins, medals, candelabra, vases, etc.

FIG. 2. WATT'S BATH TUB

The Soho, or perhaps better, Smethwick Foundry was built as an extension in 1796 for the firm of Boulton & Watt, who had joined in business in 1775. When James Watt the younger died in 1848 the title of the firm was altered to James Watt & Co. and from this firm the foundry was purchased in 1895 by the present owner, W. & T. Avery, Ltd., manufacturer of weighing, counting, testing and other machinery. The original entrance is in existence, with the old drawing offices above, and behind them the private offices of the old firm, the lower floor being occupied then by clerks, while the cashier and others were on the other side of the gates. The clock installed in 1812 is still in use. Watt's stables have recently been converted into stores. Foundry Row, headpiece, was built at the same time as the works but only one-half now remains. The larger houses were occupied by the foremen and the others by workmen, while the house on the extreme left hand, marked by a tablet at *A*, was occupied by William Murdock in 1817.

Some little distance away, but still a part of the works area, is the site of the first gas holder. An old circular gasholder still exists, but whether it was the original one may possibly be doubted, as the first drawings show one of a rectangular form. In the distance, something like a mile away, is Sycamore House, where Murdock afterward lived and which still stands. A copper pipe was used to convey the gas to this house, which is thought to be the first private residence thus illuminated. W. & T. Avery, Ltd., states that part of the copper pipe was found a few years ago when excavations were being undertaken for another purpose. Fig. 2 shows a bath which was used by the principals of the firm, including, it is understood, Watt, Boulton and Murdock. This bathroom is not now used for any purpose; in fact, it merely exists.

Among the shops is the one where the engine was built for Fulton's steamship, the first steam-propelled vessel made; the engines of the Great Eastern were also built there. Now testing machines are erected in the

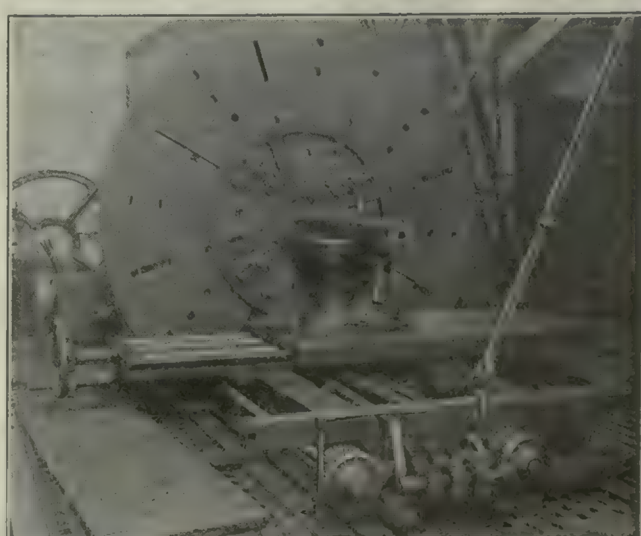


FIG. 3. PIT LATHE 90 YEARS OLD

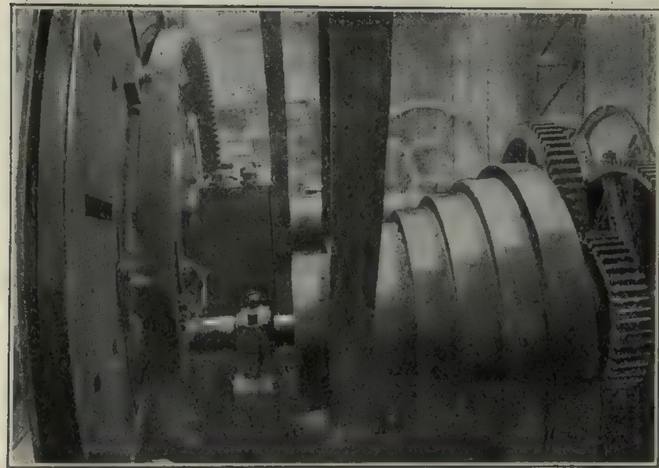


FIG. 4. FACEPLATE DRIVE ON OLD PIT LATHE

same building. Adjacent is the erecting shop which is understood to have been opened by Boulton with a roaring feast. Boulton's speech has been recorded as follows:

"I come now as the Father of Soho, to consecrate this

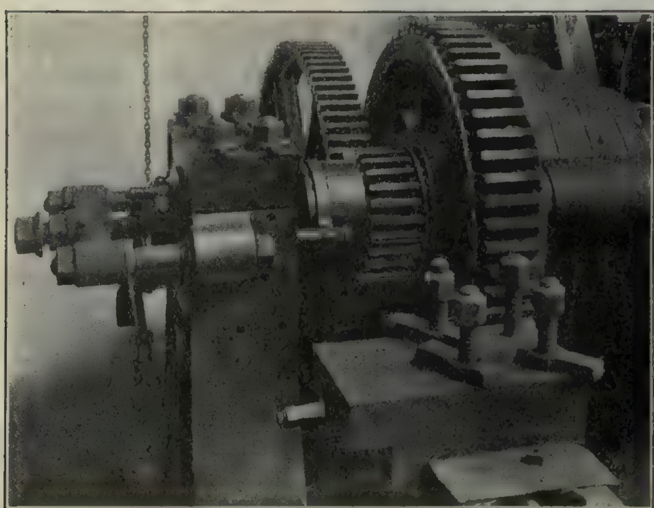


FIG. 5. SPINDLE THRUST ON OLD PIT LATHE

place as one of its branches; I also come to give it a name and my benediction. I will therefore proceed to purify the walls of it by the sprinkling of wine, and in the name of Vulcan and all the Gods and Goddesses of

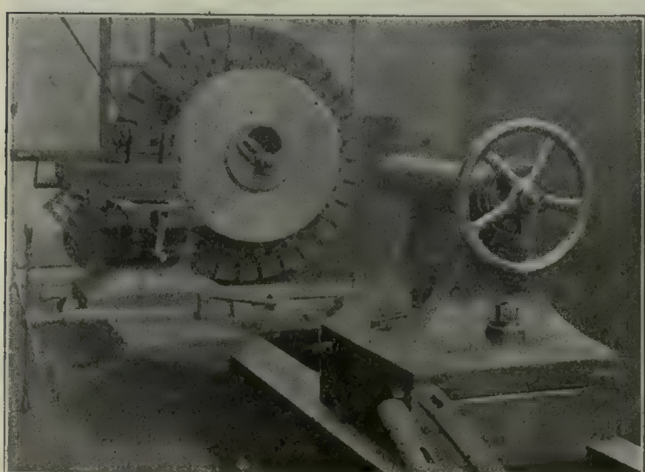


FIG. 6. SCREW-CUTTING LATHE BUILT IN 1842

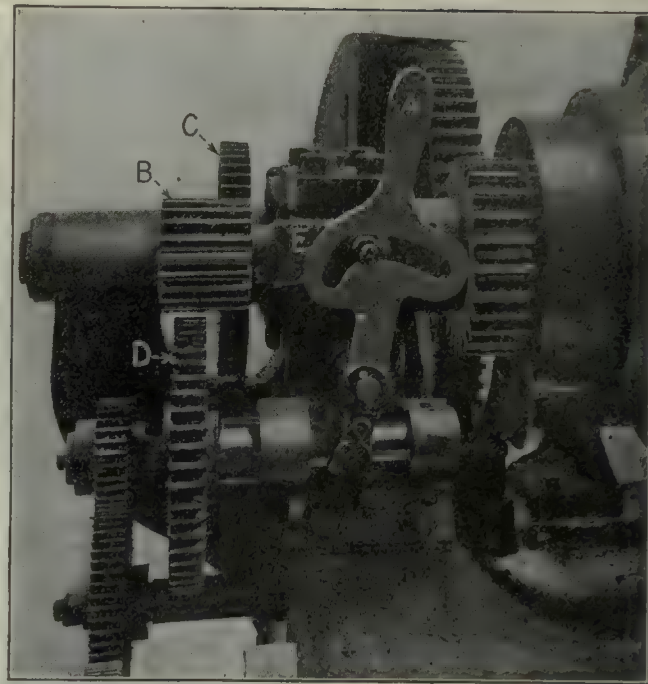


FIG. 8. CHANGE- AND REVERSE-GEAR SYSTEM ON LATHE SHOWN IN FIG. 6

Fire and Water, I pronounce the name of it Soho Foundry. May that name endure for ever and ever, and let all the people say Amen, Amen. This Temple now having a name, I will propose that every man shall fill his pitcher, and drink success to Soho Foundry. Let me

FIG. 9. RADIAL DRILLING MACHINE DESIGNED IN 1845

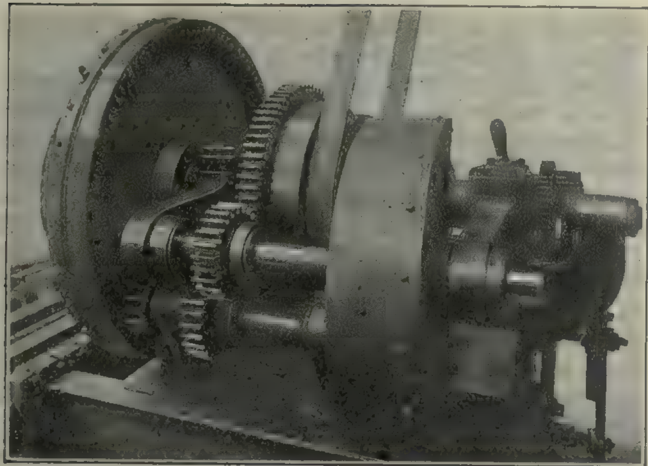


FIG. 7. GEARING AND FACEPLATE DRIVE ON LATHE SHOWN IN FIG. 6

give my benediction to Soho Foundry. May this establishment be ever prosperous. May no misfortune ever happen to it. May it give birth to many useful arts and inventions. May it prove beneficial to mankind, and yield comfort and happiness to all who may be employed in it. As the smith cannot do without his striker, so neither can the master do without his workman. Let each perform his part well, and 'do his duty in that state to which it hath pleased God to call him,' and this he will find to be true rational ground of equality. One serious word more, and then I have done. I cannot let pass this day of festivity without observing that these large piles of buildings have been erected in a short time, in the most inclement season of the year, without the loss of one life or any material accident. Therefore let us offer up our grateful thanks to the Divine Protector of all things, without whose permission 'not a sparrow falleth to the ground.' Let us chant Hallelujahs in our hearts for these blessings, and with our voices, like loyal subjects, sing 'God Save Great George the King.'" Several old machine tools remain and, in fact, are in use; but only a few years ago they were accompanied by quite a number of others, since removed and broken up. Still employed, for instance, is the faceplate pit lathe, illustrated in Fig. 3, which is understood to be the first lathe with a pinion working on a toothed ring at the back of the faceplate; see Fig. 4. This machine

FIG. 13. BOULTON'S MINT BUILDING, NOW USED AS A BLACKSMITH SHOP

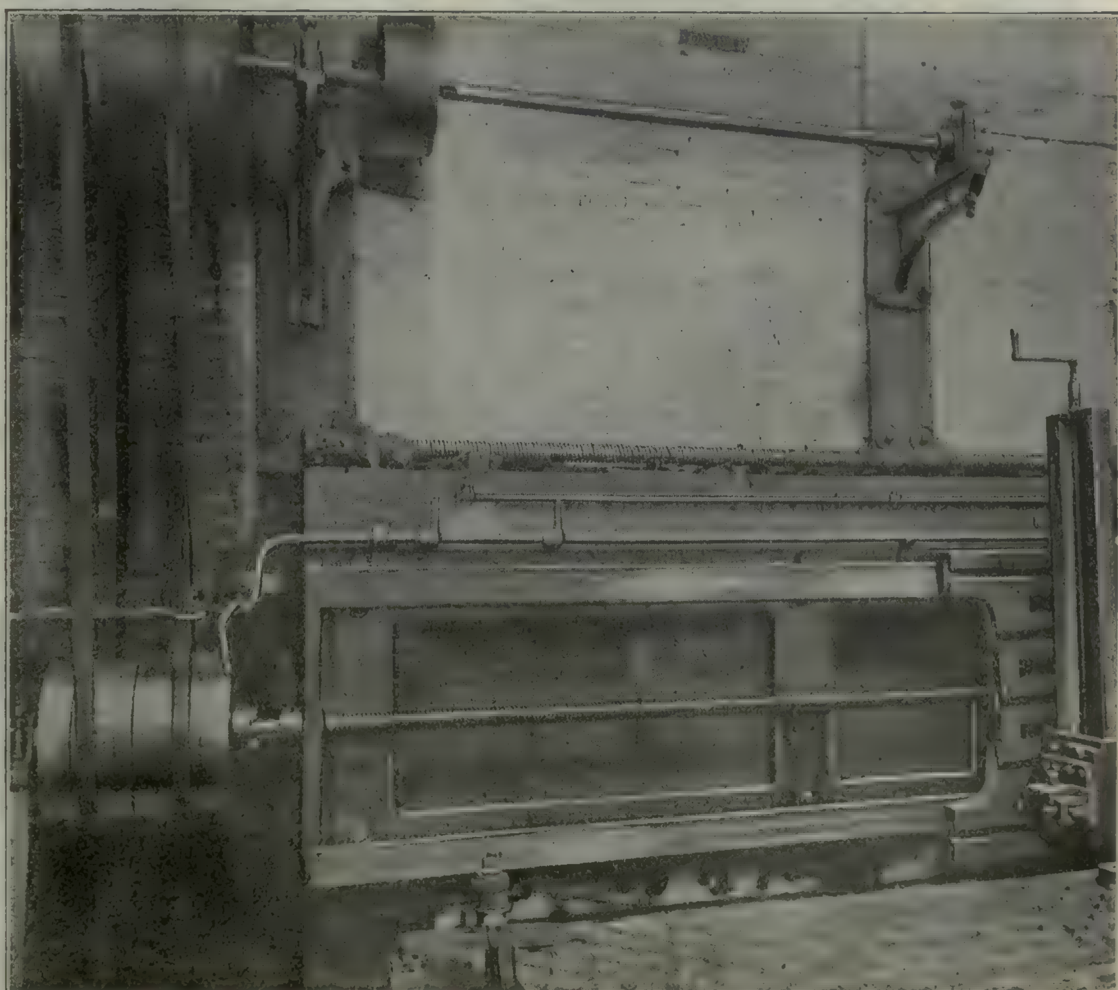


FIG. 10. WALL PLANING MACHINE 120 YEARS OLD

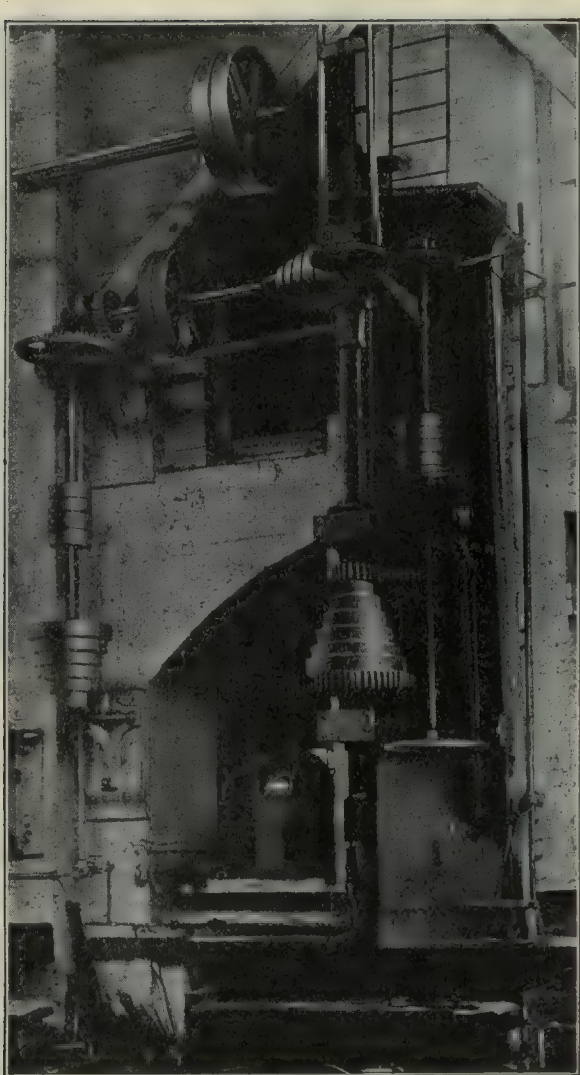


FIG. 11. A VERTICAL BORING MACHINE (NOT NOW IN THE PLANT)

was removed from the Soho Factory when it was closed in 1850. It takes work up to 26 ft. in diameter. The faceplate is 10 ft. in diameter. Driven from overhead by a shaft with universal joints the gearing shown gives three feeds, longitudinal and cross, with reverse. Fig. 5 shows the bridge piece and center point for taking the end thrust due to the cutting action, and it is understood too that this is the first example of the kind. The lathe has been running 90 years.

The screw-cutting lathe, Fig. 6, was built in 1842, the height of centers being 30 in. and the bed 40 ft. long, the maximum length of job taken being 31 ft. The gearing for the head, including the pinion driving the faceplate, will be seen in Fig. 7, a detail of the change-gear system being given in Fig. 8.

These gears are actuated by the hand lever *A* which has a cam-shaped slot, and, as shown in the illustration, the pinion *B* between the driving and the following wheels *C* and *D* is raised out of mesh with the lower wheel *D*. The gear *D* is mounted on a sliding quill attached to the tail of the hand lever, while pinion *B* is mounted on the rocking cradle *E*. It will thus be seen that movement of the hand lever in either direction will rock the cradle up or down and slide gear *D* to the right or left. If the lever is moved to the left from the position shown in the illustration, gear *D* will be slid into mesh with gear *C*. If the lever is moved to the right the pinion *B* will be dropped into mesh with gear *D* and the direction of the change gears will be reversed.

Designed by Harper in about 1845, the radial pillar drilling machine shown in Fig. 9 is one of a pair which stood on each side of the gateway and was used to drill castings while still on railway trucks. The maximum radius is 8 ft. 6 in. and the machine will take a job about 10 ft. from base to underneath the arm and still give a reasonable length for the drill. The drive is by belt to a cone at the top. This drives bevel gears fitted to the vertical shaft. The latter carries another bevel gear which drives the horizontal shaft, this in turn actuating the drill spindle. A set of gears at the bottom of the column can be put into action to raise or lower the arm and the feed is driven by spur gearing on the hand-wheel shaft and operated by a cam. A $2\frac{1}{2}$-in. hole can be drilled with the machine.

The wall planing machine, shown in Fig. 10, is regarded as the oldest machine in the works; it is said to be the first wall planing machine built and is known to be 120 years old. Above it, carried on the wall, is a spare screw cut 25 years ago in order to replace the

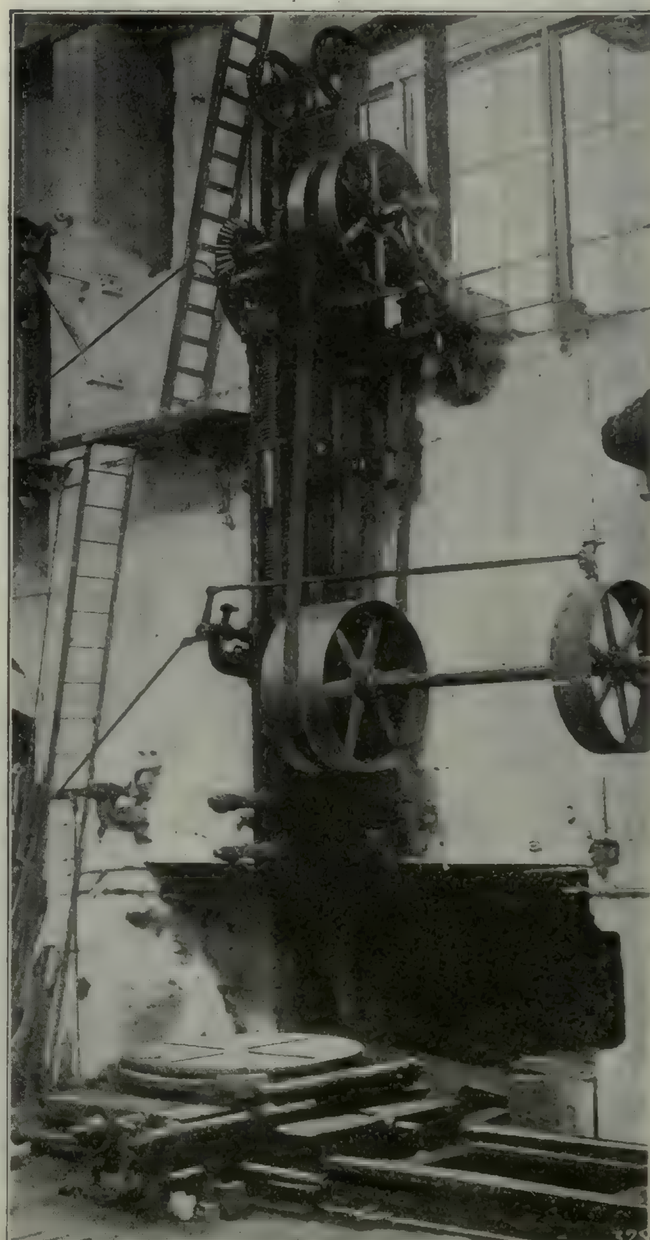


FIG. 12. A SLOTTING MACHINE (NOW DISMANTLED)

existing screw when worn. This machine will take work 15 ft. long: it is used on weighbridge frames. Another old wall planing machine in the works covers a space of 27 ft. by 9 ft., and the screw is 4 in. in diameter, double-thread. It was frequently used in conjunction with another machine adjacent, the two together being capable of covering 45 ft. in length.

Figs. 11 and 12 illustrate machines not now in use. A vertical boring machine is shown in Fig. 11, but as it has been disposed of it is impossible to obtain particulars. Fig. 12 shows a heavy slotting machine with 3 ft. 6 in. stroke. It is driven by bevel gearing and a square-thread screw to the ram, the thread being 4 in. in diameter by ⅝ in. pitch. The ram is counterbalanced by weights suspended from wire ropes passing over pulleys at the top. This machine, however, has been dismantled.

The Greenfield Tap and Die Corporation Plan of Industrial Representation

By FRED H. COLVIN
Editor, *American Machinist*

This article outlines briefly the method of securing and maintaining personal contact between the workers, shop executives and the management in the plants of the Greenfield Tap and Die Corporation. It shows an appreciation of the necessity for greater co-operation and confidence, as well as that the shop influence extends far beyond the factory itself. It gives the opportunity for inquiry or expression which prevents small misunderstandings being nursed into large grievances.

THE Greenfield Tap and Die Corporation and its employees are endeavoring to work out a plan for securing individual expression and co-operation as a means of increasing production and bettering conditions generally.

As a prelude to the industrial administration constitution, there are seven statements to which all can subscribe.. These are:

1. We believe in a square deal on the part of management and workers, one toward the other and both toward the community.

2. We believe that the principal desires of management and workers are identical, namely, happiness; that the basis for happiness is health, progress, opportunity and prosperity.

3. We believe industry, the most important factor in determining the basis of happiness, must recognize that men are men, something more than mere machines, something more than money—recognition being the basis of self-respect.

4. We believe management should give just returns for work performed; should provide opportunity to learn and grow; should establish clean, orderly, safe and sanitary working conditions, proper equipment, reasonable hours, and opportunities for recreation and rest.

5. We believe workers should give honestly applied energy, constructive thought to the reduction of cost and the production of the highest quality of product, regular and dependable service; that they should assume responsibility for indolence, indifference, restriction of output and poor workmanship.

6. We believe workers should be loyal and enthusiastic, should boost for their company product, management and fellow workers.

7. We believe management and workers, comprising industry, will effect better mutual and community happiness by co-operation, stimulated through representation, and based on the principle of democracy—a square deal.

With the foregoing as a basis, an industrial administration constitution was drawn up, with the object of establishing a unanimity of purpose between employees and their employers.

It is hoped to create means for the equitable adjustment of difference; by creating a common basis of understanding, co-operation, and decision pertaining to working and living conditions, and such other matters of mutual welfare as their relations may concern; by the establishment of such environment as will tend to safeguard more carefully the life and health of the workers; by providing means of practical education and nationalization, developing both mind and matter to the betterment of the workers as a whole.

This, it is believed, will reduce the cost and waste caused through misunderstandings, and that by applying the saving thus effected both the employee and the employer will be benefited.

The plan of representation includes chosen representatives of departments. These representatives constitute the general assembly, the branches being divided into legislative and the judiciary.

The legislature is composed of representatives of general employees, office employees and both skilled and non-skilled workers. Their primary purpose is to make suggestions and to deliberate on the suggestions that may be referred to them at the option of the upper body.

Where the Shop Executives Come In

The judiciary is composed of foremen, assistant foremen and department heads. Its function is to interpret and sift the suggestions of the legislature and to make recommendations of its own to the upper body. It is also to deliberate on suggestions and recommendations submitted by the upper body.

The executive council is composed of the factory manager, superintendents of different departments and the general foremen. Its function is to devise and deliberate on the suggestions received from the lower body and to refer them to the chief executive or to the board of directors. It also considers recommendations made by the chief executive or the board of directors.

The executive officers consist of the president, vice president, and the board of directors of the corporation.

Representatives to the legislature are elected in the proportion of one for every twenty workers. But each department, no matter how small, is entitled to at least one representative.

There are five standing committees. First is the advisory board on social and industrial betterment, composed of such officers as the chief executive may designate. This meets at least once a month or for special meetings at the call of the chairman.

The joint committee on industrial co-operation and conciliation is composed of six members, three designated by the judiciary and three by the legislature. This committee brings up matters for discussion on its own initiative, or discusses matters referred for its consideration pertaining to the prevention and settlement of industrial disputes, conditions of employment, reported grievances, appeals from discharge and similar cases. This is perhaps the most important committee in its relation to the harmonious operation of the shop. It provides a method of taking up and adjusting small misunderstandings or annoyances before they become real grievances.

There are three other joint committees, one on safety and accident; another on health, sanitation and housing, which includes living conditions as well as the shop itself. The third is a joint committee on recreation, education and insurance. These joint committees meet quarterly unless called in special session. The personnel secretary may, however, confer with any joint committee at any time and may call an impromptu meeting for the purpose of taking up matters requiring immediate attention. This is particularly important from every point of view.

The main advantage to be gained from plans of this nature is the opportunity for self expression on the part of every employee, whether it is exercised or not, and a development of the feeling that he is really part of an organization and not merely a number on the payroll. Confidence in the management is increased, and this goes a long ways toward securing co-operation, which is so badly needed at this time.

Finishing a Commutator in Place

By M. L. Lowrey

The turning of a commutator described on page 1002, Vol. 51, of the *American Machinist*, reminds me of a job that fell to my lot recently.

The collector rings of a 200-kw. alternating-current generator had become so badly worn that it was necessary to have them trued up, and as this machine must run twenty-two hours a day, seven days a week, it was a question how best to do the job, as the machine could be idle only from six to seven in the morning and from six to seven in the evening.

This generator was driven by a steam engine, and it was impossible to run slowly enough to permit turning the rings with a lathe tool; also there was not room enough to use the portable electric grinding machine.

After considerable study, I decided to make a long wheel-arbor that would run in boxes to be secured to the frame of the generator, and with a grooved collar and lever so arranged that the arbor could be moved through the boxes to pass the grinding wheel over the rings. Returning to the shop, I took a piece of 1-in.-round, cold-rolled steel about 3 ft. long, and, after centering and straightening it, one end was turned to $\frac{7}{8}$ in. and threaded to fit a nut which, with the flanges, I took from the small shop grinding machine. This was the only thing that had to be made with which to do the job.

From the stockroom I took a small countershaft with its hangers, two 1-in. boxes for the arbor, some used belting, the necessary pulleys, and some bolts and lag-screws. With these I returned to the plant and set up the countershaft over the generator, belting it from the pulley on the generator shaft that ordinarily drove the exciter.

At six o'clock that night I assembled the grinding part of the rig, to see if it was all right, and then took it down again so they could run through the night. Next morning at six o'clock I reassembled the rig, and with a medium-grade, free-cutting wheel the rings were soon ground true. A fine wheel was then placed on the arbor and the rings finished, the brushes replaced and the machine started up before seven o'clock.

The arbor boxes were adjusted for height by shims, and for downfeed, shims were removed as required. The time on the job was seven and one-half hours.

The superintendent was so pleased with the work that he would not allow me to take down the countershaft, but bought the whole rig and kept it for future use.

The Mechanics of the Future

By Fred Price

On page 70 of the *American Machinist*, Joseph T. Taudvin asks what American boys are going to do about the machinist's trade. He draws attention to the fact that the majority of advertisements for shop executives call for technically trained men and he infers that the practical man has a comparatively small chance of working up the line to a responsible position.

Mr. Taudvin also states that the majority of machinists to be found working at the trade at present are foreigners. This depends upon the locality where the observations were made. In all large manufacturing centers, especially in the cities, there are, of course, to be found a large number of foreign-born mechanics. On the other hand, in my travels about the country I have often found localities where the majority of machinists were Americans; indeed, I have worked in some shops south of Mason and Dixon's line where the entire shop's crew were Americans. In many small towns in the Northern States it is nothing uncommon to find the majority of mechanics employed of American parentage.

It is true that technically trained men stand an excellent chance of obtaining the high-paid positions, but it is not the fact that practical men cannot fill these positions that accounts for their absence; it is, rather, due to the fact that practically trained mechanics, men of vision, executive ability and broad training, are indeed hard to find.

If the young man just out of his time will travel and work in different manufacturing centers for a few years with the idea of getting a broad insight into the trade, there is no reason why he cannot work up to an important position if it is in him to do so. It must be borne in mind that executives, whether practically or college trained, are born and not made. All the training in the world will not make a man a good executive if it is not in him to be one. It is a case of the survival of the fittest and the practically trained American seems to stand as good a chance of succeeding as he ever did. It is up to the man himself.

The Evolution of the Workshop—V

BY H. H. MANCHESTER

In the fifteenth century, evidences of the tools employed in the workshop and of their gradual improvement become more noticeable and frequent. It is noteworthy, however, that in spite of the invention of printing about 1440, the records of the workshop are from manuscripts.

(Part IV appeared in our last week's issue.)

SEVERAL important factors bearing upon the development of the workshop during the fifteenth century should be kept in mind. One was the tremendous impetus given to metal work by the general use of cannon and firearms which had been invented in the previous century. The second factor was the revival of the arts, resulting in an increase in the employment of ornamental iron and bronze. The third factor was the more common use of horseshoes. The relative importance of this latter factor may be understood by remembering that up to a few years ago a blacksmith's time was confined almost wholly to horseshoeing. Besides these comparatively new tendencies, the demand for armor still continued; the guilds still flourished, and in fact subdivisions into special trades were common.

FIG. 18. AN EARLY PICTURE OF A WATERWHEEL USED TO DRIVE BLACKSMITH'S BELLOWS, FROM A SILVER VASE DATED ABOUT 1400 A. D.

At the beginning of the century several manuscripts dealing with the new field of firearms were composed which have aided us in understanding the condition of the art of mechanics during that period. Besides dealing with such military subjects as cars of war, attacking and scaling, and engines for throwing missiles and fire, the manuscripts contain interesting sketches of tools, including files, saws, shears, and chisels; also a horseshoe with nail holes. Though somewhat beside our subject, there were also quaint pontoons, boats with paddle wheels, and diving apparatus. Two unexpected

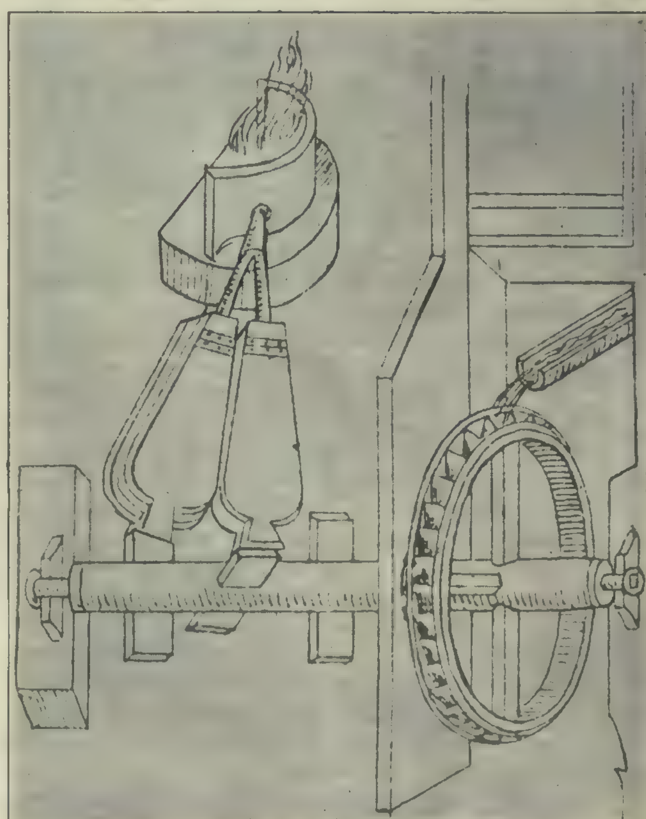


FIG. 19. MARIANUS' CONCEPTION OF A BELLOWS WORKED BY WATER POWER

FIG. 20. THE PRACTICAL ARTS OF 1480, FROM A HOUSE BOOK OF THAT PERIOD

scenes represent elevators hoisting men; probably for the purpose of attacking some fortress.

In the Library of Göttingen is a codex dating between 1430 and 1440 and consisting of two manuscripts. The first one is in German by an unknown author and the second one in Italian, probably by Jacobus Marianus, of Sienna. In the first manuscript are curious sketches of tools and cranes, of hand-run stamp mills, of a hand boring machine for firearms, and of a polishing device, besides boats with wheels, a pile-driver, and many purely military subjects.

In the manuscript by Marianus is an interesting roller conveyor, and perhaps the oldest picture of a crane on wheels. Of immediate interest, however, is the sketch of a waterwheel, Fig. 19, applied to two pairs of bellows which are used to blow a furnace. The importance of this can scarcely be appreciated by us who live in an age of steam, electricity, and gasoline. It is only when we realize that the waterwheel was the first great effort of man toward the use of natural power and was, by all odds, the most important prime mover of the early modern period, that we attach sufficient significance to its gradual application to the different industries. Another illustration of the first part of the fifteen century shows a stamp mill run by hand but with the pestle hung from a bough, the spring of which greatly lightened the work of stamping.

Toward the end of the fourteenth century, Mendel had founded in Nuremberg an institution for superannuated members of the guilds. Some of these members, painters by trade, made pictures of the others while at work. These portraits are crude from an artistic point of view, but they are exceedingly valuable as historical documents.

Among them we find an illustration of wire drawing by means of rollers without a draw plate, and another of wire drawing through a plate by hand. In the same collection is a picture which dates from about 1417, of a filemaker cutting a file with a hammer and chisel. Later pictures of this kind include armor making, chain-armor forging, auger making, a tinsmith, a pipesmith, and a padlockmaker. In all these the operations are still performed by hand, which would seem to indicate that water power had not been applied to these industries to any extent.

The first dated copper-plate engraving seems to have been made in 1446, and from this time we begin to find occasional engravings which incidentally illustrate subjects more or less industrial. For example: one of the early engravers, Israel van Mechenem, produced a cut which illustrated the forging of cutlery and the employment of the grindstone. Other interesting drawings from the latter half of the fifteenth century appear in a housebook of that date. One of these cuts is shown in Fig. 20.

In this book are other cuts showing furnaces, probably used both for smelting and forging; a very crude lathe shown in Fig. 21 and perhaps the oldest known picture of a vise for holding work. Incidentally, the book includes what appears to be the earliest known drawing of a spinning wheel.

Evidence that guilds were still in full force is found in a picture taken from the back of one of the early

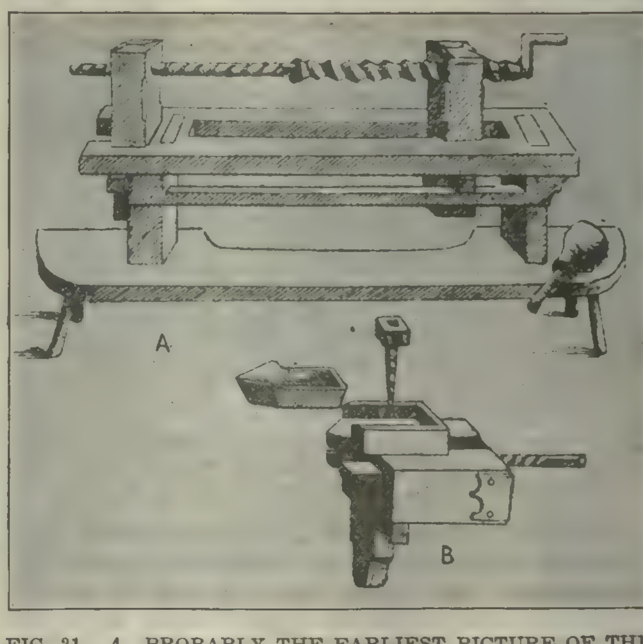


FIG. 21. *A* PROBABLY THE EARLIEST PICTURE OF THE METAL WORKING LATHE. *B* THE OLDEST REPRESENTATION OF A VISE

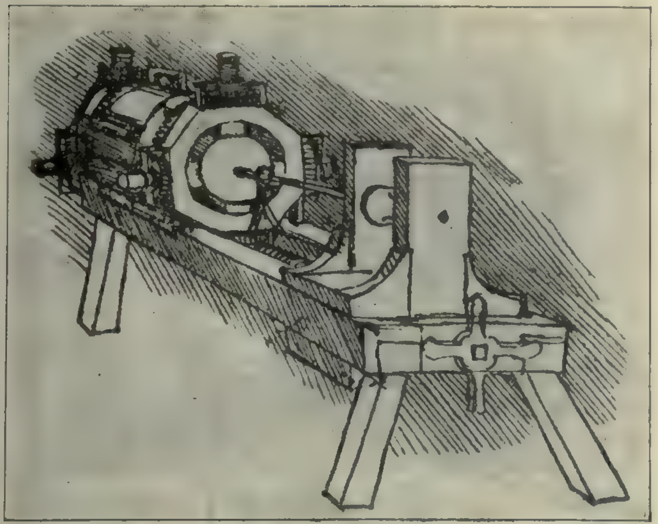


FIG. 22. A HORIZONTAL BORING MACHINE BY LEONARDO DA VINCI

playing cards produced in Italy but now in the British Museum. This shows a locksmith and his apprentice demonstrating their efficiency before the head of the guild. At that date, the guilds were practically in full control of industrial life in the metal and other manufacturing fields in Italy, France, Germany, Austria and England.

The fact that hand labor predominated, fostered the small shop with a master workman and a few journeymen and apprentices, and this in turn lent itself to the guild organization. One characteristic difficulty of this system, however, was already making itself felt. As the theory of the guild was based on the association of shops with mutual interest, a tendency developed to break the guilds into smaller and smaller subdivisions of the trade. Thus, in many places instead of there being one great guild of iron workers, there were separate guilds of founders, hammerers, armorers, locksmiths, cutlers, ornamental ironsmiths, nailmakers, spurriers, horseshoers, and various other crafts each striving to preserve a monopoly in its own field, causing trouble among themselves in fixing the lines of demarkation that separated one from another.

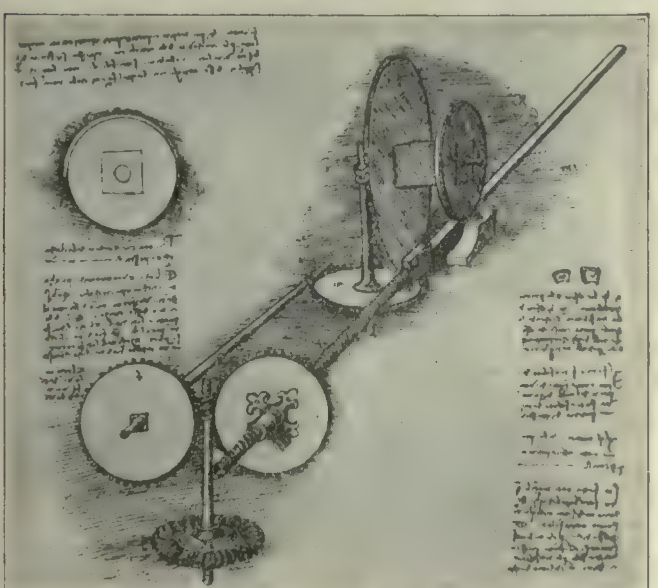


FIG. 23. LEONARDO'S IDEA FOR A WATER-POWER ROLLING MILL

The shops at this time still maintained hours from dawn until dark, and the wages of the full-fledged journeyman in the most advanced cities, such as Florence, were about 50 cents a day at a time when wheat was 80 cents a bushel. In other words, the skilled craftsman of this period had to contend with the high cost of living.

Toward the end of the century, we reach the work of the almost universal genius, Leonardo da Vinci, who lived between 1452 and 1519. His sketches include many ideas for devices which were never constructed; many of them being rough designs for improvements on apparatus already proposed or even experimented with. Whether the designs were ever carried out or

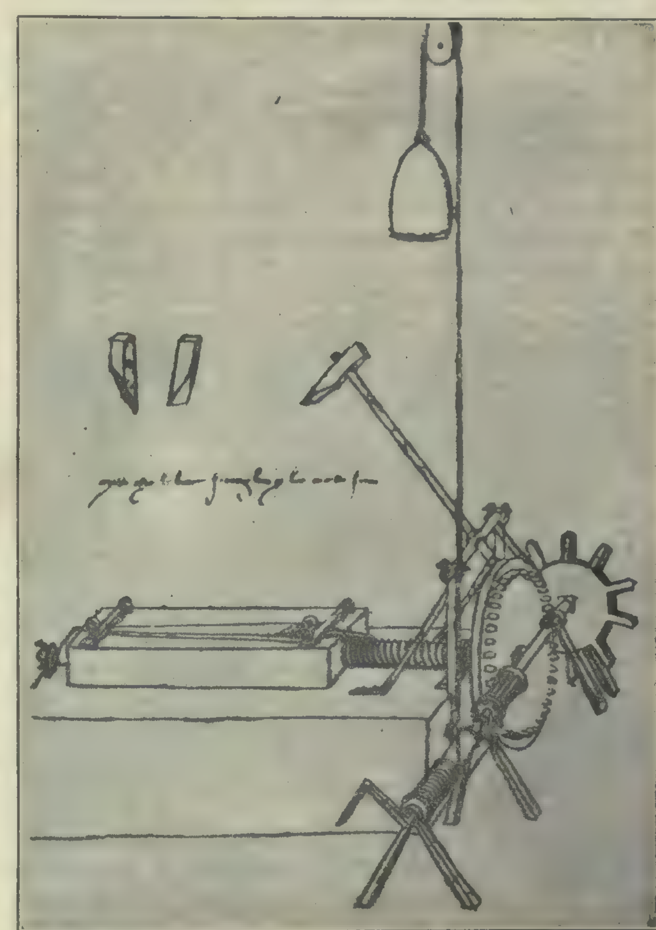


FIG. 24. LEONARDO'S DESIGN FOR A FILE-CUTTING MACHINE

not, they are important as showing the ideas which were then extant.

Among these designs are hoisting machines with wheels, pulleys, screws and clutches, all of which methods were previously known. His two designs of swinging cranes run by tread mills are radical improvements over anything previously designed. His crude sketch of a dredge also seems to be a new departure. Foundry practice occupied a prominent place in his drawings, including a foundry yard, molding and casting of cannon and cannon balls, as well as the molding of statuary. The details representing cannon molding seem to be the first on record though the process had been known before.

It is interesting to note here that he shows molds for concrete, the mixture for which was well known to the Romans, but lost in the early part of the Middle Ages.

There are cuts of furnaces and bellows much the same as those already shown in the military manuscripts. His horizontal boring machine, Fig. 22, is shown in far greater detail than in any preceding cut.

Several rough sketches for crude lathes give an idea of how simple this device still was, but also indicate that engineers were studying to improve it. The horizontal waterwheel had perhaps been used in northern Europe before his time, but two of his designs, showing, without a doubt, the forerunner of the modern turbine and its application to the rolling and drawing of metal, as shown in Fig. 23, are of more than passing interest.

Leonardo's File-Cutting Machine

He pictured a file-cutting machine, Fig. 24, operated by a weight. His idea of a machine for cutting files was apparently new. The employment of the weight for running it was, however, merely an application of an arrangement already used in milling grain. Among other interesting sketches are hand thread cutters for screws and nuts, and a device for sharpening needles. His attempts toward prime movers include a water turbine which was perhaps original, windwheel, wheels run by the hot air from a fire and used to turn a spit, and certain other devices acted upon by fire and steam. He gives us sketches for several kinds of dividers, measuring and mathematical instruments, which indicates that a demand for exactness was being felt. Many other interesting subjects are included in his sketches which are too far out of our field to be mentioned here.

To Prevent Tracings in Storage from Curling

By E. A. Dixie

The illustration, Fig. 1, shows one of our tracing cabinets and the method we employ to prevent the tracings from curling. The tracings vary in size from about 6 x 9 in. up to something like 30 x 48 in. The size is, however, of no consequence as this method of storage will take care of any size.

The tracings are laid flat in the compartments in the drawers or, in the case of the large ones, in the drawer itself. To keep the smallest tracings flat, a single piece of shellacked white pine, 7 x 10½ x ½ in., is laid on the top of the pile of tracings. This piece of wood is a very loose fit for the compartment and has two holes bored in it as shown at A, so that it can be easily lifted.

FIG. 1. PREVENTING TRACINGS FROM CURLING

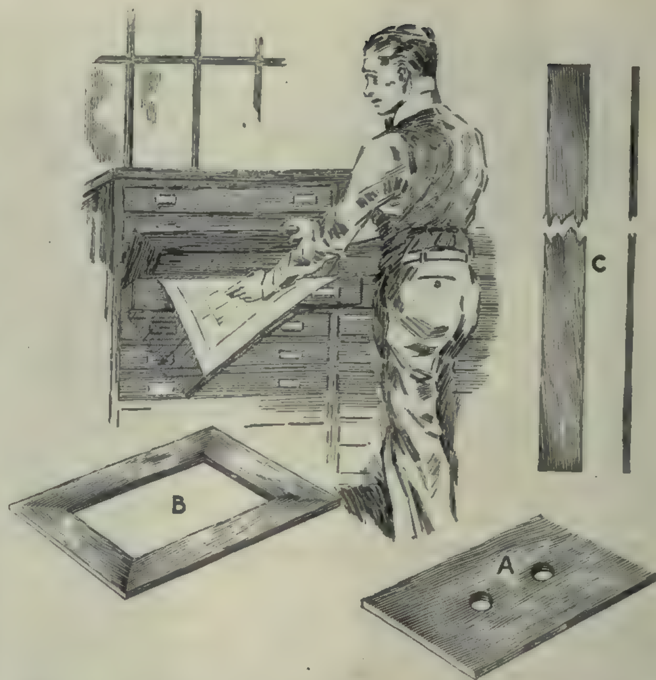


FIG. 2. DETAILS OF BOARDS TO PREVENT CURLING

The larger sizes are rectangular frames as shown at B, the opening in the center permitting them to be easily lifted.

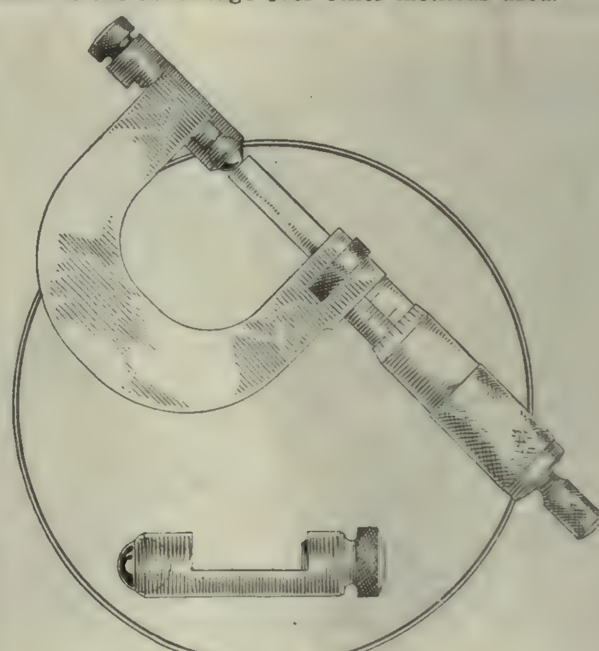
For the very large sizes of tracings two ½-in. strips of wood 4 in. wide, as shown at C, are laid at each end of the drawer on top of the tracings. This method of storing tracings has been entirely satisfactory.

Ball Anvil for Micrometers

By E. W. Mawhinney

It is sometimes desirable to have a rounded contact point on the micrometer, as when measuring from the inside of curved surfaces. A quickly made and efficient attachment for doing this is shown in the sketch.

This attachment not only holds the ball solid on the anvil but can be made to fit more than one micrometer, which is one advantage over other methods used.



A BALL ANVIL FOR THE MICROMETER

Industrial Motor Control—IV

BY C. W. STARKER

In the last few years automatic starting and regulating devices for alternating-current motors have gained considerable importance, and in this article, which is the last of the series, many interesting features of these devices are brought out.
(Part III was published in our Feb. 12 issue.)

IN LARGE installations, such as in steel-mill electrifications, self-starters are used almost exclusively. The magnet-operated switch avoids the necessity of running heavy mains to a distant point for control of the circuit and large currents are easily handled by the main switches, which are controlled by push-button, snap or knife switches at any convenient point. Alternating-current self-starters consist of a series of magnet-operated switches and suitable protecting devices. Two methods of automatic acceleration are used with alternating-current motors; namely, starters equipped with time limit acceleration, and with current-limit acceleration devices. With the time-limit method, the motor is brought up to speed in a predetermined period, which can, of course, be adjusted within given limits. In the current-limit method the motor is started and accelerated slowly if the load is heavy, and quickly if the load is light. The current-limit method is also used primarily with wound rotor (slip-ring) motors, where frequent starting and stopping is required. The time limit, however, is used principally with squirrel-cage motors, on light starting loads, and where overload protection is provided by other means.

A standard form of automatic starter is the double-pole magnet switch, Fig. 35, for the remote control of light or power circuits up to 500 amperes. It is equipped with arc shields and magnetic blowout coils. In Fig. 36 is shown a three-pole alternating-current magnet switch with low-voltage release and magnetic blowout devices.

FIG. 35. DOUBLE-POLE MAGNET SWITCH FOR REMOTE CONTROL OF LIGHTING AND POWER CIRCUITS

This switch is operated by a push-button or a knife switch. Magnetic blowouts should always be used where it is necessary to break any considerable amount of current. Switches of similar construction, so called across-the-line self-starters, are used with polyphase squirrel-cage motors or self-starting, single-phase motors up to 15 hp. These may be equipped with overload devices and inverse time element overload protection, which, as the name implies, takes into account the duration of an overload current. The reset of this device may be hand-operated or automatic, to suit local conditions. Sometimes the inconvenience of hand reset may be purposely employed to lessen the abuse of the motor by overloading. In addition to the usual remote-control station devices, float switches, pressure or vacuum devices may be used with alternating-current self-starters to suit individual applications, as well as with direct-current automatic starters.

A type of automatic starter commonly used with alternating-current squirrel-cage motors is the trans-

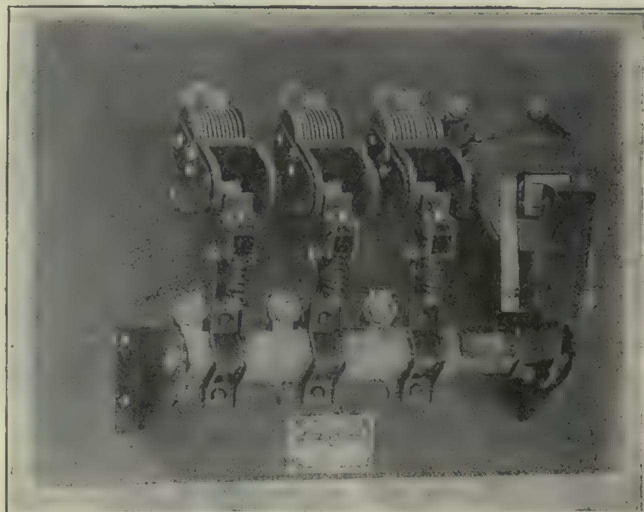


FIG. 36. THREE-POLE MAGNET-SWITCH FOR PUSH-BUTTON CONTROL WITH LOW-VOLTAGE RELEASE AND MAGNETIC BLOWOUTS

former type of self-starter, Fig. 37. It is commercially made for motors up to 200 hp. which are used on centrifugal pumps and similar service, where a starting torque equivalent to not more than 70 per cent of the full voltage is required. An auto-transformer, which is used to reduce the voltage at the motor terminals at starting, is automatically disconnected from the circuit, when the motor is up to full speed. These starters are made in two types, single- and two-step. The former consists of three double-pole magnet contactors, and a dash-pot timed relay. In operation one contactor first connects the starting transformer to the supply lines, a second one connects the starting taps of the transformer to the motor terminals, and the third connects the motor terminals direct to the line, the time element between operations of the contactors being controlled by the setting of the relay. The operation of the two-step starter is identical with that of the single-step, with the exception that one more contactor is used to connect the second transformer start-

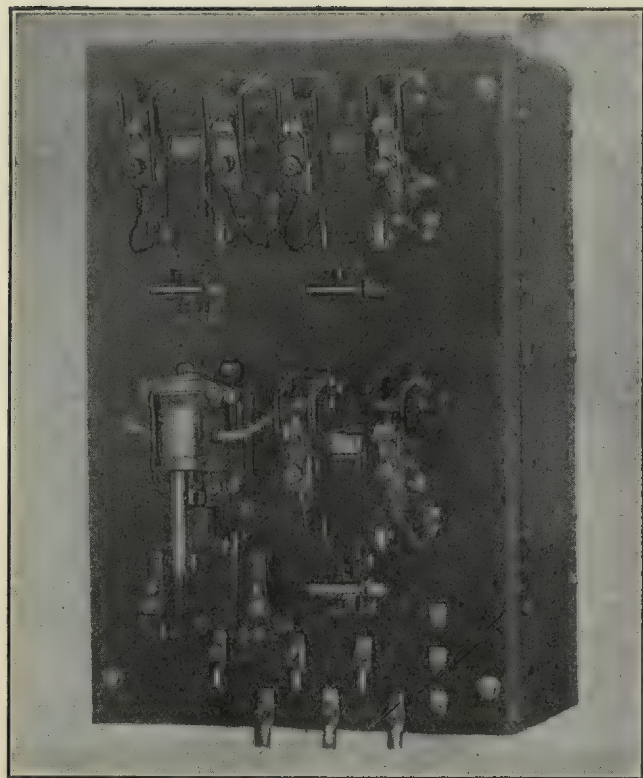


FIG. 37. TRANSFORMER TYPE OF SELF-STARTER FOR LOW-TENSION CIRCUITS

ing tap to the motor terminals, and an additional timing relay is used for the control of this contactor.

The single-step starter is designed for use when the starting torque required is in excess of that corresponding to 40 per cent, but not more than 70 per cent of the normal line voltage is impressed upon the motor. If the starting torque required does not exceed that corresponding to 40 per cent of the normal line voltage, a smoother acceleration and decreased line disturbance is obtained by the use of the two-step starter.

It is, however, of no advantage to use this type, unless the starting torque required is less than that corresponding to 40 per cent of the normal line voltage.

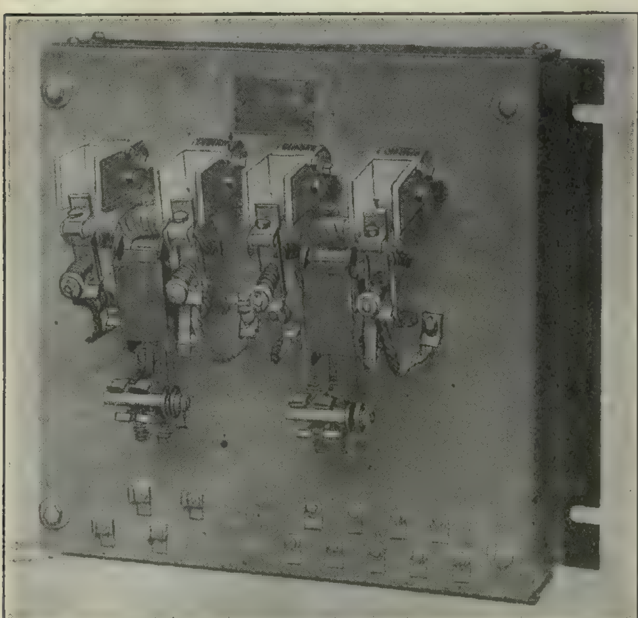


FIG. 39. A FULL-MAGNETIC, PUSH-BUTTON CONTROL, ELEVATOR CONTROLLER FOR SQUIRREL-CAGE MOTORS

On both types of starters extra taps are provided on the starting transformer in order to allow some adjustment of the starting voltage. Connections to the transformers are usually made to give 60 per cent of the normal line voltage for starting on a one-step starter, and 40 per cent on the first step and 85 per cent on the second step of a two-step starter. Control of the starters may be by push-button, knife switch or other means.

The starters just described are intended for low-tension motors, 110 to 550 volts, but for the standard high voltages, 1100 and 2200 volts, a type of self-starter, Fig. 38, is used, which employs a step-down transformer. These starters are again made as one- and

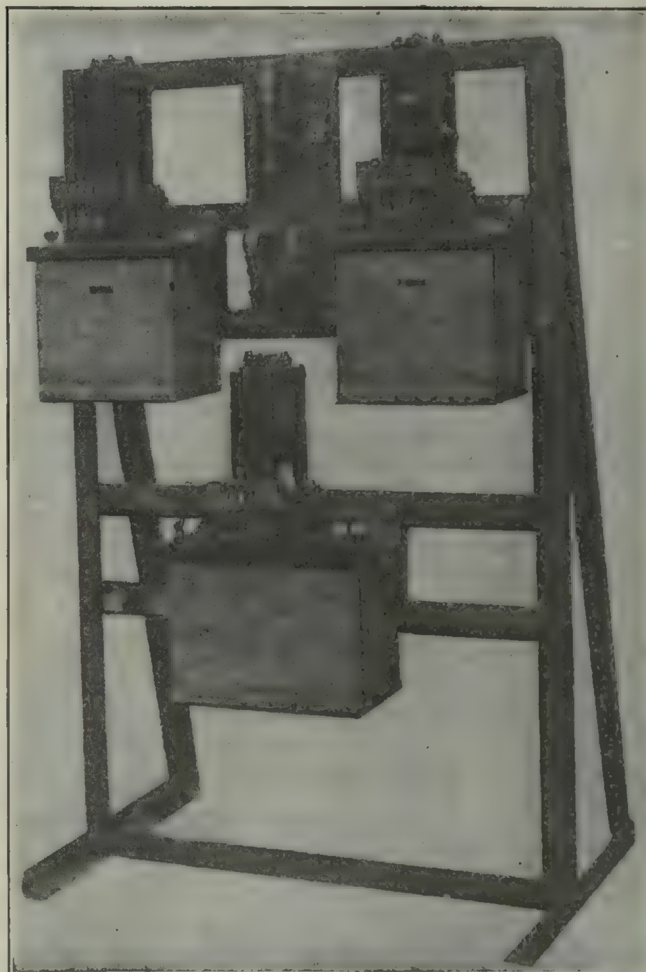


FIG. 38. TRANSFORMER TYPE OF SELF-STARTER FOR HIGH-TENSION CIRCUITS

two-step starters, with limitations as to the percentage of starting voltage similar to the above.

In polyphase starters it is common practice to connect the installation so that the motor and starters are entirely disconnected from the line in the "off" position. The exception to this practice leaves one terminal of the motor and transformer connected to the line in the "off" position. The functions in starting the motor are the same in both cases. In the last case, the danger from accidental grounds is greater than in the other type, and the switch contacts burn up more rapidly because the circuit is broken at only two points instead of three. For these reasons it is recommended to use starters which entirely disconnect the motor from the line.

Until recently the direct-current motor has dominated in elevator service on account of the ease in controlling

its speed. However, slip-ring and squirrel-cage alternating-current motors are now used, particularly for slow-speed elevator work.

A full-magnet, alternating-current elevator controller is shown in Fig. 39. It is designed for push-button operation and for use with single-speed squirrel-cage motors having high-resistance rotors. Such controllers are adapted for use in slow-speed passenger- and freight-elevator service with car speeds of not more than about 125 ft. per minute, and also for dumb-waiter service. The motor is directly connected to the line, and only one speed is obtainable. The control may be arranged for two, three or more landings and may be equipped with floor-stop devices where required.

Full Automatic, Single-Speed Controllers for Low-Speed Elevators

With slip-ring motors, full automatic, single-speed controllers, as in Fig. 40, may be used. These are intended for either freight or passenger elevators with car speeds not in excess of about 200 ft. per minute, and are operated by a car switch. The magnetic accelerating switches are energized by a pilot relay, which has an air dash pot for time limiting. Resistance is cut out of each phase simultaneously in order to secure current balance in the rotor circuit during the entire starting period.

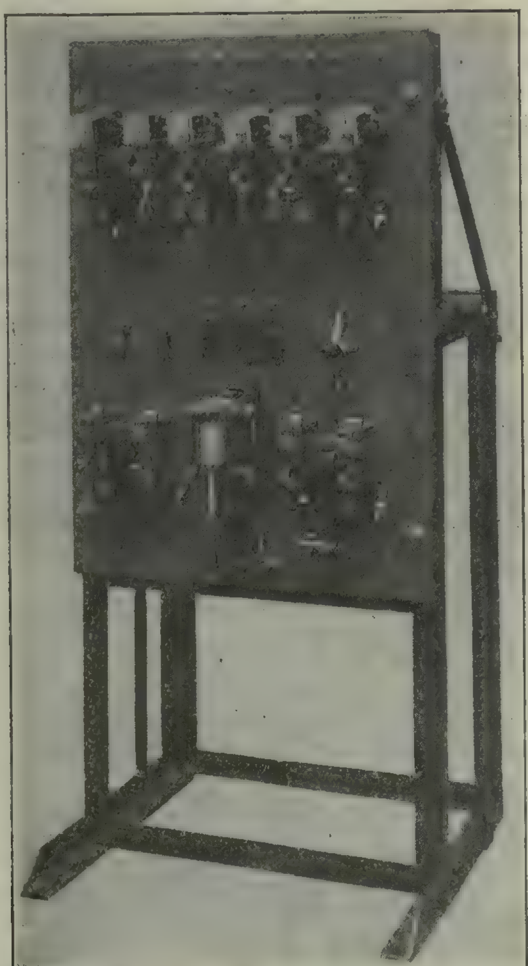


FIG. 40. FULL-MAGNETIC, DASH-POT TYPE, HIGH-SPEED ELEVATOR CONTROLLER FOR SLIP-RING INDUCTION MOTORS

In conclusion it might be well to add that local electrical suppliers and power companies should be freely consulted before placing orders for motors and starting devices in order to ascertain correct power factors. Furthermore, when ordering machine tools which are to be factory equipped with motors and starters, special care should be taken to see that complete power-factor data is incorporated in the machine-tool order.

A Spiral Milling Cutter for Side Rods

By Frank A. Stanley

The milling cutter illustrated is of interest as showing a very coarse-pitch type combined with an unusually steep angle of helix, particularly in the case of a cutter of such small diameter. Furthermore, the length of cutter face as compared with its diameter is unusual. The cutter was made at the Southern Pacific shops at Sacramento, Calif., and is regularly used there for milling out the forked ends of locomotive side rods.

The cutter is shown in operation in Fig. 1 on a horizontal milling machine, the view being from the rear of the housing to show distinctly the character of the work and the form of the chips removed. A 2-in. high-speed steel cutter is here shown in operation, and details of this tool and also of a 2¼-in. cutter are given in the drawing, Fig. 2. The detail at the top of the same drawing shows the method of supporting and driving the cutter in the machine.

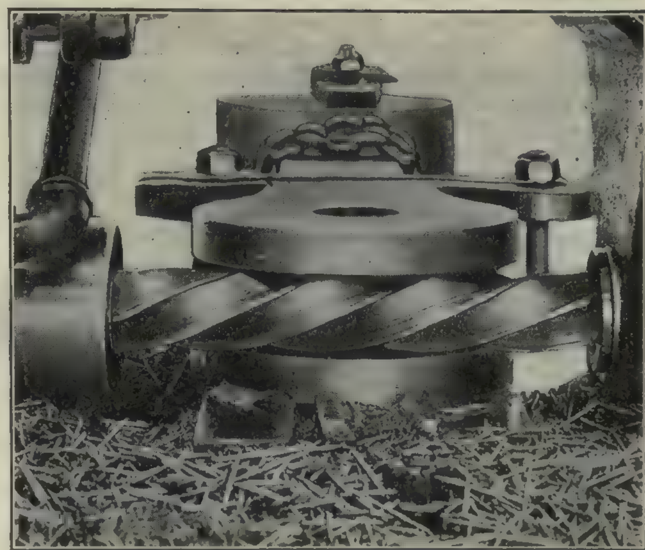


FIG. 1. MILLING FORK IN SOLID ROD END

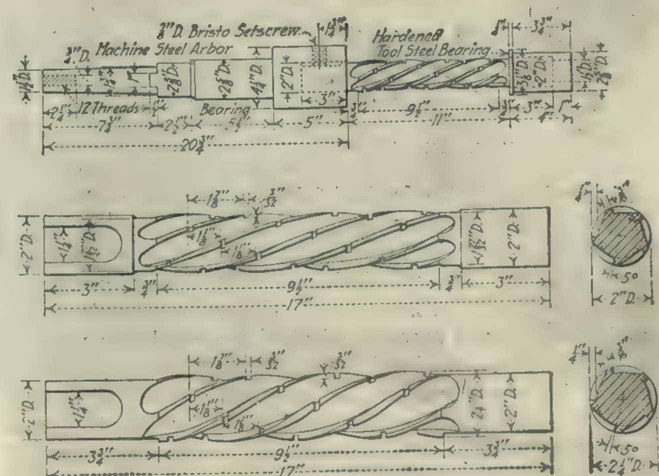


FIG. 2. CUTTER DETAILS

A sketch of the side rod, giving general dimensions, is reproduced in Fig. 3. The work is openhearth forged steel with the forked end to be milled out of the solid to a distance of 9½ in. The greatest width of cut is 8 in. at the diameter of the round end.

With so wide a cut and such a small diameter of cutter, a coarse-pitch tooth is essential to aid in clearing out the chips, so the cutter shown is provided with five teeth

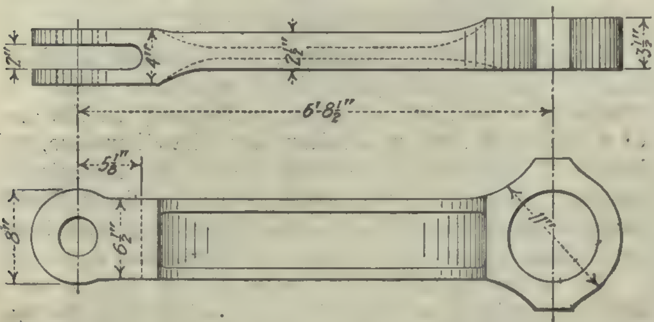


FIG. 3. LAYOUT OF SIDE ROD

only which gives a width between cutting lands of nearly 1¼ in. This liberal chip space combined with the sharp angle of helix allows the cutter teeth to roll the chips out freely, and the action of the cutter is naturally very free, owing to the pronounced shearing effect of each tooth as it passes across the work.

A Layout of the Cutter-Tooth Slope

The diagram, Fig. 4, is a layout of the cutter-tooth slope where the circumference, 6.283 in., represents the height of the rectangle and the lead of 12 in., the length of the diagram. The sloping line from corner to corner shows the true angle of spiral as taken, of course, at the top of the tooth. This angle is computed by dividing 6.283 by 12 which equals 0.5236 and this is the tangent of 27 deg. 38 minutes.

The fork is milled out in one cut from the solid; therefore, the feed cannot be crowded too hard, especially in view of the width of surface operated on and the slender proportions of the cutter itself. Still the feed is ¾ in. per minute and the speed of the cutter is 148 turns per minute, or about 77 ft. surface speed.

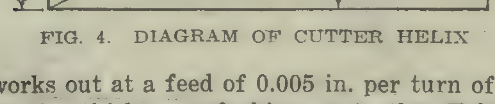


FIG. 4. DIAGRAM OF CUTTER HELIX

This works out at a feed of 0.005 in. per turn of cutter, or 0.001 in. thickness of chip per tooth. Taking the section of cut at the maximum width of the connecting-rod; that is, 8 in. multiplied by 2 or the diameter of the cutter, and we have 16 in. times ¾ in. or 12 cu.in. as the maximum amount of steel removed per minute.

Referring to the detail, Fig. 2, it will be seen that the cutter teeth are nicked and are undercut or hooked to the extent of 5 deg. to give a clean "bite" on the work surface, and thus still further aid in the shearing out of a smooth chip and the production of a clean, smooth surface in the sides of the forked opening in the work.

The Status of the School Shop

By George Heald

On page 650, Vol. 51 of *American Machinist*, J. B. Phillips, after commenting on the statements of W. O. Forbes on page 122 of the same volume, asks the questions, "Should time allowance be made for school-shop work?" "If so, how much?" and "Who shall define the requirements?"

It seems to me that the question of time allowance would be applicable only to the few shops that still have some kind of an apprenticeship system, and that there should be some form of agreement between those shops and the schools.

In one city the manufacturers, after visiting the schools, agreed in conference with the school authorities to allow the school graduates the full two years they had been in the school and start them in their shops as third-year apprentices. This constitutes quite an incentive to a boy to finish his two-year school course.

We will all agree that a school-shop graduate should be able to prove his superiority over a boy who has had no industrial training, but unless his training is recognized by the employers, he may get no opportunity to demonstrate his ability. One foreman told me that he would be glad to take school-shop boys, but that they would be obliged to follow the same routine as the other apprentices. Such a course of procedure might result in the lapse of considerable time before the school graduate would be permitted to do work that required any degree of skill.

If this foreman's attitude reflected the general opinion it would seem to be a waste of time for a boy to enter a vocational school, but most of us who have had something to do with the training of boys in the school shop know that such boys are worth considerably more to an employer than one who has had no industrial training.

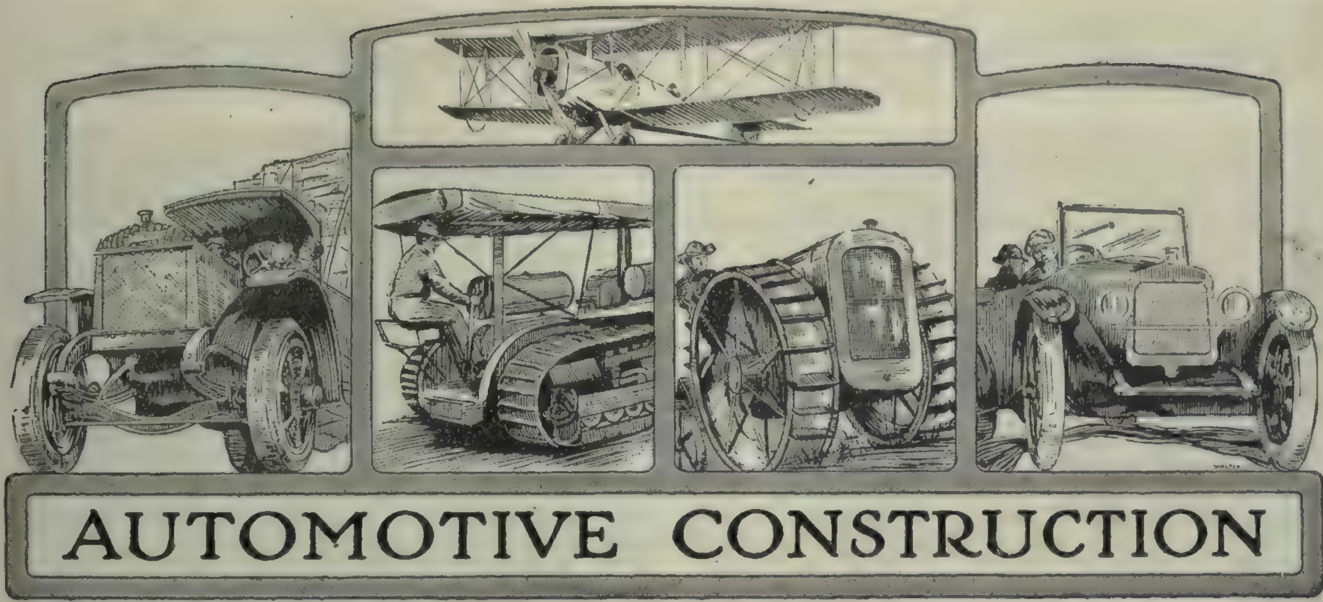
I believe that the definition of requirements asked for by Mr. Phillips should be determined by a joint conference of employing manufacturers and school men, and I think that enough of the manufacturers could be interested to take care of all the graduates, and that the benefit would be mutual.

In highly specialized plants where the tendency is to establish training departments, I do not believe an agreement is necessary. The school-shop graduate will be able to prove his worth and will be ready to take his place in production in a shorter period of time than will the boy who has not had the advantage of such training.

Copper in Rustproof Steel

In a paper read by D. M. Buck before the American Society for Testing Materials, it was brought out that very small amounts of copper have the effect of reducing corrosion in steel. Tests were made of openhearth steel with various copper additions, so that there was from 0.012 to 0.254 per cent of copper in the ingots. These were rolled into sheets and exposed to the atmosphere in the Connellsville coke region, together with a number of pieces in which there was no copper. It was found that a mere trace of copper was sufficient to prevent rapid corrosion.

At the time of the Vienna peace conference in 1815 there was not one steamship on the ocean. In 1914 there were 30,000,000 tons of steam vessels.



Finishing Liberty Motor Connecting-Rods

By H. A. CARHART
Mechanical Engineer, Lincoln Motor Co., Detroit

Putting the finishing touches on the forked rod involves a number of interesting problems which are brought out in this article. The utmost care fails to prevent the springing of rods, but the methods of locating and clamping are interesting and suggestive.

THE actual finishing of the Liberty motor connecting-rods may be said to begin with the sawing off of the caps, and the way in which the rods and caps are finished by grinding has many interesting features. The testing and straightening of the rods indicate beyond question that it is impossible to prevent the parts from springing during the machining operations even though the utmost care is used in designing fixtures and in handling the work itself.

In the same way, burring or removing the slight burrs thrown up on the edges and corners from all machine operations is a necessary part of work of this kind, for unless these burrs are removed it is impossible to locate the pieces accurately in the fixture, not to mention the annoyance and danger to the operators.

The bolt holes in both rods and caps are line-reamed so as to insure the bolts going together properly without stress. This final reaming is done with a bit brace and a reamer, 0.3125 in., the holes being tested by plug gages. Care is taken that the hole is properly cleaned of chips and that the bolt is well lubricated before assembling, and a tolerance of only 0.005 in. is allowed. Three men are used on this operation. One man reams and assembles 130 caps and rods in a 9-hr. day.

After grinding the outside of the fork, it is again necessary to be sure that the rods are straight and they are checked in a special fixture to determine if the piston-pin boss is in the proper relation with the forks.

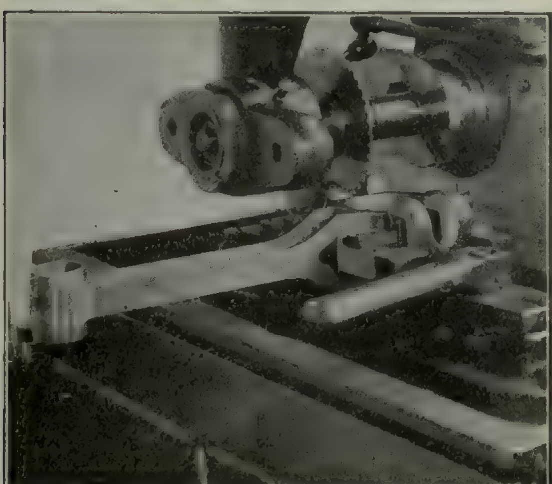


FIG. 1. SAW OFF CAPS

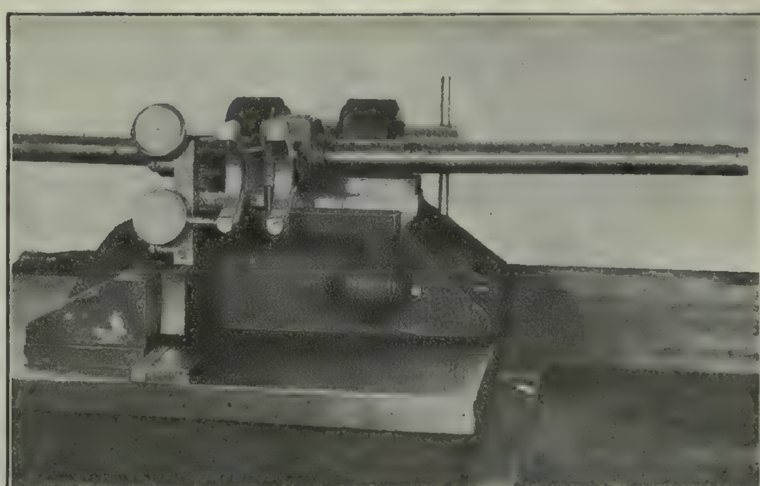


FIG. 2. TEST AND STRAIGHTEN

Fig. 1—Caps are sawed from the rod on a 12-in. Cincinnati milling machine; 1-in. arbor; saw, $\frac{3}{32}$ in. thick by 6 in. in diameter. Rod located at end of bolt boss and clamped against outside of boss by claws shown. Rod is turned over after sawing one cap. Cutting speed, 65 ft. per minute; hand feed. Production 400 rods in 9 hr., one man. Fig. 2—Test parallelism of forks with piston-pin boss. Spring as necessary by long bending iron. Rod is trued until it checks with the dial gages, also parallelism of forked end with piston-pin hole. Capacity, 350 rods in 9 hr., 2 men per fixture.

AUTOMOTIVE CONSTRUCTION

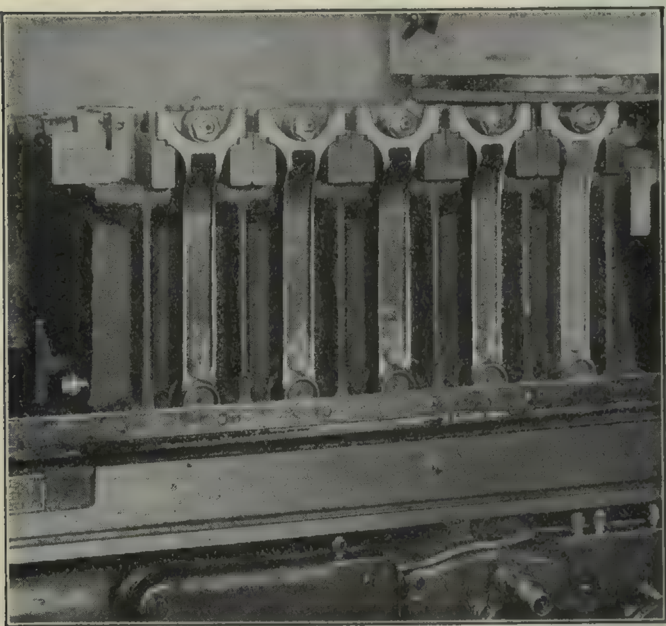


FIG. 3. GRIND JOINT FACE OF ROD AND CAP

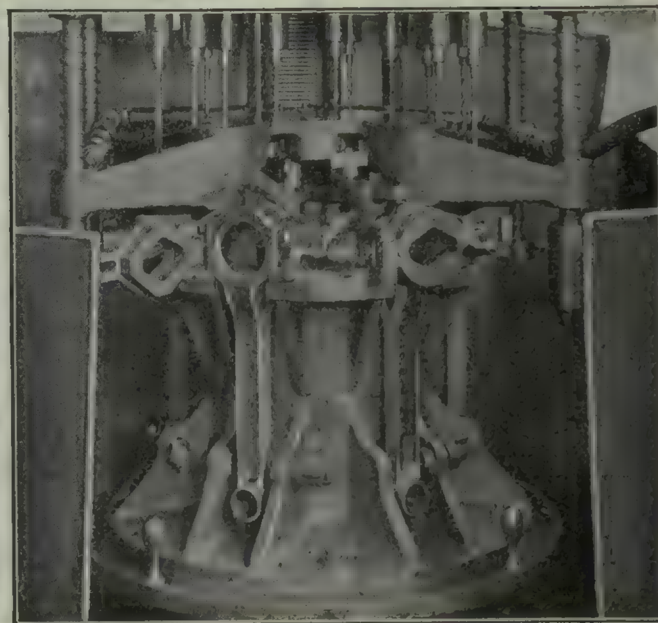


FIG. 4. DRILL AND REAM BOLT HOLES

Fig. 3—Pratt & Whitney 48-in. surface grinding machine; 14 in. by $4\frac{3}{4}$ by $10\frac{5}{8}$ Alundum wheel; Grade T; grain, 38 x 24. Five rods on side, one at each end. Located by piston-pin hole and clamp on side fork. Caps located on end of bolt bosses. Wheel speed, 5000 ft. per minute. Production, 350 rods in 9 hr., one man. Fig. 4—Sixteen-spindle Natco drilling machine; eight spindles carry $\frac{5}{16}$-in. high-speed drills, others carry high-speed reamers 0.309 in. Two rods are drilled, two reamed, two mounted and unmounted. Rod located from end of bolt boss and side of fork. Caps and rods held by equalizing clamps on face. Speed, 30 ft. per minute; feed, 0.005 in. per revolution. Production, 250 rods in 9-hr. day, one man.

It was found that the forks have a tendency to change parallelism after being ground. About 50 per cent. of the rods require straightening at this point. One man checks 400 rods in $4\frac{1}{2}$ hr. The over-all width of the fork is 2.4375 in. plus or minus 0.002 in. and the width of the side of the fork is 0.5625 in. plus or minus 0.001 in.

Checking the Piston Hole

After finish-reaming the large and small holes, the piston-pin hole is checked with a plug gage to be sure there is sufficient stock for grinding. The crank-pin bearing hole is also checked for the same purpose.

After the hole in the small end is ground, the dowel hole in the cap is drilled and reamed on a Natco four-spindle drilling machine carrying two $\frac{11}{64}$-in. drills and two 0.187-in. reamers. Rods are located on a pilot with a spacer in the large hole and on a pilot in the piston-pin hole. The cutting speed for this is 50 ft. per minute with hand feed. Production is 450 rods in 9 hours.

Following this is another burring operation over the entire rod. This operation is performed by women who average 70 rods per 9-hr. day.

Washing in Hot Soda

The rods are then washed in a hot soda solution, the washing liquid being contained in a vat heated by steam pipes. This keeps the temperature of the solution at about 200 deg. F. A woman operator using a hook of half-inch steel in the form of a letter S and

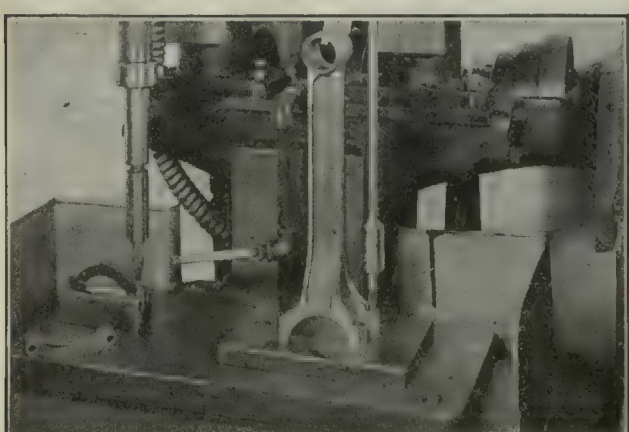


FIG. 5. SPOT-FACE AND COUNTERSINK BOLT HOLES

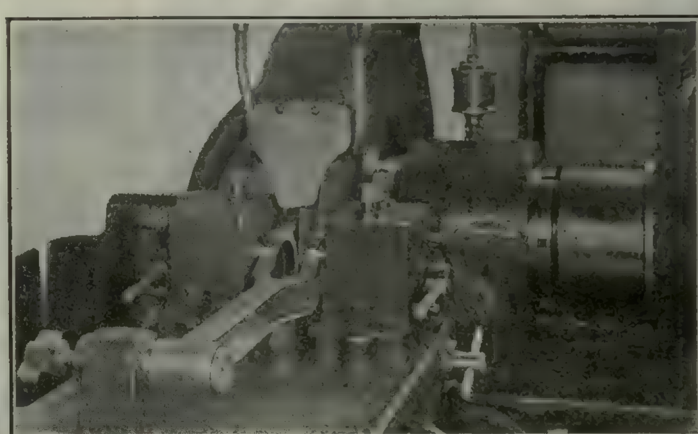


FIG. 6. GRIND INSIDE OF FORK

Fig. 5—Leland-Gifford double-spindle drilling machine; $\frac{5}{8}$-in. countersink with 10-in. extension; $\frac{5}{8}$-in. spot facer with 0.309-in. pilot in second spindle. Rods and caps placed on steel blocks shown. Cutting speed, 110 ft. per minute; hand feed. Production, 350 rods in 9 hours. Fig. 6—Norton 10 x 36-in. grinding machine; 18 x $1\frac{3}{16}$ x 5-in. Alundum wheel; grade M; grain, 38-36. Rod clamped by expansion plug in piston-pin hole, located by buttons against outside of fork. Wheel speeds, 6000 ft. per minute; hand feed. Distance between forks checked with gage 1.3125 in., plus 0.002 in., minus 0.000 in. Production, 150 rods

AUTOMOTIVE CONSTRUCTION

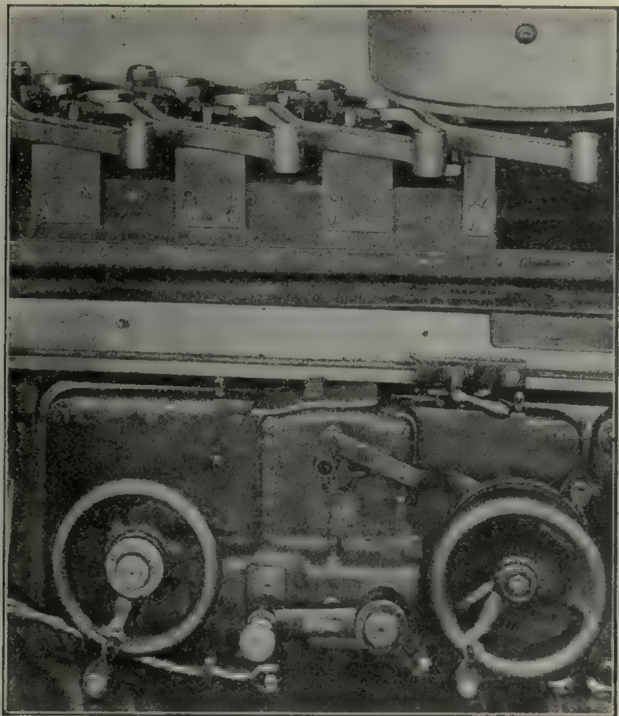


FIG. 7. GRIND OUTSIDE OF FORK

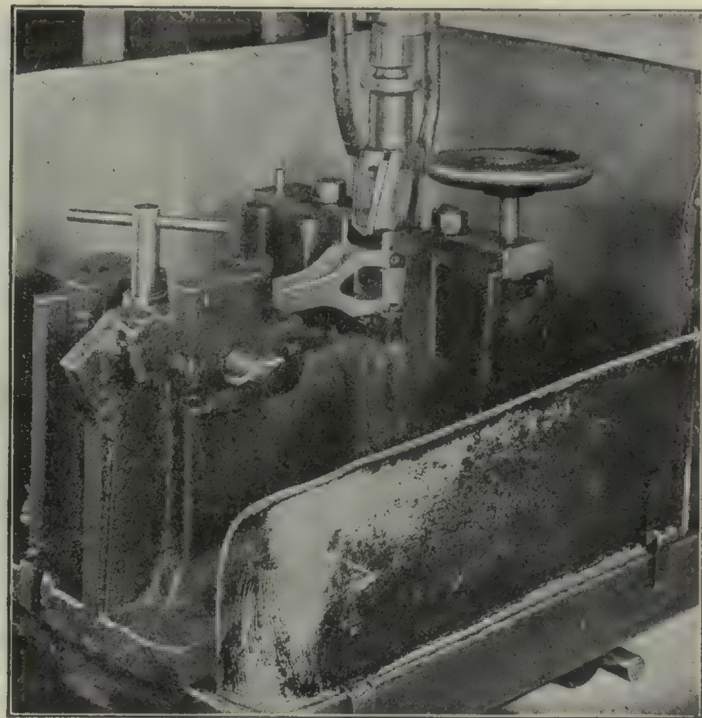


FIG. 8. ROUGH-REAM LARGE HOLE

Fig. 7—Pratt & Whitney vertical grinding machine; Alundum cup wheel, 14 x 4 x 10⅝ in.; grade J; grain, 36-38. Eight rods held in fixture, located on hardened buttons inside of fork; equalizing clamp on bolt bosses. Rods reversed for second side. Wheel speed, 5000 ft. per minute. Production, 250 rods in 9 hr., one operator to two machines. Fig. 8—No. 310 Baker drilling machine; inserted blade reamer, 2.884 in. Locate rod on pilot in piston-pin hole, spacing washer between forks. Parallel blocks fit against outside of bolt bosses. Cutting speed, 75 ft. per minute; feed, 0.020 in. per revolution. Production, 400 rods in 9 hr., one man.

covered with rubber hose to protect rods from injury does the washing. This hook holds three rods by the large end and they are dipped three or four times in the solution, after which they are allowed to drain and dry. One woman washes 800 rods in 9 hours.

Then comes the final inspection, in which the rods are removed from the boxes and the center of the crank-pin bearing hole is checked with a special gage. The rod is then placed in a fixture to determine if the centers of the holes are in the same plane and paral-

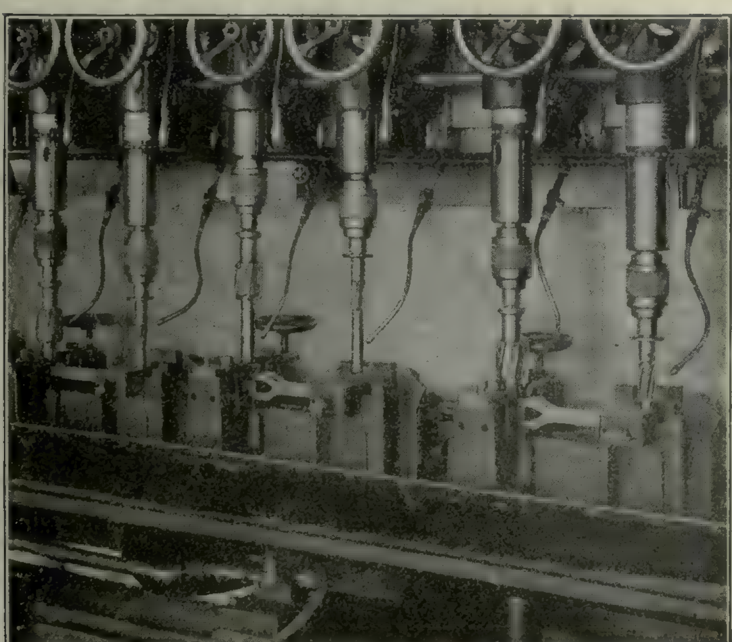


FIG. 9. FINISH-REAM LARGE AND SMALL HOLES

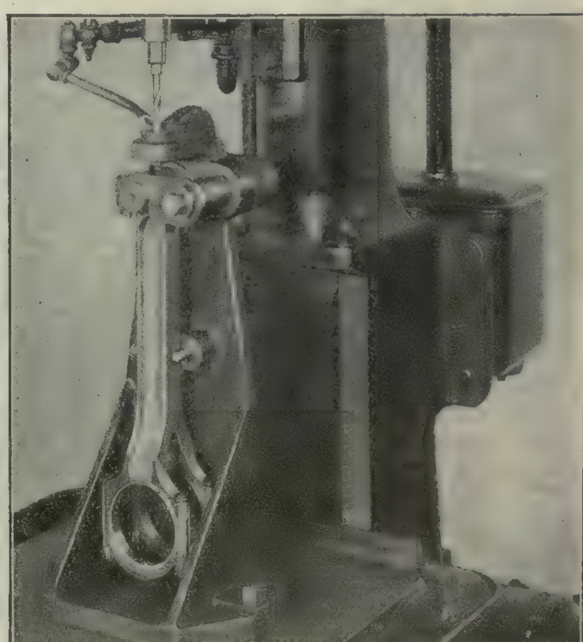


FIG. 10. DRILL OIL HOLE PISTON-PIN END

Fig. 9—Eight-spindle Foote-Burt drilling machine; two spindles to fixture; Wiard chucks; reamers, 2.911 in. and 1.422 in. Reamer pilot guided in bushing. Spacer between forks. Located by bolt bosses. Cutting speed, 70 ft. per minute; feed, 0.009 in. per revolution. Production, 350 rods in 9 hr., two men. Fig. 10—Sipp drilling machine; $\frac{3}{16}$-in. taper shank drill. Locate on pilot in piston-pin hole, held by pins against side of rod. Cutting speed, 50 ft. per minute; hand feed. Production, 200 per hour.

AUTOMOTIVE CONSTRUCTION

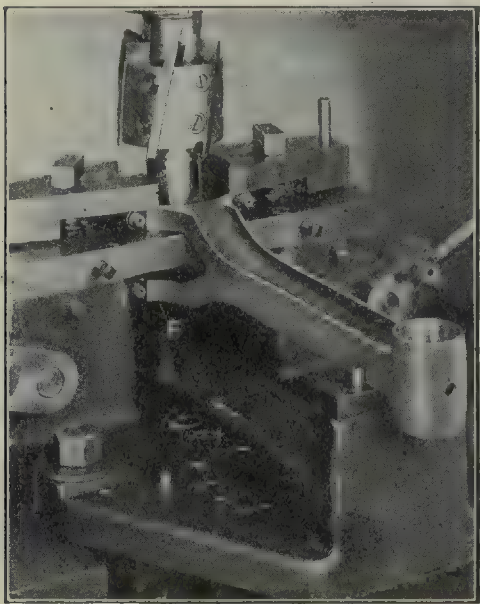


FIG. 11. COUNTERBORE RECESS IN LARGE END

FIG. 12. GRIND HOLE IN LARGE END

FIG. 13. GRIND HOLE IN SMALL END

Fig. 11—No. 310 Baker drilling machine; counterbore, 3.120 in. Rod located by plug in large hole, clamped on large end. Rod reversed for second cut. Cutting speed, 80 ft. per minute; hand feed. Production, 400 rods in 9 hr. Gaged from inside of fork. Fig. 12—No. 70 Heald grinding machine: 2½ x ¾ x ⅞-in. Alundum wheel; grade K; grain, 60. Rod located in revolving fixture by plug acting as pilot to centralize before clamping. Crank-pin bearing hole, 2.9375 in. plus or minus 0.00025 in. Spindle speed, 9200 r.p.m.; wheel speed, 4000 ft. per minute. Production, 100 rods in 9 hours. Fig. 13—No. 18 Bryant grinding machine; Alundum No. 38 wheel, grade K; grain, 60. Rod located by pilot through large hole, spacer between forks when clamping. Piston-pin bearing hole, 1.4375 in. plus or minus 0.005 in. Wheel speed, 350 ft. per minute; fixture speed, 350 r.p.m. Production, 100 rods.

lel. This fixture also checks the piston-pin boss for alignment with the outside and inside faces of the forked end.

Bell Cranks for Transmission of Uniform Motion

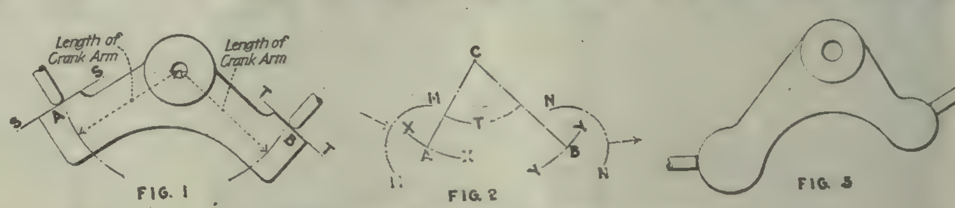
By Joseph J. Sullivan

In the design of bell-crank levers for the accurate and uniform transmission of motion in an angular direction, where a system of tappets or contact surfaces are used instead of the conventional practice of linkage, we are confronted with the problem of designing a system of contact surfaces that will give a movement at least as accurate as would be obtained were the parts connected by links.

In Fig. 1 is shown a form much used, in which the contact surfaces of the crank are straight, as shown at *SS* and *TT*. Obviously, this crank gives uniform movement between mover and moved parts at an infinitesimal movement of the crank only, for as the movement at *A* is applied to the crank and the latter takes up a curvilinear motion about the fulcrum, the point of contact at *A* changes and assumes rectilinear motion in reference to *SS*. Of course the same condition arises at *B*. This, as is plain to see, will cause the lever arms of the crank to change, therefore making the movement inaccurate; for unless the distances from the points of contact *A* and *B* to points on the imaginary arcs scribed by a radius equal to the length of the lever arms remain a constant, the crank arms will not remain a constant. The problem then is to design a bell crank that gives this feature of an unvarying length of crank arms.

In Fig. 3 is shown such a design. It is laid out in the following manner:

From center *C*, Fig. 2, with a radius equal to the desired length of the crank arm, we scribe the arc *XX*. From this same center, with a radius equal to length of other crank arm, we scribe the arc *YY*. From *C*, we lay off lines *CA* and *CB*, with *T* equal to the angle of the crank arms. With *A* and *B* as centers, and any radius desired, we scribe arcs *MM* and *NN*, representing the contact surfaces. As can be plainly seen, any



FIGS. 1 TO 3. LAYOUT OF BELL-CRANK

point on *MM* or *NN* will always remain equidistant from *A* and *B*, and as *A* and *B* always remain in their respective arcs centered at *C*, the length of lever arm of crank, therefore, always remains a constant.

Of nearly 9,000,000 men between the ages of 21 and 31 registered in the first draft, 2,721,792 were engaged in manufacturing and mechanical industries. Some of the other classifications were: transportation, 953,062; trade, 618,331; extraction of minerals, 284,456; professional service, 255,572.

Some Tools Used in Making the Keyboard of a Composing Machine

BY S. A. HAND
Associate Editor, *American Machinist*

In perfecting intricate machines it is sometimes advisable to have the parts machined by the use of jigs so that when minor changes are made in existing parts, or new parts are made, there may be certainty that they can be assembled with the minimum amount of fitting. This is especially desirable where new parts performing one function may need to be assembled alongside of, or in conjunction with, old parts performing another function. The tools illustrated and described in this article were designed for making parts of a machine that is well past the experimental stage but is still subject to improvements as a manufacturing proposition, and their purpose is to obtain accurate and interchangeable work rather than that of a productive character.

A LINE-CASTING machine similar in its product to the well-known linotype is being constructed by the Electric Compositor Co., Bridgeport, Conn., and the tools here illustrated have been made for getting out parts of the keyboard for the first machine.

Fig. 1 is a general view of the keyboard. It is built up of several parts, two of which must accommodate in one way or another the 128 keys necessary to operate the machine. The top plate *A*, Fig. 2, has 128 perforations punched in it. These are arranged in 16 rows, each row containing eight staggered perforations. The punch and die are made to punch one row at a time so that it requires 16 strokes of the punching machine to complete the work which is accomplished in the following manner:

With the die *B* and the punch *C* set in the punching machine, the plate *A* is placed on the carriage *D* where it is confined by suitable stops and clamps. With the carriage at the end of its travel and the index pin *E* in one of the end holes *G*, the punch will perforate the first row. Succeeding rows are punched by moving the carriage until the index pin drops into the next hole. The punch is made up in eight sections, so that in case of the breakage of one section it can be replaced with another at a comparatively small expense. The die is made in two parts, the dividing line being at the holes.

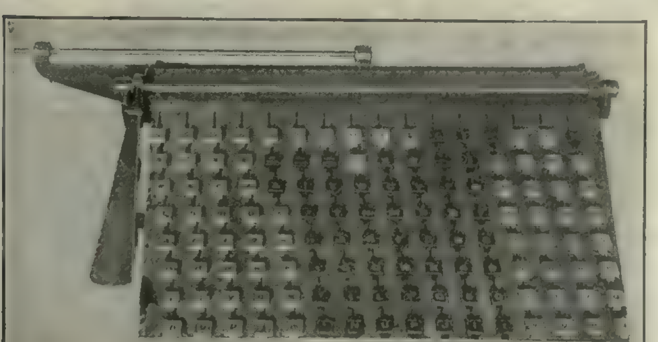


FIG. 1. THE KEYBOARD

By this means of construction, any warping that may take place in hardening can be corrected by grinding and all the holes can be made of uniform size by the same process. At *H* is shown the stripper, which needs no description.

The fulcrum block for the keys *A*, Fig. 3, has 128 transverse and eight longitudinal slots milled in it by means of the gangs of cutters shown at *B* and *C*. To accurately space 128 cutters on one arbor and have the whole gang run true takes a high order of workmanship.

The sides of the keyboard which give it the proper angle of inclination and also support the perforated

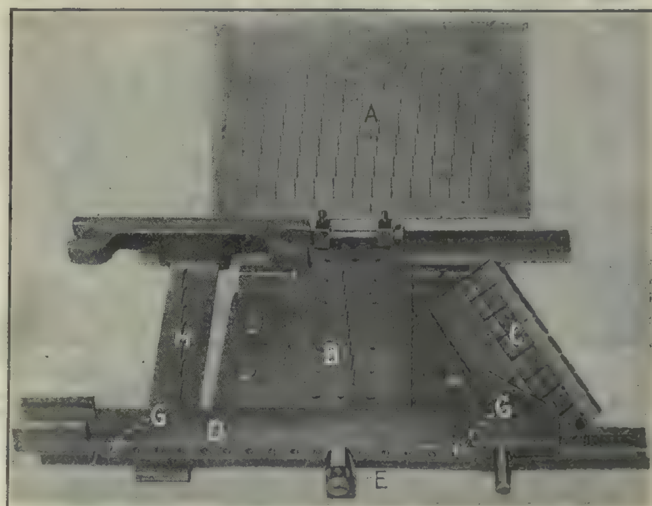


FIG. 2. PERFORATING TOOLS FOR THE TOP PLATE

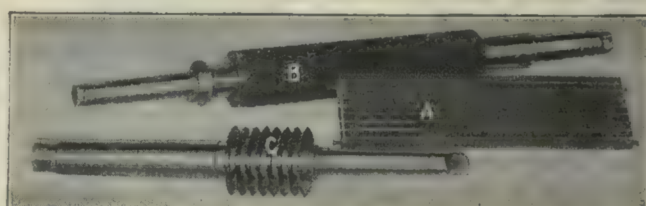
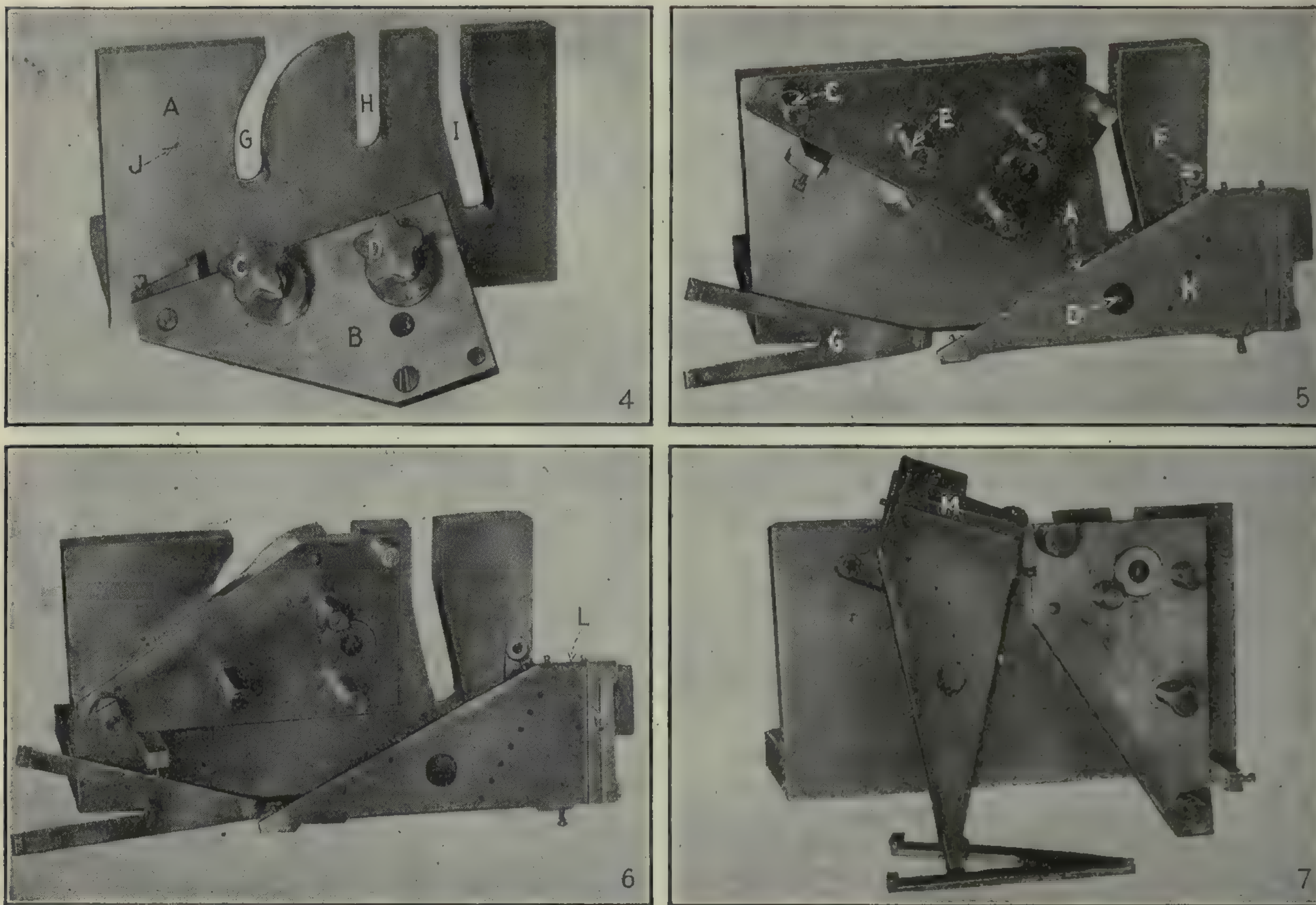


FIG. 3. GANGS OF CUTTERS AND THEIR PRODUCT

plate and the fulcrum block undergo several milling and drilling operations, for which only two fixtures and one jig are required. The milling fixture, Fig. 4, consists of a peculiarly slotted angle plate *A* and a work holder *B*, provided with clamping studs *C* and *D* so spaced as to enter either of the slots *G*, *H* or *I*. On the other side of the plate are some locating studs, a stop and a gage for setting the milling cutter.

For milling the surface *A* of the work *K*, Fig. 5, the work carrier is set as shown in the illustration where it is located by one of the clamping studs resting against the bottom of the center slot in the angle plate, and a stop pin placed in the hole *J*, Fig. 4. The cutter is set for height by the flat on the stud *C*, Fig. 5, and the work is mounted on the carrier and clamped in place. The hole *D* in the work passes over the stud *E* and the clamp *G* is applied so that the head of stud *E* catches



FIGS. 4 TO 7. THE MILLING FIXTURE FOR SIDE PLATES
Fig. 4—Fixture and work carrier. Fig. 5—Carrier positioned for first operation. Fig. 6—Carrier positioned for second operation. Fig. 7—Carrier positioned for last operation.

the inside edges of the fork. Clamping is accomplished by a hand nut in the rear. The other studs on the carrier are contacts against which the work rests. They also act as distance blocks to prevent the offset lug *F* from resting against the carrier.

The edge *L*, Fig. 6, is milled by moving the carrier to the position shown. For this operation the previous adjustment of the milling cutter is not disturbed. In milling the surface *M*, the carrier is set in the position shown in Fig. 7; and the only adjustment required is to move the milling-machine slide so as to allow the end teeth of the cutter to do their work. All these changes are made without unclamping the work from or disturbing its location on the carrier. As there are two pieces of work to be made, a right and a left hand, two fixtures of the type described are required.

After the milling operations have been completed, several holes are to be drilled through the sides and in the edges of both pieces. For this purpose the jig shown in Fig. 8 was designed to accommodate both a right- and a left-hand piece of the work. In operation these pieces are placed one on each side of the central portion where they are held by suitable stops and clamps. The two side bushing plates are then applied.

As shown in the illustration, the jig is in position for drilling holes through the bushings *A*. For drilling the holes through the bushings *B*, the jig is removed from the inclined block *C* and the surface *D* allowed to rest on the table of the drilling machine. For drilling the holes at *E* the jig is turned on its side with the feet *G* resting on the table of the drilling machine.

There is a row of eight holes to be drilled in each piece for which all the bushings could not be located in

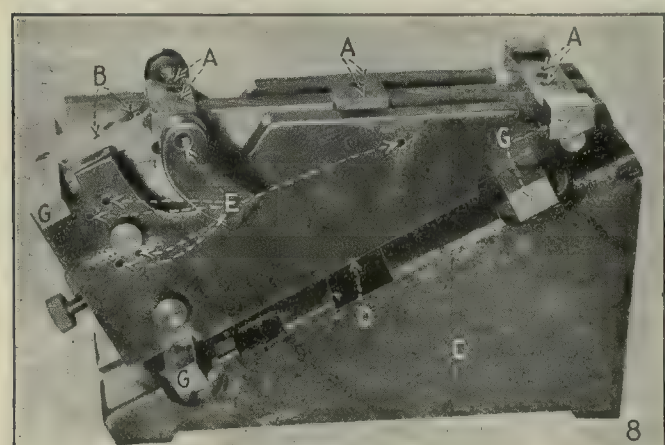


FIG. 8. THE JIG ASSEMBLED

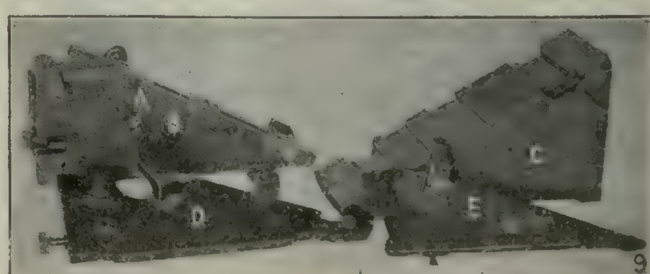


FIG. 9. THE JIG PARTS AND THE WORK

the bushing plates, owing to clearances that were necessary to avoid interferences with offset lugs on the work.

To accomplish the drilling of these holes, bushings were located in the central web of the jig at *A*, Fig. 9. In drilling the holes the work and bushing plate were removed from one side and the jig turned over, being supported by the feet *G*, Fig. 8. As the jig was provided with feet on both sides it was only necessary to reverse the operation in order to drill the row of holes in the other piece. Fig. 9 shows the jig *B* separated from the inclined block *C* and with one bushing plate *D* removed. One of the completed pieces of work may be seen at *E*, in which the row of eight holes referred to is visible.

Industrial Conditions in Japan

BY MARSHALL J. ROOT
Vice President, the Fairbanks Co., New York

Japan is in a splendid position to develop its manufacturing in machinery and other lines. The war left Japan with no great excess of armed forces over peace time, and consequently no great increase in taxes as is the case with other belligerent nations. The greatest pinch is that the armistice left her with considerable pig iron and steel on hand, for which she has paid war prices as high as $35 a ton for pig iron and $900 a ton for steel. Pre-war prices were about 15 to 20 per cent of this.

THE inability of Japan and the Far East to procure machine tools from Europe and the United States during the period of the war, especially after the United States became involved, forced her to very largely increase her manufacturing facilities as well as to utilize to the fullest extent her railroad and other government shops, the outcome being that some very large plants for the building of machine tools of various kinds have been developed in the past five years.

Quantity production is, of course, unknown, and the shops of necessity make any kind of machine ordered. Much of the shop equipment had to be built in Japan, with few facilities and few mechanics skilled in this kind of work, and the shop owners and managers realize that the machines are not first class, especially for a shop building other machine tools.

New Machinery Wanted

Several of these shops expect to relegate many of their present machines to the scrap heap and to purchase new equipment, presumably in the United States. They are also considering the engaging of engineers and production managers to help in putting their shops on a good working basis. Production at the present time is very low as compared with shops in the United States. They use practically no jigs or fixtures, and the output per man is necessarily low.

Foundries are particularly bad, both as to quality and quantity of castings turned out. Except in the larger establishments, such as the shipbuilders, government shops, etc., which employ chemists in their laboratories, very little attention is paid to the mixture, with the usual result of such neglect.

The larger machine-tool builders have in most instances very modern equipment as to the handling of their products, such as overhead cranes, etc., but are woefully lacking in modern methods and equipment for accurate production. On the other hand, due to the abnormal price paid for machine tools during the war, most of the machine works are in a very strong financial position. They are planning to develop their plants into real manufacturing establishments as fast as the market warrants—and this means not only the markets of Japan but of China and of Siberia.

One weakness which they must and will overcome is the failure to have their sons who take the technical courses, get practical experience in the shop. This is a remnant of the caste system, which is fast disappearing in some places, and which cannot last long.

Our weakness in Japanese trade, as in all our foreign

business, is in not being well represented, in not studying the field and the customs of the country, and in the matter of credit. As a result, we have supplied approximately but 25 per cent to 35 per cent of the machine tools in Japan, while Europe has supplied the rest. We do not take time to get the point of view or in fact that of the people of any other country, nor to find out wherein their customs, ideas, and standards of business differ from our own.

There are machinery houses in both Japan and China that cover the country with experienced salesmen who know conditions thoroughly. At present, there is a strained relation between Japan and China, and this prejudice may throw many orders to the United States for the time being. But if Japan gets into the machine-tool business in earnest and can sell machines cheaper than we can, the dollar is apt to be the deciding factor.

The average mechanics in machine shops receive a

wage of 60 cents per day of 12 hours' work, whereas the laborers, a great many of whom are women, receive 30 to 35 cents a day. The output of the individual is about 20 per cent to 25 per cent of that in our American machine shops, but this factor will not be maintained forever and the probability of cheap labor for some years to come would make it seem advisable for manufacturers of some articles to establish themselves in Japan and manufacture there for the Far East, instead of attempting to supply these markets from home. Capital for such enterprises is said to be available in most parts of Japan where factories would be liable to be started.

The Japanese worker is more versatile than the Chinese. The latter can be well trained for one operation or one job, but having learned one job, he seems almost incapable of forgetting enough of the first job to learn how to do another.

Not being manufacturing countries, plain machines, capable of a variety of work, are most likely to be in demand for a long time to come. And, as machines of this kind can be most easily made the Japanese are very likely to increase the output of their shops and in this way decrease imports from the United States and other countries.

The talk of establishing an automobile industry of which we sometimes hear considerable, seems to be built on slight foundation, owing to the lack of streets or bridges suitable for motor traffic. The thoroughfares usually have no sidewalks, compelling pedestrians to use the street itself. The drainage is at the side, in gutters at least a foot deep, and if a motor vehicle drops a wheel into one of these gutters it is in difficulty. Then, too, many of the streets and roads are barely wide enough for two cars to pass.

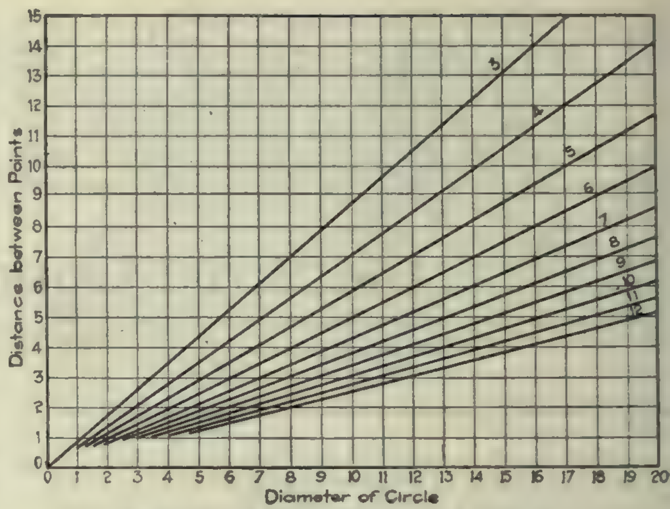
Just as an example of the difficulties of motor traffic, I may mention a ride from Tokio to Yokohama, a distance of only 18 miles. The whole trip was a problem of working one's way through a mass of pedestrians, jinrikishas, and coolie carts, and required 2½ hours.

In closing, let me add, having been in Japan, I have little fear of the so-called "yellow peril," and if trouble does arrive it will be brought about principally by our yellow journals. The ruling class of Japan dominate all policies in their entirety and they are an extremely small percentage of the total population of sixty millions, possibly two or three per cent. Of this class, fully 90 per cent are decidedly pro-American and are very highly educated. Most of them have visited America and are aware of the potential strength within our boundaries. Furthermore, Japan has a number of very shrewd politicians and they realize that their best interests lie in friendship with the United States. However, as competitors in the industrial field in years to come, we must not overlook this small nation and their wonderful industry and ability to succeed.

Chart for Locating Equidistant Points on a Circle

By Sidney K. Eastwood

The problem of determining the proper spacing of any given number of points to be laid out on a circle at equal distances, occurs in the shop or drawing room whenever a pipe flange or cylinder head is to be drilled and in many other cases. Its solution involves con-



CHORDAL DISTANCE SPACING CHART

siderable calculation or a resort to geometrical means. To eliminate this work the accompanying chart has been devised which will give the corresponding chordal spacing in decimals of an inch, for from three to twelve equally spaced points corresponding to any given diameter.

The chart consists of a series of lines numbered to correspond to the required number of divisions. These lines are plotted with the given diameters at the bottom and the resultant spacings at the left of the chart. To determine the spacing necessary to give a required number of equidistant points, consider a perpendicular erected from the bottom of the chart at a point corresponding to the given diameter to the line corresponding to the number of divisions required. The height of this perpendicular which is read at the left is the required distance between the points to be laid off on the circle. As this distance is given in decimals, it is necessary to convert it to units and fractions thereof if the scale available for laying out the work is in feet and inches. This can be readily done with a table of decimal equivalents. If a hundredth scale is available the chart gives the result direct.

Zinc Production in Australia

One of the metals of which the Germans had obtained control before the war was zinc. That control, such as it was, was due to the arrangements made by the German metallurgical organizations with the producers of zinc in Australia, the supplies of the zinc concentrates obtained from that source annually representing the equivalent of 200,000 tons of the metal. The technical difficulties in the way of recovering the metal from the highly complex Australian ores were too great to make the production of the metal in the Commonwealth feasible at the time; while British metallurgists were not prepared to attempt the task. Hence the field was left to the Germans. It would appear from a report recently presented to the Commonwealth government by the Electrolytic Zinc Corporation of Australia, that there is little likelihood that Australia will ever again lose the control of the production of zinc from her ores. Electrolytic methods of zinc recovery in the United States and Canada has led to the introduction of that process. The output of zinc has now reached about 25,000 lb. per day, the metal having a purity of 99.9 per cent.—*Brass World.*

Locating a General Machine Shop

BY L. W. ALWYN-SCHMIDT

This article tells of the subdividing of the machine-building industry into smaller specializing machine shops, these selling their services to other bigger shops. The problem of the location of these machine-shop subdivisions, regarding labor, renting, hauling, shipping and new work facilities, is described in detail.

THE American machine-building industry is running into a period of intense division of labor. Only by such a policy can it be hoped to overcome the handicap of rising wages and high cost of material. Some machine shops specialize in making certain small parts of machines; while others manufacture and assemble parts comprising different units, the whole being completed in a large machine-construction shop. These different organizations may be parts of one big organization having shops in different localities, as is the case today with the automobile industry. The next few years will see a rapid growth in the number of the machine shops of this country, all selling their services to other bigger shops for which they make special parts under contract. Such a division of labor, which is not at all new to our country but has not been tried as yet on so large a scale, will be of considerable benefit to the industry as a whole. It will permit the more intimate equipment of a machine shop just for the kind of work it sets out to do. It will make possible a better selection of the labor force, and will bring in the reach of every machine builder a highly efficient establishment which he can engage by simply giving his contracts to the shop that has assembled a perfect organization.

But the higher the specialization of each shop, the more difficult it will be for the individual enterprise to select a suitable location, meaning one where it can find the sort of jobs for which it was equipped and where it can prosper.

There have been many sins against our industry in former years in the matter of location. General machine shops, especially, have often been placed in localities which, owing to their special character, could offer little real attraction to other industries likely to be interested in their services. In such cases the personal likings and dislikings of the shop owner have often been the deciding factor for the choice of the location, while the business prospect of the enterprise should have been predominant. Often machine shops have remained in localities after the real cause for their organization had ceased to exist. Some of these shops are still making out very well. The great majority, however, are unfortunately destined to fail. Bad location, in fact, is responsible for many of the machine-shop failures of recent years.

The situation at the present requires especial care, as the great industrial activity of the war has caused an expansion of the machine industry in many localities which are not well suited for such a purpose. A good example is offered by many of our Eastern cities which now have large machine works that were built during the war, either because their organizers thought that labor was cheap in the district or that a vacant lot could be had for a reasonable price. If these enterprises should have attracted also supplementary industries to the neighborhood, as, for instance, general machine shops, they would be bound to suffer after the closing down of the principal enterprise. They would lose their leading customer or all those customers which were called to the district by the existence of the large enterprise and the end would be the going of a number, if not all, of these shops unless new work could be found for them.

While in this way a reduction will take place in the number of machine shops in certain localities, the reorganization which is now under way is bound to cause a demand for the services of the general and specialized machine shops in many neighborhoods which have not attracted much attention during the war. The very existence of peace will change the character of the industrial life of many cities. It must have a powerful effect upon the large industrial enterprises located within their limits, necessitating a thorough reorganization of the supplementary industries. The problem of location for a machine shop, therefore, arises just now in two distinct forms: in the instance of many large shops, it is the problem of relocation; in that of others, the search for a suitable location for an entirely new enterprise.

Relocation is always more difficult than placing an entirely new enterprise. The machine-shop owner, who for one or the other reasons is compelled to relocate his plant, already owns a complete industrial equipment which he must move. This equipment may be either of a general character, or it may have been installed for a special purpose. A general machine shop can easily turn from one job to the other. If a large contract is lost in the neighborhood, there is still the possibility of taking other local work.

General repair work and similar jobs can mostly be had in any neighborhood. To relocate a machine shop equipped for general work is comparatively an easy matter. All that is wanted is a neighborhood where much general machine work is done. If the shop, however, should be one doing special work with a machine equipment made for this particular work, the selection of a new location may be more difficult. It means that a district must be found which has a great number of works requiring the special services of the shop, and such districts are not always easily spotted. The transfer as a rule is complicated by the necessity of moving, not only the equipment but also the staff.

Entirely new shops find it much easier to settle. They are mostly the outcome of local demand and organized by local interests. They will locate, therefore, in their own district and will be equipped in a manner most likely to appeal to the customers of that district.

In the following a few of the principles will be discussed which should determine the location of a modern machine shop. Care will be taken to differentiate between the case of the shop under the necessity of relocating and the new enterprise.

It should be stated beforehand that the selection of factory sites for any industry is a science which is carefully studied by experts in the real estate and factory-property field and which has made especially rapid progress in Europe. Industrial real estate is now most carefully valued by the purchasers and, in the case of extensive properties, an investigation is made not only in the financial value of the property but also

in its economic value for the prospective purchaser. A continental European firm, for instance, which had to locate an industrial plant in England, had the whole question studied for more than a year before a property was decided upon. When, after the outbreak of the war, this property was taken over by the government for the manufacture of war material, it was pointed out in the press that it was because the excellent location of the enterprise made it a perfect factory unit in every respect.

Returning to the case of locating a general machine shop, the following may be suggested to the intending buyer or lessee of any property or location:

Professional locators of industrial real estate are accustomed to speak of the local and the national suitability of a prospective location. Many factory sites are offering both the advantages of local and national suitability, while others may be favored only as to one of the two.

Picking a Location for a Machine Shop

If a machine shop should be located in a city like New York, the national suitability question will arise only rarely. These shops work nearly all exclusively for New York. However, the suitability of the local situation may often be under suspicion. Generally speaking, New York machine shops do not trouble very much about their location. They pick it, if possible, in a neighborhood where rents are cheap and where power can be easily obtained, but they also consider all the other factors that make for a suitable location for a machine shop. Let us imagine a medium-sized machine shop in a city like New York. For this shop there would not be the need to arrange for a location offering exceptional facilities as to the proximity to its most prominent customers. These customers will be distributed all over New York. Owing to the excellent traffic conditions in this city it is possible to reach each of these in a short time. It may be more difficult, however, to deliver the manufactured goods. Haulage in a city like New York is a very expensive matter, and there are instances where it will cost less to ship a certain shipment on a sea voyage than from one part of New York to another. So if a machine shop should locate too far away from its consumers, other shops more favorably situated would secure the business on the strength of being able to deliver more cheaply.

The same case may arise in any other of our large cities where conditions are analogous to those existing in New York. The more recent development of our modern cities has led to an increasing specialization in certain districts. There are great districts holding practically nothing else but millinery factories; while in others, printers, tailors, furniture makers, and, incidentally, also machine shops of all kinds, may be found. Each of these districts, as a rule, is the result of careful city development which has seen to it that these localities contain all that is required to make a good home for a machine shop. One of the advantages of this system is the facilitation of intercourse between the individual enterprises. The principal gain, however, is that labor is attracted more easily to these districts. Tramways can be built, carrying the men to and from the shops, and residential quarters can be provided for.

The problem of local accessibility arises less often in medium and small cities where distances are not great and where men can walk to their work more conveniently than in a big city. But small cities are often lacking other advantages for the location of a machine shop of which the foremost is the smaller supply of trained labor.

A good supply of labor is essential for the local development of any industry. A medium-sized city rarely collects a sufficiently large surplus of labor in any particular branch of industry so as to offer a solid guarantee for a permanent supply. While relocating a plant in a medium-sized or small city, it is therefore necessary to look at first very closely into the labor situation. It may be necessary to bring the operatives of the former plant along, which in turn assumes that the new location offers living accommodation for an influx of labor.

Such medium-sized cities may be understood to have between 80,000 to 150,000 inhabitants and a comparatively small number of well-equipped general machine shops may be able to do all the work necessary for the immediate needs of the neighborhood. Of course, there are many cities which take an exceptional position in this respect; cities where the iron and steel industry or the manufacture of articles from iron and steel is at home. We have many such cities in the United States, where the population is composed largely of industrial workers. In such cities, a generation of iron and steel workers trained thoroughly in the particular specialty of their city grows up, and from the workers employers arise who settle in the neighborhood with new industrial enterprises. Such a city rarely sees a rebound in its prosperity. It has no industrial boom, but grows by reason of its own strength. Localities like these are ideal ones to locate in either under a scheme of relocation or for a new enterprise.

The usefulness of the services of a general machine shop to its customers is determined largely by the price by which this shop can supply the ready product to his customer. Take two machine shops, one located in A, and the other located in B, both having a prospective customer in C. It is clear that the shop which has the cheapest means of reaching C, both for getting and delivering the order, is favored in every respect, unless one of the two shops has special means of making its services more effective, as cheaper labor, lower overhead expense, or better class of production. Each of the three factors in favor of one or the other competitors may be a matter of location. It stands to reason that the most favored competitor will not win out only in the matter of gaining the trade of C but also will withstand better the general competition of the market with the ultimate chance for future prosperity.

Selecting Location by a Map

Take a map showing the city which you think offers special facilities for a location. Mark your city and make it the center of a circle including the most promising cities of the neighborhood, cities where you expect business. Now, pick the competing location in the same region and repeat the process. This will show where and how the different localities overlap and what competition you may expect. But competitive ability depends not always upon distance. A longer distance may be often outweighed by the possibility of having more trains or cheaper freight rates. So, before making the decision, it is a wise proceeding to study also the number of passenger and freight trains operated to and from the location and the number of mails that are available.

If two cities should prove equal on the basis of the general location test, the supply and permanency of labor should be gone into. It must be assumed that a new shop will be attracted by a demand for additional machine-shop service, which means that the existing shops cannot do all the work required by the district. This may result from a lack of equipment but it results much more often from a lack of help. This, at least,

is one of the primary causes just now. In the case of a new enterprise, it may be possible to attract outside help which may come from nearby cities having a surplus. It has been found of value in such instances to study the labor conditions in related industries. Nearly all cities having a large industrial population have a certain percentage of floating labor belonging to different industries. To take up this surplus when it appears in the market and train it for the special work of the new shop has been tried successfully by many employment managers and may prove of help also in the case of a new establishment.

Rent and taxes play an increasing part in the budgets of machine shops. To evade the high rents of one locality has become a frequent motive for relocation of industrial enterprises. With the rent situation as it is today in nearly all the industrial cities of the United States, it is not easy to find a neighborhood offering special advantages in this respect. Nevertheless, there are still cities where rents are reasonable and which will offer to the newcomer certain facilities encouraging his settlement. A look in the advertising pages of the trade press may assist in finding such localities.

The Power Supply

The power supply, so important in most machine shops, is now taken care of as a rule by large central stations that are found in all industrial neighborhoods. Where these cannot be had or where it is necessary to employ the factory's own produced power, the problem of coal supply deserves the closest attention. Our more recent winters have shown that the supply of coal is by no means so permanent as we might wish it. It may break down any moment again and the factory which is placed conveniently in this respect has a decided advantage.

The war has taught us many lessons. It has shown us that the basis of our industrial life is by no means as solid as we may have assumed it to be. For centuries we have been wont to talk about the inexhaustability of our national resources. We have learned now that we have come to the end of some of them and that others are not always as easy in our reach as they were to our fathers. Having once recognized these undeniable facts, we must set out to live more frugally and to make a better use of what is left to us. Locating our factories and industries in such a way as to facilitate economy of material and labor must be part of a policy of national efficiency and it is up to every machine-shop owner to take his individual share of the responsibility.

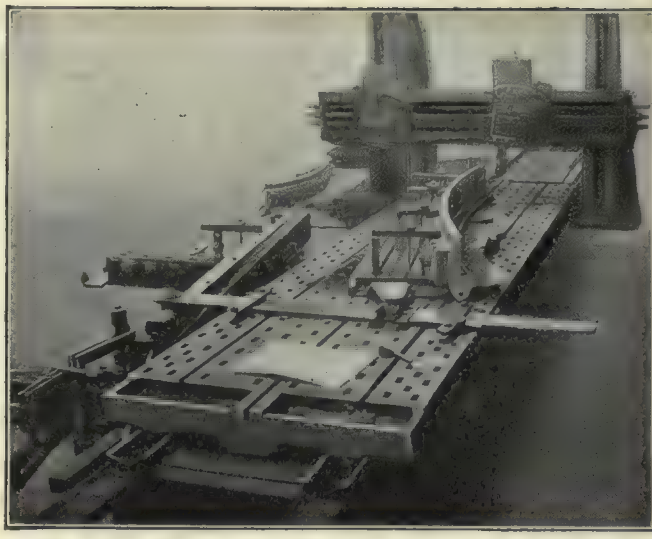
A Radius-Planing Device

By W. H. Shipler

A simple and satisfactory rig for planing large radii is shown herewith. When the illustration was made the device was set up for planing the interior curve of gear segments, the radius being 18 ft. 6 in., and the length of cut, 10 feet.

A specially built plate, having stake-holes and T-slots in its upper surface, is placed on the platen of a 72-in. planing machine, being attached thereto only by a stud at the forward end, about which it is free to swing.

Beyond the other end of this plate, a rectangular bar of iron is so mounted on the large platen that while it moves forward and back with the latter, it may slide lengthwise in a direction at right angles to the movement of the platen.



PLANING A LARGE RADIUS

A bracket on the rear end of the swinging plate carries a stud and slide block which work in a transverse yoke on the bar, formed by two pieces of angle iron bolted to the latter.

Mounted on the box parallels, alongside of the planing machine and held by bolts to the floor-plates, is a guide-bar and slide similar to the taper attachment of a lathe. The slide is attached to the end of the crossbar previously mentioned, and through it transmits movement to the plate upon which the piece to be planed is mounted. The amplitude of this movement is, within its limits, adjustable to plane any desired radius.

While the writer makes no claim to originality in devising this rig, he believes it to be a simple, satisfactory and inexpensive means of machining surfaces that would otherwise require a very large boring mill.

Why Don't the Employees Read the Shop Paper?

By Frank H. Williams

If there is anything more discouraging than to edit a shop paper and find that the employees don't read it, I would like to know what it is.

Certainly, it is a heart-breaking job to spend time, money, thought and work in getting up what you think is a "nifty" publication and then find that the employees, who should be reading each copy from cover to cover and preserving every issue for future reference, are actually using them only as a means of starting the kitchen fire in the morning, or for the purpose of adding to the poundage of waste paper sold to the rag man.

In some plants the regular monthly or weekly publication date of the shop paper is a real event. The employees talk about it and wait eagerly for their copies. They actually read them in the way that every shop-paper editor wants his publication read, and what they read makes a deep impression on them.

What's the answer? Why are some shop papers eagerly read and why do others receive little attention from the people for whom they are issued?

Well, perhaps your paper is too high brow. High-brow talk to the average man and woman means dullness. Consequently, it too frequently happens that

when the editor does what the manager of the firm wants him to do—get out a publication that will be a credit to the institution—the whole thing "misses fire." It doesn't register at all with the employees who are the very persons for whom it has been issued, sometimes at considerable expense. The reason the employees don't like it is because it is just that—a credit to the firm in make-up, typography, paper, printing and diction, but a publication that is entirely lacking in the colloquial snap and pep which characterize the daily life of the firm's workers.

Getting the Shop Paper Read

To get itself read, a shop paper must tune itself to its readers. It must keep away from anything that savors in the least bit like condescension, or "high falutingness"—like an effort to teach by underhand methods, or like an attempt by the firm to show its superiority to its workers. A too-good paper has the appearance of doing all these things. Its very classy make-up and expensive paper make it look more like a memorial adopted by the board of directors on the death of the company's president, than like a handy, interesting, heart-to-heart talk from the executive end of the business to the laboring end. Its stilted English and perfect horror of splitting an infinitive makes it savor entirely too much of being too high-toned for common folks and the whole thing conveys the impression of being a matter of condescension on the part of the company toward its workers.

Perhaps the most fatal factor in creating this false impression in the minds of the workers and making them steer away from contact with the shop paper, is a too exacting use of the English language. It is all very well to have your diction absolutely perfect, but why do so when it simply makes the workers think you are poking fun at the way they talk or trying to air your superior knowledge?

Publications, to get by nowadays, have got to talk in the language of the people to whom they are addressed. To get read they have got to sound like regular folks instead of like some long-haired man who is fussy on the subject of grammar.

The most popular magazines of the day are the ones that are colloquial in their articles and their stories, and that do not hesitate to throw in a bunch of popular slang phrases when the occasion seems to call for them. The least widely circulated magazines are the ones that strive always for "purity of expression" in everything they say.

The shop papers that fall by the wayside—like a flivver with a couple of flat tires and a "busted" carburetor—are quite generally the ones that are conducted on the principle of saying a thing properly instead of saying it the way that Jim in the blacksmith shop or Joe in the machine shop would be apt to say it.

Look at the proposition from the standpoint of an outsider. You pick up the splendidly printed and rich-looking shop paper of a large manufacturing company. The thing looks "deadly," to put it mildly. It is as elaborately printed as the family history of some new millionaire—and it is just about as interesting to the layman. Look, for instance, at the account of a dance recently given by the boys in the office. Here's the way it reads:

"Thoroughly enjoyable was the dance given at the Tanner Academy last Thursday evening by the young men of the office force. The hall was tastefully decorated for the occasion in the National colors. Music was rendered by the Jazzbo Band. At a late hour refreshments were served."

Is it any wonder the employees won't read the shop paper when it is filled with dull stuff like that? It would be the most surprising thing in the world if they did read it.

Besides, is that the proper and uninteresting manner in which those responsible for the dance speak of it? Not on your life it isn't. Here's the way those young fellows talk about it:

"Some dance the office gang 'threw' the other night! Tanner's Hall—you know, best floor in the city. Jazzbo Band wiggled 'mean' fiddles. Eats at midnight; m'm 'n everything!"

Why not give that sort of an account of the dance? Make the little item sparkle and smile. Make the employees read it just because they will be entertained while reading it. Make the whole paper sizzle with the zest of living and the joy of being happy and healthy.

There's no real reason why employees shouldn't read every issue, if only the publications are written in a way to make the reading of them a delight.

To revert to the popular magazines—do you think any of them would have their present large circulations if they were always pompous and dignified and conservative? Do you think the popular magazines would ever get very far if their writers never "jazzed" 'em up a bit in their writings the way human beings do in their daily intercourse with each other?

How to Get Your Shop Paper Read

The way to get your shop paper read is to put yourself in the position of the editor of a popular magazine. You are going to get out a publication and the only way you can get people to buy it is by putting into it the stuff they want to read. Do you imagine that if you were selling the paper to your employees you'd be so dull in the stuff you put into it? Rather you'd put into it the sort of stuff that employees would be willing to pay for; and, when you get into the frame of mind where you forget that your publication doesn't have to depend upon subscriptions and news-stand sales and where you feel that you must put into the house organ the sort of stuff that would make the employees "plank down" their good money for it, right then you will find that the employees are changing entirely from their former dislike for your paper and are not only reading it, but eagerly grabbing for it and saving every issue after they've read it.

Capstone Nickel Salts

Please give formula for a nickel solution for plating steel forgings; a good white deposit on rough work. Also a barrel plating solution for bright plating same class of work.

Answer—We do not make a practice of exploiting any special brand of plating salts in the Questions and Answers department, but the Capstone Nickel Salts distributed by the Hansen & VanWinkle Co., Newark, N. J., if used according to instructions which are sent out with the salts will give you just the deposit that you are looking for, both in the still solution and the automatic plating barrel.—*Brass World.*

A Quick-Action Drilling Jig

By Amos Ferber

The fiber rings, one of which is shown below the jig in the illustration and another in drilling position in the jig, require four holes drilled radially through them. By reason of the nature of the material, the actual drilling time was so short that it took several times as long to jig them as was required to drill the holes. The jig here shown was designed to reduce this proportion, and so simple and effective is it that the rings are now handled as quickly as though no jig was used.

A post is fastened to one face of a small angle plate and turned to the proper diameter to be clamped into the knee bracket of a sensitive drilling machine in place of the regular table. A hollow stud projects horizontally from one of the inner faces of the angle plate in such position that its center line intersects at a right angle the center line of the machine spindle.

Upon this stud there turns a shouldered ring of steel, the periphery of the larger shoulder of which is knurled to afford a grip for the thumb and fingers of the operator's left hand; while the smaller diameter fits the opening in the work, having keys fitting into the grooves of the latter for the purpose of locating it.

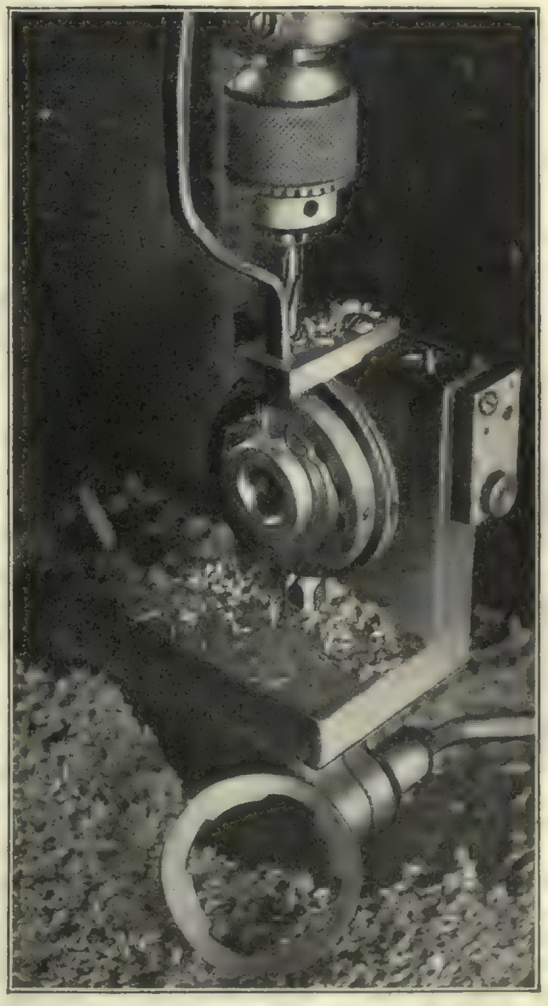
Let into the upper edge of the angle plate and held by screws there is a piece of steel with a properly located round hole for the drill bushing and beyond the latter a rectangular hole in which slides the steel piece which may be seen to the left of the drill; which, bending out around the drill chuck and quill bracket of the machine, is attached by screws and dowels to the upper part of the quill and moves up or down in unison with the drill.

The shouldered steel ring before mentioned bears closely against the inner face of the angle plate, being held thereto by a shoulder on the hollow stud which latter is put through from this side and held by a nut. The ring thus is confined against end movement, but is free to turn.

A spring plunger, having its inner end pointed to about the angle of a twist drill, is located in the base of the angle plate immediately under the shouldered ring, its beveled or pointed end entering correspondingly shaped depressions upon the knurled edge of the latter. It may plainly be seen in the cut. There are four of these depressions, locating the steel ring successively in the desired drilling positions.

To put a fiber ring in the jig all that is necessary is to pick it up in the left hand and place it on the shoulder to which it is fitted, entering the keys in their respective slots as the ring goes to place; this requires but a fraction of a second, and while this is being done the right hand is bringing down the drill.

As the drill comes down the steel guide piece moving with and slightly in advance of it strikes against the fiber ring, and by reason of its beveled end, pushes the ring up against the shoulder of the indexing ring,



AN INDEXING DRILLING JIG

insuring that the hole shall be drilled in the center, widthwise, of the fiber. As the drill is fed downward the guide piece continues on past the end of the indexing ring; entering a clearance hole in the hollow central stud.

When the drill is raised, the thumb and fingers of the operator's left hand (which during the drilling has

not left the work) grasp the knurled portion of the indexing ring, turning it forward to the next position. The beveled or pointed end of the spring plunger permits this movement to be made with but little effort on the part of the operator and without attention from him or her, the plunger receding against the action of its springs; yet it unmistakably indicates the position of the next hole.

These movements follow very rapidly; the pieces being accurately indexed and centered as quickly as they could be drilled in an open V-block with no attention paid to either indexing or centering. The fiber ring is free to be taken out any time that the drill is raised. Any position is right for stopping or starting; all that is necessary is to put in a piece of work and make the required number of movements.

Because of chips or burs of the fiber being carried by the drill into the clearance holes in the indexing ring there would be difficulty in taking off the drilled rings if the operator's fingers were relied upon, and therefore, a mechanical ejector forms a part of the jig. Four steel pins about ¼ in. in diameter pass through holes in the angle plate, being arranged concentrically with respect to the center of the hollow stud which is the center of the whole device. Four holes axially through the larger diameter of the indexing ring permit these ejector pins to pass through the latter and bear against the fiber when the indexing ring is in any one of the drilling positions. A round steel plate has a central stud, and through holes near the edge of this plate the shouldered outer ends of the ejector pins are riveted.

No part of the ejector can be seen in the picture for the reason that all exposed parts are outside the angle plate away from the observer, while the inner ends of the ejector pins are covered by the fiber ring in the jig.

A spring maintains the position of the ejecting device with the ends of the ejector pins just clearing the indexing ring so as not to interfere with the movements of the latter; thus, a smart blow with the palm of the right hand against the round plate will cause the ejector pins to knock a fiber ring out of the jig and the spring will withdraw them instantly from the indexing ring. Should the blow be struck when the ring is misplaced—that is, between drilling positions—no harm would be done, as the ejector pins would merely stop against the steel ring and a blow from the hand could accomplish no damage.

This device was designed by Charles H. Cuno, and is in use in the shops of the Cuno Engineering Corp., Meriden, Connecticut.

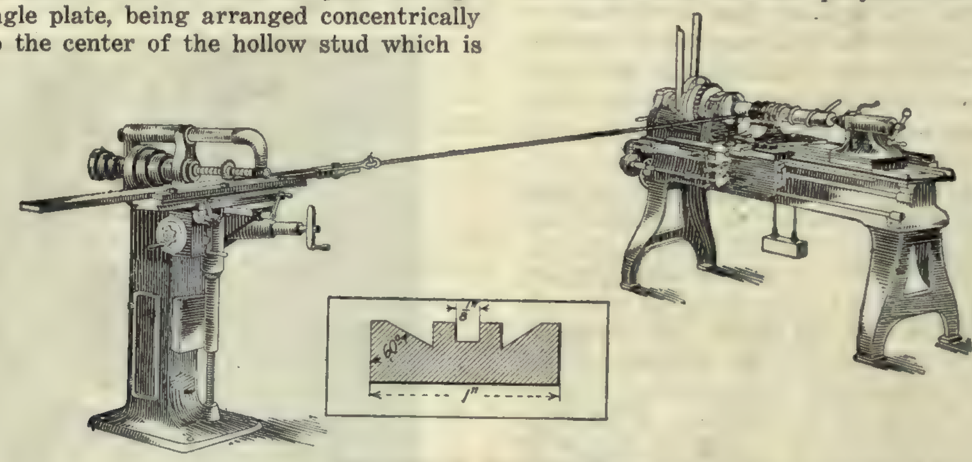
Milling Special Shapes in a Bar

By Donald A. Hampson

Several hundred pieces of steel were required of the section shown by the illustration. Naturally, these had to be machined from rectangular bars but instead of cutting to length first—the lengths averaging 3 in. each—the scheme here described was adopted to mill the section in stock lengths, after which the pieces were cut off. By this method a decided saving of time was effected.

Three cuts were made on each bar—one for the center channel and one each for the right and left angular face. Pieces clamped to the table of the milling machine guided the bars sideways and held them down to a running fit as they were drawn through. After the cutter was set in proper relation to these guides, the entire lot of bars was passed through before making a change to another cutting.

In starting, the end of a bar was beveled much as in screw machine work to make it easier to push against the cutter until an inch projected at the rear. Then



MILLING IN BAR LENGTHS

a clamp was fastened to this end for connection with the "power feed."

The lathe standing in the background furnished the feed. A 3-in. piece of steel on the centers, and driven by the dog, forms a drum on which is wound a rope that is carried to the clamp attached to the bar being milled. When the lathe is started, the bar is pulled through under the cutter at uniform speed, producing a smooth cut that could not be improved upon.

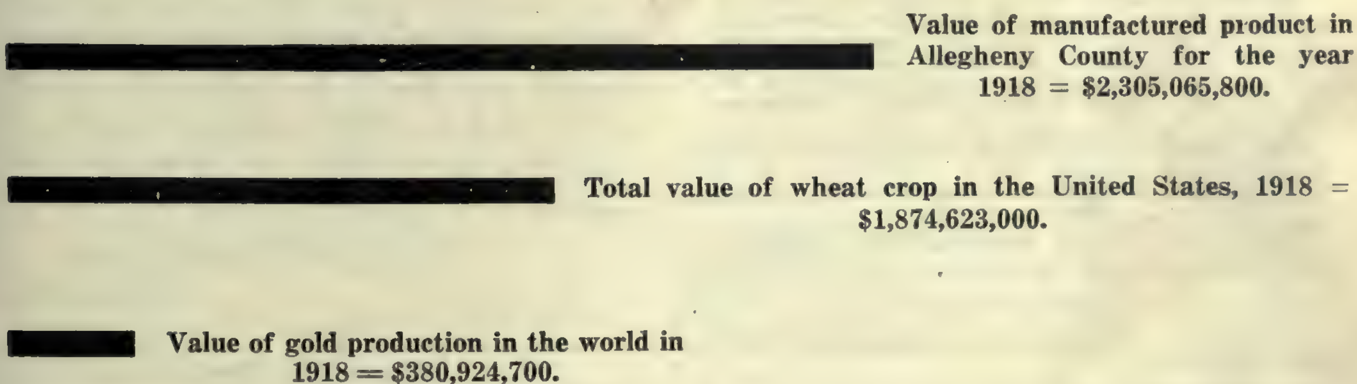
The quality of the work is better than that produced by the common method of cutting to short lengths first, while the saving in time is effected by the less frequent loadings and the higher rate of feed possible with this method. By selecting a day when the lathe was not in use, the tying up of an additional machine was a matter of no importance.

Very often in manufacturing and in special work a number of pieces are required that are best made of drawn steel but the shape is such that certain cuts in the direction of the bar must be made; if these cuts could be made over the whole length of the bar, the work would be greatly expedited, but equipment that makes such cuts possible is usually of the roll feed variety, the cost of which is out of all proportion and the further serviceability of which is problematical. The arrangement that is here described was set up in half an hour from parts already available and it answered just as well as an expensive outfit.

Pittsburgh Chamber of Commerce
Unanimously
Approves Directors Report!

The report of the Board of Directors of the Pittsburgh Chamber of Commerce, opposing the compulsory use of the metric system, which was given in full on page 309, was submitted to a vote of the members at the last regular monthly meeting and UNANIMOUSLY approved.

The importance of the metal-working industries in the Pittsburgh district is here graphically shown:



The value of this action is obvious.

Now, Mr. Manufacturer, what is YOUR Chamber of Commerce going to do?

Ethan Viall

Editor

The Veracity of Pro-Metric Statements

Read these Letters and others which will appear in our columns and draw your own conclusions as to the reliability of any statement made in literature issued by the World Trade Club of San Francisco in its pro-metric propaganda.

Rochester, N. Y., February 16, 1920.

Ethan Viall, Editor,
American Machinist.

Dear Sir:

Referring to yours of February 13th we have already received a communication from Mr. Burlingame advising us of the unauthorized use of this company's name by the World Trade Club of San Francisco. We have written the following letter to the club asking them to remove our name from the list as we are unalterably opposed to the use of the metric system in this country.

"World Trade Club,
681 Market Street,
San Francisco, Calif.

Gentlemen:

We have just noted that in the periodical issued by your organization, entitled 'Who Urges Meter-Liter-Gram?' the name of this company is listed as a manufacturer urging metric standardization. The use of our name in this connection is unauthorized and we request you to remove it from any further editions of this booklet, as we are unalterably opposed to the compulsory adoption of the metric system of weights and measures in this country.

Kindly favor us with acknowledgment of this letter."

Yours very truly,
Eastman Kodak Company,
F. W. LOVEJOY,
Vice President.

Athol, Mass., February 16, 1920.

Ethan Viall, Editor,
American Machinist.

Dear Sir:

Answering your letter of the 13th, our attention was called to the matter you refer to, several weeks ago, and we at once wrote to The World Trade Club of San Francisco asking for a copy of the printed matter said to have been issued by that club, in which our name appears as favoring the compulsory use of the metric system.

We have not yet received the literature asked for. Any such use of our name is entirely unauthorized and without our knowledge or consent. We are not in favor of the compulsory metric system.

Yours respectfully,
The L. S. Starrett Co.,
F. E. WING,
Treasurer.

Lockport, N. Y., February 16th, 1920.

American Machinist,
New York City.

Attention Ethan Viall, Editor.

Dear Sir:

In reference to the advice recently received from Mr. Burlingame that our name has been used by the World Trade Club as urging the standardizing of the metric system, beg to advise you that this statement was absolutely unauthorized. We are not in favor of the compulsory metric system, and have advised Mr. Burlingame that our name was used in this connection without authority.

Yours very truly,
Harrison Radiator Corporation,
H. C. HARRISON,
President.

New York, February 17, 1920.

Ethan Viall, Editor,
American Machinist.

Dear Mr. Viall:

Replying to your letter of February 13, I cannot understand how the World Trade Club of San Francisco happens to be using our name to urge the use of the metric system, as we have never knowingly endorsed metric standardization. We have taken the matter up with this concern and asked them on what authority they are using our name, and in the meantime I wish to say to you that such use is entirely without our knowledge or authority and we are greatly opposed to such a move, assisting the American Institute of Weights and Measures in their fight against its adoption.

Yours very truly
American Locomotive Company,
C. K. LASSITER,
Vice President.

Beacon Falls, Conn., Feb. 19, 1920.

Ethan Viall, Editor,
American Machinist,
New York, N. Y.

Dear Sir:

We are in receipt of your letter of Jan. 13th and have carefully noted contents. We understand that our name is being used by the World Trade Club as urging the use of the metric system. This is being done without our knowledge or authority.

You are at liberty to use this letter, as we would like to have it come before the public, showing how the World Trade Club has acted in this matter. We are writing them today relative to same.

Yours very truly,
The Beacon Falls Rubber Shoe Co.,
R. L. FISHER,
General Manager.

January 29, 1920.

The World Trade Club,
San Francisco, Cal.

Gentlemen:

We have just been advised that this company's name has been published in a pamphlet under your name, as one urging metric standardization.

We are at a loss to know who authorized any such use

of this company's name and demand that you either show authority or make a prompt and public apology.

Yours very truly,
Pratt & Whitney Company,
B. H. Blood,
General Manager.

WORLD TRADE CLUB
681 Market Street
San Francisco, Cal.

10 February, 1920.

Mr. B. H. Blood,
Gen. Mgr., Pratt & Whitney Co.,
Hartford, Conn.

Dear Sir:

Replying to your letter of January 29, 1920, let me say that Book 4, "Who Urges Meter-Liter-Gram?" was made up from letters received in this office, and from records received from Washington, D. C., of petitions directed to the Bureau of Standards, Department of Commerce. Every attempt was made, in preparing the manuscript of this book to indicate whenever a member of a concern spoke not on behalf of his firm but as an individual.

We will search through the thousands of letters that have been received here in order to answer your question as to the use of your company's name. Our impression has always been that the Pratt & Whitney Co. was a believer in metric standardization, because of the fact that in the report of Director S. W. Stratton, of the Bureau of Standards, for the International High Commission in 1915, your firm is named along with the *American Locomotive Co.*, the Baldwin Locomotive Works, the Standard Tool Co., *and many others, as a concern using metric gages and standards.* It may be that the name of your concern was included in Booklet 4, "Who Urges Meter-Liter-Gram?" because of this mention in Director Stratton's report.

In issuing further editions of "Who Urges Meter-Liter-Gram?" we shall of course eliminate the name of your company, if you request it. Please read the inclosed booklets.

Is it true that your concern manufactures gages and standards of metric measure and finds that this can be done with practically no inconvenience or increased cost?

Yours for world standardization,
World Trade Club,
(Signed) Aubrey Drury,
Secretary-Treasurer.

February 18, 1920.

World Trade Club,
681 Market St.,
San Francisco, Cal.

Gentlemen:

Answering yours of February 10th, you are hereby urgently requested to eliminate the name of this company from any and all mention among those who favor forcing the metric system down the throats of American manufacturers.

We have always been open-minded toward the more extensive use of the metric system, but your unfair and underhanded methods are calculated to drive us to the opposition. We believe in fair play. Your method of circulating petitions to the authorities results, as you well know, in certain people filling them out and mailing them as requested, while those opposed simply consign them to the waste basket. A practically unanimous vote by a small minority is thereby made to appear as representative, while the large majority have no vote. Why in the name of fairness, if you wished to be fair, did you not send out a ballot *for* and *against*, so that those wishing to vote might have a chance to express a preference? It is our belief that you did not dare to do so. This belief is based not only on the methods you are pursuing, but upon numerous and glaring misstatements of fact which we cannot believe are due entirely to ignorance.

The accomplishment of your aims would in our opinion be a commercial calamity. By this we refer to the compulsory adoption of the metric system by American manufacturers.

We do manufacture gages and standards of metric measure, but we do it by translating metric measurements into English before the drawings go into the shop, just as the Ordnance Department found it necessary to do with their French drawings during the war, or as we would do with Russian or any other foreign measurements with which our workmen are not thoroughly familiar. The added cost is passed on to the customer.

If the proposed law making the use of the metric system compulsory should become effective, it would bring us a large amount of business in providing new gages and standards. We, therefore, are not selfish in opposing it. But we do not want business which is a needless burden on the industry of the country.

We have had numerous inquiries from the technical press and from other manufacturers as to whether your use of our name in "Who Urges Meter-Liter-System?" was authorized. To all such we have roundly denounced your action. It is obvious that such inquiries and such answers tend to discredit your propaganda work, but unfortunately our denunciation can reach but a very small proportion of your mailing list, and we therefore demand a printed apology and renunciation on your part, reaching the full list of those to whom you have circulated misinformation.

Yours very truly,
Pratt & Whitney Company,
B. H. Blood,
General Manager

Latest Report from Washington

In view of statements to the effect that the present is not the best time to consider metric system legislation, Representative Vestal, the chairman of the House Committee on Coinage, Weights, and Measures has agreed to withhold the bill pending the submission of a brief by the American Institute of Weights and Measures. The brief, which will set forth the disadvantages of starting a metric system agitation at this time, will be laid before the committee, which will decide whether or not the matter is to be taken up at this time.

Since announcing that the metric system bill will be introduced, Representative Vestal has been flooded with communications bearing on the subject. Some have requested that he allow the bill to be introduced by some other member as it was feared that there would be implied necessity for him to work for the passage of the bill which will bear his name. Mr. Vestal calls attention to the fact that it is a very common occurrence in both the House and the Senate for members to introduce bills for the simple purpose of getting them up for consideration and which they in no other sense sponsor. He admitted, however, that he is considering having the bill introduced by another.

The bill providing for the compulsory use of the metric system in Government Departments was practically ready for introduction when Mr. Vestal became convinced that it hardly would be fair to raise the issue on the Government Departments alone, when it simply meant that it was to be an entering wedge with the idea of making it generally compulsory at the next step. He expressed the opinion that the bill should stand or fall on the general proposition of making its scope nationwide.

The redraft of the bill has not been completed but it is thought that it will be in final form before the end of the month.

Observation of a Field Editor

By FRED H. COLVIN

Machinery in Houston, Texas

The machine-tool situation in and around Houston, Texas, must not be considered in the same light as in either New Orleans or Mobile. The conditions and the outlook in these places have already been outlined, and they are not particularly encouraging, for the near future at least.

Houston, on the other hand, not only wants machines now, but is likely to want more in the future. This city may be called the center or headquarters of the South Texas oil fields, and these are increasing every day. Although new as an industrial city it has already laid a firm foundation for the future and comes as a surprise to the traveler when he sees twenty-story buildings rise out of the prairie as he approaches it.

* * *

Here is the active headquarters of the Texas Oil Company and many others, with oil fields within a short radius and others farther afield. Here, too, are huge new oil refineries which combine all the best experience of the past and which are the last word in both buildings and equipment; and still more surprising, Houston is now a seaport of no mean proportions in spite of its being 52 miles inland from the Gulf of Mexico.

Taking advantage of inland water and spending money freely in dredging shallow waterways, as well as cutting a real ship channel for several miles and a turning basin for ocean-going cargo ships, Houston is today shipping millions of dollars worth of cotton direct to European ports.

This waterway affects its position in the machine-tool market by making it possible to receive machinery direct from New York, Philadelphia or Baltimore in seven to eight days, by boat, and with no rehandling.

* * *

Further than this, Houston is no longer in the jobbing-shop class, but is fast becoming a manufacturing center for oil-well tools as well as a distributing center for oil-well and similar supplies. The demand for oil-well tools of the latest and best type—the ability and the willingness to pay a good price for good tools—has developed manufacturing to an unbelievable extent. Instead of the job shop of the usual Southern city we find new shops with saw-tooth roofs, with batteries of motor-driven standard machine tools, well equipped, and other things equally surprising. These, however, will be shown later.

So far as concerns machine tools, the great demand is for deliveries—price is not so important—and the recent advance in lathes did not prevent new orders being placed. This section of the Southwest will be well worth watching and cultivating.

The question as to how long this will continue, is by no means certain. There is every reason to believe, however, that it will last a long time, as the demand for oil for fuel is increasing by leaps and bounds. A very few years ago it was necessary for the producers to build huge storage tanks, some of earth and some of metal, where millions of gallons of oil were stored to prevent it from going to waste. Today the demand outruns the supply and is still going. New wells are coming in every day and will continue to do so.

The small companies which are springing up everywhere in this section are for the most part likely to strike oil, but it must be remembered that this is only the beginning and that the oil game is one which runs into money by millions, not figuratively but literally.

* * *

Not only is oil-well drilling expensive—the average hole costs approximately $50,000—but that is only the beginning, even assuming that it comes in all right and that it does not blow out all the three or more thousand feet of casing and demolish the derrick and machinery. The oil is of little value until it is refined and it must be sold to the large companies who own and operate refineries. This also involves transportation, and here is where the millions play their important part.

The only economical way to transport oil is in pipe lines, and these cost money, not only for the pipe, which now runs around two dollars a foot, f.o.b.—but in laying it, which costs real money. It also involves pumping stations every twenty or thirty miles, sometimes maintaining a little settlement twenty miles from a railroad, all of which requires capital in huge chunks.

* * *

These pipe lines run clear across the country to New York for export shipping. They almost honeycomb the State of Texas, where thousands of miles are already laid and in use. This of itself makes it a rich man's game, and the usual result is that, after a small company gets a good-paying well, the large company makes an offer for it and usually gets it. If the demand is good, as at present, the small company makes a profit, but if the demand is poor, the terms are correspondingly lower.

The huge companies play a safe game. They are glad to let the little fellow develop the properties. He takes the risk, for the lure of oil-well prospecting and drilling is closely akin to that of mining, though the distribution is different.

Whatever happens, however, Houston is likely to be a good market for machine tools and supplies for some time to come. One house is now handling over a million dollars' worth of general supplies a month.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT
• NEWS •
A weekly review of modern designs and • equipment •

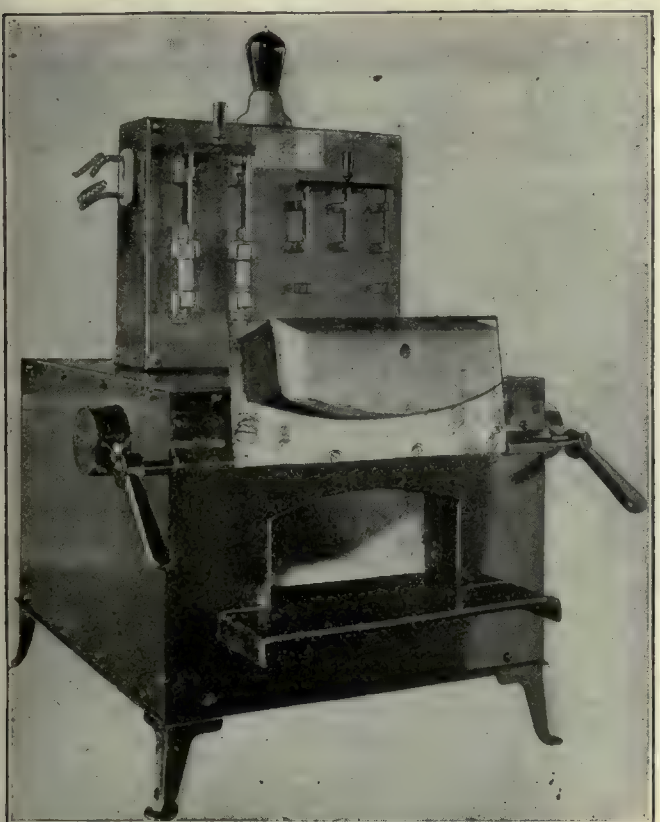
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED •
CLIPPING INDEX
A continuous record of modern designs • and equipment •

General Electric Muffle Furnace

The General Electric Company has developed an electric furnace of the muffle type, which is designed to meet the demand for a durable, economical and convenient furnace for temperatures up to 850 deg. C. (1,562 F.) for baking vitreous enamel, hardening and tempering tools, dies, etc.

The device as shown in the illustration consists of the furnace proper with a control panel mounted on top of the front. The heating element is mounted on the outside of the muffle and covered with compound. It is claimed that it is so placed as to give a very even distribution of heat throughout the inside. The element is divided so that it is possible to get two degrees of heat. The muffle is mounted in a strong steel casing, and the walls, door, etc., are thoroughly insulated, thus preventing loss of heat from radiation.



GENERAL ELECTRIC MUFFLE FURNACE

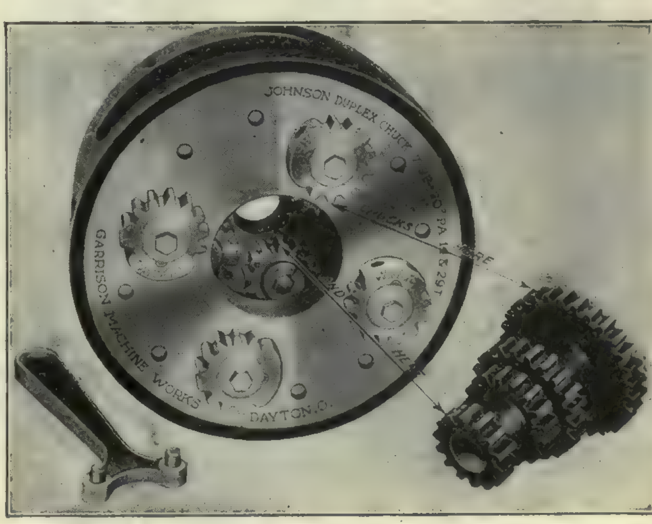
The control panel is equipped with a main-line switch, a double-throw switch for high or low heat, and a red pilot lamp which acts as a warning to the operator when the furnace is at high heat. There are connections at the side of the panel for connecting rheostats when temperatures as low as 300 deg. C. (572 F.) are desired.

The furnace is further provided with a shelf in front for the convenience of the operator, and the door is equipped with counterweights to keep it open. The high heat requires 4 kw. to bring it up to 850 deg. C.

Johnson Duplex Universal Gear Chuck

A special chuck designed to hold a gear cluster while the hole is being bored or ground, is a product of the Garrison Machine Works, Dayton, Ohio. The term duplex applies to the manner in which the chuck grips the two outer gears of the cluster. The illustration shows how this is accomplished.

In place of the ordinary chuck jaws, small eccentric gears are used. Four of these are mounted on the outside face of the chuck and are free to turn. The face of the chuck is also free to turn in the casing or body,



JOHNSON DUPLEX UNIVERSAL GEAR CHUCK

a spanner wrench being used for this purpose. Three other eccentric gears are mounted inside the chuck on the back face. All of the eccentric gears have but a slight throw when turned. When chucking a cluster and the spanner wrench is applied with a closing movement, all of the gears turn a part of a revolution, as they are geared together by the cluster. As a result, the two outer gears of the cluster are firmly gripped and held by the wedging action of the two sets of eccentric gears. The cluster is thus automatically

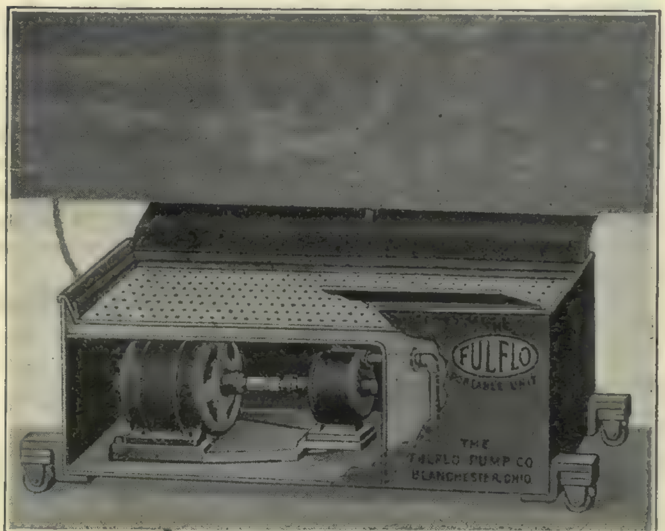
centered with a balanced pressure by the universal movement of the chuck.

The chuck has a range of 0.010 in. plus to 0.020 in. minus on the pitch diameter and it is claimed that after the hole is ground the pitch line will not vary 0.003 in. from truth. The four openings in the rim of the chuck, besides admitting the spanner wrench, serve to prevent the accumulation of chips, etc., within the chuck. The body of the chuck is made from cast iron that is first rough-turned and then allowed to season before being finished. The chuck members and their supports are of alloy steel and are hardened and ground. The diameter of the chuck is approximately 5 in. larger than the gear it is used for, and the weight averages about sixty pounds.

Fulflo Portable Motor-Driven Pump

The illustration shows one of many applications of a portable motor-driven pump unit made by the Fulflo Pump Co., Blanchester, Ohio.

This unit was designed to supply lubricant to the cutting tools on machines not originally equipped with a



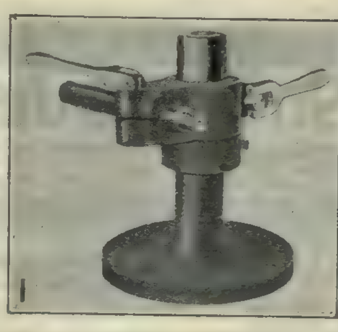
FULFLO PORTABLE MOTOR-DRIVEN PUMP

pump. It can also be used on machines having individual coolant systems when for any reason the system may be out of commission.

In operation it is only necessary to roll the unit beneath the machine to be supplied with coolant and to attach the motor cord to a lamp socket. Provision is made for attaching additional splash boards when required. The pump and motor are completely covered and it is claimed that the pump is not affected by dust, grit or chips.

Thor Vise for Pneumatic Drills

The Independent Pneumatic Tool Co., Chicago, Ill., has introduced a special vise for use in connection with pneumatic drills of all makes. The vise, shown in Figs. 1 and 2, holds the drill body in various convenient positions for assembling, repairing and testing. It is made of a flanged upright column upon which is mounted a stop collar and clamp bracket. The stop collar supports the clamp bracket at the correct height for the workman, being locked by a setscrew. The clamp bracket can swivel on the column until securely locked in position by means of the clamp handle. At the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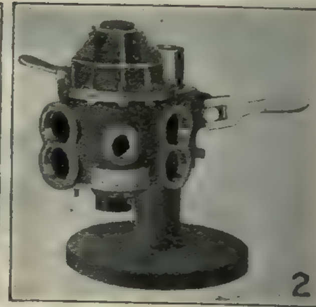
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THOR VISE FOR PNEUMATIC DRILLS

outer end of the bracket, a second clamp, at right angles to the first, is used to hold a stem of correct size to fit the drill. The stem has a threaded end to fit the dead handle hole of the drill. Three stems are furnished having $\frac{1}{4}$-, $\frac{1}{2}$- and $\frac{3}{4}$-in. pipe threads respectively. When screwed into the drill body the shank may then be placed in the bracket hole and clamped in position. When the drill body is to be supported in a vertical position, as shown in Fig. 2, an additional fixture is used, known as a stem support. This simply provides a vertical hole for the stem to fit into. To obtain the best results the special vise should be located conveniently near the workman's regular vise.

"Standard" Geared-Head Engine Lathe

The 14-in. x 12-ft. lathe shown in Fig. 1 is known as the "Standard" and is a product of the Springfield Machine Tool Co., Springfield, Ohio. It differs in design to some extent from other geared-head lathes made by this company. A positive clutch is used instead of a friction clutch to return the carriage at high speed when cutting threads. This clutch is operated by the lower lever on the front of the headstock. The machine is equipped with the regular friction clutch by means of which the power can be instantly applied or released while the motor is running.

A Logansport air chuck and special tool rest, as shown in Fig. 2, are provided for cutting threads. The rest is adjustable and carries a circular threading tool combined with a small turning tool of high-speed steel. The turning tool is adjusted for the diameter of the

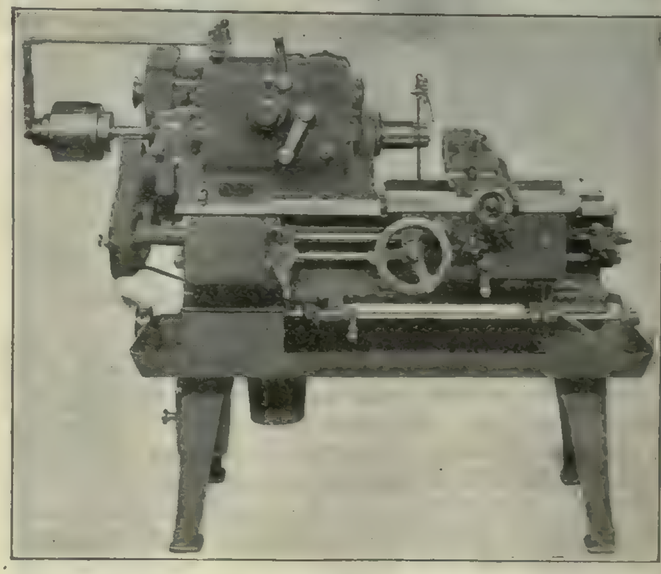


FIG. 1. "STANDARD" GEARED-HEAD ENGINE LATHE

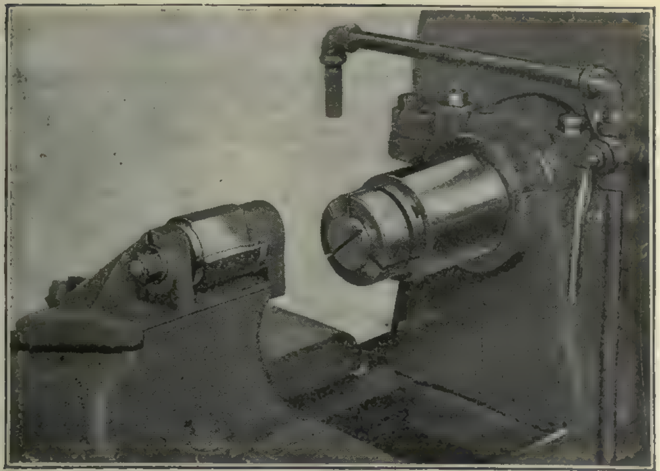


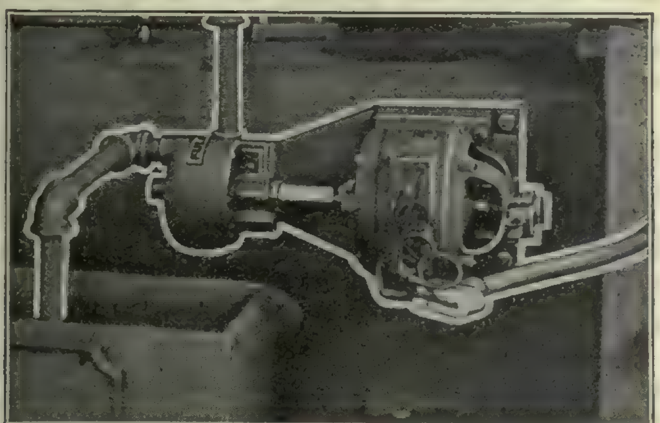
FIG. 2. AIR CHUCK AND SPECIAL TOOL REST

work and is independent of the threading tool. The function of the arrangement in Fig. 2 is to turn and thread collars from the rough by passing over them once. A 1½-hp. motor is mounted back of the headstock, and a silent chain is used for the drive.

The Fulflo Electrically Driven Pump

The Fulflo Pump Co., Blanchester, Ohio, has added to its line an electrically driven pump for permanent installation on machines provided with the company's drainage systems.

This makes it possible to attach the unit at almost any convenient place, even where a belt-driven pump



FULFLOW ELECTRICALLY DRIVEN PUMP

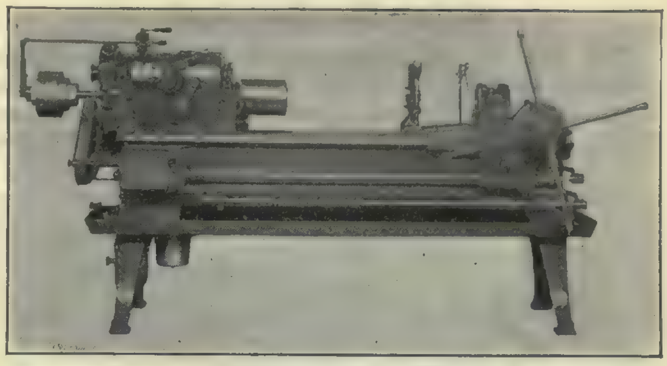
would be hard to operate on account of interference with the belt by overhanging or moving parts.

The pump can be mounted above the level of the coolant, as it is claimed that it will hold its priming without the aid of check or foot valves.

In operation it is only necessary to attach the motor cord to a lamp socket.

"Springfield" Boring Lathe

The lathe shown is intended only for boring and reaming operations at high speed. It is a recent development of the Springfield Machine Tool Co., Springfield, Ohio. It has a geared head and the same system of clutch controls used on standard models of this make. The lead screw is omitted, as it is unnecessary for the work mentioned. The air chuck is of the collapsible col-



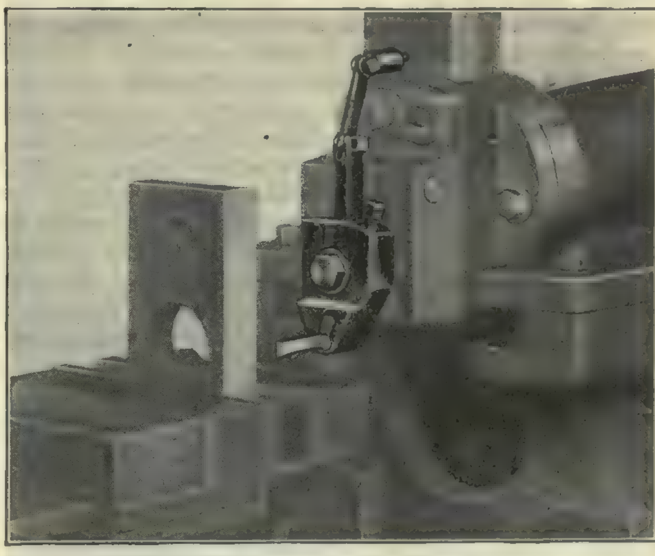
"SPRINGFIELD" BORING LATHE

let type. The carriage is the same style that is commonly used for boring spindles and axles. The steadyrest is of special design and consists of a counterbalanced quick-acting locking mechanism requiring merely a push of the hand to open it and a slight pull to close it. The cutting lubricant is circulated by a pump and is carried to the work by means of telescopic brass tubing. The motor is attached at the rear and has a silent chain drive.

Bruno Slotting Attachment for Planing and Shaping Machines

The H. A. Moore Co. Rochester, N. Y., has placed on the market the Bruno slotting attachment for planers and shapers as shown in the illustration herewith.

The device is simple in construction and can be readily attached to the clapper of a shaper by removing the toolpost and using a clamping bolt furnished for the purpose. An adjustable friction arm provided with a



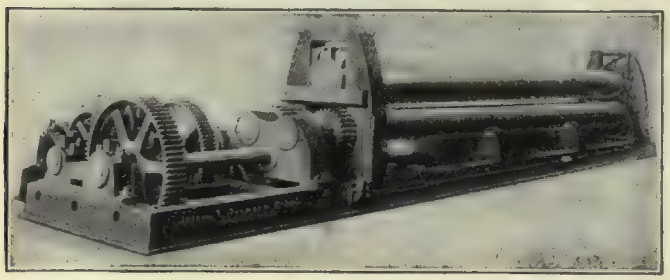
BRUNO SLOTTING ATTACHMENT

spring buffer insures the dropping into place of the clapper at the end of the return stroke and is claimed to prevent vibration of the tool at any speed. The cutting tools can be made of ordinary stock and may be turned to any position to cut on bottom, side or top.

Three sizes are made taking tools with round shanks of the following sizes: No. 0, ⅜ to ½ in.; No. 1, ½ to ⅝ in.; No. 2, ⅝ to ¾ in. Each size is furnished with two cutting tools. Weight, 5 pounds.

Kling Bending Roll

The bending roll illustrated is built by the Kling Brothers Engineering Works, Chicago, and sold by its agent, Joseph T. Ryerson & Son. This machine measures 34 ft. 2 in. between housings, and has a capacity for bending ¾-in. mild-steel plates. Cut gears and bronze bushed bearings are used throughout.



KLING BENDING ROLL

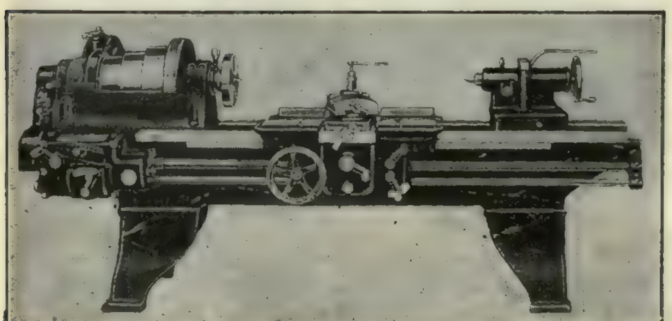
The top roll is 29 in. in diameter and weighs about 40 tons. The bottom rolls are 21 in. in diameter and each has two roller supports. The whole machine is built on a rigid gray cast-iron base. The drive is by two direct-current motors, one for the main roll drive and the other for power adjustment of the top roll.

Morris 22-In. Engine Lathe

The Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio, has placed on the market the 22-in. engine lathe illustrated herewith.

The headstock is of the semi-inclosed type and is provided with large reservoirs from which oil is supplied to the bearings. The tailstock is offset and will permit the compound rest to be set parallel with the ways. The base is graduated and provided with setover screws. The spindle is clamped in position by two bushings operated by a single screw.

The bed is braced with numerous crossribs and is so supported on the legs as to balance the weight. The carriage travels on a flat surface at the back and on a large V at the front. It is gibbed to the bet at both the front and back and is drilled so that a taper attachment can be supplied. A dial for screw cutting is provided. The apron is a one-piece box casting with all bearings cast as an integral part. All gears are of steel and the shafts have bearings at both ends. Both feed frictions are operated with one lever and an interlock prevents the engagement of the feed and screw-cutting mechanism at the same time.



MORRIS 22-IN. ENGINE LATHE

Specifications: Distance between centers (8-ft. bed), 3 ft. 6 in.; swing, over shears 23 in., over carriage 15 in.; front spindle bearing, 3¾ x 6 in.; hole through spindle, 2 in.; taper hole in spindle, Morse No. 6; spindle speeds, eighteen, 10 to 300 r.p.m.; countershaft pulleys, 16 x 4½ in.; countershaft speeds, 165 and 200 r.p.m.; weight, crated 3,800 lb., boxed 4,750 lb.; size of case, 134 x 46 x 46 in.; cubic feet, 165.

The compound-rest swivel is graduated in degrees and is clamped by a single bolt through a dovetail clamping ring. The taper attachment is graduated both in degrees and in taper per foot. The lathe can be furnished either with a quick-change or a semi-quick-change gear box.

Reed-Prentice 14-in. Geared-Head Lathe—Erratum

In the article describing the Reed-Prentice 14-in. geared-head lathe on page 315, Vol. 52, the statement was made that the regular equipment included a taper attachment. The maker advises us that this is not correct, as the taper attachment is only furnished as an extra.

Less Scrap and More Production

By John J. Wharton

Having just read on page 157 of *American Machinist*, John R. Godfrey's article on Johnson's "spoiled work" campaign I am much interested in it. I worked as an apprentice machinist in a shop for four years and found conditions that Johnson certainly could have wiped out by his new plan.

In this particular shop, piece-work rates were continually being lowered because a man finished up a job an hour or two before time, until the situation got so bad that over half the ordinary piece-work jobs were cut down so much that it was impossible for a man to make any extra time on them; still the management expected him to turn out the job in the usual time he had made when the piece-work rates allowed him an hour or two extra.

As Mr. Johnson says, a man with an ounce of gray matter in his head would balk at this attitude of the management. It went so far that when a man was assigned to a piece-work job, one of his fellow workers, who had previously worked on the job, would come to him and tell him "to take it easy" because there was no money in it; consequently, the man would take his time and the job he had to do would take twice as long as it would have done had he had a reasonable rate.

What the management gained by cutting rates on piece-work, I could never discover. They certainly wanted the job finished up quickly when they put a piece-work rate on it, or they would not have issued a card on it.

In regard to paying for not spoiling work, I think it is a splendid idea. It will not only make the men careful, but it will make them put all that is in them on the job. I have seen job after job scrapped, that the foreman never knew anything about, for the simple reason that if it became known, the man would likely lose his job. The foreman never seemed to think that even the best of us make mistakes. A large percentage of all the spoiled work was due to the machines themselves, rather than the man; some of the machines used should have been scrapped instead of the jobs.

The production game has several sides and in regards to treating the men with fairness, I think Johnson has the right idea. If more of the men in charge of shops would try to see the employees' side of the situation I think we would have better conditions and greater production.

Investigation of Phosphorus and Sulphur in Steel

A REPRESENTATIVE committee has been appointed at the initiative of the American Society for Testing Materials, the U. S. Railroad Administration and the U. S. Bureau of Standards, for the investigation of the effect of phosphorus and sulphur in steel.

The need for a research on this subject has been felt for some time, but it required the stringency of war conditions to bring the question sharply home to the manufacturers and users of steel. It will be recalled that the American Society for Testing Materials recognized at its annual meeting in 1918 the abnormal difficulty in obtaining an adequate supply of steel in time of war, and particularly of meeting the phosphorus and sulphur limits as specified in the A. S. T. M. specifications, owing to the high-sulphur coal and low-phosphorus pig iron and scrap which had to be used to meet war-time demands. The society accordingly raised the limits for sulphur in all steels and for phosphorus in acid steels 0.01 per cent above the requirements in forty-three of its specifications for steel, to be effective during the period of the war and until otherwise ordered by the society. The armistice was signed in November of 1918 and in the next six months conditions had so improved that the society restored the original limits for phosphorus and sulphur in twenty-nine of these specifications, covering what might be called the special steels, such as spring steels, forging steels, and tire and wheel steels. Action on the removal of the note from the remaining fourteen specifications, covering in general the tonnage materials such as plates for buildings and ships, was deferred until 1920. The Committee on Steel of the Society, however, realized that it was essential to secure reliable information concerning the effect of phosphorus and sulphur in steel in order to make suitable recommendations to the society concerning the limits of these elements in the A. S. T. M. specifications.

The Committee on Steel recommended to the Executive Committee of the Society that a thoroughly representative joint committee be formed consisting of representatives from those organizations and industries having a particular interest in the subject. A hearty desire to co-operate was evidenced by all interests approached, and the joint committee was formally organized on Nov. 29, 1919. The personnel is now as follows:

Representing the Bureau of Standards: George K. Burgess, Bureau of Standards, Washington, D. C.; H. L. Whittemore, Bureau of Standards, Washington, D. C.

Representing the U. S. Railroad Administration: F. M. Waring, Pennsylvania Railroad, Altoona, Pa.; H. E. Smith, Box 491, Eleventh Street Station, Washington, D. C.

Representing the American Society for Testing Materials: Robert W. Hunt & Co., 90 West St., New York; T. D. Lynch, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

Representing the Society of Automotive Engineers: F. P. Gilligan, Henry Souther Engineering Co., Hartford, Conn.

Representing the Association of American Steel Manufacturers: E. F. Kenney, Midvale Steel Co., Widener Building, Philadelphia, Pa.; J. J. Shuman, Jones & Laughlin Steel Co., Pittsburgh, Pa.

Representing the Steel Founders' Society of America: J. E. McCauley, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.

Representing the U. S. War Department: F. C. Langenberg, Watertown Arsenal, Watertown, Mass.

Representing the U. S. Navy Department: D. J. McAdam, Naval Engineering Experiment Station, Annapolis, Md.

Representing the U. S. Shipping Board: Frank Gentles, 140 North Broad St., Philadelphia, Pa.

Representing the National Research Council: John H. Hall, Taylor Wharton Iron and Steel Co., Highbridge, N. J.

The tests are to be divided into two series. Series A includes six groups of material, each typical of its class as to carbon and manganese, and with phosphorus and sulphur ranging from 0.02 to 0.08 per cent, it being understood that when studying the effect of sulphur, the phosphorus content is to be as nearly constant as possible and equal to the usual value for the group of material, and vice versa. Also, the sulphur in the steels of this series is to be "residual sulphur"; that is, sulphur present in the steel through fuel or from pig iron or scrap.

Series B is designed to provide for higher sulphur than can, generally speaking, be obtained as "residual sulphur." In this series, therefore, sulphur may be added during the later stages of manufacture. Any heats originally prepared for series A which run too high in phosphorus or sulphur may be diverted to series B.

Although the committee has been formally in existence only for some two months, it has made a good beginning. The following committees have been appointed: Committee on Statistics: H. L. Whittemore, chairman; Committee on Manufacture: Geo. K. Burgess, chairman; Committee on Tests: F. C. Langenberg, chairman.

The Committee on Statistics will visit steel manufacturers and users to obtain information on material high in phosphorus and sulphur which has either failed in service or which has proved satisfactory. A complete record of such material will be obtained, if possible. Material worthy of study will be secured and placed at the disposal of the Committee on Tests. The committee will also prepare a bibliography of this subject for the use of the joint committee.

The Committee on Manufacture will supervise the manufacture of all steels to be prepared under the program of tests adopted by the joint committee and revised from time to time. Members of the committee or their representatives will be present at all essential operations in the manufacture of steels to be tested.

The Committee on Tests will receive all material as submitted to it by the other two committees and make suitable tests upon it in accordance with the program of tests outlined by the joint committee. Special proof and service tests, including impact and endurance tests, will be made where possible. The committee will also endeavor to determine the amount and types of gases present in steels under investigation.

The Committee on Manufacture has supervised the manufacture of a number of tons of rivet steel, and will select all material which is approximately constant in chemical content as to carbon, manganese and phos-

phorus, with sulphur varying from 0.03 to 0.08 per cent. A beginning has been made in the tests of series B by arranging with a large steel company for the manufacture of three heats of steel—covering plate and structural steels, forging steels, and wheel, tire and rail steels—from each of which eight ingots will be poured to obtain varying sulphur content from 0.04 up to 0.15 per cent, by the addition of sulphur or iron pyrites in the pouring box.

The greatest interest has been shown in this investigation. The manufacturers in particular have given it their very hearty support, having agreed to furnish the material necessary to conduct the investigation. The Government Departments have offered the facilities of their laboratories for conducting tests, as have also the manufacturers and several of the large railroads who have been approached. The various interests represented on the joint committee have agreed to assume such expenses of the investigation as come up naturally in the course of their participation therein, so that up to the present the joint committee has not found it necessary to raise a general fund for this purpose; nor is there any reason to believe that, for the present at least, the raising of such a fund would be necessary. Financial matters have been delegated to a committee on finance.

It is hoped that this investigation will receive the hearty support of all persons and organizations at interest. Any information of value to the committee will be welcome and should be sent to the secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pennsylvania.

Non-inflammable Japan

Baking japan as ordinarily used in manufacturing consists of two elements, the base and the solvent. The base is usually some variety of asphalt, combined with linseed, or some similar oil, the whole making a hard, rubbery appearing substance. This must be liquified for use, and the common practice is to dissolve it in naphtha, or kerosene. The process of japaning various metal articles consists of dipping them in the liquid japan, and then baking them in an oven.

Owing to the volatile and inflammable type of the solvents used, this baking process is somewhat hazardous. After several bakings have been consummated the atmosphere in the oven resembles that of the inside of a gasoline engine cylinder, only needing a spark, or even excessively high temperature to cause an explosion of great force.

Manufacturers became interested in the possibility of developing a type of japan with a non-combustible solvent. The Research Laboratory of the General Electric Company was requested to try to evolve such a product and a course of research resulted in the development of a variety of japan which eliminated the necessity of a hazardous solvent.

A "Water" Japan Evolved

This water japan, as it is called, is an emulsion of the asphalt oil base with water. It was found that this japan had no tendency to settle out, even after months of storage, and that, owing to its being "suspended" in water, losses by evaporation were practically negligible.

The methods of applying the japan are two in number, the electric dip and the hot dip. The former is appropriate for small articles and consists in placing them, charged positively, in a negatively charged iron tank of japan. The result is that an even, smooth coating of japan is deposited on the articles in question, and, since the japan is deposited free from solvent, there is no resultant drip when the lot is conveyed to the baking ovens.

The second method, or the hot dip, which is applicable to large pieces of metal, was found more or less by chance. It had been the custom in the laboratory to preheat the metal before dipping, in order to free it from dirt and grease. This preheating evidently had the same effect of causing the japan to form a deposit on the metal as giving it a positive electrical charge. A third method is also sometimes used which is a combination of the two already mentioned. That is to say, the metal is both heated and positively charged.

The result has been that a variety of japan has been evolved that gives exactly the same effects as the solvent variety. It is cleaner to handle, owing to the absence of drip, and eliminates the danger of explosions and fires.

Deoxidizing Molten Iron by the Use of Ferro-Cerium

A recent addition to the list of substances for deoxidizing molten iron is the metal cerium. At it melts at 1,180 deg. F. its ferro-alloy lends itself readily to assimilation in molten cast iron.

Cerium for this purpose is used in an alloyed state containing 50 to 60 per cent lanthanum and 15 per cent didymium, samarium, etc. In this state it is known as misch metal.

For use in deoxidizing iron, misch metal is diluted with about 30 per cent of iron and in that state the melting point is from 1,480 to 1,650 deg. F., or well within the melting point of cast iron.

The best method for use is said to be sprinkling the granulated alloy in the stream of molten iron as it issues from the cupola or furnace spout. Used in this way the alloy becomes red hot by the time it reaches the ladle and readily assimilates with the iron.

The cerium group of metals is exceedingly active chemically and has a great affinity for oxygen. The result of its use is the liberation of great quantities of heat and a decided scavenging action, thus purifying the iron and prolonging its fluidity. It may therefore be expected that castings will be softer and more dense, as feeding through the gates and risers will be prolonged and the formation of combined carbon will be correspondingly retarded.

Tests of iron showing a transverse strength of 2,090 lb. gave, with an addition of ferro-cerium alloy in quantities of 0.05 to 0.15 per cent, transverse strengths of 2,450 to 2,840 lb. In a pig and scrap mixture the transverse strength of 2,740 lb. was raised to that of 3,110 to 3,280 lb. by the addition of the same amounts of the alloy. With like treatment of melted car wheels the transverse strength of 3,790 lb. was raised to that of 4,080 to 4,190 lb. In this latter test the last bar tested was defective and the ones tested contained 0.05 and 0.10 per cent respectively of the alloy.

Chill blocks cast from the above samples were quite instructive as the fractures indicated a prolonged setting period for the metal treated with cerium.

It is one of the noticeable features of the use of this alloy that much slag is taken from the molten metal, partly through the increase of fluidity and the balance from oxidation products of the alloy itself.—*Iron Age.*

EDITORIALS

The Responsibility for Increased Production

IT HAS become the custom to say that the one thing we need is more production. But this is about as unsatisfactory as to tell a starving man in a desolate country that all he needs is bread, without telling him how and where to get it.

There are so many phases to the production problem that it is not so simple as it seems. The unprecedented demand for labor and all its products has warped our vision in many ways. We now speak of millions as lightly as we formerly mentioned thousands. We shrug our shoulders and protest at the ever-mounting prices of nearly all commodities but we rarely deny ourselves on that account so long as we have the money to pay for what we want—whether we actually need it or not.

We have lost our perspective in too many cases. We have also lost sight of the fundamentals of economics. The worker, seeing the vast fortunes made on war contracts, has come to believe that capital is a limitless source of supply for his wage demands. The tradesman follows suit and marks up the prices of food, clothing, etc., so that the higher wage buys no more than before. We have become careless of values—and prices in too many cases bear no direct relation to the cost of production. They are rather based on the old piratical custom of "levying all the toll the traffic will bear."

High wages have not brought increased production. In some cases they have merely aided careless spending. But this is also true of the business man whose income has suddenly increased to an unexpected figure. How many of us would spend as sanely as we do if the Rockefeller income was suddenly added to our bank account?

We need to get back to first principles, to realize that more production means more to be distributed. And we must make this plain to the workers in every industry. As long as they believe that an increased product does not benefit them, there is no hope of, or no reason for them to increase their output.

Production today is not so much a question of machine equipment as it is of men, and of the psychology of handling them—not by strong-arm methods, or master-and-man paternalism, but by getting together on some common ground. Little can be done without a bond of sympathy and confidence between the workers and the management.

Production has fallen off in many places. But this reflects on the management as well as on the men because there are shops in which it has increased, and this without the incentive of bonuses or special inducements.

The White Motor Co. has increased the output per man without any bonus; wages, of course, keeping pace with the increasing cost of living as must be the case. The plant of the Oneida Community also reports an increased output per man. Here wages have remained the same as before the war but the increased cost of living is met by a special payment based on Bradstreet's reports.

Similar reports come from well-known plants where the bonus is used to induce promptness in the morning and steady work, and here it is interesting to note that the increased output per man is astonishingly high. But with or without bonuses, confidence must be established and this can only be done by fair treatment, and a desire to understand the other fellow's problems. Bonuses or high wages alone, with confidence lacking, will not secure the desired results. We have had too much of the "armed truce" attitude with both sides waiting and looking for chances to put something over.

With the establishment of confidence, problems of hours, rates and the like can be settled amicably and without hard feeling. Piece rates and bonuses can be adjusted either up or down as occasion requires and many of the reasons for small production can be eliminated.

Bearing in mind that the world needs more production than ever before, it must be clear to all that relief can only come by increasing it in all necessary lines—but it cannot be increased by either side alone. The worker who delays production is guilty of a crime against humanity in general. But equally guilty is the manager whose methods have failed to inspire the confidence and secure the co-operation of his men.

Management today is facing greater problems and greater responsibility than ever before. But with the examples before us of what can be done in securing co-operation and increasing production, we must hold management largely responsible when this condition is reversed. Theirs is the opportunity of inaugurating methods in keeping with the progress of the times. If they fail, other and better managers must be found, for only increased production can relieve the situation.

A Shop Mathematician

ONE of the developments of the war, at least the idea seems to have been developed in a war work shop, has been the creation of a new office or position known as the shop mathematician. His duty is to assist toolmakers and all others in any and all calculations which come up in their regular work.

The shop mathematician goes over all blueprints and drawings and helps interpret them in the clearest way possible to the toolmakers and other workmen. A part of the shop mathematician's job is calculating for laying out angles, with or without the sine bar; checking the center distance of holes; measuring threads by the three-wire system, pitch diameter of screws, etc. He does not take all work of this kind out of the toolmakers' hands unless they need or desire it, but he goes over it with them and checks it up. This has been found to aid materially in preventing costly errors and spoiled work. It has saved time and is a help in every way.

Sparks from the World's

By E. C. Porter,

Initial Flight of the New Aërial "Flivver"

The aërial "flivver has arrived. It made its initial flight over the muddy reaches of College Point, L. I., yesterday in view of a large number of aëronautic enthusiasts. The new flivver is a tiny monoplane, said to be one of the smallest in the world, with a wing spread of but twenty-five feet. Its manufacturer has named it "Butterfly."

The Butterfly is designed for the sportsman aviator and will retail at $2,500. It carries one person only, and despite its Liliputian dimensions flew with ease.

Captain Jack Foote, chief test pilot of the L. W. F. Corporation, took the fledgling into the air for the first flight, which was witnessed by representatives of the Manufacturers' Aircraft Association and the American Flying Club.

The tiny monoplane "took off" from the snow-covered field after a short run of seventy-five feet. It mounted the air rapidly and reached a speed of seventy-two miles an hour. After circling the field a number of times Captain Foote returned to a perfect landing, coming to a dead stop after a run of fifty feet. In this he was assisted by the skid digging deep into the snow.

The new aërial "flivver" weighs only 595 lb. when empty and but 918 lb. fully loaded. It is equipped with foolproof controls and a fire extinguisher. Its motive power consists of a new type of two-cylinder motor especially designed for it. The cylinders are horizontally opposed.

Owing to its small size and low landing speed the Butterfly can be landed on the grounds of almost any country house and can be housed in any moderate-sized garage.

Lieutenant-Commander Peterson of the Sales Division of the Navy

The sales division of the United States Navy in charge of the disposition of the surplus naval equipment, negotiated sales during December, 1919, aggregating approximately $350,000 for each working day of the month, according to Lieutenant-Commander C. G. Peterson, in charge of the sales board of the Navy.

More than $200,000,000 worth of material and equipment, which has been declared surplus for the needs of the United States Navy, is being offered for sale.

Lieutenant-Commander Peterson, who is in charge of the Washington office and six district sales offices, is a mechanical engineer and has had much experience in the manufacture and sale of naval equipment. After his graduation from Cornell University in 1906, he became associated with the Sizer Ford Company, of Buffalo, manufacturer of steel and iron forgings. He

LIEUT.-COMMANDER C. G. PETERSON

later became connected with the Watertown Engine Company.

As an executive in the Washington Block Company, of Lockport, N. Y., Commander Peterson acquired much information and experience that served him well as director of the sales of the Navy. Prior to his being commissioned in the Navy, Commander Peterson was with the Griscom-Russell Company.

Polytechnic Institute Gets Government Machine Tools

The mechanical engineering department of Polytechnic Institute, Brooklyn, N. Y., has announced that, under the provisions of the Caldwell act, recently passed by Congress, it has purchased apparatus at a discount of 85 per cent.

The "Tech" has to date acquired six engine lathes, a planing machine, power hacksaw, milling machine, drilling machine, universal grinding machine, radial drilling machine, two turret lathes and a shaping machine. This is all practically new.

Mr. Wade, in charge of the machine shop, personally inspected all of this machinery in trips to Detroit, Cleveland, Pittsburgh, Toledo, Buffalo, Rochester and Bridgeport. To make room for the new machinery much of the old will be done away with.

Instruction of Enlisted Men in Occupational Lines

The war plans division of the United States Army has begun to map out a comprehensive program for the instruction of enlisted men along occupational lines. More than 90,000 men in the army in approximately 250 different schools are to receive instruction in technical vocations. When completely developed it is anticipated that the system will co-ordinate with the educational and vocational activities of the army in such a way as to fit men for effective military service as well as for success in civil life.

Arrangements are now being made to transfer from the surplus equipment of the army to each divisional camp and training center such tools, equipment and supplies as may be needed and available for training purposes.

In this connection the education and recreation branch of the war plans division has established an office, the purpose of which will be to select and allocate to the various schools such machine tools and shop equipment held surplus by the War Department as will be needed for instruction purposes.

V. C. Kylberg, formerly with the machine-tool section, Office of the Director of Sales, War Department, will have charge of the selection and allocation of such material. Mr. Kylberg will be assisted in this work by Major Charles R. Welch and Major O. H. Stiles, who were also formerly with the Office of the Director of Sales. Colonel George M. Robinson, U. S. Army, will serve in an advisory capacity in the new office.

In addition to allocating to the schools the material and equipment necessary for competent instruction, much of the work of mapping out practical curricula will devolve upon Mr. Kylberg's office, according to present plans. In this connection, Mr. Kylberg is contemplating enlisting the aid and co-operation of the trade.

It is also anticipated that such equipment as may not be obtainable from among the surplus property of the various army bureaus will be purchased upon the open market.

For the fiscal year ending June 30, 1920, Congress appropriated $2,000,000 for army occupational instruction.

While complete details for instruction in all the schools have not yet been developed, it is expected that the first shop in a divisional camp will be at Camp Taylor.

Instruction in all the camps and schools will be under the general direction of Dean F. H. Evans.

Industrial Forge

News Editor

Company Organization To Make Machine Tools

The Davis & Thompson Company, of Milwaukee, has been incorporated to manufacture machine tools and other metal-working machinery, principally a continuous milling machine which has been developed in the last three years by Frank M. Davis and John Thompson. Both were formerly principal officers of the Davis Manufacturing Company, Milwaukee, which now is operated as the motor works of the Avery Company, Peoria, Ill. A new plant will be erected in West Allis in the spring by the new corporation, which until now has been manufacturing its tools under contract.

German War-Blind Working in Machine Shops

Germany is striving to make useful workers of her war-blind and war-maimed. They have succeeded to such an extent that today, it is reported, a considerable number are engaged in different works running machines.

Today these works believe that they have given an answer to any idea that the war-blind or the war-maimed, except in extraordinary cases, need be solely objects of charity and pity.

Working on their drills, presses, and boring machines are men totally blinded, and in some cases with an arm missing.

Utilization of such cripples has been made possible through application of special machinery. Special attachments were contrived, so that there was no danger to the operator. This company has found that with some kinds of drills, a blind man could operate a pair.

For instance, certain lathes were equipped with bells which told the blind operator when the material in the lathe had been sufficiently turned. On this machine and on drills and the like there were special guards which prevented the workman from catching his hands in the mechanism.

New Westinghouse District Manager for New York

Arthur Elliot Allen has been appointed district manager at New York for the Westinghouse Electric and Manufacturing Company to succeed Edward D. Kilburn, who has been elected vice president and general manager of the Westinghouse Electric International Company.

Mr. Allen is a native of Toronto, Canada, and received his education in England and also in this country. On Dec. 1, 1915 Mr. Allen was appointed manager of the supply division of the New York office, which position he retained until he joined the Canadian Overseas Forces as a private in October, 1917. Later he was sent to the Canadian Officers' Training Camp, was

ARTHUR ELLIOT ALLEN

commissioned as Second Lieutenant in the Royal Flying Corps.

After being honorably discharged from the army Mr. Allen returned to the New York office of the Westinghouse company as executive assistant to the manager.

Nicholson File Company Elects Officers for Ensuing Year

At the annual meeting of the Nicholson File Company, held at the offices of the Company, 23 Acorn St., Providence, R. I., last week, the following directors were elected for the ensuing year: Samuel M. Nicholson, Paul C. Nicholson, Marsden J. Perry, John Russell Gladding, Byron S. Watson, Ernest S. Craig and Augustus E. Saunders.

At a subsequent meeting of the board of directors the following officers were chosen: President and general manager, Samuel M. Nicholson; vice president and treasurer, Paul C. Nicholson; secretary and assistant general manager, Ernest S. Craig; assistant treasurer and cashier, Henry W. Harman; assistant treasurer, Albert J. Dana; assistant secretary and manager of credits, Augustus E. Saunders; domestic sales manager, Wallace L. Pond; foreign sales manager, S. Foster Hunt; assistant to president, Robert W. Hathaway.

Trade Currents From New York, Cleveland and Chicago

NEW YORK LETTER

The quietness that has prevailed in New York machine-tool circles continues. Large lists that were confidently expected to be issued about this time are still heing held in abeyance by the interests affected, and representative machine-tool men hesitate to venture a prophecy as to their appearance.

To date, the same heavy volume of business that opened the year is continuing. There is some apprehension as to a possible falling off in this volume due co rumors from the financial district that capital will be hard to obtain for industrial expansion purposes.

Opposite views prevail in some quarters, however, due to encouraging reports from manufacturing interests relative to coming increased production, thus the uncertain are now in evidence.

Railroads of the Atlantic region have not inquired to any extent in the New York market, but a number of sales to Southern and Southwestern railroads for comparatively small amounts have been reported.

The used-tool men report a gain in sales over the last week with inquiries coming in in increasing numbers. Great numbers of Government tools have made their appearance on used-tool dealers' floors, and move quite rapidly.

Railroad deliveries have had a somewhat adverse effect on local movements. One concern has been waiting ten weeks for a shipment from Chicago.

Difficulty in securing motors, ranging in size from ⅛ to ¼ hp., is affecting somewhat sales of equipment that take this type of motor, for which there is a very heavy demand.

CLEVELAND LETTER

Extensive buying featured the machine-tool situation here during the past week, most of the sales made being culminations of inquiries sent out some time ago. This turn of the market is ascribed to the impending price advances, and a desire on the part of the consumer to cover his future machine-tool needs before any further change in the already poor delivery situation.

Although the market is unsettled, due to a number of factors, it is known that a number of the larger machine-tool users have plans approaching exe-

cution that will call for heavy purchases of machine-tool equipment.

One of the larger projects is that of the Brown Body Company which will undertake the immediate construction of a plant to produce bodies for automobiles, trucks and commercial vehicles. A six-acre site in the East Cleveland industrial district has been acquired, and a $350,000 unit will be erected as a start.

The Vahan Products Company plant has been taken over by the Domestic Electric Company and will be operated by the latter in connection with its present plant in the Whitney power block, and another at Newark, Ohio.

A $60,000,000 amalgamation of the Eaton Axle Company and the Standard Parts interests will be headed by J. O. Eaton, of the former concern. The new enterprise is said to have the backing of prominent banking interests, and will be the largest concern in the country manufacturing automobile springs, axles, bearings and rims in its field.

The Cleveland office of the Wolcott Lathe Company, Jackson, Mich., has taken over all of the western Pennsylvania territory formerly handled from Pittsburg. Frank H. Wheaton, Cleveland manager, will increase his staff in order to cover the additional territory thoroughly.

The Co-operative Machinery Company, formerly located in the Marion building, has taken quarters in the Vulcan building in order to secure sufficient space in which to transact its increased business. F. A. Maxwell is in charge of this office.

Dean S. Hazen, formerly assistant advertising manager of the National Acme Company, has entered the real-estate-publicity field.

Chicago Letter

Less activity at present prevails in the local machinery trade than has been apparent for the past three months. With but one exception, dealers all state that sales and inquiries show a decided falling off, the one exception reporting business so far this month on a par with that of December and January. This slump is attributed largely to prevailing exchange conditions, the average buyer being reluctant to place orders in the face of what seems to him to be excellent reasons for expecting lower prices.

Deliveries remain, in most cases, very poor. Many items scheduled for February delivery are running over into March, this condition applying to probably 20 per cent of the goods so scheduled. All tools on back order, when delivered, are being eagerly taken by the buyers, there having been practically no cancellations.

Recent business continues to be widely diversified. Sales of interest to the trade include over ten thousand dollars worth of hardening and annealing furnaces to an auto builder; a quantity of heavy-duty drilling, and milling machines to a maker of automobile axles; and numerous gear-cutting, and drilling machines, hacksaws and milling machines to builders of washing machines. Talking-machine people, who have been buying great quantities of parts from outside sources, are equipping their own plants so as to render such outside buying unnecessary.

Anatole Mallet

Anatole Mallet, honorary member of the American Society of Mechanical Engineers, died in Nice, France, in October, 1919. He was one of the few men whose name became the designation of a standard type of apparatus in a great industry. Mr. Mallet was born at Carouge, in 1837. He graduated in 1858 from the Central School of Arts and Manufactures in Paris. Mr. Mallet devoted all his attention for a number of years to problems of civil engineering.

ANATOLE MALLET

In 1867 he engaged for the first time in mechanical engineering, giving particular attention to steam engines with double expansion. The first application of this system to locomotives was made in 1876, when he introduced the first two-cylinder compound locomotive, which operated on the line from Bayonne to Biarritz.

He was a member of the Society of Civil Engineers of France, the Society for the Encouragement of National Industry of France, and the Franklin Institute of Philadelphia. The French Society of Civil Engineers awarded him the Schneider prize in 1902, and the annual prizes in 1909 and 1911. He was made a Knight of the Legion of Honor in 1885 and promoted to Officer in 1905. The Institution of Mechanical Engineers of London awarded him a gold medal in 1915.

In addition to carrying on important engineering work, Mr. Mallet took an active part in the work of the French Society of Civil Engineers. From 1880 to within a few months of his death he was editor of the Chronicle of the Bulletin of the Society and furnished it with numerous technical notes and important memoirs, the last of which, treating of the Practical Evolution of the Steam Engine, earned him the honors conferred by the Society.

Great Storage Plant for Coal and Power Suggested for Newark Meadows

Under a plan presented last week at the convention of the American Institute of Mining and Metallurgical Engineers in the Engineering Societies' Building, by Edwin Ludlow, consulting engineer and former vice president of the Lehigh Coal and Navigation Company, New York City would be assured of abundant fuel supply during storms or transportation tie-ups such as were met with in recent weeks.

Mr. Ludlow suggested in the course of his address on "Conservation of Bituminous Coal" that the Newark meadows be made the point for the location of a great storage plant for soft coal which would serve not only New York City but every important industrial center along the Atlantic Coast.

In addition, he would erect a huge power plant there which would connect with the present generating plants of the Edison, Interborough, Brooklyn Rapid Transit and other large consumers of electricity. This power plant, he explained, would serve as a central agency for the distribution of electric current to Atlantic states industries at a greatly reduced cost. Connection with the generating plants would be established by high-power trunk lines.

"No large storage can be maintained on Manhattan Island, with its limited area and high cost of land," Mr. Ludlow said. "The Newark meadows, however, furnish a location easily reached by all coal-carrying roads coming into the neighborhood of New York, and also on tidewater, where coal can be brought from Norfolk or Baltimore. A central power plant erected there could have unlimited storage, and where coal could be brought in at the minimum of expense and unloaded on these storage piles."

With the successful operation of the central power plant at Newark he predicted that similar plants would be built at Baltimore, Philadelphia, Boston and Providence. By connecting them all with the proposed main trunk line he said intermediate industries would receive their electric power at the minimum of cost.

Liquidation of War Contracts

The value of contracts reported liquidated to Jan. 31 is estimated at $2,247,622,000.

Contracts liquidated consist of 18,925 formal contracts valued at $1,231,287,000 and 4,981 informal agreements valued at $1,016,335,000. It has cost $281,530,000 to liquidate these contracts. In addition partial payments amounting to $97,184,000 have been made on other contracts, making the total amount paid in liquidation $378,714,000.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Mill, Vertical Boring and Turning
J. Buckton & Co., Ltd., Leeds, England.
"American Machinist," (English Edition), Jan. 17, 1920

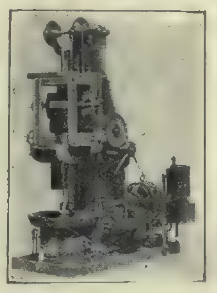
For wheel centers and similar work up to a diameter of 5 ft. Work table is 66 in. in diameter, fitted with 5-jaw chuck. Table spindle runs in adjustable bearings and is provided with footstep to take load. Table runs on a circular sliding way which is continuously under oil level. Drive is by 25-hp. motor at 300 to 900 r.p.m., through spur gearing and bevels; final drive by spiral gear. All driving gears run in oil and are of steel, except gear ring under table which is cast iron. Table runs at any speed from 1½ to 33½ r.p.m. Cross-slide has square guide ways; work 20 in. high can be admitted. The two stool slides are balanced and provided with self-acting feed motions for horizontal, vertical and angular cuts. Four feeds to each tool slide can be stopped, started, reversed or varied, independently.

Surfacing Machine, Hand Feed
Wadkins & Co., Leicester, England.
"American Machinist" (English Edition), Jan. 24, 1920

Made in two sizes. Small machine used on bench or on a column driven by motor or countershaft. Cutter-block is 8 in. wide; work tables are 3 ft. 10 in. overall. Steel lips secured by screws to tables, reducing width of gap at cutter-block. Tables raised or lowered independently; fence can be fixed in any position across full width of cutters, permitting rebating without change of cutter. In both machines cutter-block is two-knife circular type, accurately balanced; runs at 4,000 r.p.m. Net weight of this machine is 3 cwt. The larger machine has a cutter-block 20 in. wide, tables 8 ft. 1in. overall by 2 in. By handwheels each table can be independently raised or lowered on inclined planes while machine is running; also by screw and handle tables can be withdrawn horizontally. The fence cants from square to 45 deg. relative to table and can be instantly locked, with stops to insure its return to the square position. It has pressure springs and quick adjustment across and up to the front edge of the table; rebating possible without change of cutter Weight, 2,100 lb.

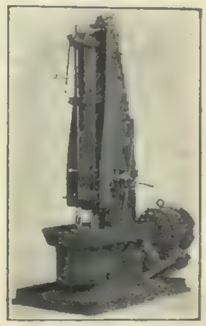
Drilling Machines, Inverted
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," Jan. 29, 1920

This machine was built for drilling 1½ in. hole, 30 in. deep, through tool-steel billet. The billet is lowered through the top of the work-holding cage and clamped centrally in position by hand-operated vise jaws. A swinging door at the top of the frame carries a heavy pressure screw which is brought down against the billet to take the end-thrust of the drill. The spindle on machine has no vertical movement and feed is obtained by lowering the work-holding fixture, which is mounted on a saddle sliding on vertical ways of the column. Counterweights are used to compensate the weight. An oil-tube drill is used and coolant which is contained in a reservoir in the base is fed constantly by a pump to the cutting point of the drill.



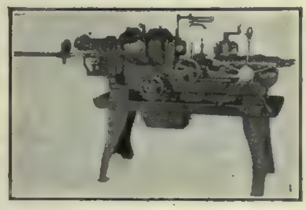
Drilling Machine, Inverted
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," Jan. 29, 1920

This machine performs three separate functions; it is provided with the jig A with trunnions at each end, about which it is revolved by releasing the locking lever B. There are nine spindles arranged in groups of three. The first spots for the drills, the second drills and the third reams the holes. While the jig head is feeding the three loaded sides to the tools the operator is loading the fourth side, and he has only time to complete this while the machining is in progress, and then revolves the jig 90 deg. and repeats the operation.



Screw Machine, No. 2 Friction-Head
Millholland Machine Co., Indianapolis, Ind.
"American Machinist," Feb. 5, 1920

Chuck capacity, 1 in.; hole in spindle, 1$\frac{1}{16}$ in.; holes in turret, 1½ in.; swing over turret slide, 4⅝ in.; length turned, 7 in.; greatest distance end of spindle to turret, 15 in.; swing over bed, 14 in.; swing over cut-off, 7 in.; spindle bearings, front 2¾ x 4½ in., rear 2 x 3½ in.; lever movement of cutoff, 5½ in.; belt for cone, 2⅝ in.; pulleys on countershaft, 10 x 14 in.; width of belt for countershaft, 3 in.; floor space, 60 x 26 in.; extension feed rod, 47½ in.; weight, net 1,300 lb., crated 1,500 lb., boxed for export 1,710 lb.

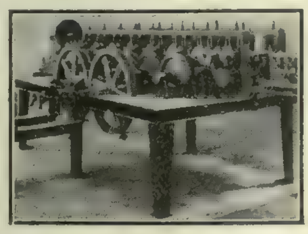


Heater, Hauck No. 2F Ladle
Hauck Manufacturing Co., Brooklyn, New York.
"American Machinist," Feb. 5, 1920

The outfit consists of a sheet-iron firebox and a 20-gal. steel fuel tank. The number of openings varies, as firebox is made in different lengths. The burner is provided with a regulating valve designed to consume any grade of fuel oil, crude oil, or kerosene, delivered under a pressure of 20 to 100 lb. per square inch. Tank containing oil is charged with compressed air and has a gage and regulating valve for oil and air. Pipe connections between firebox and tank are of a length to suit conditions.

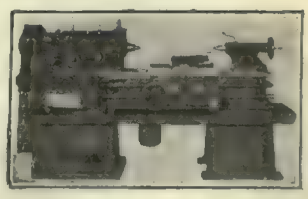
Rolling Mill, Molding and Tube
United Machine and Manufacturing Co., Canton, Ohio.
"American Machinist," Feb. 5, 1920

The rolling mill has a capacity to roll tube and molding sections at 60 to 300 ft. per minute. Maximum width developed, 13 in. Upper and lower spindles are power driven. The feeding-in device is a set of horizontal tool-steel rolls hardened and ground, mounted in phosphor-bronze bearings. Different widths of stock are guided into the die rolls by vertical grooved rolls of feeding-in device, which are mounted on spindles carried on an adjustable cross-slide. Roll bearing blocks are mounted in housings that can be adjusted transversely without changing vertical adjustment of the rolls.



Lathe, 14-In. Geared-Head
Reed-Prentice Co., Worcester Mass.
"American Machinist," Feb. 5, 1920

Specifications: Spindle bearings (front, 2½ x 5 in.; rear, 1 3-16 x 3 in.); hole through spindle 1½ in.; taper hole, Jarno, No. 4; number of speeds, eight; number of feeds (44), 0.0045 to 0.0667 in.; threads cut, 4 to 60; taper attachment will allow turning 18 in. at one setting; will turn 26⅝ in. long with 6-ft. bed; floor space, 41½ x 91 in.; weight (net, 2,800 lb.; boxed, 3,200 lb.).



Clip, paste on 3 x 5-in. cards and file as desired

Obituary

PIERREPONT BIGELOW, treasurer of the Bigelow Company, New Haven, Conn., manufacturers of boilers and plate-iron products, died at his home on Briar Lane, New Haven, Jan. 27, after a brief illness.

ARTHUR D. HAWLEY, president of the Bristol Manufacturing Company, Bristol, Conn., died at the Hartford Hospital, Feb. 8, from pneumonia. Mr. Hawley has been with this company for several years and was also a director of the Bristol National Bank.

JOSEPH M. FLANNERY, known as a producer of vanadium and radium, died at his home in Pittsburgh, Pa., on Feb. 14, 1920. He was 53 years old. Mr. Flannery obtained control of a vast supply of vanadium in Peru many years ago and later with a number of business associates developed the radium deposits of Colorado and Utah. He was an organizer of the American Vanadium Company and president of the Standard Chemical Company. He furnished the United States Government with large quantities of radium for use during the war. More than $1,000,000 is said to have been spent by Mr. Flannery before he perfected his radium processes.

Personals

WILLIAM GWILYM, for the past four years general foreman of the Waterville Machine Works, Waterbury, Conn., has resigned his position.

C. W. ELTON, formerly with the T. H. Mathews Company, has resigned to accept a position as general manager of the Pittsburgh Steel Stamp Co., Inc., Pittsburgh, Pa.

M. R. CARSON, former sales engineer of the Swind Machinery Company, has accepted a position with the Monarch Machinery Company, 300 North 3rd St., Philadelphia, Pa.

ELISHA H. COOPER, secretary of the Fafnir Bearing Company, New Britain, Conn., has been appointed a director of the Savings Bank of New Britain, Conn.

RICHARD CUSHMAN, treasurer of the Cushman Church Company, Hartford, Conn., has been appointed to the board of directors of the Colonial National Bank, Hartford, Conn.

J. D. APGAR, formerly of the Machine Tool Engineering Company, New York City, has joined the sales force of the Van Norman Machine Tool Company, Springfield, Mass., and will be its direct representative in the New York office, 320 Fifth Ave.

CHARLES KEENAN, auditor of the Clinton - Wright Wire Company, Worcester, Mass., has resigned his position with this company. He was formerly with the Morgan Spring Company, Worcester, for fourteen years as its credit manager.

B. C. SAUNDERS, formerly sales manager of the Wilmarth & Morman Company, has resigned his position and is now associated with the Grand Rapids Grinding Machine Company, Grand Rapids, Mich. Mr. Saunders has purchased an interest in this company. At the annual meeting of the board of directors of this company Mr. Saunders was elected secretary and sales manager.

CHARLES D. WRIGHT has resigned his position as master mechanic in the rolling mills of the Bethlehem Steel Company's local plant at Harrisburg, Pa., and left Feb. 15 to take a position with the American Tube and Stamping Company at Bridgeport, Conn. He will be assistant general superintendent of the Bridgeport plant. Mr. Wright has been connected with the local plant as a master mechanic for the past four years.

Officers Elected by the Norton Company

The Norton Company, Worcester, Mass., at its adjourned annual meeting last week, elected the following officers: President and general manager, Charles L. Allen; chairman of the board of directors, George I. Alden; treasurer and general counsel, Aldus C. Higgins; secretary and works manager, George N. Jeppson; directors, the foregoing and R. Sanford Riley and John Jeppson. The other officers are appointed by the directors, and there is no change in the list as announced at the time of the reorganization July 1.

C. E. Hildreth Made Vice President

Charles E. Hildreth, president and general manager of the Whitcomb-Blaisdell Machine Tool Company and president of Worcester Chamber of Commerce, has been elected vice president of the New England Foundrymen's association.

Business Items

The Billings & Spencer Co., of Hartford, Conn., at a recent directors' meeting, announced the election of J. B. Sehl, formerly factory manager, to the office of second vice president, and A. W. Gray to assistant treasurer.

Gardner-Bryan Co., Cleveland, Ohio, has been appointed special representative for the Precision and Thread Grinder Manufacturing Company, Philadelphia, Pa., in Ohio, Indiana and western Pennsylvania.

The Lyons Metal and Tool Co., New Haven, Conn., has been organized to deal in tool, mill, hardware, specialties, etc. The incorporators are: G. E. Lyons, West Haven, Conn.; J. Wm. Moffatt, New Haven, and Ernest Gregory, Derby, Conn.

The Irving Iron Works Co., Long Island City, N. Y., has been awarded the contract for supplying all flooring, grating, walkways, and ladder steps for the two new superdreadnaughts "California" and "Tennessee." The terms of this contract demand that the grating shall be galvanized throughout.

Stuart W. Webb, Henry P. Kendall, John N. Bruce, Fred R. Ayer, Henry J. Guild and Charles B. Wiggin have formed a company under the name of Webb, Kendall & Bruce, Inc., with offices at 65 Broadway, New York, and 199 Washington St., Boston, Mass., for the purpose of consulting industrial management problems.

Henry Prentiss & Co., New York, is establishing branch offices in Hartford, Conn., to take care of its rapidly increasing business in that section and has secured quarters in the Hartford Trust Building, 750 Main St. L. P. Goodspeed of its main office in New York will be in charge with T. I. Shriver as his assistant.

Hodson-Feenaughty Company, of Portland, Oregon, which handles contractors' equipment, has changed its name to the Feenaughty Machinery Co. The officers of the company are: W. O. Feenaughty, president and general manager; E. L. Thompson, vice president; J. I. Overman, secretary and sales manager. C. W. Hodson has retired from the firm.

The business of manufacturing and selling Delco-Light products heretofore conducted by the Domestic Engineering Co., Dayton, Ohio, has been transferred to the General Motors Corporation. For the present this business will be conducted by the Delco Light Company and in the future all mail addressed to the Domestic Engineering Company should go to the Delco Light Company.

The New England Brass and Foundry Co., Worcester, Mass., was recently incorporated to do a general foundry business. This new company is a subsidiary of the Coppus Engineering and Equipment Co., Worcester, Mass. The headquarters of the new concern will be located in the new foundry building now being erected on Park Ave., Worcester, Mass. The president and treasurer of the company is F. H. Coppus, who is president of the Coppus Engineering and Equipment Co.

The American Machine and Manufacturing Company, maker of oil mill machinery, has consolidated its Greenville, S. C., and Atlanta plants. Hereafter the company's main plant, in fact the only manufacturing establishment it operates, will be located in Atlanta, Ga., and branch offices will be maintained in other cities. Transfer of the company's entire equipment from Greenville has now been completed. This company's principal product is oil mill machinery. During the war the company produced shells for the Government. The Atlanta plant now comprises a machine shop, foundry, warehouse and general offices.

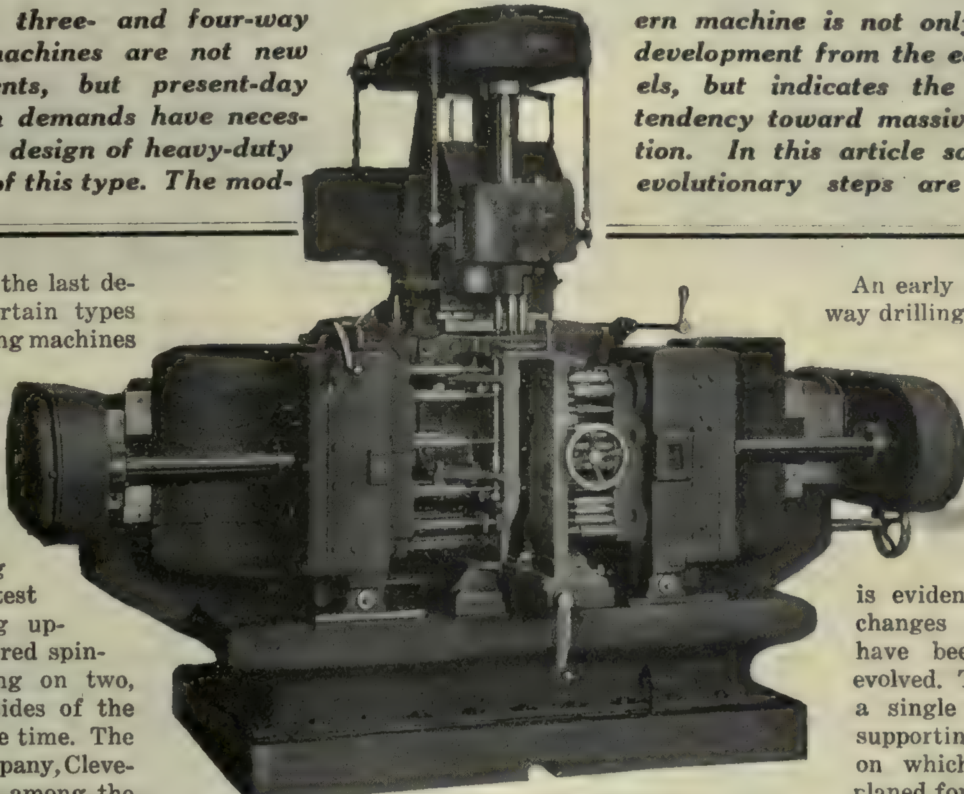
March 4, 1920 American Machinist Vol. 52, No. 10

The Foote-Burt "Way" Drilling Machines

"A Study in the Evolution of Machine Design"

By J. V. HUNTER, Western Editor, *American Machinist*

The two-, three- and four-way drilling machines are not new developments, but present-day production demands have necessitated the design of heavy-duty machines of this type. The modern machine is not only a logical development from the earlier models, but indicates the increasing tendency toward massive construction. In this article some of the evolutionary steps are indicated.



WITHIN the last decade certain types of drilling machines have been developed from the single-spindle machine on through single-unit multiple-drilling heads, to the latest models carrying upward of a hundred spindles and drilling on two, three or four sides of the work at the same time. The Foote-Burt Company, Cleveland, Ohio, was among the pioneers in developing a type of highly specialized machines, which are today sometimes called "Way" drilling machines.

An early model of a four-way drilling machine is illustrated in Fig. 1. This machine was shipped from the factory in July, 1910, and a comparison of it with later models is evidence of the great changes in design that have been gradually evolved. This machine had a single vertical column supporting the work jig on which ways were planed for the travel of the saddles of both the upper and inverted drilling heads. The side heads were carried by comparatively light wing brackets bolted to each side of the column, which gave

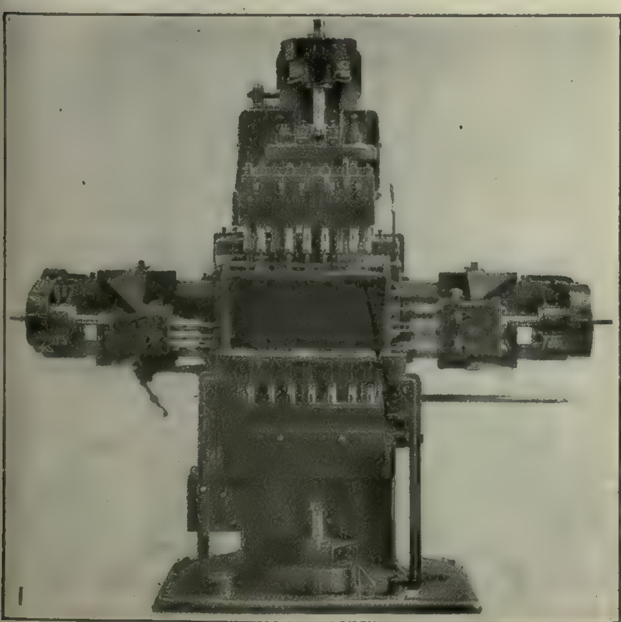


FIG. 1. EARLY TYPE FOUR-WAY DRILLING MACHINE

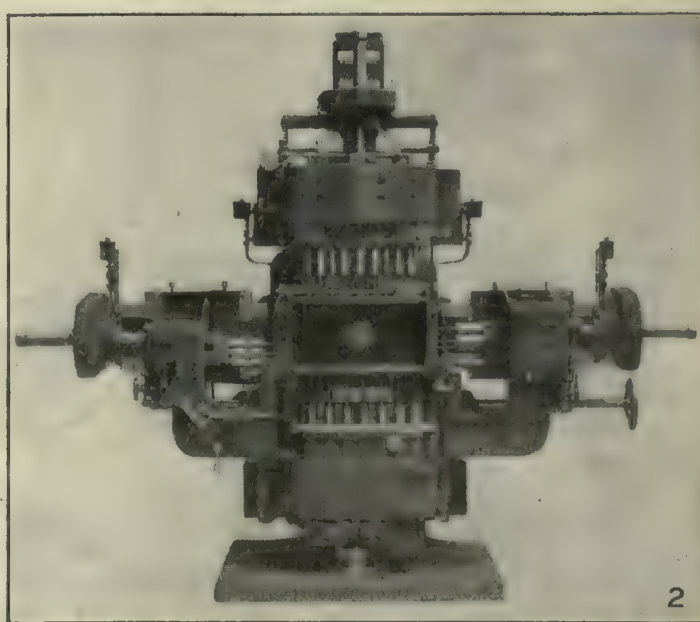


FIG. 2. DRILLING MACHINE BUILT IN 1912

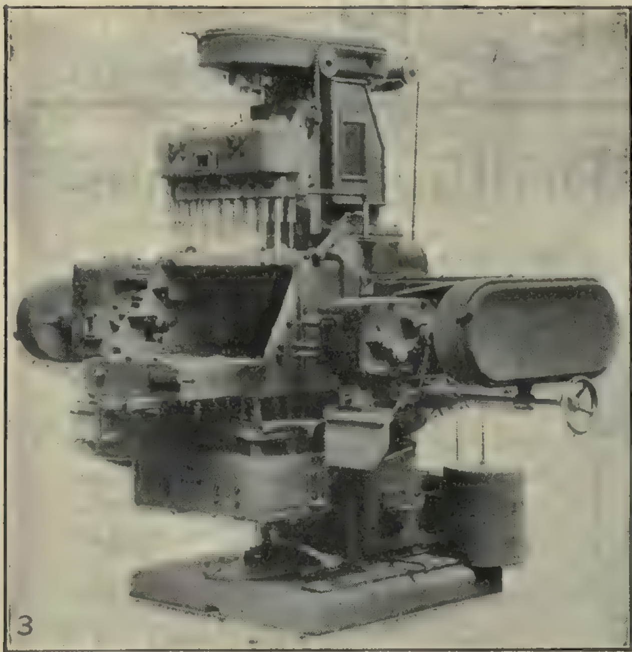


FIG. 3. LATER MODEL SHOWING REFINEMENTS OF DESIGN

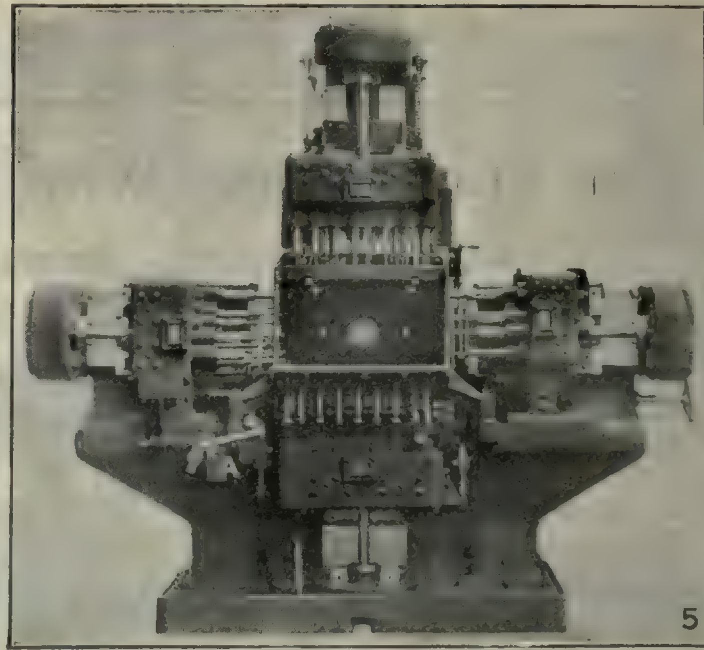


FIG. 5. LATEST MODEL OF FOUR-WAY DRILLING MACHINE

the machine a somewhat spidery appearance. Numerous oil cups show prominently on all of the bracket bearings, and oil-level indicators showed the height of the oil in the upper and lower spindle-head compartments, which were the only portions of the machine designed to run in an oil bath.

During the year 1912-13 other machines, of a design shown in Fig. 2, were built for the same job, which shows that new ideas developed as the result of experience with the earlier models. The spindle-head bearing saddles were widened and carried on supplementary slides to permit compensatory adjustment for the wear and regrinding of the drills. The bracket slides for the side heads were more heavily constructed and were supported by supplementary brackets extending from the column. These brackets also served to support the forward corners of the work jig. The many individual oil cups were supplanted by gang sight-feed oilers with feed pipes to the various bearings.

Flooded lubrication from separate pumps was provided for each spindle head. Each pump was belted to a pulley on an extension of one of the spindle shafts. This arrangement furnished a constant flow of oil while the spindles were in motion.

A year or two later the re-design, Fig. 3, shows relatively little change in the general structure of the machine, but extensive alterations were made affecting many of the minor details. One of the outstanding features developed was a provision to avoid the troubles caused by chips and dirt which worked into the bearings of the inverted spindle head. This improvement was an elaboration of a method more simply applied on earlier models.

This head is now protected at the top by a sloping

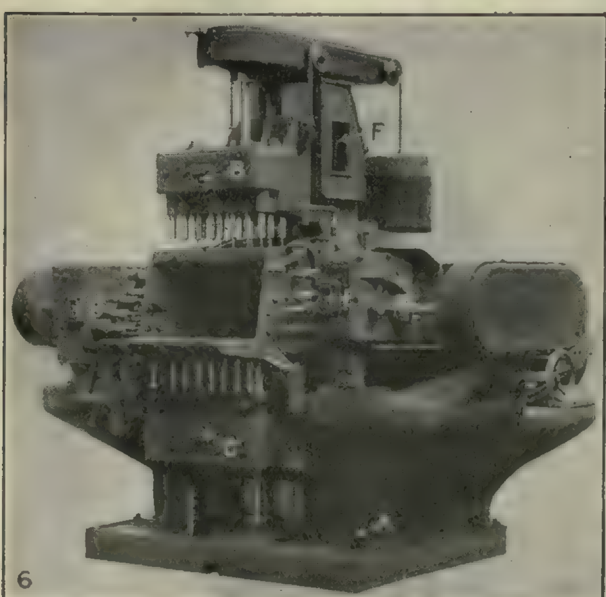


FIG. 6. SIDE VIEW SHOWING MASSIVE FORM OF CONSTRUCTION

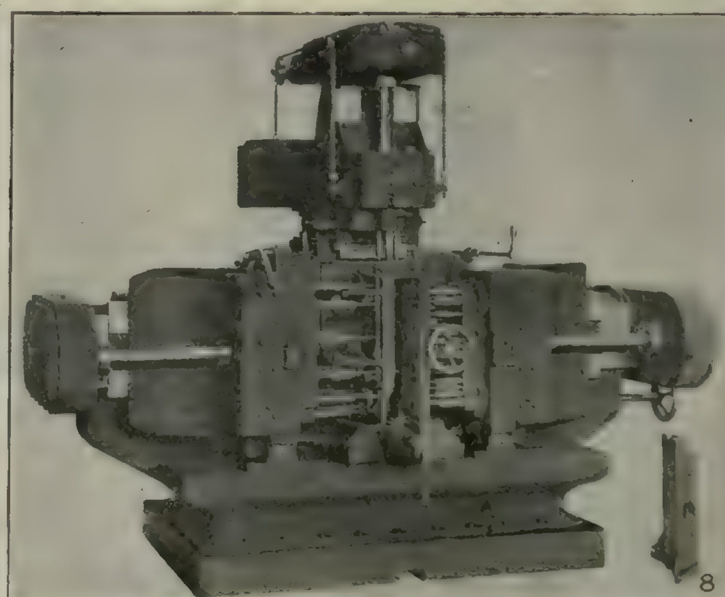


FIG. 8 LATE MODEL OF THREE-WAY DRILLING MACHINE

shield *A*, Fig. 4, which tightly surrounds the spindle and prevents the accumulation of chips.

Below the shield are two plates, *B* and *C*, spaced a fraction of an inch apart where they surround the spindles and bolted together with an airtight flange around the outer edges. At each end of these plates is an air hose connection; from one of these a blast of air can be blown, the exhaust taking place through the other, and all fine dust which enters this space is blown out, thus preventing its reaching the inner bearings. In addition to this each spindle is surrounded by a tapered cone *D*, which fits over a stationary sleeve *E* that extends through the top shield to the plate *B*. The sleeve *E* is stationary so no wear occurs between it and the shield.

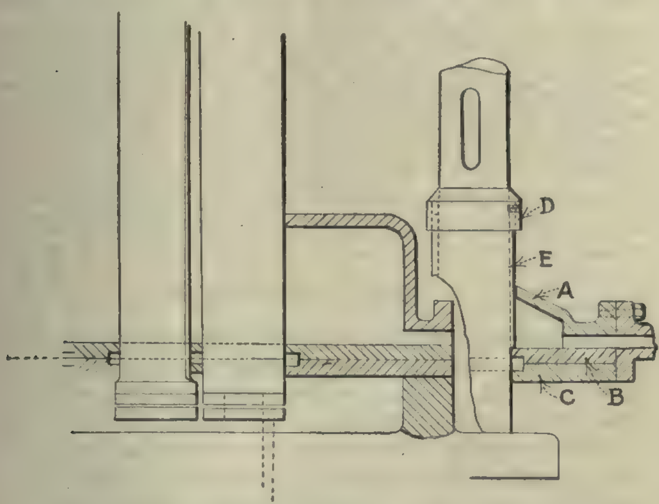


FIG. 4. CHIP PROTECTION DEVICE USED ON INVERTED HEAD

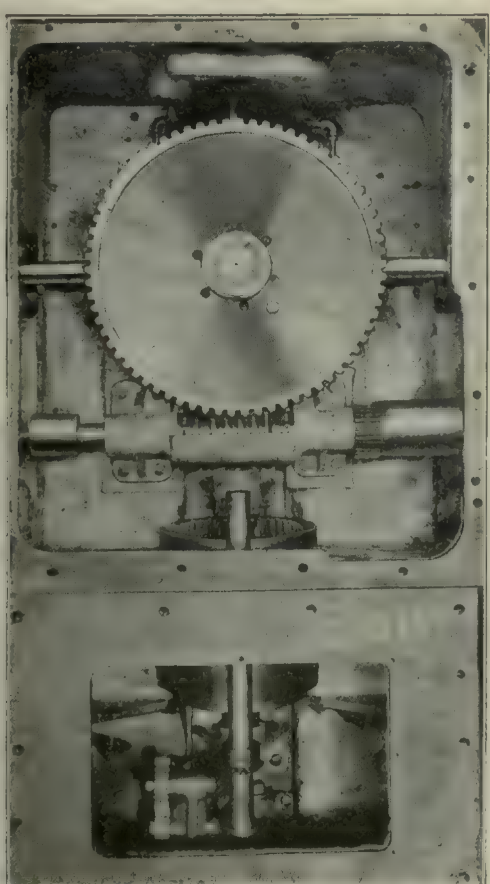


FIG. 7. DRIVE GEARING FOR FEED MECHANISM OF SIDE SPINDLES

The more recent developments have resulted in a machine of heavier design as illustrated in Fig. 5. The base is wide and heavy, supporting a full-width column of such proportions that the side arms formerly used are obviously not required. Longer saddles are supplied with wide bearing faces on the ways. A great change is to be marked in the oiling system, that is planned to be as nearly fool-proof as possible.

A single oil pump in the base handles practically the entire oiling. This draws from a reservoir indicated by the gage *A*, Fig. 6, and by a complete system of distribution provides lubrication for all moving parts, including even the head slides. The spindle heads are given flood lubrication and the operator can observe the circulation through small glass-covered windows *B* and *C* in the upper and lower heads, and *D* and *E* in the side heads. In the main vertical column a larger window *F* serves the same purpose for all the gearing and other parts in that compartment. Suitable pipes are provided where necessary to return the oil to the reservoir.

In the earliest models the main drive shafts of the spindle heads were fast in the head and passed through a sliding-key gear in the housing, which necessitated the undesirable outboard shaft extensions shown in Fig. 2. This has now been altered and one end of the shaft is supported in the drive-gear case while the other end slides in the spindle-head housing.

Control Levers That Automatically Reverse the Feed to Draw Out the Drills

The control levers *A*, Fig. 5, automatically reverse the feed to draw out the drills rapidly on the completion of their cut. The feed mechanism for the side spindles is driven by an arrangement of gearing inclosed in the main column. A view of this with its cover plates removed is shown in Fig. 7.

One of the latest machines carries 61 active spindles. It has been timed for a drilling period of 1 min. 45 sec. A 25-hp. direct-current motor drives the main shaft by a 6-in. Link-Belt chain. The motor is mounted at the rear on a heavy cast-iron pedestal which is bolted to both the main body and the base casting. The floor space requirements of the machine are 9 ft. 7½ in. long by 8 ft. 3½ in. wide, the total height being 8 ft. 9½ in.

The development of the three-way drilling machine has closely followed its four-way prototype with the same general features as may be seen from Fig. 8. This machine was built for drilling the automobile engine oil pan shown standing at the right. Although simplified by the absence of the inverted spindle head, the heavy structure with its extensions for the side spindle heads shows the substantial design of the machine.

Indirect-Fired Cyanide Furnace

By W. H. Addis

The economically upkeep of the cyanide furnace is one of the most troublesome factors with which heat-treating departments have to deal. Where such furnaces are run 24 hr. a day they must possess a very nice combination of qualities in order to be practical.

One of the most expensive faults of the average furnace equipment is the ever-recurring shutdowns due to

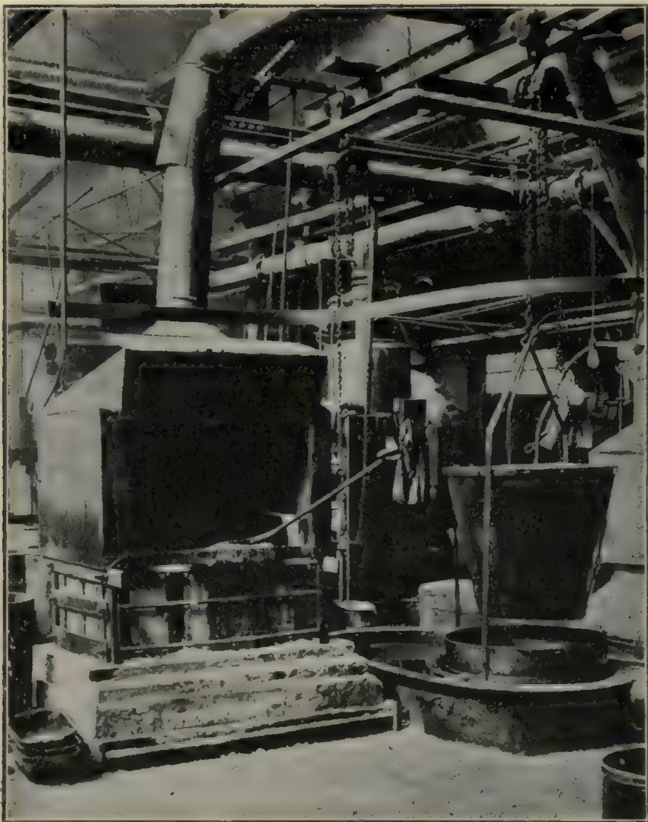


FIG. 1. THE CYANIDE FURNACE

the burning out of pots, but this fault is being overcome to some degree by the recent advent of the cast-steel pot of special composition, and the still more recent pots of nickel-chromium alloy.

Yet, with these improved containers on the market, the day is not past when great quantities of cast-iron pots are in use, and in most types of such furnaces there is direct contact of the burner flame with the pot. This has seemed necessary because the cyanide furnace requires a very flexible heat control that will enable the operator to raise the temperature of his bath very rapidly to counteract the chilling effect when cold work is entered in the melted salts. If this chilled condition is not quickly overcome by forced firing there will be a marked degree of variation in the finished product, especially if the parts be small and the desired case very light.

In the indirect-fired furnace shown in Fig. 1, the following conditions are met: flexible burner control; indirect firing with consequent pot protection from wasting flame action; low fuel consumption; low initial expense; ease of repair and low maintenance costs.

As may be seen in the engraving, this furnace is almost entirely of standard firebrick construction. The floor, or base, is laid with firebrick and refractory cement, and upon it is built the combustion chamber shown in Fig. 2. Covering the top of this rectangular chamber are four special flue-brick forming flues or ports for the distribution of heat from the combustion chamber beneath.

Being 8 in. thick and of good refractory quality, they will last about two months of day and night continuous service and to replace them is but the work of a few moments.

Location of the Burner

The burner opening is in the center of the back wall. The flame, striking directly against a central baffle brick, is diverted to the right and left, where it is in turn given an infolding movement at either end of the combustion chamber by two baffle bricks at the front corners of the chamber. A clean-out door is provided at either side of the burner port, which provides for the removal of all cyanide that might drip down into the combustion chamber when the pot burns out.

The rectangular side walls are formed by using firebrick slabs 4 in. thick upon the top edges of which the front and back flanges of the cast-steel pots rest.

The Pots and Forks

It might be interesting to describe the pots, sometimes called baskets, used for holding the work in the cyanide, one of which is shown in Fig. 3. They are made by sawing a piece of extra-heavy steel pipe into suitable lengths and welding in the bottoms after which they are drilled to permit the escape of cyanide into the bath when they are lifted out. As these pots and their contents are too heavy to be comfortably managed by hand, a suitable trolley has been provided which will be seen in Fig. 1.

This type of furnace has shown such decided advantages in every way that it has been adopted as standard equipment by the plant where the first one was designed by the writer.

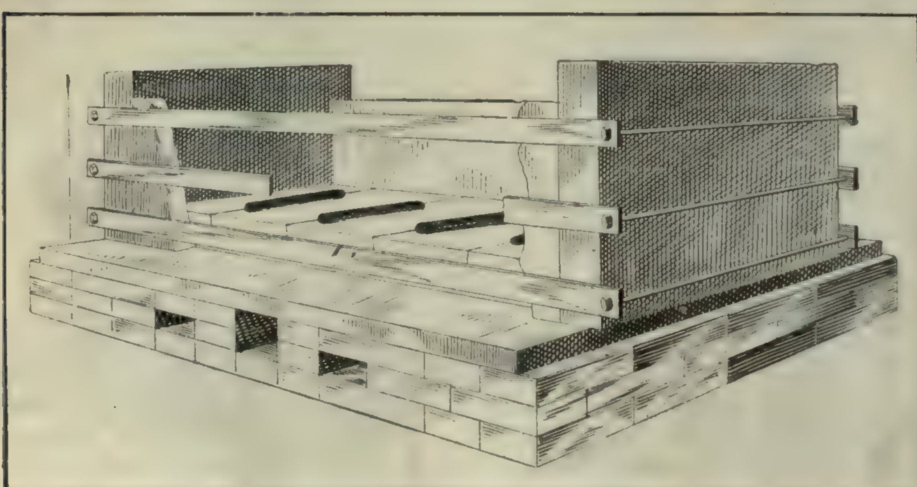


FIG. 2. CONSTRUCTION OF FURNACE

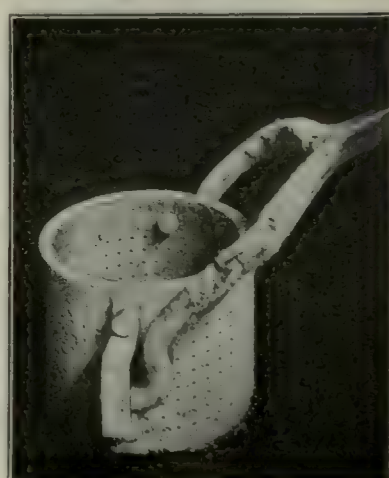


FIG. 3. DIPPING "BASKET"

Hardening Steel Without Distortion

By FRED. H. COLVIN
Editor, *American Machinist*

What would it mean to your shop and to the country at large, if all hardening could be done without distortion or breakage? How much could be saved if we could avoid the necessity of correcting errors due to hardening? Herein is described a method which enables the hardener to determine definitely the proper instant for quenching each piece to be hardened.

WE HAVE become so accustomed to the element of uncertainty in connection with the hardening of steel that we deliberately allow for a certain amount of distortion in such small tools as taps and dies, and we also accept a certain percentage of loss from cracks as being a necessary part of the process. Whenever we happen to secure perfect results we are more apt to consider it an act of Providence than the result of correct hardening conditions. But as every effect has its cause, so must there be causes for good, bad and indifferent results in hardening steel; and it has evidently been the privilege of the Leeds & Northrup Company to discover some of the causes and to devise apparatus to enable the expert hardener to secure results which he has heretofore deemed impossible of attainment. For it must be distinctly understood that the apparatus and the method to be described will not enable the novice to do expert work. On the contrary, it only makes it possible for the good man to do better work than ever before and to secure results which he had heretofore considered impossible.

The development of this method dates back several years, during which time it has been tried out in various ways and new facts discovered as time went on. The critical point of steel has long been studied and the endeavor has been to use the pyrometer to determine whether the furnace reached the proper heat for the kind of steel being treated.

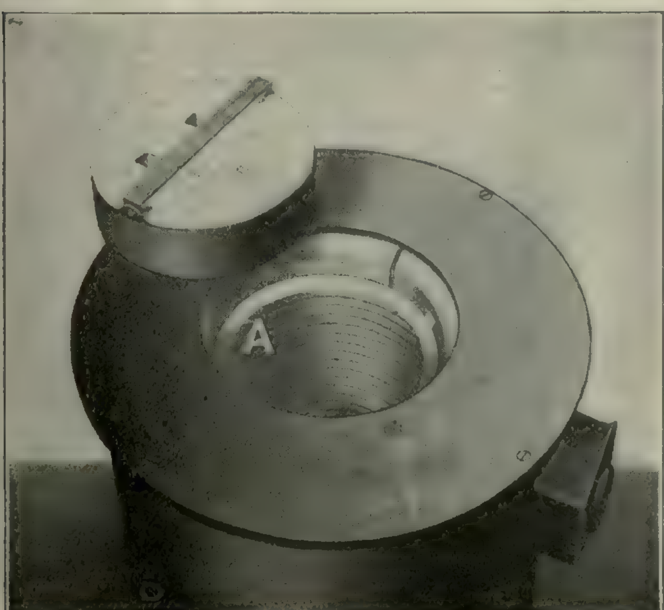


FIG. 1. A VIEW INTO THE FURNACE

Careful experiments, extending over a long period and with practical results always in mind, have shown that the hump in a pyrometer record of a piece of steel may easily vary from 30 to 40 deg. F. in accordance with the rate at which it is heated. For example, a piece of steel heated at the rate of 15 deg. per minute may appear to reach its critical point at 1370 deg. F., while the same piece of steel, heated at the rate of 40 deg. per minute, will not seem to reach its critical point until about 1400 deg. F.

This does not mean that the actual critical point of the steel on the heated side is affected by the heating rate, for in the vast majority of steels at least, this is

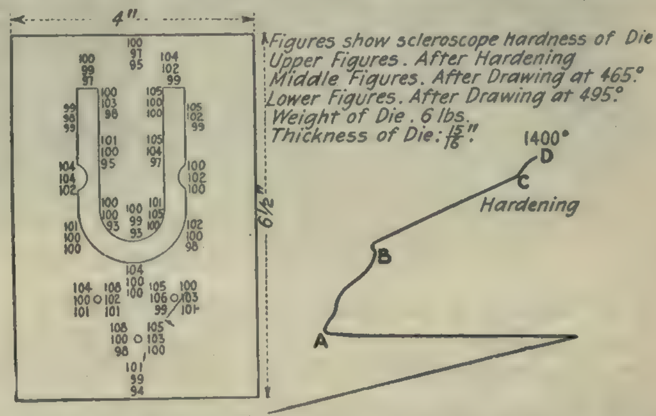


FIG. 3. DIAGRAM OF DIE AND HARDENING TEMPERATURE

not the case. The vital point is that the apparent temperature of the critical point has no bearing on the successful operation of the process.

The cause of the variation of the "hump" on the record is that the thermocouple does not, while the steel is rising in temperature, measure the true temperature of the steel itself at any given instant. The couple is outside of the steel, in contact with it or nearly in contact, but it is also acted upon by the air of the furnace and subject to the direct action of the heat radiated from the furnace walls. Consequently, the thermocouple, at any given instant, indicates on the record a temperature that is neither of the steel nor of the furnace itself, but is a mean between the two.

If the steel is heating rapidly there will be a greater difference between the steel and the furnace than when the heating rate is slow. Consequently, the thermocouple at any given instant, when the steel is heating rapidly, will indicate a higher temperature than would be the case were the steel heating slowly. Hence, on the record, the "hump" will occur at a higher point on the temperature scale than would be the case were the steel heating more slowly, and while the apparent critical point would be higher, the actual critical range is unchanged. The crucial thing is that, regardless of the heating rate, the time at which the steel passes through the critical range is infallibly indicated by the record.

This discovery, together with the fact that steel heated in the proper way and quenched at exactly the proper point can be hardened without distortion, pointed out the necessity of some heating method in which the rate of increase could be definitely controlled. This led

FIG. 2. THE HARDENING UNIT

enters the critical period. Watching the change here very closely, the piece was removed from the furnace when it reached the point D, this temperature happening to be 1400. The exact temperature in degrees, however, is not important, the quenching point being determined by the critical period in the particular piece of steel being hardened, regardless of the exact temperature which this may show on the Fahrenheit or other scale.

After hardening, the die was drawn twice, first at 465 and later at 495 deg. F. The three sets of figures on the die block show the scleroscope hardness at the various points, the upper figures being after hardening, the middle figures after the first drawing and the lower figures after drawing at 495 deg. F. The uniformity is quite remarkable, but not so much so as the fact that this method of hardening retains the die in its original shape to such an extent that no stoning is necessary before putting it into use. This is all the more remarkable when we consider that the die is quenched in brine, which is usually considered a very severe shock in hardening tools of this kind.

Fig. 4 shows a punch and die made by this method some time ago, and, as can be seen from the water marks still on the die, the surface of this has never been ground since the first hardening. The die was hardened by this method and retained its shape to such a degree that absolutely no grinding or stoning was necessary to make it fit the punch perfectly. In fact, it still cuts tissue paper, although it has in the meantime been used in punching metal disks.

That this is not simply an accident is indicated by the fact that over 800 punches and dies have been hardened by this method, and in no case has it been necessary to stone or in otherwise fit the die and punch together. This seems to indicate that the reason for distortion has been discovered, as well as means for overcoming it.

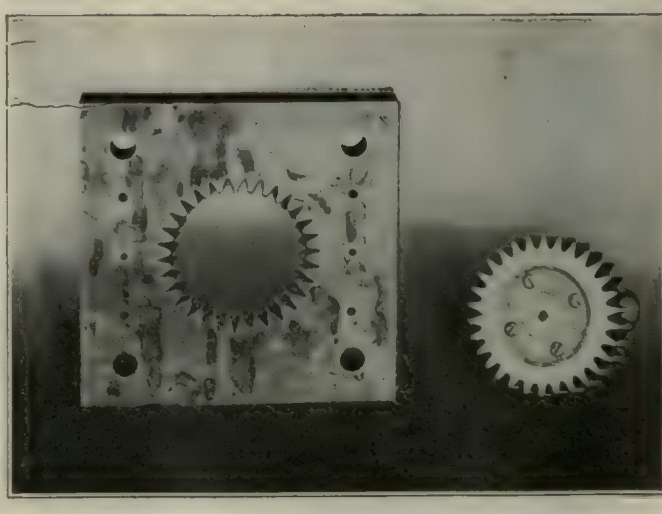


FIG. 4. A TYPICAL PUNCH AND DIE

to the adoption of the electric furnace shown in Fig. 1, while Fig. 2 shows how it is coupled up with the rheostat and the recording pyrometer, which makes a complete unit.

The heating element of the furnace is the thin cylinder shown at A, Fig. 1, which contains the resistance wire embedded in a special non-conductor. The wires are quite near the inner surface so as to require as little current as possible to secure the necessary heat, while the cylinder itself is surrounded by heavy segments of insulation as can be seen. The combination keeps practically all the heat inside the inner cylinder, and one of the surprising features of the furnace is the fact that the cover remains cool enough to be easily handled without gloves.

Fig. 2 shows the complete hardening outfit, including the quenching tank, with a die which has just been quenched. The diagram shown in Fig. 3 is the record of the heating of the die shown in outline in the left of the cut. This die is $\frac{15}{16}$ in. thick, 4 in. wide, and $6\frac{1}{2}$ in. long, and weighs 6 lb. The hardening process is as follows:

The temperature of the furnace is brought up to between 1300 and 1400 deg. F. and the current shut off. The die is then suspended vertically in the furnace so that the lower edge rests on a thermocouple connected with the recorder shown on the stand in Fig. 2. The heat record of the piece begins at A, Fig. 3, and it will be seen that the temperature line increases fairly regularly up to B. As soon as the work and the furnace reach the same temperature, current is again switched on, preferably at a rate which will give an increase of about 20 deg. per minute, this having been found most satisfactory for carbon steel.

The diagram shows that the furnace had begun to cool very slightly before current was turned on, this being indicated by the small loop at B. From this point the temperature rises uniformly to C, where the steel

One of the interesting features of the punches and dies, and which proves conclusively the practical side of the process, is the way in which the die is made from the punch. The punch is first made to the desired size and hardened. The die is then cut out and shaped fairly close to the finished size. It is then broached out with the punch which has already been hardened and the die is then hardened in the same way as the punch. This method of hardening holds the die sufficiently close to the shape made by the punch as to avoid the necessity of stoning, which is the almost universal custom.

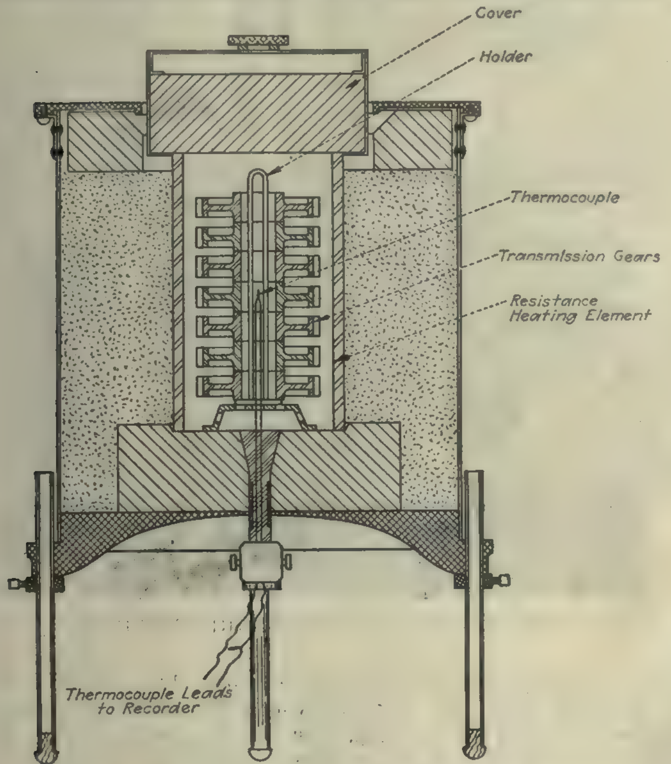


FIG. 5. FURNACE FOR AUTOMOBILE GEARS

The use of this method has not been confined to the Leeds & Northrup Company plant, but it is now being used by high-grade automobile manufacturers for hardening gears so as to prevent the distortion which necessitated the grinding of the piece in order to secure perfect gears and quiet running. The furnaces for this work are shown in section in Fig. 5.

This illustration shows how the gears are held, the location of the thermocouple and the general arrangement. In Fig. 6 is a production record indicating the regularity with which the furnaces are heated, the uniform rate of heating obtained and the continuity of the whole process. No time was lost and the regularity of the 45-min. interval is remarkable. It is also interesting to note that, in spite of the higher cost of heating by electric current when the total cost of the product is considered, the balance is found to be on the right side of the ledger by a very wide margin.

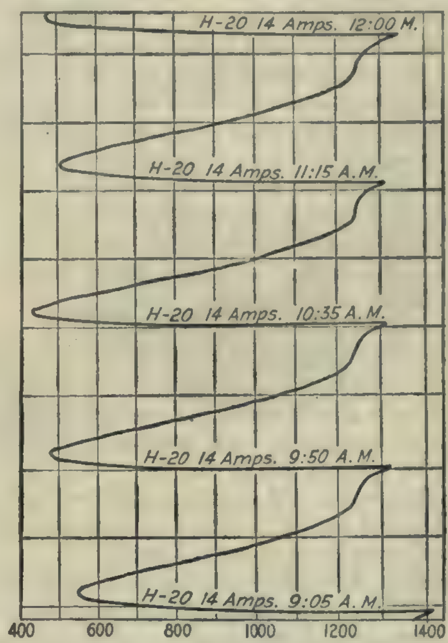


FIG. 6. A RECORD FROM A PRODUCTION FURNACE

Perhaps the greatest difficulty of introducing a sys-

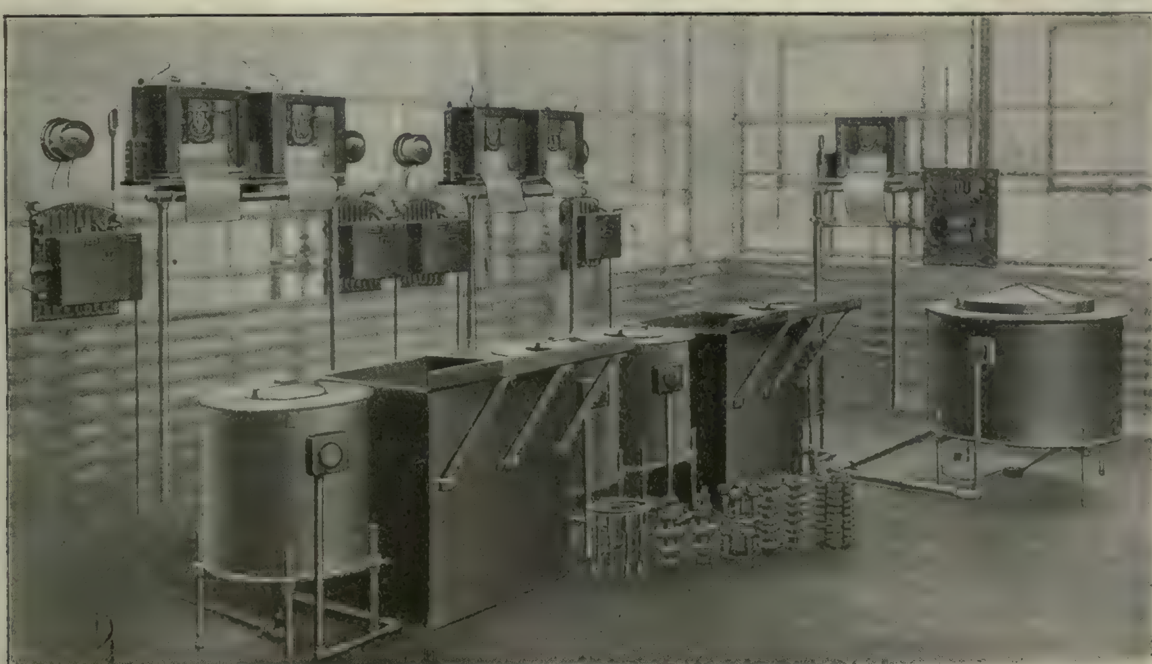


FIG. 7. AN AUTOMOBILE-PLANT INSTALLATION

tem of this kind lies in securing men with the proper training who will appreciate the assistance of such a device and who can make use of it to the fullest extent. Experience alone will enable them to secure best results as the best quenching point will vary with the size of the work and possibly with the kind of steel being handled.

With such a method of knowing exactly what is taking place in the piece or pieces being hardened, the hardener can learn to secure exactly the results he desires and can depend upon securing uniformity. For, unlike the dependence upon obtaining a given temperature, this method disregards the exact number of degrees but shows positively the exact time at which the work passes into the critical period, so that the hardener can watch for the end of this period and can remove the work at such a time as his experience shows to be best for the particular kind of work being hardened.

On small work, quenching is done at or just before the piece passes through the critical period. On larger work it has been found best to allow it to pass through the period by a given amount, depending upon the size and shape of the piece. All special treatment of this kind must be worked out by the individual hardener for his particular work, and is the reason why no device of this kind can, or should, attempt to take the place of the highest skill obtainable for this work.

With such a method of control it is easy to conceive of the possibility of so controlling the time of quenching as to secure a given amount of distortion, either enlarging or shrinking, should such a change be necessary in order to reclaim work a little over or under size. This is in keeping with the old practice of enlarging pins or shafts intended for force fits by a series of heatings and coolings, which has been practised by blacksmiths for many years. This, however, provides an exact method of accomplishing this should it be necessary. The main advantage of the system, however, is that tools or other work can be hardened with the certainty of retaining their exact dimensions and of avoiding the losses due to cracking, which has heretofore been considered a necessary evil in connection with the hardening and treating of steel.

A recent installation in an automobile plant is shown in Fig. 7.

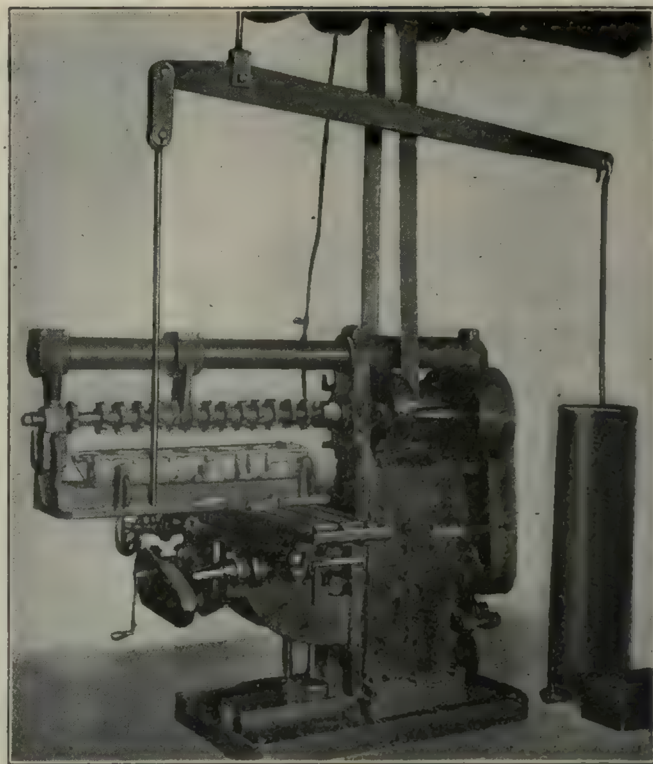
Supporting an Overhanging Fixture Automatically

By I. B. Rich

The illustration shows the way in which the H. H. Franklin Manufacturing Co., Syracuse, N. Y., was enabled to use a comparatively light knee-type milling machine for a job which would otherwise have required a much more expensive machine.

The operation is milling the ends of the main bearing seats of the aluminum crank case shown, this requiring a milling arbor the full length of the crank case and carrying 14 coarse-tooth cutters. An extension overarm supports the arbor at the outer end, and also near the center, and it will be noted the outer arm guides the outer end of the fixture, tying the arm and the fixture together against cross movement and insuring the alignment of the arbor and the work.

Instead of attempting to support the overhanging weight from below, a simple but ingenious counterweight was devised, which not only takes care of the overhang at a fixed point but allows the knee to be adjusted vertically to any desired position, and maintains its support in all positions. The work is fed up to the cutters, and the counterweight takes the desired proportion of the load in all positions.

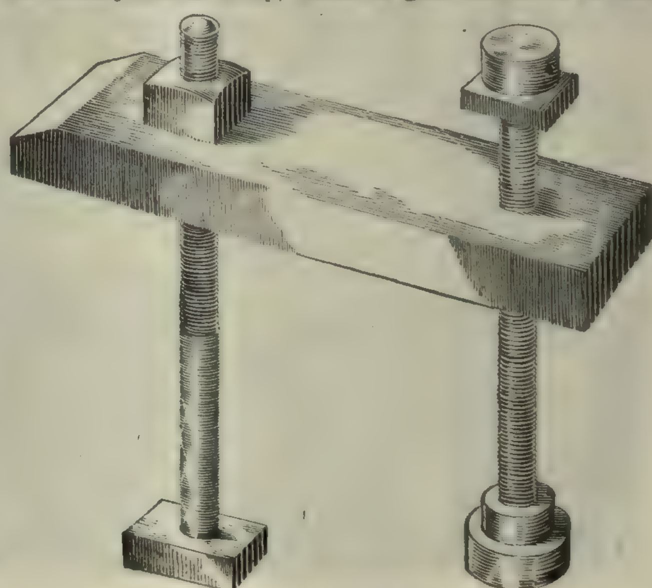


SUPPORTING AN OVERHANGING FIXTURE

An Adjustable Strap

By Joseph C. Fisher

The sketch shows an adjustable strap or clamp which can be used to advantage on drilling, milling, and planing machines, etc., that is a great time saver in several ways; for instance, when a man gets a job to do in any one of these machines, he doesn't have to look around the shop for a half hour, trying to find straps, bolts and blocking, but goes to the tool crib and asks for an adjustable strap, when he gets the three in one.



AN ADJUSTABLE STRAP

IX. Complete List and Comparison of Base Curves

Systematic methods of cam construction for different types of fundamental base curves have been given in preceding articles. In the present issue all of the cams from these base curves are brought together to show their relative sizes for the same data. Diagrams are introduced to show the relative velocities and accelerations given by each type of cam. The methods for drawing these diagrams and for computing the cam factors which have been used throughout the series are also given in this issue.

THE base curves which have been used in the previous articles are: All-logarithmic curve, Fig. 84; logarithmic-combination curve, Fig. 88; straight line, Fig. 92; straight-line combination curve, Fig. 96; crank curve, Fig. 100; parabola curve, Fig. 104; tangential curve, case 1, Fig. 108; circular curve, case 1, Fig. 112; elliptical curve, Fig. 116; cube curve, case 1, Fig. 120; circular curve, case 2, Fig. 124; cube curve, case 2, Fig. 128, and tangential curve, case 2, Fig. 132.

Comparison of base curves, their applications and their characteristic motions.—Figs. 84 to 135 illustrate: (1) The forms of each of the base curves, column 1; (2) the form and true relative size of cam, all having the same data, column 2; (3) the velocity diagram for each cam, column 3, and (4) the acceleration diagram for each cam, column 4.

The data for all of the cams and diagrams illustrated in Figs. 84 to 135 are as follows: (a) The follower to rise 1 unit in a 60-deg. turn of the cam; (b) the follower to fall 1 unit in a 60-deg. turn of the cam; (c) the follower to remain at rest for 240-deg. turn of the cam, and (d) the maximum pressure angle to be 30 deg.

All of the cam charts illustrated in column 1, Figs. 84 to 132, include only the first item in the above data, and they show therefore only one-sixth of their full length. In column 2 the entire cam is shown in each case, and it is drawn to one-third of the scale used for the chart in column 1.

Velocity and acceleration diagrams showing characteristic action of cams having different forms of base curves.—All of the diagrams in column 3, Figs. 86 to 134, show the velocity given to the follower by the cam at every instant during the follower stroke. In each case the length of the diagram *AC* represents the time required by the cam to turn through 60 deg., the camshaft being assumed to be turning with uniform angular velocity. The numbered scale on each diagram shows the relative velocity given by each cam at any phase of the stroke.

All of the diagrams given in column 4 show the acceleration given to the follower by the different cams. These diagrams have a special interest when it is remembered that force = mass × acceleration, and if the mass is the same in all cases the ordinates of the diagrams represent the forces necessary to move the follower at any instant. A diagram with a distinctively long ordinate indicates that the cam will "run hard" at the phase where the long ordinate occurs. The scale numbers shown on the diagrams are based on the uniform acceleration given by the parabola cam as shown in Fig. 107.

Characteristic Actions of Cams Having Different Base Curves

The all-logarithmic curve, Fig. 84, gives the smallest possible cam for a given pressure angle. It differs from all other curves in that it gives the maximum pressure angle all the time that the follower is moving, whereas the others, with the exception of the logarithmic-combination curve, give a maximum pressure angle for an instant only. One of the disadvantages of the all-logarithmic cam is that it causes the follower to attain nearly its full velocity instantaneously and causes it to come to rest in a similar manner, thus giving a shock at the beginning and end of the stroke. This gives excessively large acceleration and retardation at the ends of the stroke and causes the cam to "pound" or "run hard" at these phases of its action. Another disadvantage is that a roller cannot be used with it because the pitch surface has a sharp edge, or angle, on the working side as shown at *C*, Fig. 85. The reason

why a roller cannot be used under these conditions was explained in Article III. The logarithmic base curve gives a slowly changing velocity to the follower with small and nearly constant acceleration as will be noted from Figs. 86 and 87.

Logarithmic-combination curve.—The disadvantages of the all-logarithmic cam may be overcome by rounding off the ends of the logarithmic base curve with some other useful form of arc. The arcs of circles could be used, as illustrated later in connection with the straight-line combination curve, but they would give variable acceleration to the follower at the beginning and at the end of the stroke. The best arcs for rounding off the ends of the logarithmic curve are parabolic arcs, which give uniform acceleration and retardation at the beginning and at the end of the stroke and therefore smoothest and easiest action. A logarithmic-combination base curve with parabolic end arcs is shown in Fig. 88, its corresponding cam in Fig. 89, and its velocity and acceleration diagrams in Figs. 90 and 91 respectively.

Straight base line.—The characteristics of a cam having a straight base line have already been considered in article II. A sharp or V-edge sliding follower is the only kind that can be used with the straight base line for true results; a roller cannot be used for reasons referred to in a preceding paragraph. The form of the pitch surface of the cam which is derived from the straight base line is the Archimedean spiral. The straight base line gives the smallest *simple* cam for a given maximum pressure angle.

Straight-line combination curve.—The straight-line combination base curve gives increasing velocity and acceleration at the beginning of the stroke, uniform velocity and zero acceleration during a large middle portion of the stroke, and decreasing velocity and retardation at the end. The length of the period for uniform velocity and the amounts of acceleration and retardation depend entirely on the length of the easing-off radius. This may be taken at any value. The acceleration diagram in Fig. 99 is based on a radius equal to the follower motion as shown at BA, Fig. 96. The shorter this radius is taken the nearer the straight-line combination curve approches the cam having a straight base line, and the action at the beginning and at the end of the stroke becomes more violent. The longer the easing off radius is taken the nearer the combination curve approaches the circular base curve of Fig. 112 and the smoother the action will be, but in this case the cam will be relatively large.

Crank curve.—The crank curve base described in article II gives increasing variable velocity during the first half of the stroke and decreasing variable velocity during the last half. The acceleration and retardation are also variable, being greatest at the ends as may be noticed by an inspection of Fig. 103.

Harmonic curve.—The crank curve is sometimes called the harmonic curve, due to the fact that it gives to the follower a motion similar to that described by the foot of a perpendicular let fall on the diameter of a crank circle from a crankpin moving with uniform velocity in that circle; or, in other words, a motion similar to that of a crosshead which is operated from a uniformly rotating crank with a T-headed or "infinite" connecting-rod. It will also be observed that the crank curve is a projection of a helix onto a plane surface parallel to the axis of the helix, and is further a sine curve, or sinusoid, in which the length or pitch is not necessarily equal to the circumference of the construction circle.

Effect of crank curve following its tangent line closely.—The crank curve has the marked characteristic, under ordinary conditions, of following its tangent so closely, as for example on each side of E, Fig. 100, that when the crank-curve chart is bent to form the cam, as explained in article III, a maximum pressure angle slightly greater than 30 deg. is produced in the cam. In the case illustrated in Fig. 101, the pressure angle would still be 30 deg. at E, but it would be 30 deg. 27 min., just to the left of E toward A. If it were desired to keep the maximum pressure angle exactly 30 deg. instead of 30 deg. 27 min. it could be done by moving all the points from A to C, Fig. 101, outward radially by the amount d given in the following formula:

$$d = \frac{0.5h}{\sqrt{1 + \frac{\pi^2}{b^2}\cot^2 a}},$$

where d = distance the points on the pitch surface, as obtained in the ordinary way, would have to be moved out radially to obtain exact size of crank curve cam for a given maximum pressure angle;

h = total rise of follower.

b = angle turned by cam during the follower's total rise, in radians.

If b is taken in degrees the number 180 must be used in place of π.

a = pressure angle in degrees.

The maximum pressure angle of 30 deg. would then occur where the enlarged pitch surface crosses the pitch circle which would be slightly to the left of E, Fig. 101. The cam would be 0.09 larger in maximum radius, or 3.19 units from O to C instead of 3.10 as shown and as used in practice.

Another way of obtaining exact results with the crank curve would be to compute the length of the chart from the following formula:

$$l = 0.5b\,h\sqrt{1 + \frac{\pi^2}{b^2}\cot^2 a}$$

For the case in hand l would equal 2.77, which it will be noticed is 0.05 larger than the practical value used in Fig. 100. With this length of chart the crank-curve base line would not reach a 30-deg. angle in the chart, but the cam pitch surface would at a point just inside of the pitch circle.

Parabola curve.—The parabola base curve, described in article III, gives uniformly increasing velocity to the follower up to mid stroke when the velocity is twice that produced by the straight base line, as illustrated in Figs. 106 and 94 respectively. The follower has uniformly decreasing velocity during the second half of its motion. Both the acceleration and the retardation are uniform throughout the stroke as shown by the horizontal lines in Fig. 107.

Perfect cam action.—The parabola is the only base curve that gives a theoretically perfect motion so far as inherent smoothness of action is concerned. It gives to the follower the same gentle motion on starting as a falling body has when starting from rest, and it brings the follower to rest at the end of its stroke with the same gentle action reversed. For this reason the curve is sometimes called the "Gravity Curve." The

curve for the parabola cam is also referred to by some as the curve of squares from the fact that the radial expansion of the curve varies as the square of the time, as may be noticed from the fact that the construction numbers 1, 4, 9 and 16 in Fig. 104 are the squares of 1, 2, 3 and 4 respectively. In Fig. 120, which will be described later, a curve is used in which the expansion of the curve varies as the cube of the time.

The parabola base curve will also operate a follower with the least amount of effort of any of the base curves, due to the fact that the acceleration is constant. In this connection actual comparative figures will be given in a later paragraph under the heading of "Comparison of Relative Velocities and Forces."

Comparison of parabola and crank base curves.—While the parabola base curve combines the two highest theoretical considerations, namely, smoothest possible motion and least power for operation, it has not become so widely used as the crank curve. This may be due to the experience of builders of cams who have found that the crank curve permits of a smaller cam for a given pressure angle than does the parabola, or for the same size cams the pressure angle is the smaller for the crank curve and therefore does not "stick" or "run hard" so much as the parabola cam of equal size. Figures on which the above statements are based may be seen in Fig. 101, where it is shown that a maximum radius of 3.10 in. is required for a lift of 1 in. in 60 deg. with a maximum pressure angle of 30 deg. when the crank curve is used, while in Fig. 105 a parabola cam is shown to require a maximum radius of 3.80 in. for the same data. The crank curve has obtained some undue comparative credit over the "parabola" curve on account of the fact that the "parabola" was constructed with spaces in some other ratio than 1, 3, 5, etc. While, for example, a true parabola may be constructed with spaces of 1, 2, 3 instead of 1, 3, 5, as used in these articles, the parabolic curve of the cam surface in the former case will not be tangent to the circular part of the cam surfaces, or, in other words, the base curve *EA* in Fig. 104 will not be tangent to the horizontal base line of the chart at *A*, but will intersect it at that point. A "parabola" cam therefore, with ordinates that are in any other ratio than 1, 4, 9, etc., will actually show "bright spots" and rapid wear at the beginning and end of the parabolic surface, and this has actually been erroneously charged against the true practical parabola cam.

A further comparison of the parabola and crank base curves shows that their velocity and acceleration lines in their maximum values, Figs. 102, 103, 106 and 107, do not differ to such an extent as to make a noticeable difference in the action in many cam applications, particularly where the smoothest motion is not essential nor where there is a surplus of driving power. Furthermore the drawing of the crank curve has appeared to some builders as a much easier and better understood procedure, and this has accounted some for the use of the crank curve. It may be observed, however, that the parabola is really no more difficult to draw than the crank curve, and when it is fully understood it is quite certain that the parabola cam will come into a more general use in all cases except where space is extremely limited, or where special considerations of the follower motion as to spring or gravity action, or as to low striking or seating velocity, etc., become especially desirable. The subjects of spring action and low striking velocities will be treated later.

Tangential base curve.—The tangential base curve differs from the others in that it cannot be directly constructed by graphical processes. The cam itself is drawn first by using straight lines as the side boundaries of the cam lobe, the straight lines being rounded off at the ends by arcs of circles or other smooth curves, as shown in Fig. 109. At the inner ends the straight lines are tangent to a circle which has the center of rotation of the cam as its center. The base curve for this cam is useful only where it is desired to find graphically the velocity and acceleration diagrams, and when it is so used it must be derived from the cam drawing.

The tangential cam for case No. 1 has a characteristic retardation curve in that it is convex downward, as shown from *F* to *H* in Fig. 111, while the retardation curves for all other cams that have intermediate maximum ordinates are either straight or concave. This characteristic may be an advantage in some cam applications and will be referred to in a later paragraph on the use of springs for returning the follower. The pressure angle factors for this curve for the data given in this problem are: 5.28 for 20 deg., 3.62 for 30 deg., 2.82 for 40 deg., 2.36 for 50 deg., and 2.09 for 60 deg. These factors are used for the ordinates of curve 9 in Fig. 136, which shows that the tangential cam, for the data of problem 19, has the advantage of smaller size over the parabola, circular, elliptical and cube cams when the lower range of pressure angles are used, but it begins rapidly to lose this advantage at angles of about 36 deg.

Further characteristics of this tangential cam that may be used to advantage in assigning data are that if the angle turned through by the cam is twice the pressure angle the maximum retardation for the circular easing-off arc of the cam will occur at the end of the stroke, as shown at *CH*, Fig. 111, and that the retardation at the point on the cam where the arc joins the straight line will be 0.866 *CH*, as shown at *EF*, Fig. 111. If the angle turned through by the cam during the motion of the follower is greater than twice the pressure angle the retardation value will still be a maximum at the end but will be less than 0.866 of this value at the point where retardation begins, that is, *EF* will be still shorter in comparion with *CH* than it is shown in Fig. 111. This condition has a practical value in that it allows a lighter-weight or smaller spring to return the follower where a spring is used. If the angle turned through by the cam during the motion of the follower is less than twice the pressure angle the retardation at *EF* will be greater than 0.866 *CH*, and if it is much less the retardation value will be a maximum at the point where the easing-off arc joins the straight line, that is, *EF* will be greater than *CH*.

Circular base curve.—The circular base curve gives variable velocity and acceleration to the follower the first half of the follower stroke and also variable velocity and retardation during the last half, as shown in Figs. 114 and 115. It will be noticed that the circular curve, Fig. 112, and the elliptical curve, Fig. 116, give nearly the same sized cams, and that the velocity and acceleration diagrams for each are quite similar.

Elliptical base curve.—The elliptical base curse gives variable velocity and variable acceleration to the follower. By using different ratios for the horizontal and

vertical axes of the ellipse on which the curve is based the velocity of the follower may be made to increase rapidly or slowly at the start and the cam may be made small or large and still not exceed a given maximum pressure angle.

Elliptical base curve, ratio 7 *to* 4.—As stated in the preceding paragraph the elliptical cam may be based on ellipses having various proportions between their major and minor axes. When the proportions are as 7 : 4, as in Fig. 116, where $FG = 7$, and $FC = 4$, the length of the chart will be 3.95 times the travel of the follower for a maximum pressure angle of 30 deg. The cam will be larger, but the velocity of the follower will be less at starting and stopping and greater at mid stroke than for any of the cams described thus far. If a still lower starting and stopping velocity is desired with an elliptical cam, it may be obtained by making the ratio of horizontal to vertical axes on the chart as 8 : 4, 9 : 4, or greater, instead of 7 : 4 as here used. The drawbacks to increasing the ratios above 7 : 4 are increased size of cam and high velocity at mid stroke for a given pressure angle.

Elliptical base curve ratio 2 *to* 4.—The cam produced from the elliptical base curve is shown in the preceding paragraph to give a certain characteristic action to the follower when the ratio of the horizontal axis to the vertical axis is 7 to 4. When the ratio is 2 to 4 a totally different characteristic follower action is obtained, as may be determined by a process of construction similar to that shown in Figs. 116 and 117. The cam itself, with a ratio of 2 to 4, will be much smaller for a given pressure angle, as may be seen by comparing the abscissas of curves No. 5 and No. 11 in Fig. 136. Where it is desired to use a very small cam for a given pressure angle, the 2 : 4 elliptical curve will have an advantage over the ordinary straight-line combination curve above 27°, as may be noted from an inspection of curves No. 5 and No. 6, Fig. 136; but it is at a disadvantage compared with the logarithmic-combination cam at all pressure angles, as is shown by a comparison of curves No. 2 and No. 5.

Elliptical base curve equivalent to nearly all other base curves.—Since the elliptical base curve may be constructed with any ratio of horizontal to vertical axis it has a range of usefulness over the entire field covered by all the other base curves except the logarithmic curve. When the horizontal axis of the ellipse is zero the elliptical base curve coincides exactly with the straight-line base. As the horizontal axis increases in length, the vertical axis remaining constant, the elliptical base curve crosses the straight-line combination curve. When the horizontal axis of the ellipse equals the vertical axis the elliptical base curve is identical with the crank curve. As the horizontal axis continues to increase, the elliptical curve approximates very closely indeed to the parabola when the ratio of horizontal to vertical axes is as 11 to 8. A further general characteristic of the elliptical curve is that the starting and stopping velocities grow smaller and also the accelerations or starting and stopping forces grow smaller as the horizontal axis of the ellipse grows larger.

Cube Curve.—The cube curve gives extremely low and slowly increasing velocity to the follower for a considerable period after starting, as may be noticed by an inspection of the velocity curve *AE*, Fig. 122, which shows the distinguishing characteristic that the velocity curve is tangent to the line *AC*. This curve is the only one that gives uniformly increasing acceleration to the follower, starting from zero, as indicated by the straight inclined line *AD* in Fig. 123. The disadvantage of the cube curve, however, is that it gives an extremely large cam for a given maximum pressure angle if it is used in the same way that the preceding curves are used, that is, if it is made up of two similar arcs placed in reverse order. If the cube curve were so drawn it would be made up of two arcs similar to *AE*, Fig. 120, and the pressure angle factor would be 5.20 as compared, for example, with 3.46 for the parabola, and the maximum radius of the cam would be 5.47 against 3.80 for the parabola.

The characteristic velocities, accelerations and retardations produced by the cube curve cam are shown in Figs. 122 and 123 respectively. From the latter it may be seen that the acceleration and retardation lines *AD* and *FH* respectively are straight inclined lines characteristic of the cube curve. When the retardation line *FH* is extended, as shown by the long-dash line, Fig. 123, it passes through the zero point of the diagram. A cam with this characteristic may have particular advantages in some instances, one of which will be referred to later in the discussion of the relative strength of springs necessary to return the follower.

In the second cases of the circular and cube curves illustrated in Figs. 124 and 128 the follower does not attain full velocity until it reaches three-fourths full stroke. In these cases the follower starts and stops very slowly at one end of the stroke. The velocities at mid stroke are approximately 1.2 and 1.0 as may be noticed from the dash-line construction in Figs. 126 and 130 respectively, against 2.2 and 1.7 as shown for similar base curves in Figs. 114 and 122. The accelerations at the beginning of the return stroke, however, are very high, particularly for case 2 of the cube curve which ranges from 3.2 to 4.8 as shown in Fig. 131. Herein lies the disadvantage of these cams. They are useful only where extremely low starting velocity is required at one end of the stroke and where a rapid change of velocity at the other end of the stroke is immaterial. It would require a powerful spring to keep the follower roller in contact with the cams at high speeds, and if they were used on a positive-drive cam there would be rapid wear at the beginning of the return stroke.

Case 2 of the tangential cam is even worse in this respect, having a greater acceleration on the return stroke, as shown at *EF* in Fig. 135. This tangential cam has not even the advantage of low velocity at the end of the return stroke as have the two preceding cases. This may be noted by comparing the steepness of the velocity lines in Figs. 134, 130 and 126.

Method of determining velocities and acceleration.—The velocity and acceleration values in the diagrams shown in Figs. 86 to 135 may be found by graphical methods which are simple and quite accurate enough for most practical purposes if precision in drawing is followed. The graphical method applies to all forms of cams and starts with the cam chart. Its application, however, is illustrated only in connection with the circular cam chart in Fig. 112, it being unnecessary to add similar lines to all the other chart drawings as the constructions would be the same in every case.

The use of time-distance and time-velocity diagrams.—The chart curve *AEC*, Fig. 112, for our present purpose may be termed a time-distance curve in which

the abscissa AR represents time and the ordinates parallel to AB represent distances traveled by the follower at corresponding times. If then the time-distance curve were a straight line the velocity of the follower would be constant. We may consider for the instant that the time-distance curve is straight at E and draw a straight line EP tangent at that point. If this were the time-distance line, and if it were continued for a time period represented by ED, the follower would have moved the distance PD in the time represented by ED. If ED is considered as a unit of time, then PD becomes a measure of velocity and its length is laid off in Fig. 114, at XE, which is at the center of the time-velocity diagram. The length AC of the velocity diagram may be any convenient value for the purpose of comparison. The distance DE, Fig. 112, or one-half the length of the cam chart, was selected as a time unit because it is a convenient length and because the length of one-half of each cam chart represents the same amount of time in each of the chart drawings. This is because the data are the same in all the cams represented in Figs. 84 to 135. To find other points on the time-velocity diagram divide the time-distance curve by a number of equally spaced ordinates, as shown at J, I, H, Fig. 112. The tangent to the curve at K, on the ordinate JV is KM, and the time unit KL is equal to DE. Then, from the same reasoning as given above for the point E, LM becomes a measure of the velocity of the follower at K and it is laid off at ML in Fig. 114. Similar constructions are repeated at the other points and the time-velocity diagram completed.

The time-acceleration diagrams are found graphically from the time-velocity diagrams by similar constructions. In Fig. 114 a tangent ES is drawn to the time-velocity curve at E, and if the velocity of the follower is continued along this line for a time represented by EQ it will lose a velocity of QS in the time EQ. Such loss in velocity is retardation and consequently the distance SQ is laid off at ED at the center of the time-acceleration diagram in Fig. 115. The line ES in Fig. 114 was drawn to the left, and consequently downward to make the drawing more compact. In this way retardation instead of acceleration was found logically. Had the tangent line ES been drawn to the right, and consequently upward, the value QS would have been found just the same and would have been called acceleration. The length of the acceleration diagram AC, Fig. 115, may be taken any value; also, the time unit EQ in Fig. 114 may be taken any value entirely independent of the time unit used in Fig. 112, so long as the same length of line is taken in all the velocity diagrams as the time unit in making comparisons.

If a definite speed is assigned to the cam then all the lines in the time-distance, time-velocity and time-acceleration diagrams will have a definite value in feet and in seconds, and by closely following these values the diagrams may be scaled so as to interpret them in the ordinary units of feet and seconds, even if arbitrary time lines have been used in constructing the diagrams. For example, suppose that the cam in Fig. 113 is turning at 120 r.p.m. Then it will require $\frac{1}{12}$ sec. to turn through the 60-deg. angle DOC, and DE in Fig. 112 will represent $\frac{1}{24}$ sec. DP measures 0.43 in., or 0.0358 ft. Therefore the velocity of the follower at E will be 0.0358 ft. per $\frac{1}{24}$ sec., or 0.859 ft. per second. The scale on XE, Fig. 114, would then be graded so that a mark at 0.859 would fall at E. In Fig. 114 AC represents $\frac{1}{12}$ sec., and QE $\frac{1}{48}$ sec. Since XE represents 0.859 ft. per second in this example QS represents 0.644 ft. per second to the same scale. Therefore the acceleration is 0.644 ft. per second per $\frac{1}{48}$ sec. or 30.9 ft. per second. The scale on ED, Fig. 115, would then be graded so that a mark at 30.9 would fall at D.

Another set of construction lines for obtaining an ordinate in the acceleration diagram is shown at LTV, Fig. 114, where LT is the same length as EQ and VT is the acceleration and is laid off at VT in the acceleration diagram, Fig. 115.

Degree of precision obtained by graphical method.—In Fig. 112 the tangent lines may be drawn with precision because the curve AE is an arc of a circle, but in the other curves the center of curvature for each of the construction points is not known and the tangent must therefore be drawn by eye. Even here considerable precision may be obtained if in so drawing the tangent it is remembered that the tangent at L, Fig. 114, for example, will be practically the same distance from U as it is from E when it passes each of these points, provided U and E are on ordinates equally spaced and provided also that the curve AE has a fairly uniform rate of curvature on both sides of L. If the radius of curvature to the right of L should grow noticeably shorter than the radius of curvature to the left of L the tangent at L would pass a little closer to U than to E. If in addition to using such judgment as here indicated in the drawing of tangents to irregular curves a sufficient number of points are taken closely together, and if the newly derived curve is drawn smoothly through the average positions of plotted points, a remarkable degree of accuracy may be obtained by the graphical method of obtaining velocity and acceleration diagrams.

Comparison of relative velocities and forces produced by cams having different base curves.—This comparison, which may be made by studying the several velocity and acceleration diagrams in Figs. 86 to 135, is also shown

TABLE OF RELATIVE MAXIMUM VELOCITIES OF FOLLOWER AND RELATIVE DIRECT AMOUNTS OF POWER NEEDED TO OPERATE CAM DURING ACCELERATION AND RETARDATION

Form of Cam	Relative Maximum Velocities	Relative Amounts of Direct Power Needed to Operate Cam During: Acceleration	Retardation
Column 1	Column 2	Column 3	Column 4
All-logarithmic	1.28	....	
Logarithmic-combination	1.40	1.82	1.82
Straight-line	1.00	....	...
Straight-line combination curve ($r = h$)	1.31	1.99	1.99
Crank curve	1.57	1.25	1.25
Parabola	2.00	1.00	1.00
Tangential curve, case 1	2.09	1.58	1.10
Circular curve, case 1	2.16	1.44	1.44
Elliptical curve	2.28	1.60	1.60
Cube curve, case 1	2.40	1.95	1.95
Circular curve, case 2	2.16	0.96	2.86
Cube curve, case 2	2.79	1.80	4.80
Tangential curve, case 2	3.39	2.55	6.39

in the table where the maximum velocities of the follower are shown in Column 2 and the maximum acceleration and retardation values in Columns 3 and 4. Since force equals acceleration multiplied by mass, the direct effort required to move the follower is proportional to the acceleration, and therefore the relative direct power needed to operate the follower for various cams is also shown in Columns 3 and 4.

The parabola, it will be noticed from the table and from Fig. 107, requires the least direct effort, considering the entire cycle of the follower. This effort is

Comparison of Cams for Different Base Curves, all having same Data

Figs. 84 to 135

Column 1 — Cam Charts and Base Curves for one-sixth of Cam | Column 2 — Relative Sizes of Cams | Column 3 — Velocity Diagrams | Column 4 — Acceleration Diagrams

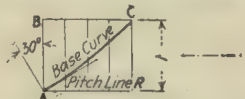


FIG. 84
All-Logarithmic Curve

FIG. 85


FIG. 86


FIG. 87

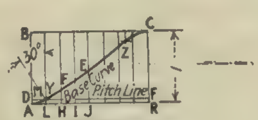


FIG. 88
Logarithmic-Combination Curve

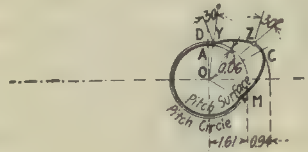


FIG. 89

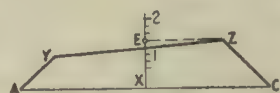


FIG. 90

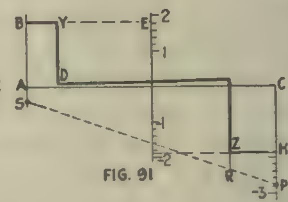


FIG. 91

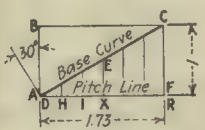


FIG. 92
Straight Line

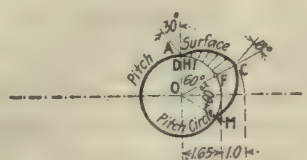


FIG. 93


FIG. 94

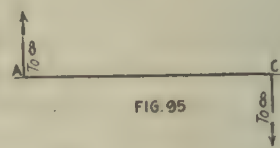


FIG. 95

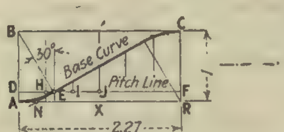


FIG. 96
Straight-Line Combination Curve

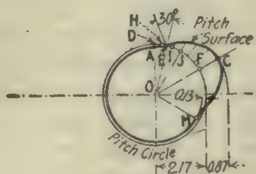


FIG. 97


FIG. 98

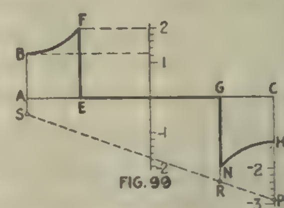


FIG. 99

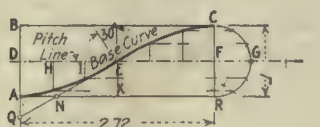


FIG. 100
Crank Curve

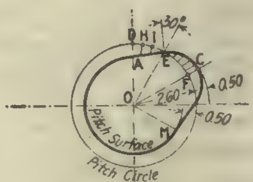


FIG. 101

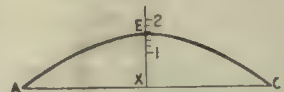


FIG. 102

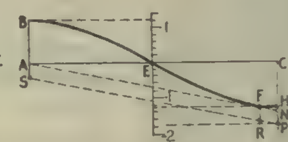


FIG. 103

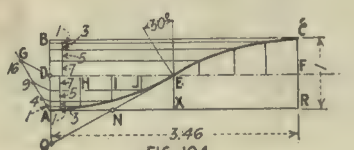


FIG. 104
Parabola

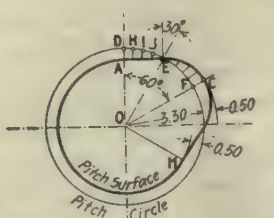


FIG. 105

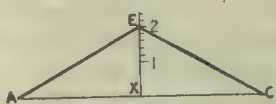


FIG. 106

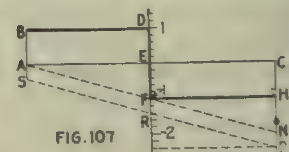


FIG. 107

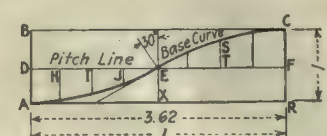


FIG. 108
Tangential Base Curve, Case I

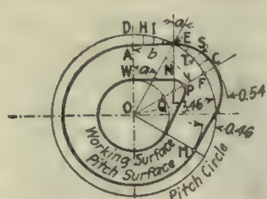


FIG. 109

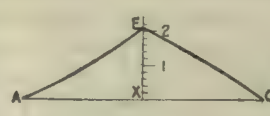


FIG. 110

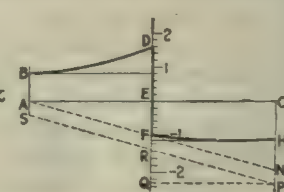


FIG. 111

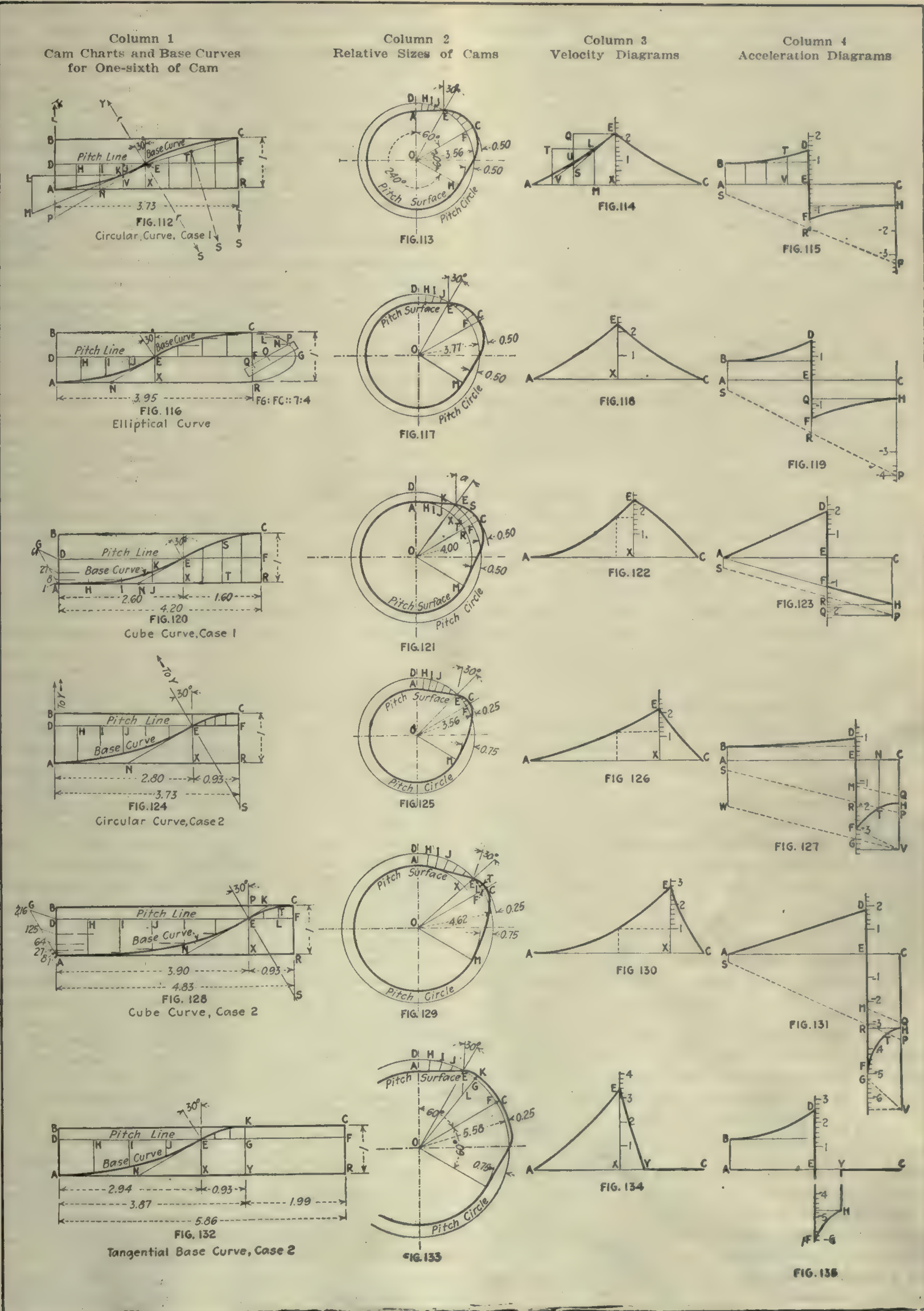


FIG. 112
Circular Curve, Case 1

FIG. 113

FIG. 114

FIG. 115

FIG. 116
Elliptical Curve

FIG. 117

FIG. 118

FIG. 119

FIG. 120
Cube Curve, Case 1

FIG. 121

FIG. 122

FIG. 123

FIG. 124
Circular Curve, Case 2

FIG. 125

FIG 126

FIG. 127

FIG. 128
Cube Curve, Case 2

FIG. 129

FIG 130

FIG. 131

FIG. 132
Tangential Base Curve, Case 2

FIG. 133

FIG. 134

FIG. 135

represented by unity for purposes of comparison. The circular base curve cam, case 2, Fig. 127, requires a trifle less effort than the parabola cam while on acceleration on the forward stroke, but 2.86 times the effort of the parabola, while the follower is on acceleration during the return stroke where a double-acting cam is used. For a single-acting cam the values given in Column 4 show the relative forces necessary to sufficiently accelerate the follower on the return stroke so as to keep it in contact with the cam.

The efforts required by various base curves in comparison with the parabola, which is taken at 1.00, are as follows: 1.25 for the crank curve, Fig. 103; 1.44 for the circular curve, case 1, Fig. 115; 1.58 for the tangential curve, case 1, Fig. 111; 1.60 for the elliptical curve, Fig. 119; 1.82 for the logarithmic-combination curve, Fig. 91; 1.95 for the cube curve, case 1, Fig. 123; and 1.99 for the straight-line combination curve, Fig. 99. These figures are for the symmetrical chart curves. Among the unsymmetrical chart curves shown in Figs. 124, 128, etc., much larger direct forces even may be required to operate the cam as illustrated by the relative maximum values of 2.9 for the circular curve, case 2, Fig. 127; 4.8 for the cube curve, Fig. 131, and 6.4 for the tangential cam, case 2, Fig. 135.

Cam follower returned by springs.—Although the cam built from the parabola chart pitch curve gives the smoothest motion and requires the least direct power to operate it so far as the cam and follower only are concerned there may be other considerations in the design that make or appear to make some other form of chart pitch curve more desirable. For example, when a follower is returned by a positive-drive parabola cam, or when it is returned by gravity, the parabola cam gives the best action because the pull on the follower is constant all the time, but when the follower is returned by a spring the spring reacts on the cam with a uniformly increasing pressure during the outstroke as represented by the straight inclined dash line SP in Fig. 107, and with a reverse uniformly decreasing pressure during the instroke.

If the spring pressure acting on the cam is zero when the follower is at rest in its lowest position the spring-compression line would be represented by the straight line AN, Fig. 107, starting at A and inclined so as to touch the retardation line as at F. Inasmuch as there would always be some compression in the spring, even when the follower is at rest, a margin of compression will be taken, as illustrated at AS. The practical spring-compression line will therefore be SP parallel to AN. As the follower moves out, its acceleration during the first part of the stroke produces increasing pressure between the cam surface and the spring-actuated follower as represented by the increasing length of the ordinates from SB to RD. At mid stroke the follower begins to slow up. In the case shown in Fig. 107 the slope of the spring-pressure line was taken so as to have the same spring pressure ($RF = SA$) on the cam at mid stroke as it has when it is at rest. The line SP could have been given a steeper slope if a larger margin of pressure than RF had been desired at mid stroke. This would have required a heavier spring. From mid stroke to the end there is again an increasing margin of pressure, the maximum being represented by the difference between the ordinates PH and RF. The full strength of the spring which would have to be used would be represented by the ordinate PC.

Relative strength of spring required for crank, tangential, cube and parabola base curve cams.—Although the parabola cam, with its perfect action as described in preceding paragraphs, permits of the use of a light spring when a single spring is used to return the follower, the crank curve, tangential curve and cube curve cams may each be designed to operate with somewhat lighter springs. Spring-compression lines for each of the three last-mentioned cams are shown at SP in Figs. 103, 111 and 123, and the maximum compression required of a single spring in each case is 1.75, 2.35 and 2.30 as compared with 2.40 for the parabola cam as shown in Fig. 107. The return spring pressure between the follower roller and the cam surface when the crank base curve is used is more nearly uniform throughout the *entire* stroke than it is with any other type of cam, as may be noticed from the maximum and the average ordinates between the acceleration-retardation curve and the spring pressure line SP in the several diagrams.

Cube curve cam specially adapted for a follower returned by a spring.—The cube curve cam possesses one characteristic over the others in that the pressure between the cam and the follower is absolutely uniform during the latter part of the up stroke and the first part of the down stroke when the follower is returned by a spring, as shown by the parallel lines FH and RP, Fig. 123. This gives an advantage of smooth-running and uniform wear when the spring is under its greatest compression.

The pressure between the spring-actuated follower and the cam is variable throughout the stroke in all cams except during part of the stroke with the cube curve cam. And it may readily happen that the acceleration called for by the cam is so great that the spring will not be strong enough to keep the follower roller against the cam surface, as may be specially noticed at or near the beginning of the return stroke. This is illustrated in Fig. 127, where the spring pressure against the follower which would be necessary to hold it to the cam is represented by FE, whereas if a spring of the same strength as for the cube curve cam, Fig. 123, were used the pressure at the phase E, Fig. 127, would be only RE. This means that the cam will "run away" from the follower because the spring is not strong enough during the part of the stroke represented by TFR to press the follower against the rapidly receding cam surface.

In order to keep the follower roller against the cam surface where cams with large retardation values are used, as in Figs. 91, 99, 127, 131 and 135, a comparatively heavy spring is required which will be unnecessarily strong during a very large part of the stroke, or else two springs will be required, the second one to come into action when needed. Both cases are illustrated in Fig. 127. A single heavy spring that will exert a pressure represented by WV will keep the follower roller against the cam surface at all times, the minimum pressure between the two occurring at FG; or a single and much lighter spring exerting a pressure represented by SP, Fig. 127, may be used, and then a second and shorter spring with an initial compression represented by ME may be so placed as to come into action at E so that the combined pressure of the two springs on the follower is ME plus RE equal FE. This means that the combined pressure of the two springs will be just sufficient to keep the follower roller against

the cam at phase E and that the total pressure of the two springs at the end of the stroke will be represented by CV, thus giving an excess pressure represented by HV at the end of the stroke. The base curves that are best suited for spring-return followers will be seen to be the crank curve, parabola, tangential curve, case 1, and the cube curve, case 1. The logarithmic and straight-line combination curves come next in order.

Accuracy in cam construction.—It need scarcely be pointed out that the pitch surfaces of cams should be constructed with considerable accuracy and the working surfaces carefully finished if definite results are required, for it may be seen by comparing the pitch surfaces of several of the cams illustrated in Figs. 85 to 133 that a relatively small difference in form may make a large difference in the velocity, acceleration and force or pressure under which the follower operates. For example, the circular curve cam, case 2, Fig. 125, and the cube curve cam, case 2, Fig. 129, are apparently quite similar in form, though varying in size, yet the maximum accelerations which they impose on the follower on the return stroke are quite different, being 2.9 and 4.8 respectively, as shown in Figs. 127 and 131. Also the cube curve cam, case 1, Fig. 121, and the elliptical cam, Fig. 117, appear somewhat alike, yet their velocity and acceleration lines are different in every way, and if a spring were used to return the follower the one for the elliptical cam would have to be enough heavier to carry 1.7 more compression at the end of the stroke than the one for the cube cam, assuming an initial pressure of AS in each one. The value 1.7 is found by comparing the lengths CP in Figs. 123 and 119.

Regulation of noise.—If a cam follower, as for example a cam-operated disk valve, comes to rest on a seat at one end of its stroke it is evident that it would be desirable for the follower to have the least possible velocity for at least a short distance before it reaches the seat in order to provide against unnecessary striking velocity. Noise will be in some proportion to the velocity of the follower at the instant of seating. With this in mind an examination of the velocity diagrams in Figs. 86 to 134 will show that the cube base curve, case 1, Fig. 120, gives by far the best results, for the vertical ordinates of the velocity curve in Fig. 122 are very much smaller as the follower approaches A than they are in any other diagram, excepting case 2 of the cube curve, Fig. 130; but in this instance the advantage is more than offset by the high retardation values at the end of the stroke, as shown in Fig. 131. The circular curve, case 2, comes next in the matter of giving small velocity to the follower, Fig. 126, but it does not possess the advantage of the cube curve when a spring is used to return the follower. The crank curve cam is least adapted of all the cams where quiet seating of a follower is desired, as may be observed by noting that the velocity curve, Fig. 102, for this cam is convex upward, whereas the others are straight or convex downward and thus have smaller initial vertical ordinates and therefore smaller velocity. The full practical advantage of cams which give low seating velocities and consequently a more quiet follower action is offset to a considerable extent where the follower operates a valve which must admit a comparatively large volume of gas or fluid quickly.

High-speed cams.—Cams intended for use on high-speed machines should give the smoothest possible motion to the follower, that is, should be free from sudden variations of velocity during the stroke and from shock due to sudden starting and stopping. A study of the velocity diagrams, Figs. 86 to 134, shows that the all-logarithmic and the straight-line base curves, Figs. 86 and 94, give extreme velocity right at the start in all cases, and that the logarithmic-combination and straight-line combination cams will also give relatively high velocities at the start, Figs. 90 and 98. Therefore none of these cams would in general be suitable for high-speed work. Among the other cams some have an advantage at one end of the follower stroke where the rate of change in velocity is low, but they lose it at the other end where it is high, as, for example, the cube cam, case 2, as shown in Fig. 131; or they lose their advantage at the center or some intermediate point, as in the elliptical cam, Fig. 119.

The cams specified in the preceding paragraph give relatively large sudden change of velocity to the follower either at one end of the stroke or the other or at intermediate positions, and of the remaining cams the parabola cam is the only one that gives absolutely uniform rate of change of velocity to the follower. The crank curve, the circular curve, case 1, and the tangential curve, case 1, give relatively good results, all being at a slight disadvantage compared with the parabola, due to variations in acceleration of the follower. This disadvantage, however, is small, and these three cams, together with the parabola cam, should give best results where there is high speed, provided they are accurately designed and made.

Balancing of cams.—In addition to the forms of the curves here discussed for the pitch surfaces of cams that are to run at high speed it is necessary to design the cam and so place the weight that the cam will be as nearly balanced as possible. This matter of balancing is one of the greatest drawbacks to the use of the cam in high-speed work, for the very nature of a cam implies irregularity in form and hence difficulty in balancing. The face cam cut on a full circular disk comes nearest to a natural balance of any of the forms of radial cams. The trouble due to lack of natural balance in ordinary radial cams may easily be so decided as to render them quite impracticable in many cases where high speed and large stroke are required, unless elaborate balancing problems are solved in connection with the cam design. Small radial cams with small strokes have been made to run at exceedingly high speeds. The cylindrical cam, because of its natural balanced form with respect to the axis of rotation, is most adaptable to high speeds.

Pressure angle factors for 20 deg., 30 deg., 40 deg., 50 deg. and 60 deg. for various forms of cams.—Most of the base curves for cams are of such nature that it is only necessary to multiply the follower motion by a given factor and then multiply the product by 360 and divide by the number of degrees the cam rotates during the follower motion to obtain the circumference of the pitch circle and the proper size of the cam for a given pressure angle. The logarithmic and tangential base curves are of such a nature that no one factor can be used for all data that include a common pressure angle. When these base curves are used, the length of chart, if desired, must be computed by separate formulas for each problem, as explained in Articles VII and VIII. The logarithmic and tangential base curves are most easily applied by constructing the cam pitch surface

directly from calculated values in each problem without the use of any chart whatever.

The factors for pressure angles for all base curves, excepting the logarithmic and tangential, are given in the table of factors for 20 deg., 30 deg., 40 deg., 50 deg. and 60 deg. These factors are also laid off graphically in Fig. 136, thus enabling one to use intermediate values if desired. For partial comparison of the curves which have no general factor with those which have, the special factor in each case for the single comparative problem which has been used throughout in designing the cams in Figs. 84 to 135 is given in the following paragraphs, and these factors are plotted to give the dash lines in the chart for factors.

Varied forms of fundamental base curves.—Several of the base curves are or may be used in practical work with variations in detail of construction, as, for example, in the straight-line combination curve, Fig. 96, the easing-off arc AE has a radius AB equal to the total

TABLE OF PRESSURE ANGLE FACTORS

For Base Curve Nos. 1 to 13 listed in order of corresponding cam size for 30 deg. according to data used for cams illustrated in Figs. 85 to 121; and for Base Curves, Nos. 14 to 16, according to data used for cams illustrated in Figs. 125 to 133.

No.	Name of Base Curve	Factor for Maximum Pressure Angle of 20 Deg.	30 Deg.	40 Deg.	50 Deg.	60 Deg.
1	All-logarithmic	No general factores				
2	Logarithmic-combination	No general factors				
3	Straight-line	2.75	1.73	1.19	0.84	0.58
4	Straight-line combination (Radius equal to ½ follower's motion)	2.92	2.00	1.56	1.31	1.16
5	Elliptical Curve (Ratio of semi-axes: 2 to 4)	3.32	2.17	1.45	1.00	0.68
6	Straight-line combination (Radius equal to follower motion)	3.10	2.27		1.77	1.73
7	Crank curve	4.43	2.72	1.87	1.32	0.91
8	Parabola	5.50	3.46	2.38	1.68	1.15
9	Tangential Curve, case 1 (Length of straight surface not specified)	No general factors				
10	Circular Curve, case 1 (Symmetrical circular arcs)	5.67	3.73	2.75	2.14	1.73
11	Elliptical curve (Ratio of semi axes: 7 to 4)	6.25	3.95	2.75	1.95	1.35
12	Cube Curve, case 1	6.68	4.20	2.90	2.04	1.40
	(Unsymmetrical cube curve)	4.13+	2.60+	1.79+	1.26+	0.87+
		2.55	1.60	1.11	0.78	0.53
13	Cube Curve, case 3 (Symmetrical cube curves)	8.22	5.20	3.56	2.52	1.73
14	Circular Curve, case 2	5.67	3.73	2.75	2.14	1.73
	(Unsymmetrical circular arcs)	4.26+	2.80+	2.06+	1.60+	1.30+
		1.41	0.93	0.69	0.54	0.43
15	Cube Curve, case 2	7.60	4.83	3.37	2.42	1.73
	(Cube curve and circular arc)	6.18+	3.90+	2.68+	1.89+	1.30+
		1.42	0.93	0.69	0.53	0.43
16	Tangential Curve, case 2 (Length of straight surface specified)	No general factors.				

rise of the follower, whereas it would be equally correct in principal to make the radius ½ AB. In this latter case the cam would be smaller for a given pressure angle, but the shock on starting and stopping would be greater. This case is not illustrated in Figs. 84 to 135 but is included under Item No. 4 in the Table of Pressure Angle Factors, and also in the Chart of Pressure Curves, Fig. 136. Likewise the factors for the elliptical base curve having a ratio of 2 to 4 instead of 7 to 4, are given in Item No. 5 in the table and also in the chart, Fig. 136. The factors for a cube base curve made up of symmetrical cube curves are also given in Item No. 13 in the table where it may be noted that this base curve gives an extremely large cam where small pressure angles are desired.

Methods of determining the cam factors.—The methods of computing the cam factors for various base curves are briefly described in the following paragraphs: The letter h in the following formulas represents the motion of the follower and the letter a the pressure angle:

All-logarithmic and logarithmic-combination curves.—These base curves do not have a constant factor for each pressure angle. The radius for the pitch circle in each problem is found by computation and graphics as described in Article VII.

The factors for the data used in the charts shown in Figs. 84 and 88 are:

All-logarithmic cam: 20 deg., 2.28; 30 deg., 1.28; 40 deg., 0.76; 50 deg., 0.42; 60 deg., 0.21.

Logarithmic-combination cam: 20 deg., 2.76; 30 deg., 1.69; 40 deg., 1.04; 50 deg., 0.62; 60 deg., 0.34.

Straight-line base, Fig. 92:

$$AR = RC \cot a = h \times \cot a = 1 \times 1.73 = 1.73.$$

Straight-line combination base curve, Fig. 96:

$$AR = 2AN + 2NX = 2h \tan\left(\frac{a}{2}\right) + h \cot a =$$
$$2 \times 1 \times 0.268 + (1 \times 1.73) = 2.27$$

Crank curve, Fig. 100.—This curve may be regarded as the projection of a helix and therefore DQ equals the length of the quadrant RG, which in turn is equal to $\frac{1}{2}\pi h$. The line EQ is tangent to the base curve at E.

$$AR = 2DE = 2DQ \times \cot a = 1.57\, h \cot a$$
$$= 1.57 \times 1 \times 1.73 = 2.72$$

Parabola, Fig. 104.—In a parabola the subtangent DQ is equal to twice the projected length of the curve AE and therefore $DQ = h$.

$$AR = 2DE = 2DQ \cot a = 2\, h \cot a =$$
$$2 \times 1 \times 1.73 = 3.46$$

Tangential curve, case 1, Fig. 108.—This curve has no common factor for a given pressure angle and the radius of its pitch surface must be computed directly by formulas given in problem 18 without the intervention of a cam chart. For purposes of comparison with other curves the following factors are given: they apply only for the data that have been used in the cams illustrated in Figs. 85 to 133:

20 deg., 5.28; 30 deg., 3.62; 40 deg., 2.82;
50 deg., 2.36; 60 deg., 2.09.

These values are shown in the dash-line curve, No. 9, in Fig. 136.

Circular curve, case 1, Fig. 112.—The chord EC is perpendicular to the line ST which bisects the angle CSE. This angle is equal to the pressure angle. The line EF is perpendicular to CS. Therefore angle CEF equals one-half of the pressure angle. Then

$$EF = FC \cot \tfrac{1}{2} a, \text{ and}$$
$$AR = 2EF = h \cot \tfrac{1}{2} a = 1 \times 3.73 = 3.73$$

Elliptical curve, Fig. 116.—The length of the cam chart for the elliptical curve for a pressure angle of say 30 deg. may be most readily found by constructing several arbitrary elliptical charts, say four, each with a pressure angle factor, or length, of 2, 3, 4 and 5 respectively and each having a common height equal to the rise of the follower. Having constructed the elliptical curve in each of the charts draw tangents in each case as at E, Fig. 116, and measure the angle ENX, which will be the pressure angle corresponding to the factor or length assumed. Then on any coördinate paper plot a curve with the pressure angle factors as ordinates and the corresponding measured angles as abscissas. This curve will cross the ordinate which passes through the assigned pressure angle, in this case 30 deg., and the length of ordinate will give the desired cam factor.

Cube curve, case 1, Fig. 120.—The pressure angle factors for this case in which two unsymmetrical cube curve arcs are used are specially computed by the formulas referred to in problem 20. The value of l in formula 1 when $h = 1$ will give the factor for whatever pressure angle is assigned to a. For a pressure angle of 30 deg.

$$l = 2.427\ h \cot a = 2.427 \times 1 \times 1.37 = 4.20.$$

Circular base curve, case 2, Fig. 124.—The complete factors for this curve are the same as for the circular base curve, case 1, and are found in the same general way. In case 1 the two arcs making up the base curve are equal; in the present case they are unequal, but the formula deduced above for case 1 of the circular curve may be used just the same for each arc. In this case 2 the first circular arc is required to lift the follower during three-quarters of its stroke, and therefore the distance AX in Fig. 124 will be $AX =$

$$0.75\ h \cot \tfrac{1}{2}\, a = 0.75 \times 1 \times 3.73 = 2.80.$$

The second circular arc is used for the remainder of the stroke and therefore the distance

$$XR = 0.25\ h \cot \tfrac{1}{2}\, a = 0.25 \times 1 \times 3.73 = 0.93.$$

Cube curve, case 2, Fig. 128.—In this case the cube curve is used for three-quarters of the stroke and a circular arc for the remainder of the stroke. The formula $x = \dfrac{3fh}{\tan a}$ is used to compute the part AX of the cam chart length. The value of h is the follower's total motion and that of f is the fractional part of the follower's motion during which acceleration takes place. Then

$$AX = \frac{3 \times 0.75 \times 1}{0.577} = 3.90.$$

The length XR is found in the same manner as in the preceding paragraph and is the same value, namely, 0.93.

Tangential curve, case 2, Fig. 132.—This curve, like case 1 of the tangential cam, has no cam chart, unless it is specially desired to lay it out after the cam is drawn by making special computations based on the pitch circle as described in problem 18. For purposes of comparison the data used in this cam, as drawn in Fig. 133, are the same as for all other cams in Figs. 85 to 133, and for the data so used the pressure angle factors are:

20 deg., 13.02; 30 deg., 5.86; 40 deg., 3.36; 50 deg., 2.20; 60 deg., 1.57.

These values are shown in the dash-line curve, No. 16. in Fig. 136.

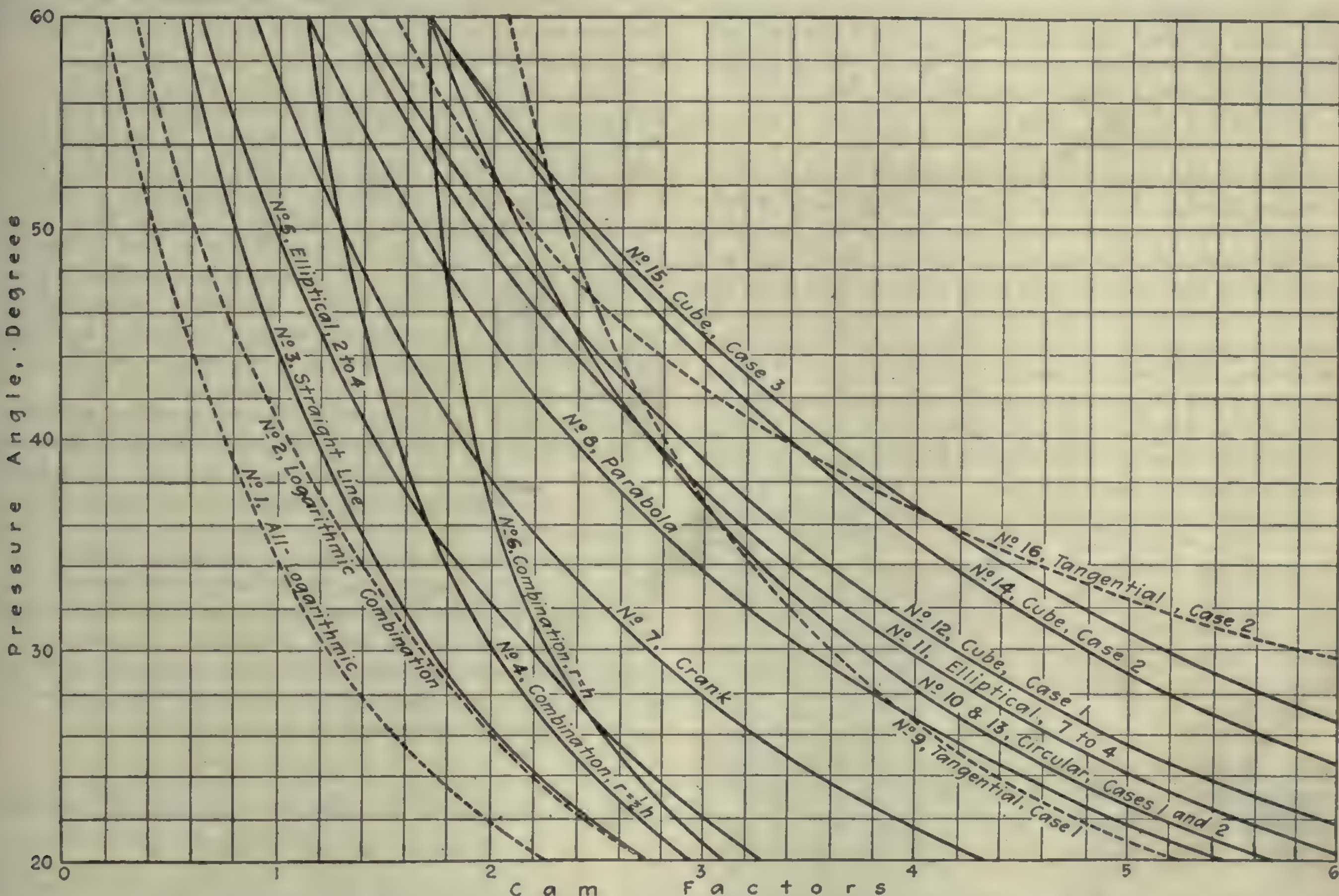


FIG. 136. CHART OF BASE CURVES SHOWING RELATION BETWEEN PRESSURE ANGLES AND CAM FACTORS AND INDICATING ALSO RELATIVE SIZES OF CAMS REQUIRED BY VARIOUS BASE CURVES ALL HAVING SAME DATA

Preventing Accidents in the Shop

BY J. E. BULLARD

Familiarity is said to breed contempt. That this is so is no doubt the reason why much more has not been done to reduce industrial accidents.

Each year wage earners in the United States lose, through not taking sufficient care of their health and not

being careful enough about avoiding accidents, not less than half a million dollars. In these days of underproduction and overdemand this sum is well worth saving for both worker and producer.

Preventing accidents does not depend alone upon providing safeguards. The men must be taught to appreciate these safeguards. During the war it was necessary to devote a great deal of time to teaching the men that the helmet and the gas mask were necessary safeguards. As it was many men lost their lives through personal carelessness.

Preventing accidents, therefore, becomes a selling problem as well as an engineering problem. Unless the men can be made to take a real interest in protecting themselves all the mechanical safeguards that can possibly be used will not prevent accidents. It is at this point that salesmanship and advertising come in.

Advertising "Safety First"

Both rail and trolley roads have found it effective to advertise "safety first." A certain railroad found that so many motorists drove into or in front of its trains that the court proceedings were proving very costly and annoying. Gates would not prevent accidents. The drivers of heavy cars would drive right through the strongest gates that could be installed and crash into the train. No sort of mechanical warnings or safety devices served their purpose and it was too expensive to eliminate all grade crossings. For this reason posters, cards in the cars, illuminated signs on all the railroad bridges crossing the highways, and newspaper advertising were used. From the time that the advertising began the number of accidents decreased. They decreased for two reasons: People began to use better judgment in crossing the tracks and those who did meet with accidents were not receiving as much sympathy, and the railroad was not blamed to the extent as was the case before it began to advertise the advisability of greater care.

We have all seen at some time or another advertisements by trolley companies showing people how to get on and off cars. This has helped to reduce accidents.

In the shop, as well as on the road and in the cars, advertising will tend to reduce accidents. Use posters, bulletins, pay-envelope slips, etc., to bring to the attention of the workers, and to keep before their attention, the need of precaution in regard to accidents, *and the accidents will fall off even though nothing more is done.*

Follow up this advertising with precautions to be taken in the way the men are clothed and the machines guarded and the accidents can be reduced to a minimum. Today machines are usually provided with safety guards anyhow. These guards serve the double purpose of protecting the machine and of preventing accidents to the worker. Hardly enough attention, however, is given to the clothing.

Now when productive labor is so essential it is more than ever necessary to guard against avoidable accidents and for this reason more attention should be given to the clothing of employees. It is loose ends, dangling shoe laces, flowing sleeves, unbuttoned jumpers, and such things that are fertile sources of accidents.

The engine lathe is not a dangerous machine but anyone who has spent many years in the shop can recall some accident caused by some part of the clothing being caught in the gears, in a dog holding the work, or in the work itself. This shows the need of close fitting clothes free from all loose ends and the advisability of keeping all of the clothes buttoned while working around machinery.

The shoes worn should be both strong and comfortable with good soles. It is a mistake to wear shoes with soles so thin that they do not protect the bottom of the feet. One can never tell when he will step upon a nail or sharp piece of metal that will pierce an old worn-out sole but which would not do any damage if the soles were in good shape.

If lace shoes are worn, every workman should keep the ends of the laces tucked inside the shoes. Loose laces have a habit of catching upon things and may cause falls that have serious results. In fact, the wearing of puttees that would cover the shoelaces and hold the lower part of the trouser legs firmly in place would tend to prevent many falls.

When working around any sort of machinery the sleeves should be buttoned close to the wrists, or snugly fitting short sleeves should be worn. In some cases employers are going so far as to sell the proper clothing to the men at cost. There does not seem to be any good reason why this should not be done. If the men buy their work clothes from their employer at cost it means that they will be able to buy them much cheaper than would otherwise be the case. All the clothing being alike means the minimum of stock and all of them buying from the employer means the maximum of buying power.

Every employer knows that even though a particular accident may not cost him anything in damages it does cost him something in slowing up production, for after an accident production does not come up to normal again for some time.

The prevention of accidents, however, cannot be accomplished by compulsion. The men must be sold the idea of precaution. They must be shown that it is to their advantage to use every precaution against accident. They must be shown that each accident means a loss to everyone concerned. Accident prevention is as much a matter of education as of safeguards.

Effect of Great Pressure on the Electric Properties of Metals

In the great majority of the metals tested by Bridgman, increase of pressure lessened the electric resistance, antimony and bismuth being the only exceptions.

According to the hypothesis of dual electric conduction the total conductivity of the metal is the sum of the conductivity due to the action of the associated electrons, and that due to the action of the free electrons. It seems that increase of pressure should increase the former and decrease the latter; and as the former is probably much larger than the latter in most metals, we should expect the usual effect of increase of pressure to be an increase of total conductivity, as it is in fact. But in the case of metals for which the ratio of the two phases of conductivity is exceptionally large, as it probably is in antimony and in bismuth, especially the latter, we should not be surprised to find increase of pressure producing a decrease of total conductivity, as it does.

In most of the metals tested by Bridgman, increase of pressure produces such an effect that heat is absorbed when a stream of electrons goes from the compressed to the uncompressed metal, this effect being especially large in bismuth.—*Brass World.*

The Production and Instruction in an Apprentice School

BY PETER F. O'SHEA

Realizing the necessity for training boys to fill executive positions as well as to maintain the supply of machinists and toolmakers, the Greenfield Tap and Die Corporation of Greenfield, Mass., long ago instituted a school to be run in connection with its plant. Located in the company's special product plant and next door to the toolroom, the school is ideally situated in respect to the class of work available, so that while the students are not tied down to tedious repetition work and production methods, such product as the school turns out is of commercial value and renders the institution practically self-supporting.

ONE difficulty in an apprentice school is to combine efficient production with efficient teaching. To accomplish these two objects at once, the best place to locate the school is where it can get a combination of two things: small production orders, such as in a semi-job shop, and toolroom work.

The apprentice school of the Greenfield Tap and Die Corporation is situated on the top floor of the building which is now devoted to the making of special taps: that is, taps and holders which are made in such small batches that they are not assigned to the regular quantity-production plant. The next room to the apprentice school is the plant toolroom, and the door between always stands open. An idea of the equipment and arrangement of the school may be gained from Figs. 1 and 2.

It is evident that some of the simpler operations upon many of the small orders that come to the special tap plant may be diverted to the school without at all inconveniencing the regular course of manufacture on the floors below. The school may also do preparatory work for the toolroom or even carry some of the simpler jobs to completion, and when the apprentices are well trained they may take on almost anything that comes along.

Production Work

On production orders which are accepted by the apprentice school one boy at first does one operation. He lays out his work, describes what he is going to do, and sets up his machine, under the tutelage of a supervisor. After the operation is done, he may be shifted to another on the same product.

At first he does not complete the order, but as far as he goes he is required to submit a sketch of everything he does. He must understand, and perhaps sketch, the work done by other boys on the same product, and know the purpose of each operation.

Each boy's main business is to understand what he is doing; production is incidental. If he doesn't thoroughly understand why he is to do a certain thing, he is supposed to ask the instructor. The superintendent makes it a point quietly to stop beside a boy at unexpected moments and question him regarding the nature and requirements of the work he is doing. If the boy does not understand, he is in disgrace. It is impressed upon him that knowing what he is doing must accompany doing it.

The work done on a quasi-production scale includes milling-cutters of all shapes for fluting taps and other work in the production departments; large numbers of chasers, which are inspected to close limits; and reamers, countersinks, etc., used in manufacture of dies.

Certain orders similar in form though differing in dimensions, are frequently sent up by the tap plant so that they get to be a standard article in the school. After a boy has worked on each of the operations on that product a sufficient number of times to be familiar with them he is assigned to follow a lot through, making the complete product himself on successive machines. Thus, he learns the correlation of operations in the best way possible by doing them himself after he has already learned each step.

The production orders from the factory not only help the school make a profit, but are very beneficial to the students. A boy, while starting out to be a toolmaker, may afterward be called upon to be a foreman, since about the only way in which the thorough mechanical training necessary to a machine-shop foreman can be acquired nowadays is either in the apprentice school or in the toolroom.

A foreman's main business is getting out production, and anyone who expects to hold such a position should have a basic training not only in each individual operation which can be applied to machine work, but in the laying out of successive stages and in scheduling of work. The best way to learn this is to follow certain typical products.

Boys learn very quickly under proper teaching. They learn quickly enough so that while on the successive steps of their progress they are of production value, provided the kind of production is fitted to the school.

Toolmaking Work of Apprentices

Working on production orders accustoms the boy to the use of machines in set-ups which are more or less standardized. After he gets into the way of setting up a machine he may be given some work on a part of a special tool or jig from the toolroom, which gives him experience in setting up jobs that he never saw before.

The tool work he does at first is the simplest possible preparatory operation. He has to lay out the work, make a sketch, and know what operations are to follow his, and why. Soon the boys get so that they can follow the logic of the progressive operations when making simple tools, and then the more complex ones, even though they cannot yet make the complete tools themselves. This stimulates their desire to learn the more advanced operations necessary to complete the tools. They are allowed an opportunity to do advanced work as fast as they prove themselves able to do it accurately and in fairly good time. A boy needs to be taught efficiency and he is not really ready for advanced work until he can, after a preliminary survey, go at it in workmanlike manner.

The superintendent is careful not to assign new work to a boy until he is capable of doing it well, for that would tend to create a habit of doing sloppy work or of "bluffing." On the other hand, it is desirable to give the boy new work as soon as he is ready for it, so that he will constantly exercise the habit of learning, and also have the encouragement of visible progress. During the last twelve months of his course a boy gets enough complicated tool work to do all by himself to enable him to say that he has learned the toolmaker's trade.

The kind of special tool work first given to the more skillful boys is jig and fixture work and the making of special forming tools. Three boys are at present on model work, each boy making a model complete from start to finish.

Costs

For the reason that a boy does not take up difficult work until he can do so with a reasonable degree of efficiency, he is able to do it at a reasonable cost. In fact, the apprentice, knowing that as soon as he finishes one kind of work he can go on with a new variety, tackles each job with eagerness. If he has been properly taught, he can finish up the job well and quickly and the cost may be less than would be the case if the work were done by settled workmen with permanent status and slower progress.

When a production order or toolroom job is done in the apprentice school, the school is credited by the tap plant with the shop cost of such work, which is accurately known. The school is entirely independent of the plant management. It simply leases, so to speak, one end of the floor, for which it is charged a proportional amount of the overhead of the building, in lieu of rent. Equipment, time, etc., are all recorded; therefore, the costs and the earnings of the school are known.

The apprentice school has the reputation of being among the more efficient departments of the corporation. This is as it should be, for apprentices should always have about them a correct example of modern manufacturing. Methods which do not make money are not practical. The earnings of the school exceeds its total expenses, including overhead, equipment, wages, supervision and instruction, by an amount sufficient to give a fair profit on the 40 x 60-ft. space occupied, even considering the school in comparison with the production departments.

The care with which the superintendent assigns work according to the advancement of each boy goes a great way toward the success of the school, both in making it self-supporting and in accomplishing its main purpose, which is to teach the boys to become skillful, accurate and efficient.

How can the superintendent be sure that in all this production work he doesn't lose sight of the interests, training and progress of any one boy? How is he sure that each boy receives his due all-round experience and omits nothing?

A clerk keeps a record of the hours a boy spends on each machine and operation. A sheet for each apprentice for the current month is in the top of the loose-leaf ledger.

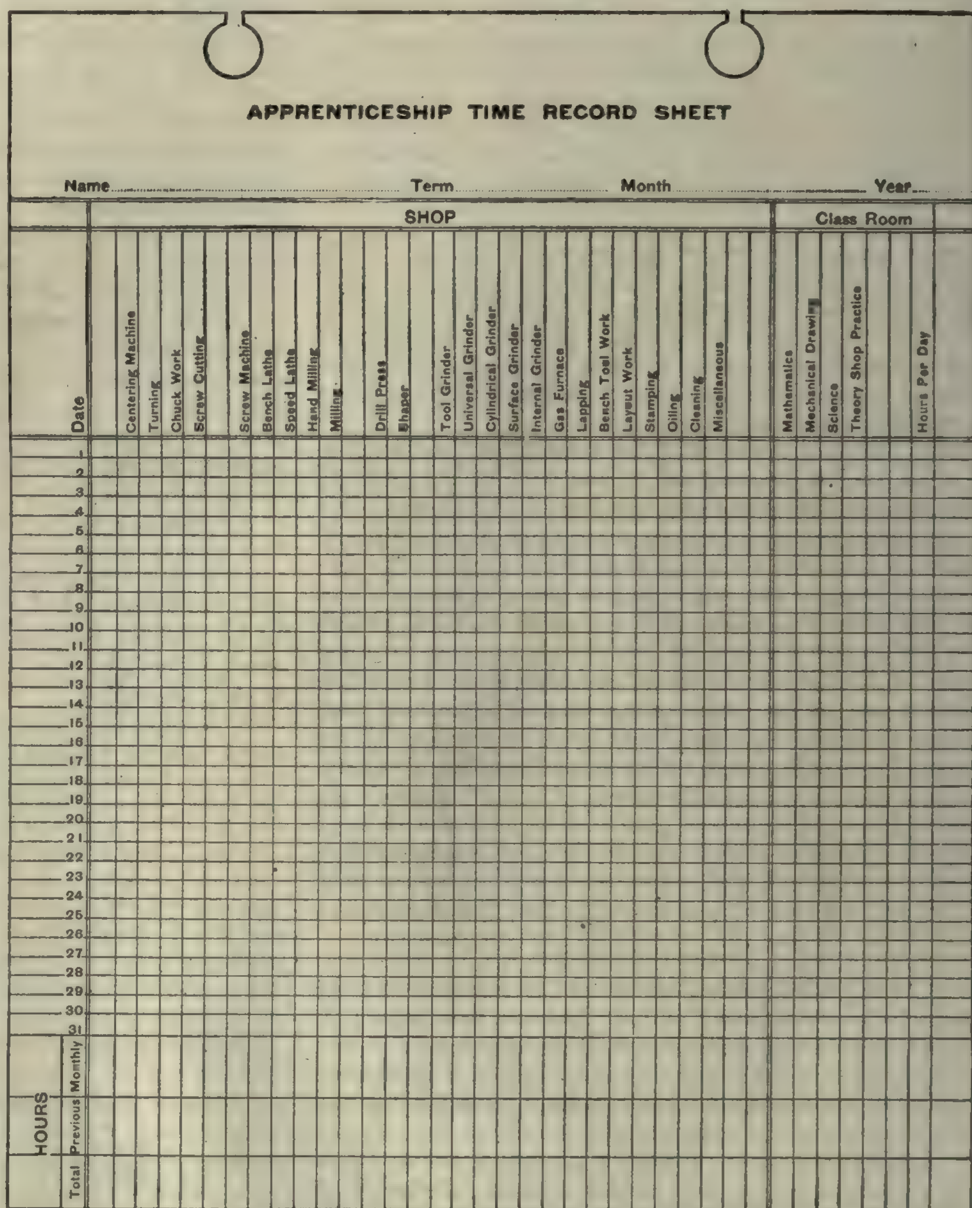


FIG. 1. BOY'S MONTHLY RECORD SHEET

This sheet, Fig. 1, is divided from left to right into columns corresponding to the various kinds of equipment and operations. From top to bottom of the printed form there are 31 spaces, one for each day in the month. The center of the sheet forms a checkerboard over which at the end of the day the clerk distributes each boy's hours from the time cards, setting

down in the appropriate square under each kind of machine the hours spent on it. At the end of the month she adds up each column in the space designated "monthly." The number of hours the boy has previously spent on that machine during his course are added to this to get totals to date, which are along the bottom of the sheet. This sheet shows the variety of equipment in the room, which is compactly arranged as will be evident from a study of Fig. 2.

If on any boy's monthly sheet the total hours given to any one machine appear insufficient the clerk calls the attention of the superintendent to it and he adjusts the discrepancy in his next assignments. A boy is free at so that it will be easier for the superintendent to compare boy with boy and get a bird's-eye view of the class progress.

On a separate sheet which is not shown here, a report of the progress and standing of each boy is mailed to his parents at the end of every three months' term. On this sheet the boy is graded either A B C or D in accomplishment, progress, class work, and general habits. A term report is not only due the parents as the only way of helping them to keep their boys up to the scratch, but has a strong moral influence within the school, since each boy has a certain pride in his comparative record as a workman.

FIG. 2. APPRENTICE SCHOOL OF GREENFIELD TAP AND DIE CORPORATION

any time to look over the record sheets and call the attention of the superintendent to any apparent discrimination. Each boy also knows each other boy's sheets and all idea of unfairness or favoritism is driven out of his mind. This is an important help to the morale of the school and the eagerness of the students to learn.

At the beginning of each month a new set of record sheets is inserted at the top of the ledger, and the total hours from the previous sheets are at once brought forward into the "previous experience" column near the foot of the fresh page; thus the superintendent always has facing him on each boy's current sheet a record of the boy's entire experience. The sheets for the past months remain in the back of the ledger and may be consulted in detail at any time. The records of all the boys are also consolidated into one large master sheet,

There are probably three important elements which go to make the school successful. The first is the location of the school with its opportunities for obtaining proper work. The second is the personality of the instructor. The third is the personality of the boys.

The superintendent of the Greenfield Tap and Die Corporation school is a first-class toolmaker, who has also had wide experience as a foreman, both of production departments and in toolrooms. Though not a youngster, he understands boys and has a sympathetic way with them. He is classed as a superintendent rather than a foreman, and has reason to be proud of his success with the school.

Under him there is a supervisor to every five boys. A supervisor must be a first-class workman, as otherwise the apprentices would soon surpass him. It is his duty to set up machines for beginners, train the boys

as rapidly as possible, and coach the more advanced apprentices upon special work.

The clerk who keeps the boys' records is also dispatch clerk for the room; that is, she keeps track of accepted orders, makes out production tickets, keeps the production record of each machine, is the time clerk, the cost clerk, and the payroll clerk—so far as there is one in the room—and does all other clerical work of the school. The "office" is shown in Fig. 3.

The Boys—An Important Element

The third element in the school is the personality of the boys, who are the real raw material and will be the real finished product.

The boys for the course are chosen with considerable care. Each boy seeking instruction is required to fill out an application, answering questions as to his personal history and experience, if any. The answers and character references are invariably looked up and checked. The boy should have at least the equivalent of a grammar school education and be physically strong, of good character, and of average ability. It is important that he shall have in him the desire to succeed in the toolmaking trade, and that he be mechanically inclined. It is essential that the boy shall have the hearty coöperation and support of his parents. If a boy is desirous of entering, but there is no opening, he is put on a waiting list and sent for when the opening occurs.

FIG. 3. THE "OFFICE" OF THE SCHOOL

Each boy joins the school on probation for the first term of three months. This term counts in his course if he stays. Every boy has to serve this term of probation, including those who enter with advance standing. At the end of this time the superintendent of the room is in a position to decide whether the boy has in him the qualities necessary to make good and complete the course.

The Length of the Course

The course is laid out in a number of hours which will, under normal conditions, cover practically three years. Each year is divided into four terms of approximately three months each. This includes classroom work weekly.

Allowance of from one to four terms of advance standing is offered to well-recommended young men who have had one year or more of varied experience with machine tools, and to graduates of technical high schools. But these apprentices are also on probation for their first term.

There is a difference of about 90 hours per year between the yearly hours specified for the course and the total of working days in a year. These 90 hours are allowed to provide against illness or other unavoidable absence, or the apprentice may use them for a vacation each year if he has completed his required number of hours for that year.

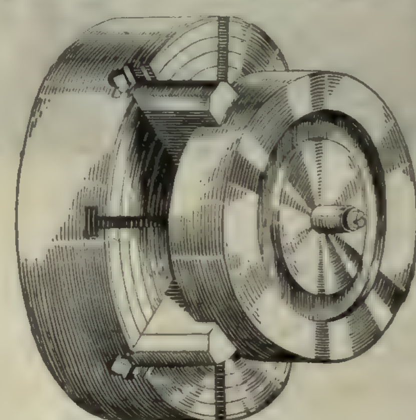
The classroom work referred to consists of not less than five hours a week—usually one afternoon—of drafting, sketching of parts on which work is being done, and shop arithmetic. Classes are held in the dining room of the adjoining plant, with the tables cleared to one side and drafting boards installed during the hours of the class. The formal sketching mentioned is done on a drafting board and is in addition to that done in the shop in preparing work. The instructor is a competent man who used to be on the staff of a large technical high school, and who is now in the engineering department of the corporation. He gives one day each week to the school.

The pay for the school apprentices was started at the rate of 14 cents an hour for the first term, with an advance of one cent an hour for each term, so that at the end of the course the pay would be 25 cents an hour. Realizing that this rate was too low under present conditions, the company in 1917 gave the superintendent authority to pay the boys a bonus up to as high as 20 per cent. depending on their efficiency. Upon completion of the course, the company pays each boy a bonus of $100 in cash and gives him a set of tools, complete enough to meet his requirements as a toolmaker, at a cost of not less than $60.

A Precaution in Boring Large Holes

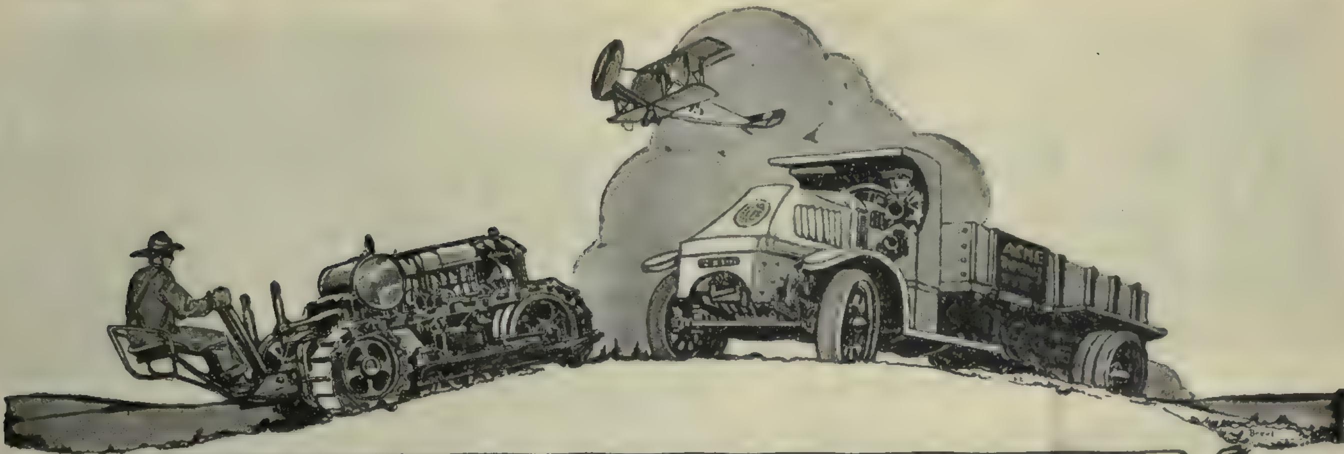
By Gustave A. Remacle

When a job has been clamped to the faceplate of a lathe and adjusted to run true either by means of a button or prick-punch mark, before the button or mark has been removed or disturbed I often machine a groove as shown in the sketch, carrying it out almost to the ultimate diameter of the hole to be bored. Should the job shift during the roughing out process, the error can be easily detected and corrected by indicating this groove.



A PRECAUTIONARY MEASURE IN BORING

Without this precaution I would be in constant fear lest the job shift and would work very carefully in pushing a large drill or taking a heavy boring cut. It takes but a few minutes to machine this groove because only one side need be smooth and run true.



AUTOMOTIVE CONSTRUCTION

Building "Quad" Trucks for the Army

BY HARRY SATTERTHWAITE

The need of the army for trucks of the "Quad" type for field work, intermediate between that of the standard trucks and of the tractors, made necessary the utilization of automobile factories which had had no experience in this sort of work. This article describes the progressive assembly of the chassis at one of these plants and also several machining operations on chassis parts.

WHEN the United States entered the war, the Government was faced with the necessity of securing an immense amount of material, much of which was not being produced in sufficiently large quantities to meet the demand. Motor trucks were one of these prime requisites, especially those with power on all four wheels, commonly called "Quads." These were used principally for hauling artillery, ammunition, mobile repair shops, and heavy supplies, and were absolutely indispensible where the "going was bad" near the front.

FIG. 1. AXLE ASSEMBLY ROOM SHOWING MONO-RAIL TROLLEY

At the time of the Declaration of War, the Government had no completed and tested design for the four-wheeled-drive trucks, and to facilitate delivery adopted two trucks of this type which were being produced commercially, and which had been in use by the allied countries in the preceding years of the war. These trucks were of different types of drive; one using the conventional passenger construction, the full floating axle, and the other having the internal gear drive as used on a number of commercial vehicles. Each of these types has its champion and each its advantages from some standpoint.

Because of the large number of trucks needed in a short time it was necessary that other factories than the parent companies should engage in their production, and, consequently, several plants were turned over to this work without their having previous experience or special facilities for its performance.

Prominent among these was the National Motor Car and Vehicle Corp., Indianapolis, Ind., large manufactur-

FIG. 2. "QUAD" WHEELS IN THE SEPARATE ASSEMBLY ROOM

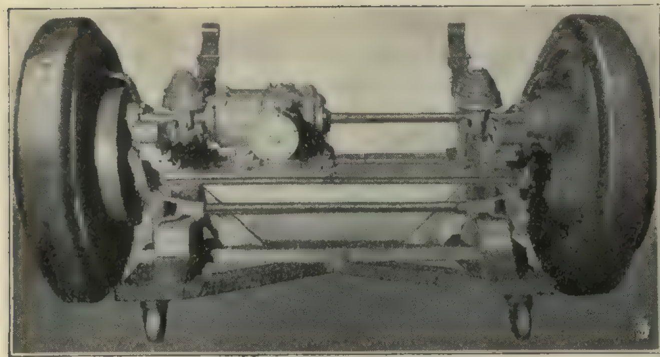


FIG. 3. AXLE ON "DOLLIE"

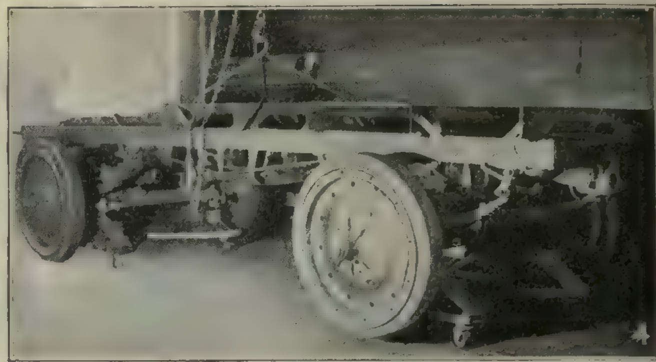


FIG. 4. ASSEMBLING FRAME AND AXLES

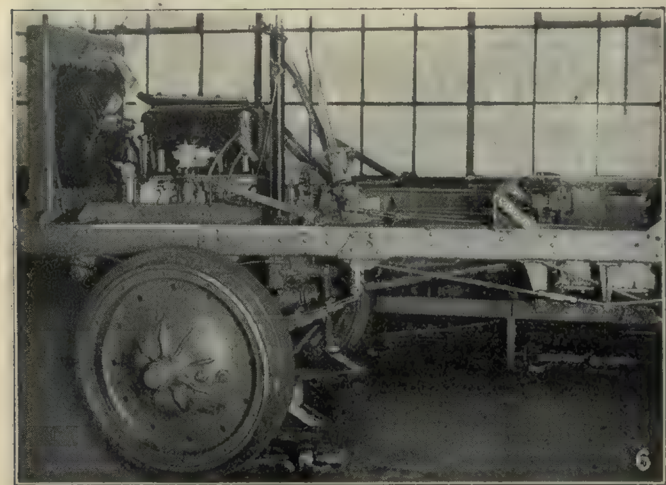


FIG. 6. ASSEMBLY OF RADIATOR, STEERING GEAR, ETC.

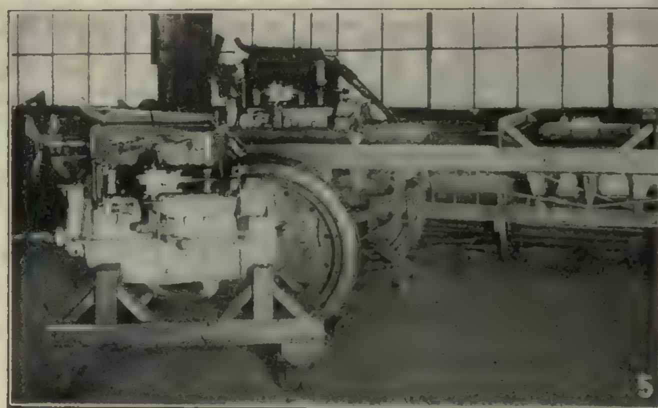


FIG. 5. INSTALLING MOTOR AND TRANSMISSION

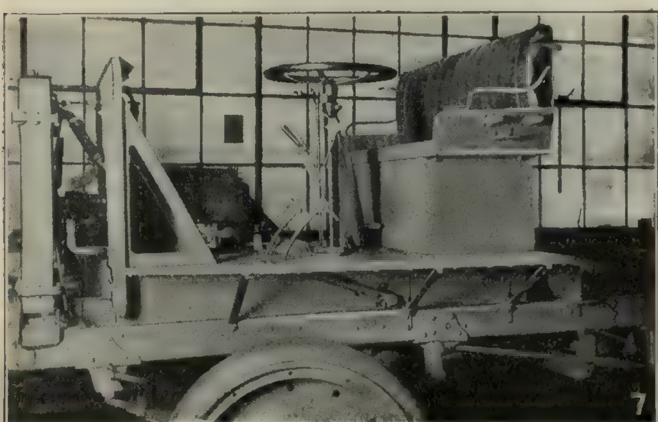


FIG. 7. THE SEAT AND PLATFORM MOUNTED

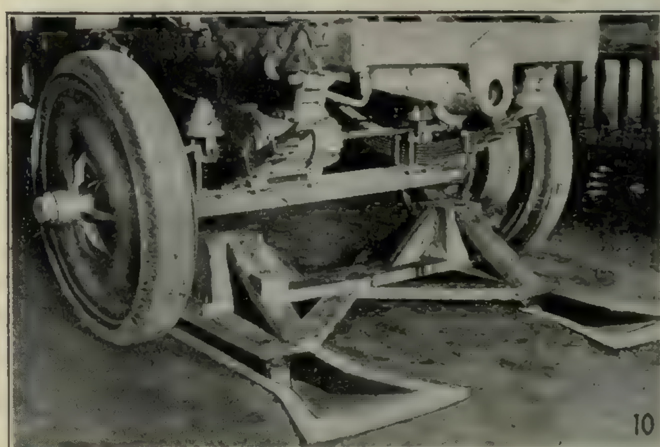
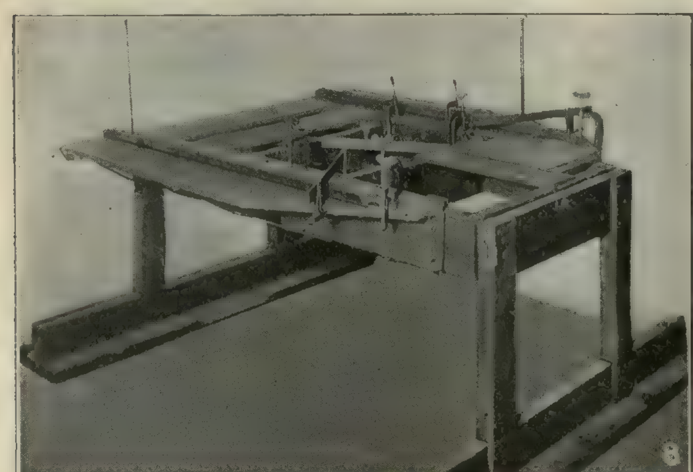
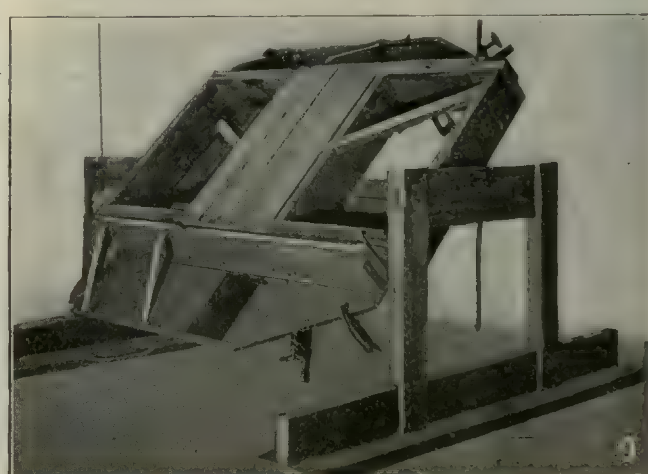


FIG. 10. ON ITS OWN WHEELS FOR THE FIRST TIME





FIGS. 8 AND 9. THE PLATFORM ASSEMBLING JIG

AUTOMOTIVE CONSTRUCTION

FIG. 11. ROAD-TEST GARAGE

ers of high-grade passenger automobiles, who undertook the manufacture of several thousand of the trucks with the internal gear drive. They constructed and installed the special equipment and facilities, illustrated and explained in this article, which enabled them to make an enviable record in the production of the trucks so badly needed by the Government.

Not having machine equipment of the type and amount necessary to manufacture the larger units, they were forced to sublet them to specialists in these lines. The motors and transmissions were made by the Haynes Automobile Co., under license from the Buda Co., and the axles were made by the Columbia Axle Co. These companies coöperated to the best of their ability in the rapid production.

The National factory, like "Topsy," just "grew up." Being one of the oldest manufacturers of motor cars in the country, its plant has been added to as the business increased and, because of its restricted surroundings, these additions have not resulted in as perfect an arrangement for manufacturing as is enjoyed by some of the companies entering the field in later years in a big way and having plants erected to suit their specific needs.

The part of the factory formerly used for final test and shipping purposes was used for the truck assembling. An electric mono-rail hoist system was installed reaching from the loading platform in the rear, alongside the assembly building and into the opposite end, thence back through the building to the center. A switch in the track connected with the general storeroom, thus providing means of quickly unloading bulky material and carload lots, depositing them at the entrance of the storeroom where the receiving inspection department was located. This mono-rail was also used to bring truck frames from storage to the starting end of the assembly line, and is shown on the inside of the building in Fig. 1.

The first operation in the truck assembly is to spray the frames, as they are brought in on the monorail, with the olive-drab paint which has become so familiar to all. This is done in a large booth equipped with motor-driven exhaust fans which carry the fumes away from the workmen.

In equipping for the truck production a central paint tank was provided, with a circulating pump to supply all the spray equipment in the various parts of the building. In this manner all the paint was of the proper consistency; there was no loss from evaporation and no lost time from operators constantly replenishing their supply. The paint was kept in constant circulation at the desired pressure which was controlled by an automatic valve.

The frames were passea on to a drying station and from there moved to the next station where the brackets not furnished with the frame were applied. When this operation was completed, the frames were placed on a caster-equipped wooden truck, and moved to the next station where the axles were attached.

Both the front and rear axles were fitted with springs, wheels, propeller shaft companion flanges, grease cups, etc., adjusted and greased in a separate assembly room located in the same building, Fig. 2. In this department they are placed on wood "dollies" mounted on casters, and delivered to the assembly floor in the manner shown in Fig. 3.

A front and rear axle, each on its "dollie," are placed in position on the assembly floor and the frame lowered to them by means of a hoist on an overhead track, Fig. 4. The spring bolts which attach the springs to the frame are placed and the assembly is pushed down the line on the "dollies" which brought the axles to the assembly floor.

At the next station, the transmission and motor are placed in position and bolted to the frame, as shown in Fig. 5. The motors are fitted with magneto, carbureter, spark plugs, wiring, clutch and propeller-shaft flange in the factory's motor-assembly department in another building, and brought to the truck-assembly floor on specially constructed trucks as shown in the illustration.

The control set, pedal assembly, gear shift rods and brake rods are attached at the next station, followed by the steering gear and radiator as shown in Fig. 6. This completes the assembly of the mechanical units

FIG. 12. PAINT-DRYING ROOM

AUTOMOTIVE CONSTRUCTION

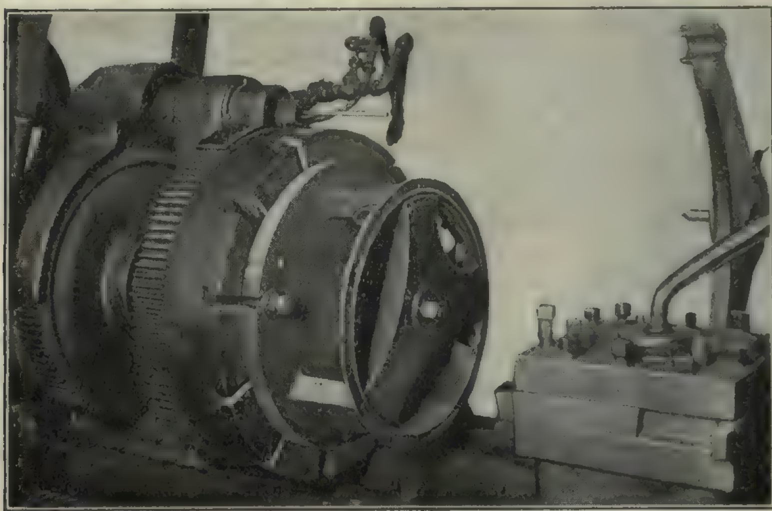


FIG. 13. MACHINING THE CLUTCH HOUSING—FIRST OPERATION

and the seat platform with the seat attached is mounted and bolted in place at the next station, Fig. 7.

This seat platform is assembled from previously cut lumber on the assembling fixture shown in Figs. 8 and 9. The platform is held together by being bolted to various irons made from angle and bar stock. These are formed to templets in the forge shop and drilled for the bolts in the machine shop, coming to the assembly jig in the body-building department, ready to set on the jig and have the boards clamped in position as shown in Fig. 8. The fixture is then revolved on trunnions, Fig. 9, so as to bring the holes in the irons in position where they can be reached and the holes in the boards drilled with electric portable drills. The bolts are placed and tightened and the platform is lifted from the fixture and another one started. Two men on a fixture assemble 25 to 30 platforms in a day of eight hours.

The trimmed seats are then attached, the assembled unit trucked to the paint spray booth and, when dry, to the assembly floor to be placed on the chassis. Electric transportation trucks are used for trucking from one building to another, thus saving much hand labor.

After the seat platform is bolted in place, the truck is moved to the next position where oil, gasoline and water are supplied and the motor started. Up until this last move, the truck has been handled on the "dollies" which carried the axles. As the truck is pulled to this position by the truck immediately preceding it in the assembly line, the "dollies" run down a slight incline into slots in the floor which are deep enough to allow the axles to pass over the tops of the "dollies" as the tires rest on the floor. This discharges the "dollies" at a point just in front of the elevator on which they are placed and sent to the axle-fitting on the the next floor, where another axle is placed on them and they again start on the trip along the assembly line. Fig. 10 shows a truck which has just discharged its "dollies," and is on its own wheels for the first time.

The trucks are fitted with tops over the drivers' seat and then driven onto a turntable, turned through an angle of 90 deg., which brings them in line with the door, through which they pass out to the road-test department on the opposite side of the street.

The trucks are assigned in order to the members of the road-testing crew who "put them over the road" in an effort to find any hidden flaws or careless and imperfect work. A view of the headquarters of this department is shown in Fig. 11. After the trucks have been passed by both the National and the Government inspectors, they go to the wash-stand which is equipped with hot and cold water, steam and gasoline washing devices. From this room they move into a spray booth where the final coat of paint is applied and they are then stored in the room shown in Fig. 12, until they are dry enough to run into the open.

Fig. 13 is a view of a Gisholt turret lathe fitted with tools for machining the clutch housing, first operation. A fixture attached to the spindle of the lathe has three posts against which the casting is held by the triangular spider. The joint face and the male pilot, which fit the rear end of the motor crank case, are finished using forged tools in the cross-slide turret.

The next operation is shown set up on a Davis turret lathe in Fig. 14. In this operation the bearing bore, shaft clearance bore, and outside face are roughed, using the combination tool with inserted teeth, shown at *A* in the front of the illustration. The next bar *B*, shown to the right, finishes these three surfaces, using double-end cutters. The next bar *C* is placed through the finished bore and a flat-facing cutter is inserted by passing it through the hand hole in the top side of the casting. By pulling back on the turret the inside face of the casting is finished so as to give the proper clearance for the clutch-actuating parts.

Fig. 15 is an illustration of the fixture used to mill the spring shackles which are of the conventional type, a rough-forging *A* and a finished piece *B* being shown

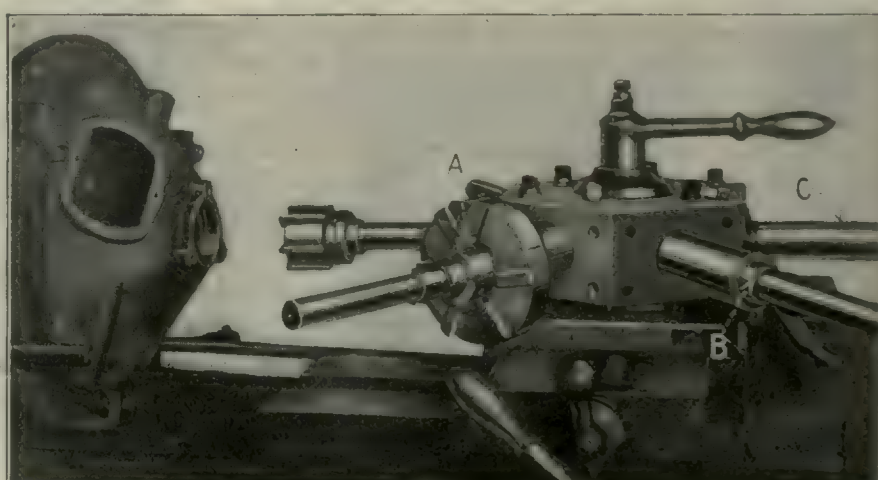


FIG. 14. TURRET LATHE OPERATIONS ON THE CLUTCH HOUSING

AUTOMOTIVE CONSTRUCTION

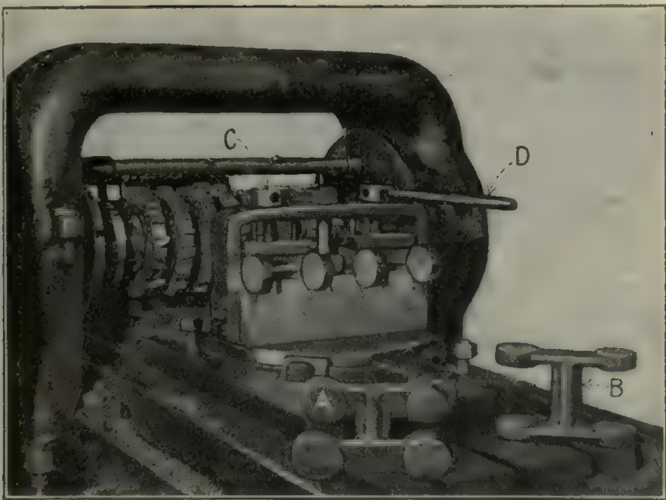


FIG. 15. MILLING SPRING SHACKLES

in front. The two ends of the shackles are identical as regards the milling which permits of them being milled in this indexing fixture. Two forgings are held side by side, being clamped with the round-headed screws *C* operated with a pin handle *D*. Two of these fixtures are used, one each side of the cutters. As the cut is finished on one end of the forgings, the table is traversed to bring the forgings in the opposite fixture up to the cutters and they are machined while the first set is being indexed for their second cut, or replaced with rough-forgings if need be. The two fixtures are located on the table so as to require the least travel possible which gives practically a continuous milling set-up.

Two Drill Jigs for Motor-Truck Work

By I. B. Rich

One of the pieces to be drilled, a part of the clutch, is shown at the lower right-hand corner of Fig. 1, and it will readily be seen how this slips into one of the four openings of the drill jig as shown at *D*. The plate *A* fits on the two guide posts *BB* and it is lifted off to put the pieces in place and to remove them after being drilled. This plate carries 12 bushings.

The projection *C* on the work slips into the opening *D* while the slot goes over the ears *E* and *F* of the slide which prevents the drill pressure from closing them during the operation. Then the work and its holder are moved forward under the holes in the drilling bushings by means of the handle *G* which can be applied to any one of the four square studs shown.

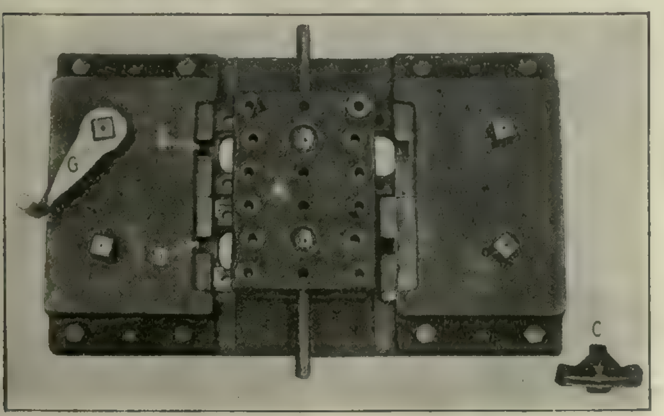


FIG. 1. DRILL JIG FOR CLUTCH BOSS

In Fig. 2 is shown a five-station rotary drill jig for drilling the small end of the brake-shaft levers shown in foreground. The hub of the lever fits over one of the central studs *A* while the outer end is centered by the V-blocks *B*, controlled by the cam *C*. The two sets of stubs enable the same fixture to handle two different sizes of levers, and as a two-spindle Baker drilling machine is used, it allows the drilling and reaming of holes at the same time. The fixture is rotated from one station to the next, which makes the operation continuous.

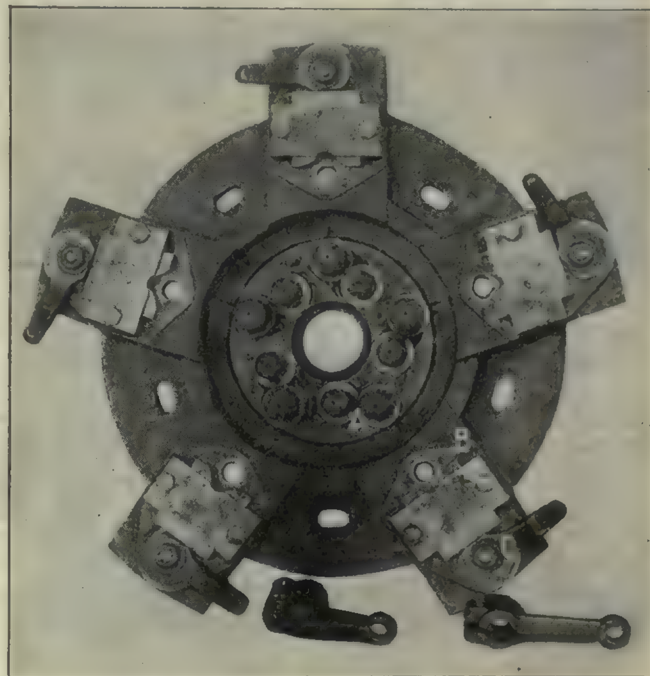


FIG. 2. A STATION-TYPE DRILL JIG

Bearing in mind that this is for comparatively small production, it will readily be seen that numerous modifications can be made so that it may be applied to a variety of work. These tools are in use in the shops of the Autocar Co., Ardmore, Pennsylvania.

Boring and Milling Transmission Housings

By Fred H. Colvin

The methods used by the Chandler Motor Car Co., Cleveland, Ohio, in machining its transmission housing, are illustrated in Figs. 1, 2 and 3. In Fig. 1, which shows the initial operation, the fixture is bolted to the face of a substantial chuck and utilizes the chuck jaws for holding the inner end of the casting, while the fixture itself centers and supports the outer end. The central hole and the large outer flange of the aluminum casting are machined in this operation, the hole and the flange being used for locating the piece during future operations.

AUTOMOTIVE CONSTRUCTION

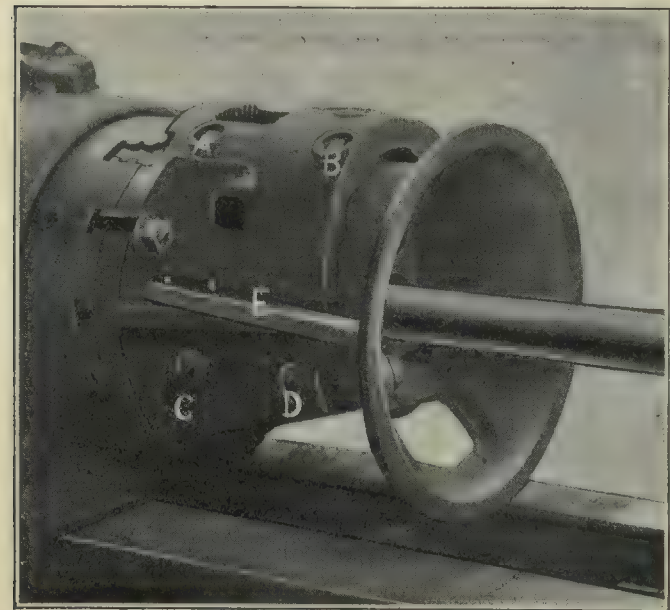


FIG. 1. FIXTURE FOR BORING HOUSING

By studying the shape of the casting from Fig. 2, it will be seen how the screws *A* and *B*, Fig. 1, center and support the casting each side of the upper horizontal opening, while screws *C* and *D*, matching corresponding screws on the other side of the fixture, support it at a number of points so as to avoid springing, and at the same time provide sufficient hold for driving during the boring and facing operations. The bar *E* adds to the support of the flange, and the whole fixture is carefully balanced by blocks of metal so as to avoid undue vibration in the lathe.

In Fig. 2 the piece is located on the angle fixture by the flange which has already been faced, while the

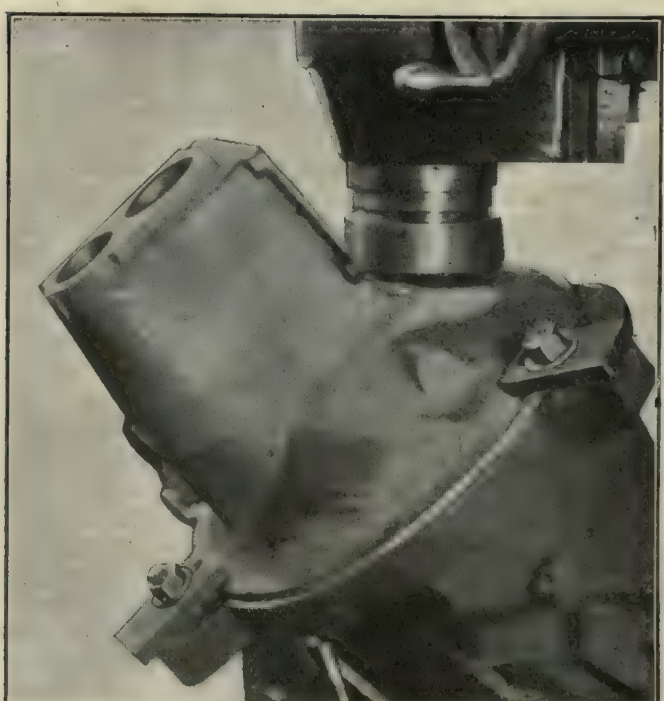


FIG. 2. MILLING HAND-HOLE OPENING

angular hand hole, which allows access to the clutch, is being machined by a vertical cutting machine. The boring of the second hole is accomplished with an offset fixture which is not illustrated.

Fig. 3 shows the way in which the holes for the clutch-operating shaft are drilled and faced on the inside. Here the housing is mounted in the special fixture shown, being centered through the main hole by a suitable pilot and clamped in position by the C-washer and nut *A*. This locates it in proper position so as to have the holes at the right angle, and the first hole is drilled through a suitable bushing in the fixture. The fixture is then revolved 180 deg. and the opposite hole drilled.

After this the holes are line-reamed straight through so as to correct any slight inequality in alignment and

FIG. 3. BORING HOLE FOR CONTROL SHAFT

the inner ends of the bosses are surfaced by the double-ended cutter shown at *B*. This is mounted on a plain bar, held in position by a pin, and the ends back-faced in the usual way. While such shaped pieces are somewhat awkward to handle, the illustrations indicate how a little ingenuity overcomes all such handicaps.

Stamping the Size on Mandrels

BY JOHN A. GRILL

On page 278 of *American Machinist* E. M. Long, under the title "What's in a Name?" wants to know why manufacturers of lathe mandrels do not mark their product on the small end so that a workman may know which way it is to be put into the work.

In all my experience I have observed that, in the case of mandrels regularly made for the market, the size is stamped on the *large* end. I know that Brown & Sharpe and other large manufacturers of this class of tool follow this practice.

If Mr. Long will familiarize himself with this common custom, a few moments' reflection in each case should convince him that it is the other end that goes in first.

Notices and Claims Under Compensation Acts–I

BY CHESLA C. SHERLOCK

This is the first of three articles dealing with the technicalities incident to the reporting of accidents and the obtaining of compensation under the compensation acts. The necessity for prompt notification in case of accident is brought out in some detail.

EMPLOYERS who have been following the growth of the workmen's compensation acts and the decisions of the courts relating thereto have probably been surprised to note the growing tendency on the part of the authorities to lay more stress upon the technicalities of the law than has been true in the past.

When the compensation system was in its infancy, slight stress was laid upon the technical demands of the law. If a workman failed to present his claim in the proper manner or was a little slow in presenting it at all, the tendency was to resolve the doubt in the favor of the employee and proceed to apply compensation benefits anyway.

While this was the early tendency of the compensation commissions no such broad thought is to be found in the more recent decisions handed down by the courts which have had occasion to review these decisions. The courts have taken a firm stand in favor of a strict construction of the technical provisions of the compensation acts, and they have, consequently, had a tendency to bring the commissions up sharp.

The compensation acts, without exception, contain provisions making it necessary for the injured workman to give notice of his injury or of any accident that may occur in the course of his employment, within a certain specified length of time. While the statutes in the respective states do not agree as to what this length of time shall be, the majority of them provide that the notice of the accident must be filed with the employer within 30 days from the time it occurred.

While there may or may not be reasons for thus arbitrarily fixing a limitation upon the time in which an employee can file notice of an accident or injury, that is not for us or the courts to discuss. It is a legislative move which can be considered only as it is given to us.

The legislative authority evidently had it in mind to encourage the early report of accidents in order to make it as easy as possible for the employer to inform himself as to the facts surrounding them, and not permit employees to delay the matter or the question of the employer's liability until such time as suited their whims or made it more convenient for them to press their demands. Witnesses are often tampered with and sometimes lost sight of, and unless the employer has an equal chance to ascertain the facts as soon after the accident as possible, he is being put at a disadvantage which cannot be too strongly emphasized. Then, again, it is manifestly unfair to keep employers in a state of suspense and unrest as to their actual liability under the compensation acts. The compensation acts sought to fix a liability upon each employer, so certain and definite that he could insure his risk thereunder in some insurance carrier.

In a New York case decided last year it was stated in the footnote by the court: "The provision of the New York Workmen's Compensation Act providing for written notice of injury to be given by an employee within 10 days after disability must be complied with by giving prompt service of the notice in order that the employer may have an opportunity to investigate the circumstances of the claim." Also, ". . . it must be presumed that the opportunity for prompt investigation by the employer is one of value."

It is presumed that where a workman has failed to comply with this provision of the compensation acts, he has thereby prejudiced the rights of the employer. The claim is not completely barred, although it will be necessary for the injured workman to sustain the burden of proof in court and show that his failure did not, in fact, prejudice his employer's rights. If he is unable to make this showing then his right to compensation for injury is lost.

BEGINNING OF LIMITATION PERIOD

The greatest difficulty under these acts, however, is to determine whether the time commences to run from the date of the accident or from the date of the disability, these two often being separated by a lapse of time, although the disability is due to the original accident. There is only one way to settle this and other questions arising upon this phase of the compensation acts, and that is by a careful examination of the decisions of the courts which have been called upon to render decisions covering it. And in this connection it is well to keep in mind that the decisions mentioned in this discussion are of very recent origin. All have been decided within the past year, unless otherwise expressly stated.

In an Indiana case it was shown that the workman sustained a hernia in June, 1916, but that he continued at work, with the aid of a truss, until January, 1917, when he was forced to give up work. On Feb. 7, 1917, he gave the statutory notice of injury and on March 19, 1917, he made formal application for compensation. The court held that under the circumstances the injury did not develop until January, 1917, and that the proper notice was given within 30 days.

In a California decision handed down in 1917 it was pointed out that where notice has been given of an injury and compensation paid, but that later greater disability arises from the same injury, it is not necessary to give a new notice. All that the law requires is notice of the original injury.

As to the sufficiency of the notice to be given, the Texas court held that the phrase "as soon as practicable" does not mean as soon as possible, "the word 'practicable' importing a difference according to the circumstances, and meaning ordinarily that the thing must be done as soon as reasonably can be expected."

In a Michigan case the injured workman did not report his injury to the employer, and the only person to whom he mentioned it was to one who was subordinate to him in the employer's factory. Said the court: "It appears that the deceased mentioned his alleged injury to two employees of the defendant; one, the witness Kelleher, 1½ days after the alleged accident; and the other, the witness Bennett, in the summer or fall following.

It appears that Kelleher was not an officer of the company nor a proper person to whom to report the injury. The testimony is conclusive that he was working under the deceased, who was acting as yard conductor, and, being a subordinate employee, notice to him cannot be held to be notice to the company. . . . In reference to the witness Bennett, it appears that he was a general yardmaster, and conceding for the purpose of this case that he was a proper person to whom to report of an injury should be made, the record seems to be undisputed that no report of the injury as such was ever made to him, and the only knowledge he had thereof was the result of a casual conversation with the deceased."

This is to the effect that an oral communication of the fact of injury is not sufficient compliance with the law.

In Michigan the statute provides that "no proceedings for compensation for an injury under this act shall be maintained, unless a notice of the injury shall have been given the employer three months after the happening thereof." The law also provides that claims for compensation must be made within six months after the occurrence of the injury, but if the claimant is physically or mentally incapacitated, within six months after the removal thereof. It was claimed by the claimant that following the injury he was physically incapacitated from giving notice, and that as soon as the incapacity was removed the notice was given.

Notice of Accident Must Be Given

The court held that the expression in the statute relating to incapacity related to filing a claim for compensation and that it had no application to the duty to give notice of the injury received. This is a distinction that should be kept in mind by all employers. The duty to give notice of the accident or injury is paramount to everything else; the duty to bring a claim for compensation can be allowed to wait, depending upon the circumstances, but that is not true in the first instance.

In a New York case the workman, while working alone, injured his hand with a tack. He continued work for several days, when an infection set in and it was necessary to perform several operations on his arm. He did not give written notice of the accident until two months after the operations were performed.

The Industrial Commission held that the employer was not prejudiced by this failure to give the notice "for the reason that there was no one present when the accident occurred, and therefore the employer could obtain no affirmance or denial of the fact of the accident, and for further reason that as soon as evidence of infection appeared, Hynes was under the care and attention of a duly authorized medical practitioner."

The court reversed a decision of the appellate division affirming this decision, saying: "The logic of the commission seems to be as follows: Because the claimant tells the truth as to his accident; because no one was present to contradict him; because later blood poisoning developed and developed as a result of the injury; because a licensed physician attended him who was presumably competent—no investigation could have been useful to the employer.

"This is reasoning in a circle. Notice and consequent chance of investigation is given for the very purpose of enabling the employer to test the good faith of the claimant. Without it no contradiction is possible. If many are present at the time of the alleged accident; if their stories agree; if there is no doubt of the injury and its results—there may be a basis of the finding that lack of notice did no harm. But assume that the injury was so slight as not to cause attention at the time; that no physician was called for 11 days; that the accident is remembered only after the lapse of six or perhaps 13 days; that blood poisoning may result from any slight prick, any scratch, any bite of an insect, then the absence of witnesses would seem to require rather than to excuse notice."

Wherever in law it is required that notice be served upon another, the question always arises as to whether it is necessary to give such notice when the other party has knowledge of the fact already, or has been placed in such circumstances that he cannot help having prior knowledge of it. This question of "knowledge and notice" is one that has caused a great deal of discussion in the courts and it even crops out in the compensation acts.

In a Massachusetts case decided in 1917 it was held that oral notice given by an employee of an injury to his employer cannot be said to constitute knowledge on the part of the employer which would obviate the giving of written notice of injury as required by the compensation act. In another case decided by the same court in the same year it was held that such knowledge as would excuse the giving of written notice of an injury must have been acquired within the time when written notice should have been given; that is, "as soon as practicable."

In a Nebraska case it was held that where the employer admits that he knew of the injury and the death of the employee the necessity of giving notice thereof is obviated.

In another Massachusetts case it was shown that the employer had rendered a report of the accident to the proper authorities. The court said: "The fact that a report of the injury was made by the employer is amply sufficient to warrant a finding that the subscriber had knowledge of the injury in accordance with the act."

Foreman Presumed to Be Owner's Agent

In a Maine case it was held that if a foreman who has complete superintendence of the men has knowledge of the injury that it obviates the necessity of a written notice to the employer, the foreman being presumed to be the "agent" of the latter. The court said: "The decision of the commission does not, we think, carefully distinguish between findings of fact and rehearsals of evidence, nor between notice and knowledge. Knowledge is not the notice required by the statute. Oral notice is not the statutory notice and although the employer may obtain it from the former knowledge of the injury, it is not necessarily knowledge within the meaning of the statute. We conclude, however, that the decision contains sufficient to show that the commission finds that the foreman, Penwarden, had seasonable knowledge of the injury, and that the discussion as to notice may be separated from such finding and treated as reflections by the way."

In a Texas case it was held that verbal notice given to a foreman within two or three days after the injury was sufficient notice within the meaning of the act and satisfied the provision regarding notice.

In an Indiana case the court said: "The knowledge of the foreman under whose direct and immediate supervision appellee worked from day to day must be regarded as the imputed knowledge of the employer, and for the

greater reason the knowledge of the superintendent of the factory who had general supervision of the plant must be held to be the imputed knowledge of the corporation. No other construction can be made to harmonize with the manifest legislative intent as revealed by the statute itself."

In a New York case the commission held in a case where notice had not been given within 10 days, as required by the statute, that the employer was not prejudiced because the factory superintendent had heard of the injury within 10 days. The court refused to sustain this finding, declaring that it made oral notice equivalent to the written notice the statute requires.

It is fairly well settled that where the failure to give notice within the time specified by the statute has not prejudiced the employer, it will not be fatal to the right to compensation, especially where it was not due to any effort to mislead or deceive the employer.

A case was recently decided in Wisconsin where it was shown that the workman was employed in a camp some 10 miles from town and that he received an injury which later caused his death. His wife had to walk back and forth to town for supplies and medical aid and during the interval mailed two letters to the employer. These, however, were not mailed until the expiration of the statutory period. Since it was shown that no effort had been made to mislead the employer and that he had not in fact been misled or prejudiced in his rights, the court sustained the finding of the commission awarding compensation.

The whole question of notice of an accident or injury to be given to an employer has been pretty well covered by these decisions, which should point out to employers that they are acquiring some definite rights under these later decisions of the courts that it may pay them to examine carefully. The time limit set upon the filing of notice of accident or injury is not, in any sense, an effort to cut any workman off from the just benefits of the compensation act to which he might be entitled, for the courts even now will extend the mantle of protection afforded to him when so doing does not in any way alter the employer's rights.

The time limit is in the nature of a miniature statute of limitations which is put there for the protection of the employer and which seeks to confine his liability to a given, definite point of time. No employer can be entirely uncertain, under such circumstances, as to just what his liability under the compensation acts may be, for the limitation is constantly either extinguishing or bringing to light, within its period, evidences of his liability.

Employers, however, who attempt to use this safeguard fraudulently or to take advantage of their workmen who may not know about it will receive no sympathy at the hands of the court. It is not there for that purpose; it is there for the purpose of focusing the employer's liability.

Employers should be very plain and explicit to their employees, making it especially emphatic that all accidents must be promptly reported and notices of injury given as soon as practicable after the injury occurs. If workmen know that any dilatory tactics on their part will extinguish their rights to compensation, they will make prompt reports and this will aid the employer in getting the facts quickly and make for a speedier settlement all around, which is one of the basic reasons for the existence of the compensation acts.

We have found, then:

1. That the provision of the statutes relating to notice of accidents or injuries received must be substantially complied with.

2. That oral notice may be sufficient, if communicated to the employer or to some one standing in a representative capacity, but it is always wise to make the notice in writing, as is required in New York.

3. That while knowledge may be notice, it is not to be trusted and the statute should be complied with in spite of it.

Pipe Dreams of a Tramp Machinist—English as She Is Spelled

By Glen Quharity

One day, some time after electric lights had become common at Brookdell, a shop order made out in due form came to the desk of Tom Jones, the master mechanic, to "repair 1 leight."

The order bore the signature of a comparatively new foreman in one of our manufacturing departments which was housed in an outlying building away on the other side of the shop yard and across the brook. Tom had put his official O.K. on the order and sent it by shop mail to Bill Shailer, the engineer who was the immediate boss of everything electrical around the plant.

Next day the same order reappeared on Tom's desk, O.K. and all. Tom scratched his head and wondered if he had dreamed about that order yesterday; then he sent it back to Bill. Next day the same order turned up again in Tom's mail box, and this time Tom is worried. He grabs the telephone, gets Bill on the wire and roars "S'matter'd'ju, you ole fat head? I sent you Van Dorn's order to fix a light and it's come back three times. Don't you fellers know how to fix a 'lectric light?"

"Ain't nothin' the matter with no light over there," says Bill. "I sent a man over three times and he can't find no trouble."

"Aw'rite!" says Tom, as he hangs up the 'phone and pushes a button for a boy. The bell was promptly answered by a junior cub from the machine shop, just outside of which Tom's office was located, and when the boy appeared Tom handed him the order and said: "Take that order to Van Dorn, make him show you the light and tell you what's the matter with it."

The boy disappeared with the order and in due time returned, saluted respectfully and said: "Mr. Jones, I am disappointed in you. I had supposed that you possessed a superior education, and I find you falling down on a simple example in orthography."

"No son," Tom confessed rather sadly, "I never had much schooling. When I was a kid the schools were not what they are now, and we boys had to get out and hustle at an age when you fellows are mooning over a desk in the high schools. What have I done now?"

"It's my duty," said the boy solemnly, "to inform you that l-e-i-g-h-t spells *lathe*."

"The h—l you say!" roared Tom, as the boy vanished quickly through the machine-shop door to avoid being hit by anything that might happen to be following him.

Tom changed the order to conform to his own crude notions of spelling and dispatched it to the machine shop with the request that the junior cub be sent to make the repair.

Modern Aviation Engines—II

By K. H. CONDIT
Managing Editor, *American Machinist*

IN this installment of airplane engine sketches we are showing the engines of the more conventional type about which the French aviation program was built. At the beginning of the war France was about as well equipped with aviation material as any of the belligerents, but at that time very little was necessary to hold one's own in this field. The engines, however, were of the rotary type which had been successful on account of their lightness and in spite of their unreliability.

There was little to choose between the antagonists until the Germans brought out the fast Fokker pursuit machine which showed promise, for a while, of driving the Allies out of the air. The emergency was met by the appearance of the first Hispano-Suiza aircraft engine designed by the Swiss engineer, Marc Birkigt, and built by the makers of Hispano-Suiza automobiles whose factories were in Barcelona and Paris. These motors were built in a number of models both for land and seaplane work but they achieved fame in combination with the famous Spad single-seater fighters which were designed for them in time to turn the tables on the Fokkers. A later model in the British SE5 was equally successful.

The same basic principles appear in each of the many models. The aluminum crank case is made in two halves, the crankshaft being held in four plain bearings and one radial ball bearing, the lower halves of the plain bearings coming away with the lower half of the case. The tubular connecting-rods are of the forked type, and in the latest American models are fitted with detachable bronze boxes of the marine type, a much more satisfactory job in many ways than the original. The cylinders are steel sleeves with closed tops, except for the valve seats, and screw into aluminum water-jacket blocks on the top of which are the camshafts. The cams act directly on the ends of the valve stems which are hollow and fitted with mushroom-headed adjusting screws. The first model, A, was rated at 150 hp. at 1450 r.p.m. and made the reputation of the line. It was later re-designed and became the model I with a slight increase in power. An increase in revolutions per minute and compression ratio brought the horsepower to 180. This is the present model E high-compression, or "pussé" Hispano, used in the later Spads and SE5's.

The 300-hp. model H shown here was developed later and showed great possibilities although it did not really get into production. It is essentially the same as the other models mentioned but with greater dimensions. The first of these motors was brought over from France during the winter of 1917-18 and was practically re-designed at the Wright-Martin factory. One of the first motors turned out by them was used by Major Schroeder when he broke the world's altitude record at Wilbur Wright Field with a Bristol Fighter in October, 1918. The motor was fitted with special high-compression pistons for this flight.

The "300" Hispano was also used in the Loening monoplane which was tested just before the armistice and gave a performance which placed it ahead of any plane of its type then in existence.

These four models were the only ones put in production in this country as the geared-down motors did not find favor with our aëronautical engineers. In France, however, several geared models were produced which gave good service in both land and sea service. Most of them incorporated the machine-gun barrel above the crank case and in line with the propeller hub center and one even mounted a 37-mm. cannon. Several tandem combinations of the different sizes were also experimented with.

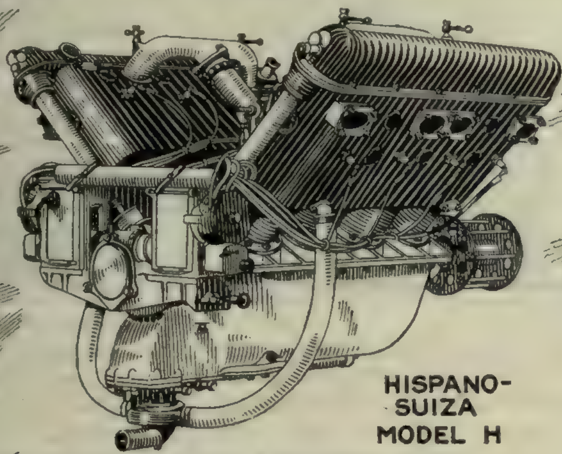
At the beginning of the war, Renault had an air-cooled V-type engine which was soon relegated to service in training planes where it gave admirable service. It was largely used by the British for the same purpose under the name RAF. The Renault engineers soon developed 12-cylinder, V-type engines of the water-cooled type in 300- and 400-hp. models, the 300 going into large production for use in reconnaisance and day-bombing machines of the Breguet type.

These motors were very different from the Hispano-Suizas as their cylinders were individual forgings with thin steel water jackets similar in general design to those used on the Liberty, Rolls-Royce, Benz, Mercedes, and Fiat engines. The overhead camshafts operated the valves through rocker-arms instead of directly and the carburetors were located outside instead of within the V. The 300-hp. model had a cylinder-block angle of 47 deg. instead of the normal 60 deg. for 12-cylinder engines, a device also used in the Liberty to reduce engine width and head resistance. Four six-cylinder magnetos were mounted between the cylinder blocks, each firing six plugs on one side of the engine. This arrangement provided the necessary two sparks per cylinder and made possible the use of standard magnetos to fire cylinders firing at uneven intervals.

The Lorraine-Dietrich engine, a 12-cylinder model, was considered by many experts the best of the French engines although it did not get into production until rather late in the war. This engine followed our practice in using battery-generator ignition and was in many respects much like the Liberty 12. The normal angle between cylinder banks, 60 deg., was adhered to, however. At the time when we were faced with the problem of choosing a combat engine of high power, only two engines were considered, this one and the English Rolls-Royce. The Lorraine-Dietrich had not yet been proved, however, and the Rolls did not lend itself to American production methods. As a result the Liberty program was started.

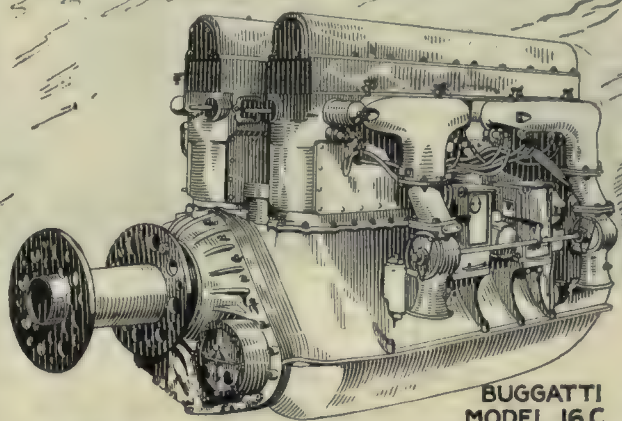
The only other high-powered engine attempted was the other engine shown. We have sketched the American development of this motor which was designed in France by Ettore Bugatti and built first as a vertical eight with a geared propeller shaft at the side of the crank case. As this model did not develop sufficient power, another row of eight vertical cylinders was placed beside the others and both crankshafts were geared to the same hollow propeller shaft.

When this motor was brought over here it promptly broke down under test and had to be entirely re-designed. It was just going into production when the armistice was signed.



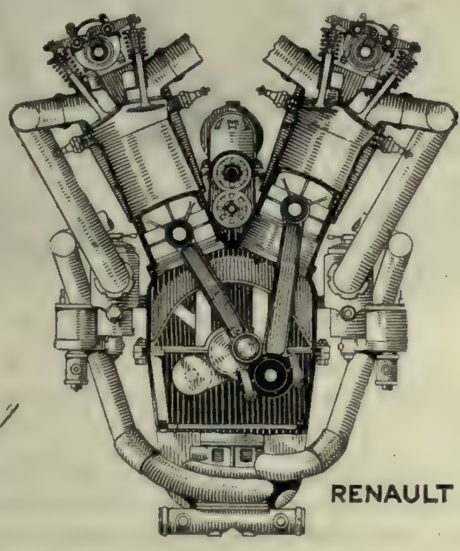
HISPANO-SUIZA
MODEL H

Eight cylinders; bore, 5.511 in. (140 mm); stroke, 5.095 in. (150 mm); compression ratio, 5.3 to 1; rated hp., 300 at 1800 r.p.m.; magneto ignition; dry weight per hp., 1.66 lb.; fuel consumption, 0.53 lb. per b.hp.-hr.



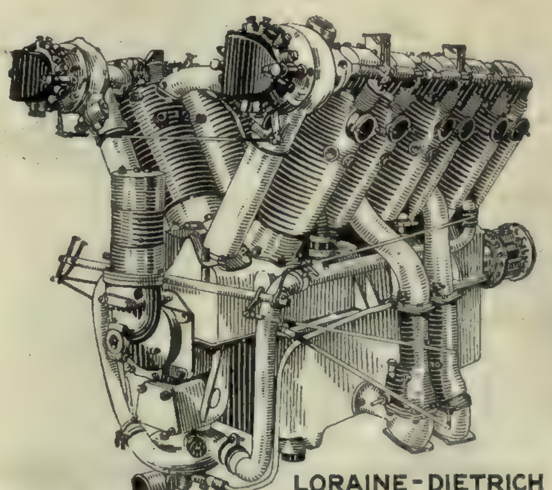
BUGGATTI
MODEL 16 C

Twelve cylinders; bore, 4.33 in. (110 mm.); stroke, 6.3 in. (160 mm.); compression ratio, 5 to 1; rated hp., 420 at 1950 r.p.m.; magneto ignition; dry weight per hp., 2.14 lb.; fuel consumption, 0.54 lb. per b.hp.-hr.



RENAULT

Twelve cylinders; bore, 5.11 in. (130 mm.); stroke, 5.51 in. (140 mm.); rated hp., 400 at 2080 r.p.m., magneto ignition; dry weight per hp., 2.05 lb., fuel consumption, 0.55 lb. per b.hp.-hr.



LORAINE-DIETRICH
MODEL 12 P

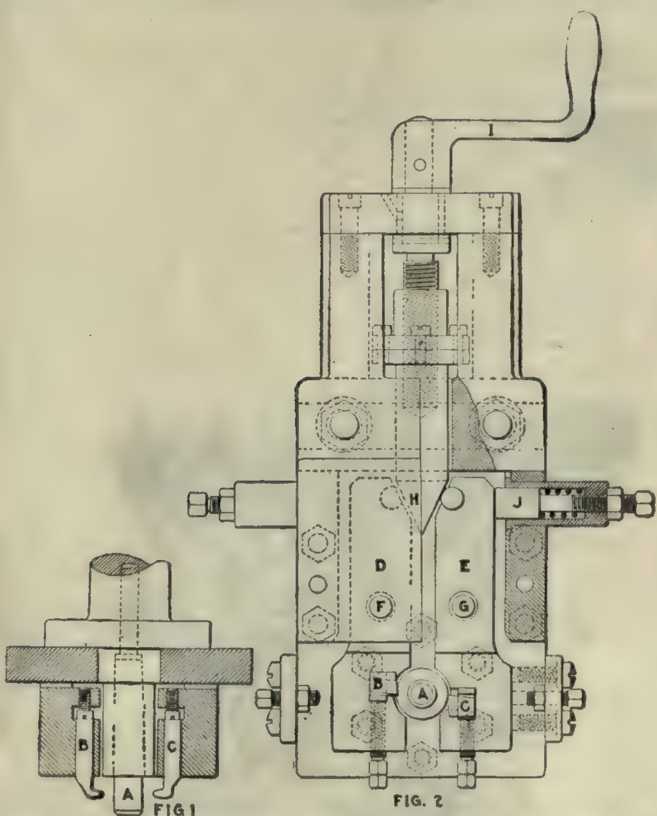
Twelve cylinders; bore, 4.72 in. (125 mm.); stroke, 6.69 in. (170 mm) rated hp., 370 at 1650 r.p.m.; magneto or generator-battery ignition; dry weight per hp., 2.08 lb.; fuel consumption, 0.55 lb. per b.hp.-hr.

-by B. Z. REITER-

Toolhead for Undercutting

By Frank C. Hudson

The design of the Liberty motor cylinder calls for the undercutting of the spark-plug boss and the tool for doing this is shown herewith. Fig. 1 is a diagram of the way the tool works, while Fig. 2 gives a good idea of the construction of the whole toolhead. The pilot A and the two tools B and C are shown in both figures. The tools B and C are held in the toolholders D and E which are pivoted at F and G. These tools are fed into



FIGS. 1 AND 2. DIAGRAM OF OPERATION AND TOOLHEAD FOR UNDERCUTTING SPARK-PLUG BOSS

the work by the cone H which is advanced by the handle I.

On each side of the holders D and E are spring plungers, one being shown at J. These tend to keep the tools in their position of greatest diameter and insure a steady cut as the cone is fed in between the two toolholders. These plungers also return the tools to their original positions as soon as the cone H is withdrawn.

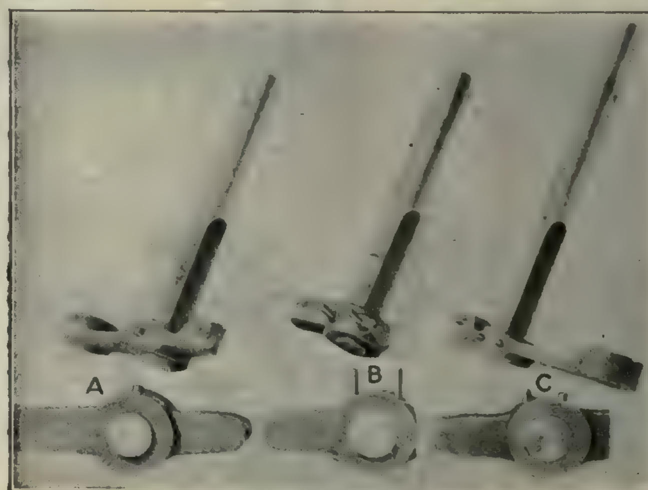
This device was used under an ordinary drilling machine in connection with a substantial mandrel or holder which located the cylinder in the proper position. It will be noted in Fig. 1 that the tools and their holders project far enough from the face of the device to clear all projections on the end of the cylinder head.

Test of Taper-pin Fastenings for Levers

By E. A. Dixie

Nearly forty years ago my old boss said, "The only way to tell how strong a thing is, is to 'bust' it." This is as true today as it was then.

In the construction of a certain machine we had a cast-iron lever secured to a $1\frac{3}{16}$-in. shaft. This lever is supposed to "stay put" in the positive position in which it is assembled with the shaft. Setscrews are



DIFFERENT METHODS OF FASTENING

out of the question, as operators are apt to monkey with setscrews and get the parts out of adjustment.

All kinds of fastenings were discussed in the drafting room, the result of the discussion leaving us satisfied that one or more taper pins properly applied would solve the problem; give us a firmly fixed position for the lever, and also a fastening which could be taken apart or renewed without injury to the parts and yet could not be easily fooled with by the operator.

There was however much divergence of opinion as to whether one or two taper pins should be used and also how the pins should be applied. To settle the matter, we decided to try several methods and "bust them" to see how strong they were.

Three levers were fitted to three $1\frac{3}{16}$-in. shafts as follows: Lever A had one No. 6 taper pin fitted (radially) through the center of the shaft. Roughly the area of a No. 6 pin is 0.093 in. Lever B had two

No. 4 taper pins (roughly 0.049 in. in area) through it and the shaft. The center distances of the pins was $1\frac{3}{16}$-in.; that is to say, half of each pin was in the shaft and half in the lever. Lever *C* had two No. 4 taper pins through it and the shaft. The center distances of the pins was $\frac{15}{16}$-in.; that is to say, the pins went through the lever and their *full diameter* through the shaft,

It will be noted that there is a flat on both sides of each of the shafts. These engage a slot in the testing fixture which is made of steel so that there is no chance of failure with it.

The whole outfit—shafts and testing fixture—was sent to the Henry Souther Engineering Co., Hartford, Conn., for test and their report follows:

"The levers were assembled in the fixture supplied and strapped to the table of our testing machine; load was then applied by bringing the traveling head of the machine down on the end of the lever with the following results:

"Sample A—The lever was assembled with No. 6 pin. This lever supported a load of 1,318 lb. when an appreciable yielding was observed. We were shortly able to increase the load to 1,335 lb. which was the maximum the lever would support. Subsequently, this lever was again subjected to loading conditions to determine if the cast-iron lever could be broken. When the second load was carried up to 1,218 lb., the pin sheared completely making it necessary to discontinue the test.

"Sample B—The lever was assembled with two No. 4 pins, $1\frac{3}{16}$ in. apart. This lever was loaded up to 1,154 lb. when the casting broke close to the shaft.

"Sample C—Lever assembled with two No. 4 pins, $\frac{15}{16}$ in. apart. This lever was loaded up to 1,326 lb., at which point the casting failed through the boss surrounding the shaft."

The test shows conclusively that the two small pins placed tangentially were stronger than the one large pin placed radially. It also shows that the two pins are stronger than the lever castings. As the levers are strong enough for the work imposed upon them, the two pins form a satisfactory method of fastening.

A close examination of the pins after the test showed that only one of the pins in each of the test pieces *B* and *C* carried the bulk of the load. This might have been due to improper fitting or possibly due to stretching of the levers while under test. This would tend to show that *one* of the smaller pins placed tangentially is stronger than the single large pin placed radially. Other tests of pinned fastenings are in contemplation and the results will be given later on.

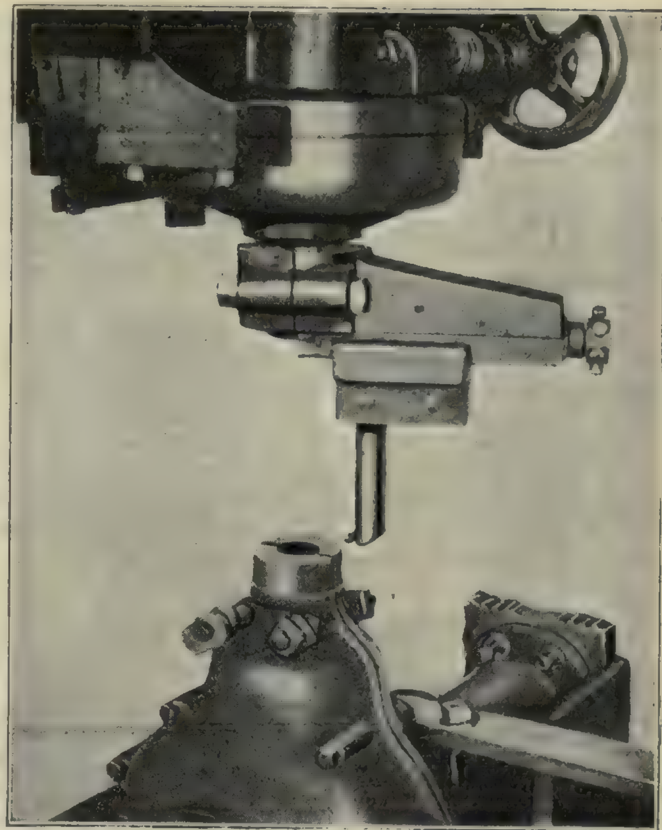
A Handy Boring Head

By John Drew

Having a lot of work to do which involved boring, facing and turning upon pieces large and awkward to hold such as automobile transmission and differential cases, etc., the boring head shown in the illustration was devised.

Nothing new is claimed for the device; it is shown rather in the hope that as a suggestion it may prove of value to others who may have similar work to do and are in despair because they have no boring mill big enough to handle it.

The construction of the device is obvious from the photograph. The main casting is bored to fit over the spindle of a large radial drilling machine, being held thereto by friction; though if heavy cuts were neces-



BORING HEAD ON A RADIAL DRILL

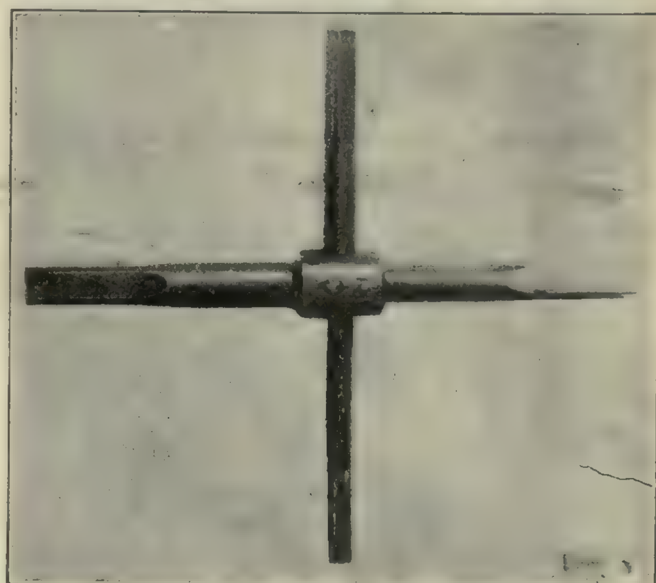
sary it could be keyed without especial injury to the spindle. No attempt was made to put a transverse feed on it, as all facing cuts are short and it is an easy matter for the operator to give the knob a twist every time it comes around. All other feeds are, of course, provided by the mechanism of the drilling machine.

Wrench for Safety Setscrews

By F. J. Atkins

A handy dog wrench which will fit four sizes of safety setscrews of lathe dogs is shown in the illustration.

This type of wrench is a novel idea for a vocational



WRENCH FOR SAFETY SETSCREWS

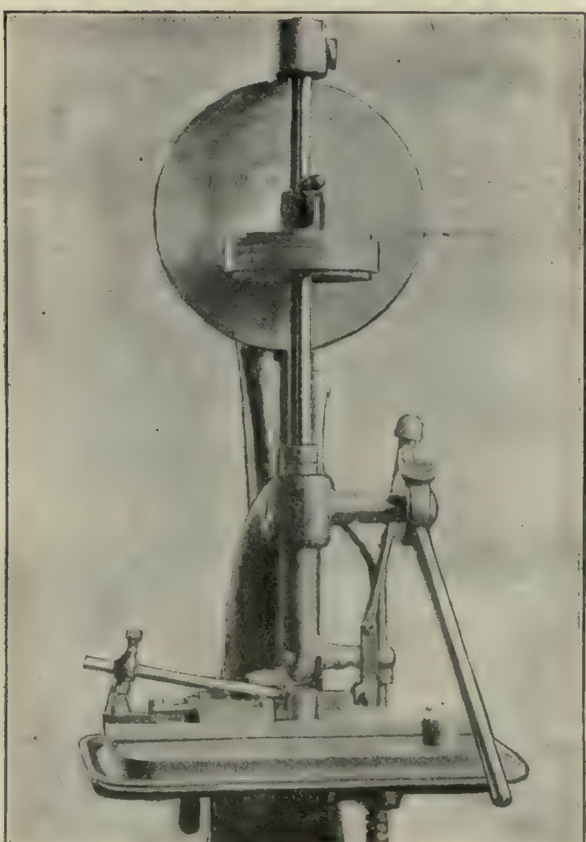
school. It eliminates a search for the proper-sized wrench, usually the last one to be picked up; it also averts the grinding of a larger one to fit a small set-screw, which is a common occurence, especially by men in the evening-school classes who are eager to get all they can out of the two hours of work, and will resort to almost any method if they think they can save a few minutes. This wrench also makes a good study for beginners as it involves the operations of centering, facing, turning, milling, drilling and hardening.

It is made from tool-steel pieces 7 in. long. One is turned to $\frac{1}{2}$- and $\frac{5}{8}$-in. diameters, 3 in. from each end, allowing for a center 1 in. long and $\frac{15}{16}$ in. in diameter. A $\frac{7}{16}$-in.-diameter hole is drilled through this part. The other piece is turned $\frac{7}{16}$ in. in diameter for 4 in. from one end and $\frac{3}{8}$ in. in diameter for 3 in. from the other. The squares are $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$ and $\frac{1}{2}$ in. and are milled back about $1\frac{1}{2}$ in. to allow for grinding back the end in case the corners become rounded.

Chain Roller Burring Fixture

By W. H. Addis

Wherever large quantities of small rollers are to be burred the fixture shown will prove profitable. It is so designed that the operator controls the spindle feed and clamps the work in position with one movement of the right hand, leaving the left hand free to place the rollers in the fixture. A connecting-rod is fastened by a ball-and-socket joint to the hand lever. The other end of this connecting-rod is attached by a yoke to a bell-crank lever, which in turn is attached to another connecting-rod and lever which causes a sliding V-block to move forward and grip the work as the feed lever is pulled down. Each connection is adjustable which permits the gripping action to be so timed that when the roller is firmly gripped the burring tool will have just enough downward movement to perform its work and then stop. This fixture works very rapidly and permits large quantities of work to be burred in a short time; the same idea might also be adapted to the work of countersinking and spot-facing.

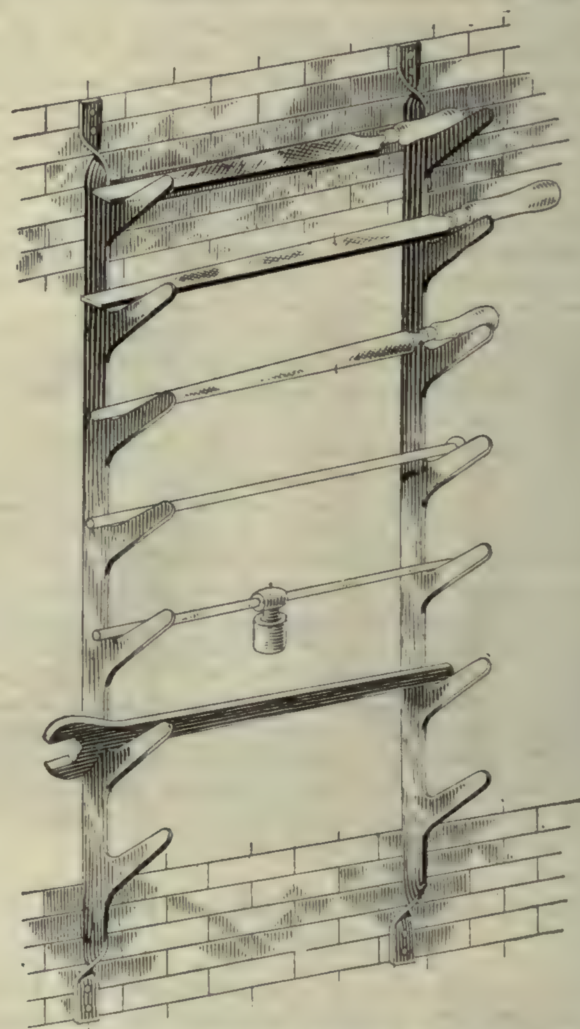


CHAIN ROLLER BURRING FIXTURE

Handy Tool Rack for the Wall

By John Vincent

Many work benches are provided with drawers in which the workman throws all tools indiscriminately, and then, when he wishes to find a certain tool, he has to search through the pile. This method is pretty hard on tools, particularly files. To avoid such occurrences and provide a convenient rack for supporting tools wanted for momentary service, the Minneapolis Threshing Machine Co. has constructed a large number of racks similar to the one shown in the accompanying illustration. These racks are cut out of galvanized sheet steel and have horns projecting at convenient distances to take care of the tools which will be placed on them. The upper and lower ends are given a twist and bent flush with the wall, to which they are usually nailed if of wooden construction, or screwed into wooden plugs when the wall is brick.



WALL TOOL RACK FOR USE OVER WORK BENCHES

What Leaders in the Electrical Field Think of the Compulsory Metric System

St. Louis, Feb. 23, 1920

Ethan Viall, Editor,
American Machinist.

Dear Sir:

Answering your letter of the 18th with reference to the proposed bill in Congress, making the metric system compulsory: our engineers and shopmen are fundamentally opposed to any such proposition, and at the proper time will co-operate in writing our representative in Congress against lending support to any such measure.

I am not in a position to advise you just what the financial result in our business would be, were such a measure to be adopted—which of course would be difficult to estimate.

The proposal seems so preposterous that I can not imagine the measure meeting with success.

Yours very truly,
Wagner Electric Manufacturing Co.,
W. A. LAYMAN,
President.

West Lynn, Mass., Feb. 25, 1920.

Ethan Viall, Editor,
American Machinist.

Dear Sir:

Anyone advocating the compulsory use of the metric system is simply crazy. There is enough trouble running business today without upsetting it further.

Very truly yours,
Massachusetts Electric Manufacturing Co.

Detroit, Feb. 13, 1920.

American Machinist.

Attention Ethan Viall, Editor

Gentlemen:

We are in receipt of your favor of Jan. 23, in regard to the Legislation now pending in Congress to make the metric system compulsory.

We wish to say that if this thing goes through, it will be nothing more or less than a calamity to this country. We are not in favor of the metric system and we do not know of anybody that is. We are having sufficient troubles at the present time without taking on any new ones in the shape of a metric system.

Such a law would not only cost many millions of dollars, but could never be enforced. It would result in nothing but confusion. Under these circumstances we are emphatically against it, and trust that Congress will never be so foolish as to pass a law of this kind.

Very truly yours,
American Electrical Heater Co.,
F. KUHN,
Vice President.

Warren, Ohio, Feb. 24, 1920.

American Machinist.

Attention Ethan Viall, Editor

Gentlemen:

Acknowledging yours of the 16th, we thank you indeed for advising that Congressman Vestal, of Indiana, is expected to introduce in a few days a bill making compulsory the use of the metric system. This system should most assuredly not be made compulsory. Aside from the cost of gages, jigs, scales, micrometers, etc., it would mean a large investment (difficult to calculate) and would result in untold confusion due to the necessity of educating our employees to the new standards.

At a conservative figure, it would mean at least an expense of $50,000 to this company with no resultant advantages so far as we can foresee.

We will be appreciative of the summarization of the replies which we judge you are requesting from various other manufacturers.

It is our opinion that this proposed bill should be submitted to the League of Nations, and then submarined enroute.

Yours very truly,
The Peerless Electric Company,
W. C. WARD,
Vice President and General Manager.

Cleveland, Feb. 19, 1920.

Ethan Viall, Editor,
American Machinist.

Dear Sir:

We have been watching the metric propaganda for some time and are genuinely alarmed at the progress of such a radical idea. **If we were to get together and plot with our Bolsheviki and Communists to strike an appalling blow to American industry, we would need to go no further than adopt the metric system. Nothing we can do would help our Hun friends more toward boosting their export trade.** In our own plant here we would have to change about everything but the factory building, and the cost to the nation's manufacturing would look like several Liberty Loans.

Due to shortages of labor and material, the average manufacturing plant is having troubles enough these days without changing its entire system of measuring. The writer wishes to go on record as being absolutely opposed to the metric system, and trusts that Congress will see that our best interests are taken care of by rejecting the metric propaganda in part, or as a whole.

Yours very truly,
Electric Vacuum Cleaner Company, Inc.,
CHARLES F. QUEISSER,
Factory Superintendent.

Ansonia, Conn., Feb. 18, 1920.

American Machinist.

Attention: Editor

Gentlemen:

This will acknowledge your letter of the 16th inst., calling attention to proposed action of Congressman Vestal, of Indiana, Chairman of the Committee of Coinage, Weights and Measures, that he is to introduce a bill in a few days making the use of the metric system compulsory.

We are, very much, opposed to the metric system. We hope it will never be made compulsory. We do not see that it has any advantage over the English system. Our business would be upset considerably if we were compelled to use it. With regard to what the change would cost us we could not say definitely. We feel sure, however, that it would be quite large. It would tend to reduce our production quite a good deal.

Very truly yours,
The Cameron Electrical Manufacturing Co.,
J. B. DAVIDSON,
Vice President and General Manager.

Plainville, Conn., Feb. 21, 1920.

Cincinnati, O., Feb. 24, 1920.

American Machinist.

Attention Ethan Viall, Editor

Dear Sir:

Replying to yours of the 18th, the compulsory adoption of the metric system would cause the utmost confusion in our factory.

It is difficult to place any figure on the additional cost, but it is safe to say that it would be a matter of years for the business to absorb it.

Yours very truly,
The Triumph Electric Company,
J. C. Hobart,
President.

Howell, Mich., Feb. 23, 1920.

Ethan Viall,
American Machinist.

Dear Sir:

Acknowledging receipt of your letter of February 16th, please note that we should object very seriously to the metric system being made compulsory. As our plant is comparatively small it would mean a serious upset in our business. It would mean a great deal of confusion in matching up metric and United States standard sizes during the change over period, and in the final analysis would mean a considerable loss in stock which could not be matched up. I estimate it would increase our manufacturing costs for some time, and with very little question would cause us an expenditure of $25,000 to $30,000 in changes in tools, fixtures, gages, etc.

We therefore believe, particularly at the present minute with the costs of manufacturing products soaring as they are and with the desirability of our lowering these costs rather than the contrary, that this is no time to permit theoretical changes to affect the general situation, and particularly where there is any likelihood of these changes increasing costs.

Yours very truly,
Howell Electric Motors Co.,
J. M. Barr,
General Manager.

American Machinist.

Attention Ethan Viall, Editor

Gentlemen:

In reply to your letter of Feb. 18th, we thank you for the opportunity of expressing our opinion in reference to making use of the metric system compulsory, referred to in your letter of Feb. 18th.

We believe it should not be made compulsory as it would certainly be a radical change in American standard of weights and measures and would cause a tremendous expense to change drawings, measuring instruments, catalogs, etc. that would be required if it was put into effect.

It would also cause countless errors due to lack of knowledge of the metric system, at least until it became generally known.

It would not be at all surprising if considerable pressure is brought to bear on this measure because of its effect on foreign trade, but we should regret very much indeed to see it be made compulsory.

Very truly yours,
The Trumbull Electric Manufacturing Co.,
S. S. Guillim,
Secretary.

Others Who Are Against the Proposed Compulsory Metric Law

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
East Pittsburgh, Pa.
Per E. M. Herr, President.

EMERSON ELECTRIC MANUFACTURING CO.,
St. Louis, Mo.
Per H. I. Finch,
Vice President and Superintendent.

BENJAMIN ELECTRIC MANUFACTURING CO.,
Chicago, Ill.
Per P. A. Bowers, Advertising Manager.

MECHANICAL APPLIANCE CO.,
(A. C. and D. C. Motors),
Milwaukee, Wis.
Per R. G. Kellog, Vice President.

WESTON ELECTRICAL INSTRUMENT CO.,
Waverly Park,
New Jersey.

CHICAGO FUSE MANUFACTURING CO.,
Chicago, Ill.
Per. G. W. Borst, Electrical Engineer.

GENERAL ELECTRIC CO.,
Pittsfield, Mass.
Per A. B. Hendricks, Jr.,
Engineer, Transformer Development.

INDUSTRIAL CONTROLLER CO.,
Milwaukee, Wis.
Per H. L. Van Valkenburg,
Chief Engineer.

CUTLER-HAMMER MANUFACTURING CO.,
Milwaukee, Wis.

EDITORIALS

Our Interest in the Railroads

ALTHOUGH the builders of machinery of various kinds are not directly interested either in railroads or in their operation, it takes but a little consideration to show that we all depend so much upon transportation for everything we eat, wear or use, that railroads and railroad management should become the concern of all. And the whole situation is far from pleasing or assuring in any way.

We must lay aside all prejudices and look at the situation as it really is, regardless of partisan affiliation or preconceived notions of any kind. With almost no exception the railroads of the country need locomotives, rolling stock, road-bed betterments and machine-shop equipment. The present equipment is being run to the limit of its endurance, and when repairs are finally made they are very heavy, take time and cost money; and the power available is too often inadequate to haul the coal, the farm produce or the manufactured articles which we all need. This adds to the high cost of living all along the line.

One method of management is to allot a certain monthly budget to each division and to each department. In one division headquarters, recently visited, the actual expenditures for the month were $11,000 in excess of the $48,000 allowed by the budget. And this merely kept the motive power in workable condition.

The management of a Southern road last year reduced the working force to a large extent as soon as the winter season was over. The summer force could barely keep the reduced equipment in running condition. And when the working force was finally increased it was too late to get all the motive power back in good condition. The question of management looms large in the railroad world, and there are too few shining examples to which we can point with pride.

Of course, the fashionable and obvious thing is to blame it all on the Railroad Administration—and far be it from us to attempt to shield them from the criticism which they undoubtedly deserve. But when we know that practically all of the conditions named existed before the war, that they are not of recent origin, we are not helping to find a solution by merely crying for a return of the railroads. If these methods existed before—and we know they did—what reason have we to expect them to be changed for the better now by merely restoring them to their former systems of mismanagement?

What the railroads need, and what the country needs, is the kind of management which is applied to other large industrial undertakings. The steel companies do not let their machinery deteriorate in order to show low operating costs. Neither does any machine builder or other business man. They know that next year's profits depend on this year's expenditure in keeping the machinery in good condition.

The railroad managers themselves also know it as well as any of us. But they are not free to manage as their judgment dictates. They are usually expected, or ordered, to curtail expenses so as to make a certain showing in the annual report, not for the ultimate good of the railroad but for its effect upon the stock market.

New railroad-shop equipment is sadly needed all over the country. Recent visits were made to railroad shops at division terminals where the newest machine was twenty years old, and from that they ran back to the vintage of 1870. The sizes of the locomotives have increased and there are more of them on the division, but no new equipment has been ordered in from ten to twenty years—which can hardly be blamed on the Railroad Administration. The machine-shop equipment needed by the railroad shops would keep the machine-tool shops busy for a year at least.

All this means that there is not enough transportation facilities to get produce to market, to carry coal from the mines to the consumer, and it all adds to the cost of living and of doing business.

Then, too, we have the question of salaries for executives, as in nearly all other lines of work. Those who think that the unrest and discontent is confined to the manual workers or to the members of the various labor organizations, do not appreciate the true conditions as they exist today. The master mechanics of railroads in various parts of the country are far from satisfied with their present remuneration and there is talk of organizing at the June convention to secure what they feel is their due.

Shopmen up to general foremen come under the wage award, and a general foreman gets $300 a month. His master mechanic, with much greater responsibilities, gets but $325 a month, by no means enough for a good executive under our present standards of prices. This situation means that the best men will leave the railroad service and get into other lines which pay better salaries.

The railroads, in common with other industries, have felt the falling off in efficiency which has been too general, even though it may be understandable as being a direct reaction from the excitement and conditions of war. But, as in the case of other industries, there are bright spots which show an increase in production and efficiency in overhauling locomotives.

A chart, recently inspected, contained data covering a period of four years and showed several interesting things. During wage discussions, when strikes or increases were pending, the production dropped, as might be expected. This was also the case when lay-offs were expected. But since the last wage discussion and the award, production had increased in a very satisfactory manner. After all, in common with most of our problems, it gets back to the question of sound management, the same as with industrial plants.

The railroads must have fair play, no matter how former managements have incurred hatred and suspicion. They must have money for rehabilitation and extension from either public or private sources. However it comes or whatever the form of management, we must not lose sight of the part the railroad plays in our private and public life, in our actual existence, as well

as in our business prosperity. And while extending the railroads every assistance they need we must not forget that the public or community nature of their service makes it necessary that we all demand the kind of management which will be of the greatest value to the country as a whole. There are greater opportunities for broad-minded and far-seeing management here than in almost any other line.

The Problem of Cheap Fuel for All Manufacturing

NOW that coal is being mined once more we are apt to drop the subject of fuel from our list of worries. This is, however, short-sighted from every point of view as fuel is the basis of our industries, and costly fuel, from whatever cause, is a menace to low manufacturing costs.

The coal situation in this country, which has been favored with the cheapest fuel in the world, is distinctly bad in several ways. It is not easy to lay one's finger on any one cause which can be blamed for it, for, as in most cases, it is a combination of causes with faults on all sides.

It is freely admitted by those who are authorities on the coal situation that too many mines are inefficiently operated, that too many operators are reactionaries and not well fitted in other ways to handle the big business problems which are being presented. Instead of having a broad, forward-looking and constructive policy they have failed to grasp the situation and have allowed it to be dominated entirely by labor and politicians.

The commission which is now making investigations is not likely to take the time to find facts which the consuming public has a right to know. The public's representation on the board is entirely inadequate and cannot be expected to obtain fair consideration for the consumer. When officials with aspirations for the presidency will play into the hands of either miners or operators, the manufacturers, to whom fuel is the basis of their business, should get together and endeavor to secure a square deal for all consumers.

But aside from this, the users of coal can help the fuel situation by doing what they can to equalize the demand throughout the year. The fluctuations between summer and winter demands for coal make it extremely difficult to mine coal economically. It is this fluctuation which tends to cause lay-offs in summer and gives the miners a basis for some of their claims.

If all machine manufacturers could increase their storage capacity for coal by even ten per cent, it would count up to a total which would be of real help in this problem. Some coals do not store well, but it is possible in most cases to do more in this line than has been done. The mine operators might be induced to store to some extent in summer if railroads could handle the coal in fall and winter. Charging for the handling and storage at a fair rate would be perfectly justified and would give the consumer the option of paying the charge or of storing on his own premises.

Unless something can be done to lessen the seasonal nature of the coal mining industry, labor is bound to be restless at times. Enforced idleness breeds discontent and affects one's attitude toward work at all times, leading to and being largely responsible for demands which are unreasonable under present conditions at least.

Every shop manager knows the difficulty of maintaining efficiency and morale in the working force when it is necessary to lay men off at intervals. Far-sighted managers prefer to build stock, either completed machines or the parts which require the most labor. So far as possible the coal operators should do the same instead of throwing the whole burden of equalizing the demand on the consumer.

But the consumer must aid in this in order to help keep down the cost of his fuel in years to come. He must anticipate his needs so far as possible in order to take all he can during the slack months of the coal trade. Co-operative buying by manufacturers of a given locality might help to regulate the demand and to avoid the peaks and hollows of which the mine operators complain.

This is a question for careful consideration by both mine operators and consumers. Arbitrary actions on either side will only tend to increase the troubles which now exist. They must get together, not only for the good of the coal industry but for all other industries which depend on it for success in low-cost manufacturing. Action must not be put off—it must begin now to prevent mine shutdowns next summer.

Wasting the Other Fellow's Time

ONE of the costs of doing business is the time of representatives of various kinds—salesmen and others. Whenever we waste an hour of their time we add that much to the cost of the product. And every customer, including ourselves, has to help pay for it.

A concrete example will make this clear: The representative of a well-known machine builder was requested to make a call at a plant which meant two hours' train travel. When he arrived the man who wrote him was in conference. After waiting an hour the salesman sent in word asking him to name a time when he could be seen, so that he could make another call and come back. The only answer was that he must wait until he was ready to see him.

Another hour and this was repeated. After waiting four hours the conferee came out and told the salesman what he knew at first—that they had decided the day before that they could not wait for his firm's delivery.

Four perfectly good hours were wasted without reason or excuse. Whether we consider the sensibilities of the salesman or not, his firm had four hours of time, plus two hours of railroad time and travel, to add to its overhead—and everyone who buys their machines helps pay for it. It must go into their selling cost.

Every time we waste a traveling man's time, the chances are some one else is wasting time for one of our men in the same way. Not only business courtesy but business efficiency and common sense demand that we eliminate these unnecessary wastes.

The seller is just as important as the buyer and deserves the same consideration in every way. It is generally possible to see men promptly, as we can usually take the time at one time as well as another. The idea that it impresses a man with our importance to keep him waiting is an exploded fallacy. The biggest and busiest men are not the hardest to see nor do they keep people waiting unnecessarily. A little more consideration of the other fellow's time and a realization that all waste adds to the cost of doing business will help us all.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT NEWS
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

CONDENSED CLIPPING INDEX
A continuous record of modern designs and equipment

The General Electric Automatic Welding Machine

The General Electric Company, Schenectady, N. Y., has brought out an automatic arc welding machine for use with the regular welding set, but designed to take the place of the hand-controlled electrode. It consists of a pair of feed rolls driven by a small direct-current motor, which draws in and delivers to the arc a steady supply of wire and automatically maintains the best working distance. The whole is controlled from a small panel.

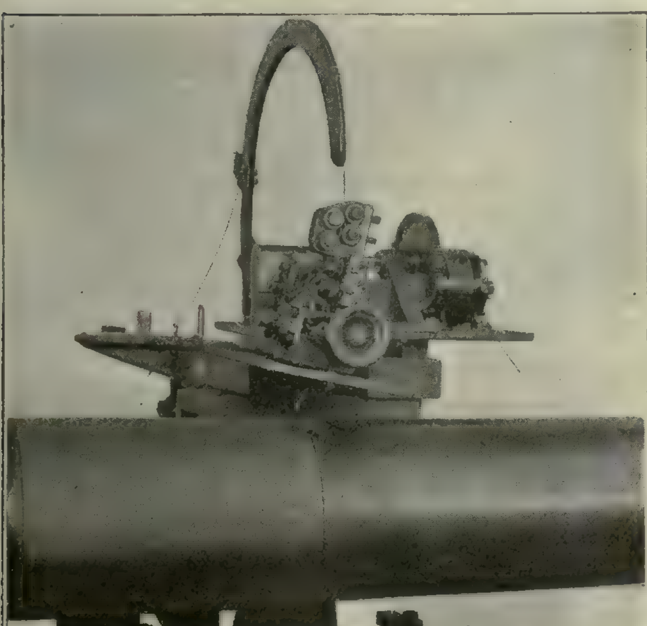
The welding head is held by a suitable support, and carries feed rolls and straightening rolls which are both adjustable for various sizes of wire. The arm is supported on a gear box, together with the motor. This box contains gears which give three gear ratios, thus extending the range of the device while allowing the motor to operate at its most favorable speed.

The control panel carries an ammeter and voltmeter for the welding circuit, as well as rheostats, a control relay, and the contactors and switches for the feed motor. It is possible to start and stop the equipment from the work by a pendant push button, but adjustment of the feed conditions must be made from the panel.

The adjustment for arc conditions by regulation of the speed of the feed motor, as the arc voltage varies, is taken care of by the panel equipment. It is claimed that the result is a practically steady arc.

The whole apparatus is mounted on a base which can be bolted to any form of support. Thus a great variety of working conditions can be met, but provision must be made for carrying the arc at uniform speed along the weld. For instance, for straight seams, a lathe or planer bed may be used, and for circular ones, a lathe or boring mill.

The device is intended for use where a large amount of routine welding is to be done, and is said to be capable of from two to six times the speed possible by skilled operators and to give a uniform weld of improved quality. It is adaptable to welding seams of tanks and plates, rebuilding worn or inaccurately turned shafts (as shown in the illustration), rebuilding worn treads and flanges of wheels, and many other kinds of work.

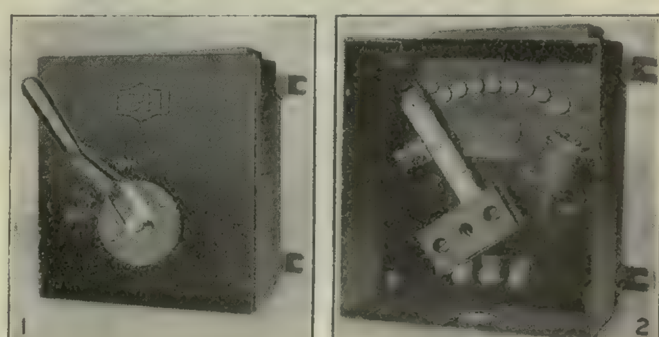


AUTOMATIC WELDING MACHINE BUILDING UP AN UNDERSIZED SHAFT

Inclosed Faceplate Starter for Small Direct-Current Motors

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has added to its line the starter shown in the accompanying illustrations. The inclosed feature removes all danger from exposed parts, and protects the button and segment contacts from damage due to fine collecting dust or spraying water. This starter, known as bulletin 2111, is intended for small direct-current motors in exposed locations, driving line shafts, fans, blowers, pumps, drills and small motor-generating sets for arc welding.

It consists of the familiar type of direct-current hand starter inclosed in a sheet-metal case, having an external lever which engages the movable arm of the starter. The external, or operating, lever is insulated from the



FIGS. 1 AND 2. CUTLER-HAMMER INCLOSED STARTER
Fig. 1—Exterior view. Fig. 2—Interior arrangement

revolving contact arm by a block of molded insulation. A pointer on the lever and legends stamped on the cover indicate to the workman whether the starter is "off" or "on." A low-voltage release coil in series with the shunt field protects the motor in case of voltage failure or if the field should be opened while the motor is running. The armature resistor is completely inclosed in the starter case, which is kept well ventilated by a flue in the top. Renewable contacts are provided on all except the smallest starter which has a black insulating composition knob in place of the ordinary operating lever. The inclosing case is arranged for the entrance of conduit from the under side.

The starter is made in various capacities up to 50 hp., operating at 115, 230 and 500 volts.

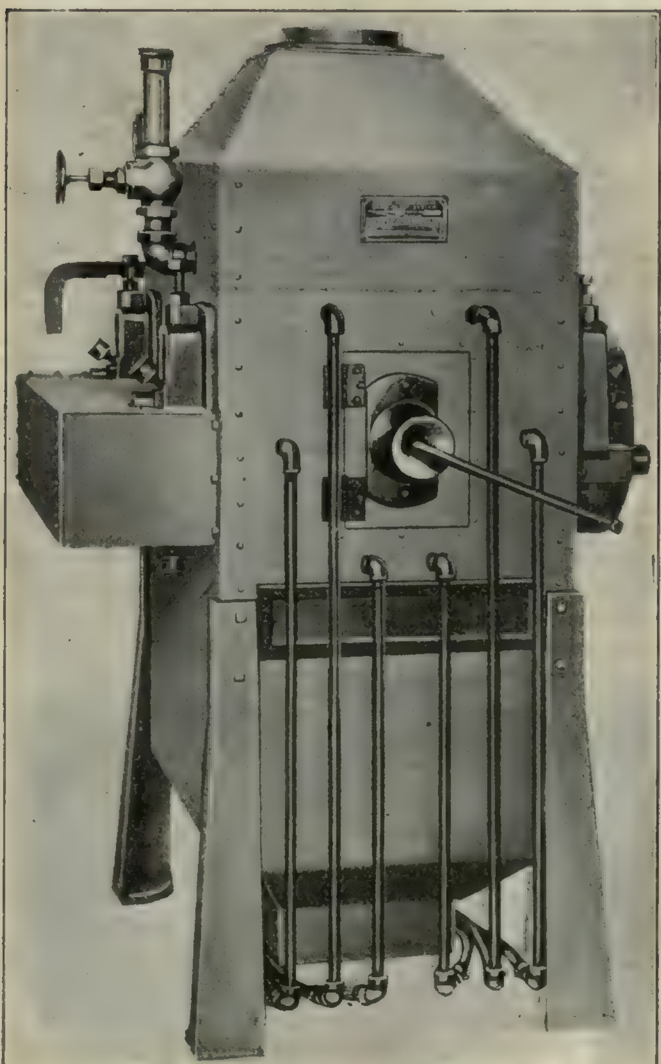
Sandblast Cabinet for Rod Cleaning

The Pangborn Corporation, Hagerstown, Md., has lately placed on the market a cabinet for sandblasting rods of various shapes, ranging from $\frac{3}{8}$ to $\frac{7}{8}$ in. in size.

Rolls and guides at each end of the cabinet provide constant and uniform travel of the rods through the blasting zone, the rolls being shaped to handle the various sizes and shapes of rods to be cleaned.

Six blast projectors are used and the blast stream covers the entire circumference of the rod. The bottom of the cabinet forms a hopper for the storage of abrasives. Individual feed boxes, in plain sight of the operator, supply abrasive to each projector, and connection to an exhaust system provides for the removal of all disintegrated material.

It is claimed that the blasting operation being entirely confined, the cabinet can be safely installed in proximity to machine tools and that the operator does not come in contact with dust-laden air. Either mineral or metal abrasive can be used.

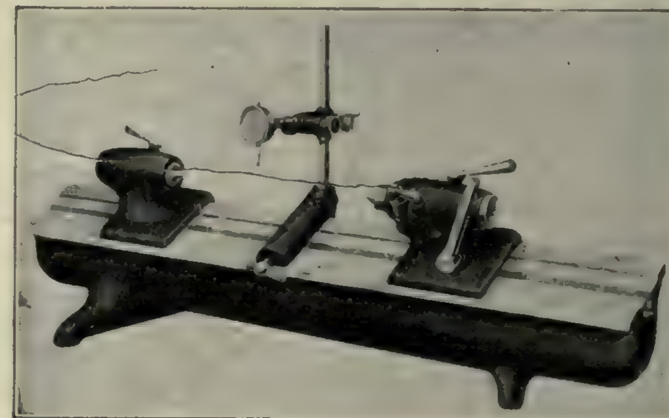


SANDBLAST CABINET FOR ROD CLEANING

American Gauge Co.'s Bench Centers

The American Gauge Co., Dayton, Ohio, has brought out the bench centers illustrated herewith.

The bed is of box section and is supported on three feet. The top face of the bed is inclined, making it impossible to be used as a "catch all" for tools. The construction also facilitates the placing of large-diameter work as it allows plenty of room for the workman's hands.



AMERICAN GAUGE CO.'S BENCH CENTERS

The bench centers are made in two sizes, 6 x 24 in. and 8 x 36 in. They are regularly furnished with a dial indicator reading to 0.001 in. A fine adjustment for setting the indicator is provided.

The Davenport-Slocomb Direct Reading Micrometer

A well-known and thoroughly tried-out counting mechanism has been applied to a micrometer caliper by the J. T. Slocomb Co., Providence, R. I.

The wear-resisting qualities of the caliper are not sacrificed in any way by the addition of the mechanism. The counting wheels and pinions, as may be seen from the illustration, are mounted on an eccentric

DAVENPORT-SLOCOMB DIRECT-READING MICROMETER

barrel which is provided with a clamp screw. This permits the pinions to be thrown into mesh in the same manner as the back gears of a lathe are thrown in, and, of course, allows of a fine adjustment for mesh. The counting wheels are 0.425 in. in diameter and are mounted on a sleeve that runs concentric with the spindle. A keyway and key in the spindle provide means for driving this sleeve and allow 1-in. traverse of the spindle.

The reading is direct on every thousandth and reads from 0 to 999. When the right-hand figure is about central with its aperture, the micrometer reading is correct within 0.0005 in. Where greater refinement is required it is necessary to refer to the nearest line on the thimble and see how it corresponds with the revolution line on the sleeve, but there is no calculating what ever.

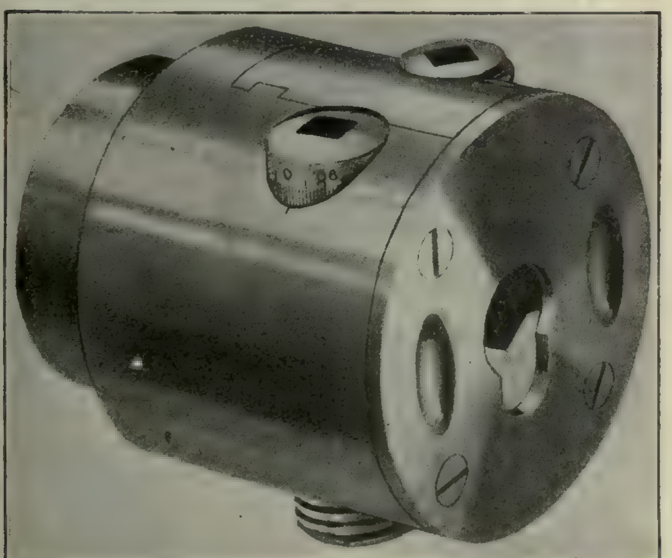
The screw is fifty pitch and there are 20 divisions on the thimble.

The counting device adds but little to the size and weight of the instrument, and as it is about central, the micrometer balances well and may be held and operated by one hand in the usual way. The frame is of drop-forged steel and is finished cold in a hydraulic press at a pressure of 300 tons which compresses the steel and adds greatly to its stiffness. This is important, as it helps the "feel" in measuring and causes the thimble to come readily to a "dead stop," and at the same time allows of a comparatively light frame.

Casler Drill-Chuck Boring-Head

Marvin & Casler Co., Canastota, N. Y., has added to its line the drill-chuck boring-head designated as No. 112 and shown in the illustration.

It is equipped with two screws—one for gripping



CASLER DRILL-CHUCK BORING-HEAD

Specifications: Body, diameter 3 in., length 3⅜ in.; will take drills from 0 to ¾ in.; will take boring tools from 0 to 9/16 in.; amount of offset with tools up to ¼ in., ½ in.; with tools up to 9/16 in., ⅜ in.

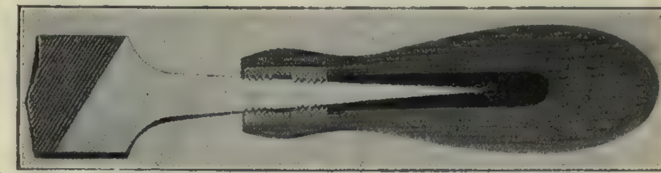
the drill or boring tool and the other for controlling the offset. The offset screw is graduated to 0.001 inch.

After a tool has been gripped by the jaws it can be brought concentric with the body of the chuck by turning the offset screw to the right as far as possible.

"Skroo-Zon" File Handle

Thurston-Bernay Co., Rialto Building, San Francisco, Cal., has placed on the market the file handle shown in the accompanying illustration.

The handle screws on, cutting its own threads by means of two dies contained in a pocket in the handle. The dies are made of hexagon steel, one being smaller



"SKROO-ZON" FILE HANDLE

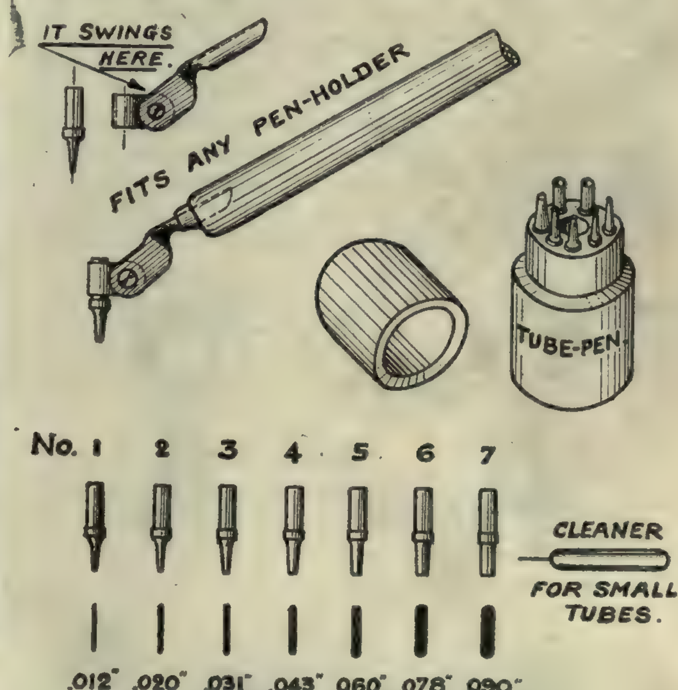
than the other, and are so spaced that they accommodate the taper on the file tang. A heavy-steel ferrule is provided to protect the handle from splitting or other injury.

Handles are made in nine sizes suitable for files from 2 to 16 in. long. The larger sizes are suitable for soldering irons and scrapers as well as for files.

Drawing Tube-Pen

Bourquin & Co., 1345 Main St., Waltham, Mass., has placed on the market the drawing tube-pen illustrated herewith.

As its name implies the pen proper is a tube. For use it is inserted in a swivel socket which in turn can be held in an ordinary writing-pen holder. The tube-pen can be filled with a pipette or quill. In use it



DRAWING TUBE-PEN

should be held perpendicular to the paper, the swivel socket being adjustable to suit the usual position of the hand.

Tube-pens are made in seven sizes from 0.012 to 0.090 in. and can be used either for free-hand or ruled work.

Newton U-96 Cold-Saw Cutting-Off Machine

The Newton Machine Tool Works, 23rd and Vine Sts., Philadelphia, Pa., has brought out the cold-saw cutting-off machine illustrated herewith.

The drive is from a belt-connected motor through worm and spur gearing. The wormwheel is bronze, and the worm, hardened steel. The worm is provided with roller thrust-bearings.

NEWTON U-96 COLD-SAW CUTTING-OFF MACHINE
Specifications: Saw, 76 in. inserted tooth; capacity, 24 in. at one cut; platen, 60 x 56 in.; V-blocks, 3, fitted with arch clamps; V-blocks will hold work 32 in. in diameter.

The feed and rapid traverse mechanism is inclosed with curtain covers and a positive safety release is provided for each extreme position of traverse.

An oil and chip pan is cast on the base to drain lubricant to the reservoir, a loose pan being fitted between the tables for draining to the base pan.

"Klingtite" Lock Washer

The Klingtite Manufacturing Co., 37 Liberty St., New York City, is marketing a line of nutlocking washers of the type shown in Fig. 1. The washer is bell-shaped, with a hole of irregular outline having inward projections. The locking feature is simple; the nut is first screwed tight, and the washer is then clinched in place, by using a short piece of pipe and hammer to flatten it against the nut. This forces the projections further inward, pinching the thread with a tight grip. Instead of a nut lock, the washer may be used to make a flange, or spool end, as shown in Fig. 2. In such a case it would of course be necessary to cut a groove in the shaft that is to be flanged, and then straighten the washer in place by a hammer blow as above described. The washers are made in all standard sizes from $\frac{3}{16}$ to $1\frac{1}{2}$ in.

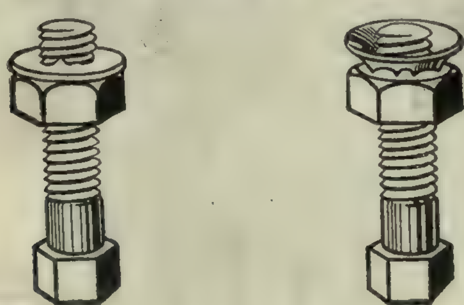


FIG. 1

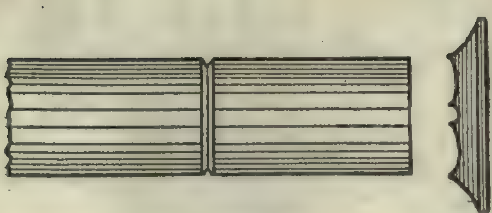
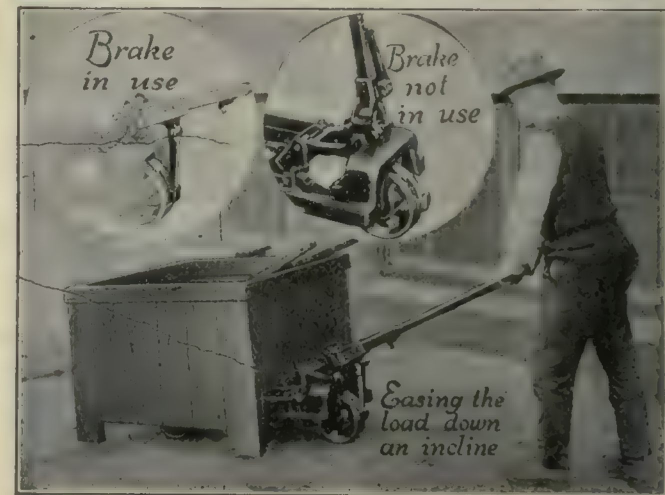


FIG. 2

FIGS. 1 AND 2. "KLINGTITE" LOCK WASHER AND WASHER USED FOR A FLANGE

Brake Attachment for Cowan Transveyors

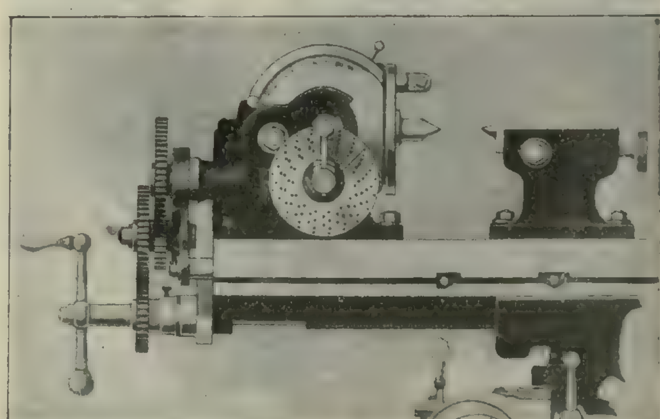
The Cowan Truck Co., Holyoke, Mass., has brought out a brake attachment for its transveyors. The illustration shows the brake both in and out of action. The brake shoe is normally held from contact with the wheel by a flat spring. A pendant hooked up to the tongue may be released and dropped into a notch in the lower part of the brake shoe. When in this position, pressing down on the tongue will apply the brake. The brake shoe is lined with raybestos.



BRAKE ATTACHMENT FOR COWAN TRANSVEYORS

The Ryerson-Conradson Universal Dividing Head

The Conradson Machine Tool Co. is building the universal dividing head shown in the illustration which is being placed on the market by Jos. T. Ryerson & Son, Chicago, Ill. This device is designed for exacting ser-



THE RYERSON-CONRADSON UNIVERSAL DIVIDING HEAD
Swing, $14\frac{3}{4}$ in.; maximum distance between centers on Ryerson-Conradson No. 3 milling machine, 41 in.; combined length of headstock and tailstock, $24\frac{11}{16}$ in.; hole through spindle, $2\frac{1}{16}$ in.; taper hole in spindle, No. 14 B. & S.; faceplate, 8 in. in diameter; weight, 335 lb.

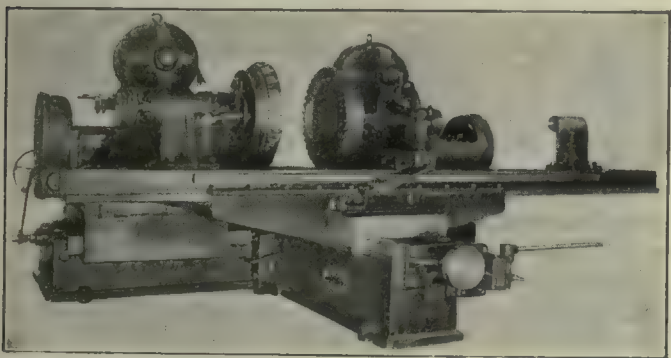
vice and is rigidly built. It has a large wormwheel meshing with a steel worm journaled in large bearings. The steel worm is made in one piece with its shaft, heat-treated and ground to size. Means are provided for disengaging the worm from the spindle and to take up any backlash which may occur from wear. The spindle and faceplate are from one piece of forged steel. The faceplate is 8 in. in diameter and has twenty-four holes for direct indexing and a $\frac{5}{8}$ x $\frac{7}{32}$-in. slot for the driving dog. The centers will swing $14\frac{1}{4}$ in. The head is graduated and can be clamped in any position from 10 deg. below the horizontal to 10 deg. beyond the perpendicular.

The regular equipment consists of three index plates that will divide all numbers up to fifty and many beyond, wrenches, bolts, driving dogs, and an index table giving all divisions up to 360.

Newton Crankshaft-Cheek Milling Machine

The Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., has added to its line the crankshaft-cheek milling machine shown in the accompanying illustration.

As its name implies, this machine is intended for milling the cheeks of the throws on crankshafts, an operation usually performed by turning in a lathe.



NEWTON CRANKSHAFT-CHEEK MILLING MACHINE
Specifiations: Maximum distance between centers, 15 ft.; swing, 22 in.; diameter of cutters, 40 in.; distance between cutters, minimum 4 in., maximum 30 in.; number of feeds, six

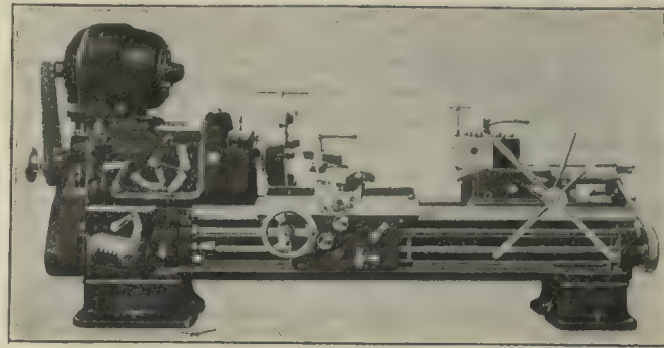
The centers for carrying the crankshaft are movable on the table to accommodate work of varying length. Suitable arch clamps are furnished for holding the work while being milled.

The cutter bodies are steel castings having tool slots machined from the solid. The internal driving gears are integral parts of the cutter bodies. The cutters are driven by individual motors. The work is fed to the cutters by a motor of the interlocking control type so arranged that in the operation of starting the table the two motors for driving the cutters will start before the one operating the table feed. In stopping the table the reverse action occurs.

Cincinnati Geared-Head Lathe

An improved geared-head lathe is being manufactured by the Cincinnati Lathe and Tool Co., Cincinnati, Ohio. The lathe is built in seven sizes, ranging from 16 to 28 in., and is furnished with either single-pulley belt drive, or motor drive through silent chain.

When furnished as a manufacturing lathe, as shown in the illustration, a power feed is supplied for the turret. A constant-speed motor is used, as all necessary speed variation is obtainable through sliding gears, which provide twelve speed changes in geometrical progression. The gears are positioned by means of the three levers on the front of the headstock, and are so arranged that safety devices are not required. Any lever may be shifted without interfering with the others, and without any danger of locking the gears.



CINCINNATI GEARED-HEAD LATHE

The index plate is easily read and an inexperienced operator is enabled to find the desired speed or feed position without confusion. The gears may be set at neutral, permitting the spindle to be turned by hand, and a control is provided at the apron by which the spindle may be started, stopped or reversed while the power is on.

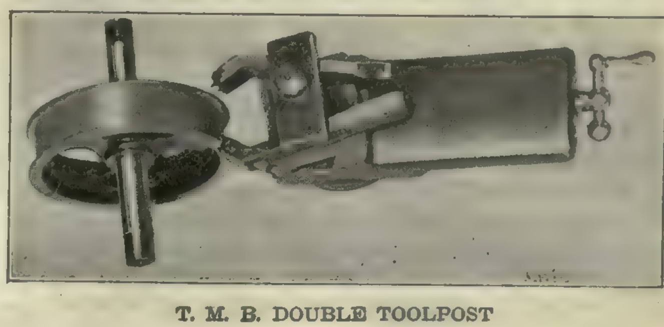
The spindle is forged from high-carbon crucible steel and carries only the face gears and one direct driving gear that is shifted by the center lever. The intermediate shaft has three sliding gears. These are controlled by the right-hand lever and mesh with the back gears. The back-gear shaft carries a pair of sliding gears and three that are fixed.

The drive shaft runs at constant speed and has two sliding gears that engage those on the intermediate shaft. One of these, when in position, furnishes the drive for the lower range of six speeds, while the other, in like manner, drives the six higher speeds. All gears on the back-gear shaft, also the direct-driving gears, are made from steel forgings heat treated; all others are made from high-carbon nickel steel.

The bearings are bronze bushed throughout and are automatically oiled by the splash system, as the gears run in a bath of oil. An indicator is provided that registers the amount of oil in the reservoir.

T. M. B. Double Toolpost

A toolpost of the design illustrated is a product of the Connery Machine & Tool Co., 56 Harrison Ave., Springfield, Mass. The broad, flat base and top clamp furnish a substantial means for holding two tools securely and

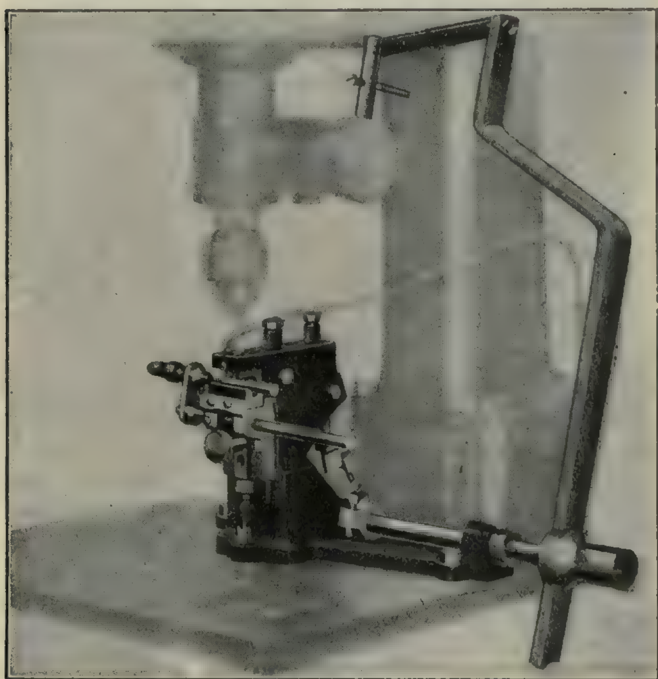


T. M. B. DOUBLE TOOLPOST

at the same time absorbing much of the vibration. The combination of a convex washer and spring under the nut allows the equalizing clamp to adjust itself to tools of various sizes. A curved plate below the base permits the tool points to be raised or lowered in the usual manner. The bolt head is of irregular shape so as to be adaptable to different widths of slots. The toolholder should prove useful for certain operations such as illustrated.

The Adjusto Drilling Jig

The semi-automatic Adjusto drilling jig, shown in the illustration, is being made by the Automatic Drill Tool Co., 549 West Washington Blvd., Chicago, Ill. It is designed to speed production by automatically clamping and ejecting small pieces of work from the jig. The



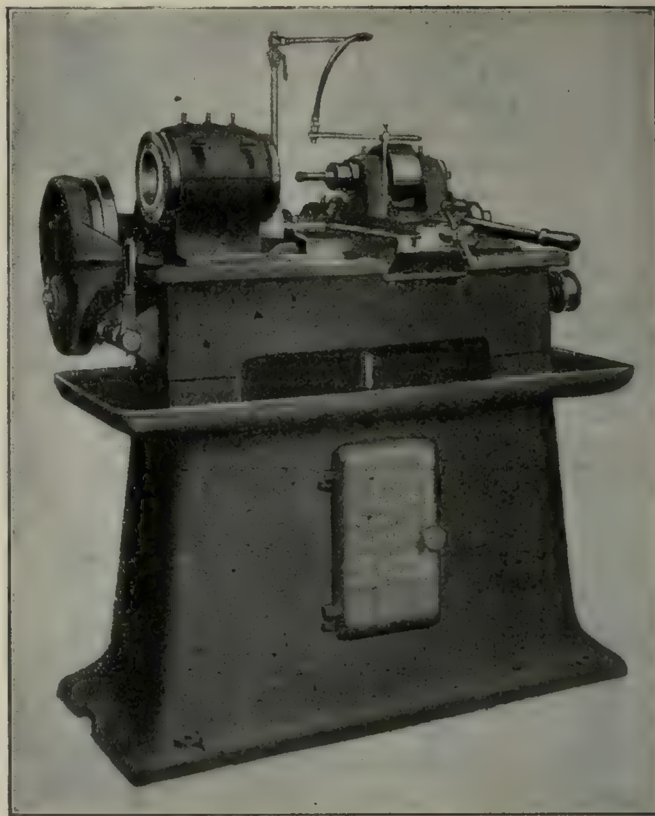
ADJUSTO SEMI-AUTOMATIC DRILLING JIG

device can be set for various sizes of work and for different locations of holes, thus avoiding the building of special jigs for certain classes of work. The device can be easily attached to a high-speed sensitive drilling machine and can be adjusted to take parts up to 1 in. in diameter. It drills up to $\frac{7}{32}$ in., and can be fitted with special holding blocks for odd-shaped pieces.

"Automatic" Thread Milling Machine

The Automatic Machine Co., Bridgeport, Conn., has brought out the thread milling machine shown in the illustration. The machine is of the hob or multiple-cutter type in which the cutter has the form of the thread to be cut but is without lead. A thread can be cut in one revolution of the work plus a slight overtravel.

In duplicate work it is only necessary to set the machine for sizing as, when once set, no further adjustment is required until the wear on the cutter becomes appreciable. The machine can be stopped either automatically or by hand on completion of the work. The only hand operation required is moving the carriage back for clearance in placing the work and re-entering the cutter to the starting position.



"AUTOMATIC" THREAD MILLING MACHINE

Specifications: Swing over bed, 14 $\frac{3}{4}$ in.; diameter of spindle face, 7$\frac{3}{4}$ in.; hole in spindle, 4$\frac{5}{8}$ in.; maximum distance between work and cutter spindles, 14 in.; hole in cutter spindle, No. 9 B. & S. taper; capacity, 6 in. in diameter; floor space, 50 x 24 in.; weight, net 2,000 lb., crated 2,200 lb., boxed for export, 2,525 lb.; dimensions of box, 72 x 56 x 30 in.

The cutter and work spindles are driven by separate belts from the same countershaft. The headstock can be swiveled on the bed so that taper threads can be milled. The carriage is moved an amount equal to the lead of the thread at each revolution of the work by a lead cam and the cutter is fed to depth and withdrawn by a depth cam. Varying feeds and speeds are taken care of by the countershaft pulleys and by the change gearing provided. Both internal and external threads can be milled. By substituting a milling cutter for the threading hob, circular milling on small work can be done; and, by changing the shape of the feed cam, irregular shapes can be milled.

The machine is mounted on a substantial base of which the oil pan is an integral part. One-half the base is used as an oil reservoir and the other half for a tool cabinet. An oil pump is included in the regular equipment.

The lecture program of the Franklin Institute for the current season is notable both for the well-known men who speak, and the subjects covered. On Feb. 26 the artillery of the A. E. F. was illustrated and described by Major-General C. C. Williams, Chief of Ordnance, U. S. War Department. Further lectures are: March 4, The Manufacture of Plate Glass, by G. A. Rankin; Mar. 11, Photographing Sound Waves from Large Guns and Projectiles, by Dayton C. Miller; March 17, The Induction Electrical Furnace, by G. H. Clamer; March 25, Optical Glass and Its Future as an American Industry, by Dr. Arthur L. Day; April 1, Aëronautical Instruments, by Dr. Chas. E. Mendenhall. Other lectures by prominent men will be made on April 8, 15 and 21.

What Other Editors Think

The Itch for Change

From *Wall Street Journal*

If Germany had won the war it is conceivable that she might have imposed upon the world a great many things the world does not really want. These drill-sergeant changes accord well with the habit of the German mind. But they do not at all suit what is inaccurately but conveniently called the Anglo-Saxon mind. This is why the agitation for a metric system, compulsory all over the world, has actually lost ground in the past few years in spite of some financed propaganda apparently originating in San Francisco.

* * *

Any system of weights and measures is necessarily only a means to an end. It is like a country's constitution, or a dozen other things. If the end of good government is attained, theoretical imperfections in the constitution may be wisely left alone. The British constitution, in fact, is the most efficient in the world, and it defies you to put your thumb on it. It achieves excellent government, which is the end for which it exists. The English system of weights and measures achieves a highly efficient international commerce, and there is no real evidence that that commerce would be improved by the scrapping of the yardstick and the pint measure.

It is not really true to say that the British weights and measures were of German origin. In the form in which the Normans found them these measures had Saxon names, but let us remember that the Saxons from which the English sprung were first cousins of the Norsemen and not even distantly related to the Hun or his parvenu descendant, the modern Prussian. Of all the diverse elements which went to the making of the homogeneous English race perhaps the most inconsiderable was the German or his real ancestors.

Loosely, in a way not to lay down a deceptive generalization the English system of weights and measures is related at many points to the system of measuring time, which is the basis of the navigation of all nations. The days, hours and minutes are solar, and the advocates of the metric system at the outset broke their shins over something so intangible as the meridian of Greenwich.

* * *

The metric system has its scientific uses and it may be left to such uses. Not only is it discarded in Spain, one of the Latin countries, for something less "scientific" but closely related to our own. You cannot even get the Frenchman to talk of five centimes. He speaks of a "sou," and what is more he speaks in multiples of sous, to the embarrassment of the American tourist.

This country is engaged at present in the eminently proper task of persuading people to let our excellent Constitution alone. There is all kind of work to do in our imperfect world. There is no present or probable future need for legislative meddling with the system of weights and measures which an overwhelming part of the trading world already accepts and understands. Any legislative enactment in Congress or in the British Empire Parliaments which was more than merely permissive would do an incalculable amount of harm, at the price of a merely theoretic uniformity which the business of the world neither needs nor wants.

The Combined Pocket-book Is Not So Fat as You Think

From *American Magazine*

Everybody wants a higher income. Fine! A laudable ambition! But don't get the idea you can pick it off the trees.

Just now the human race is on one of its periodical "bats," during which it has the foolish idea that it can get something for nothing. The notion is abroad in the world that you can arbitrarily ask for almost any kind of an increase in income—and get it.

But this is just where the error lies. There isn't as much wealth and combined income in the world as we imagine. And if we don't all get busy and go to work pretty soon there will be a whole lot less to fight over than there is now.

I know a corporation having 2,000 employees, where the average pay of all employed is about $1,300 a year—or $25 a week. Nobody in the entire establishment gets less than $12 a week. Most of the employees get from $20 to $25. A few of the managing officials get good-sized salaries. The general manager gets $20,000 a year. Perhaps ten others get an average of $10,000. The profits of the business are about $600,000 a year. Now suppose that $600,000 should be taken away from the stockholders entirely and divided among the employees. It would give an increase in pay of only $6 a week. Surely not a large sum.

Now suppose, in addition, you took the general manager and his $10,000 associates and threw them out. And suppose you took their combined salaries ($120,000 a year) and divided the money up with the workers. That would give each an increase of $1 a week! Of course, the fact of the matter is that without some return to the stockholders and some higher salaries for skilled managers you wouldn't have any business at all. The whole thing would blow up and all of the 2,000 employees would be on the street.

Think this over carefully. Study the concern you are connected with. Figure out where your best chance lies. Suppose you were with the company I have just referred to. Would you want to fire all the officers and stockholders and have $7 a week more until the sheriff arrived? Or would you rather run the thing as it is and perhaps get an increase of $10 or $15 or $25 a week if you show yourself abler and more industrious than some of your fellow workers?

Sparks from the World's

By E. C. Porter,

Duty-Free Admission of Samples for Bordeaux Fair

Consul Theodore Jaeckel, Bordeaux, France, states that samples for the Bordeaux Fair will be admitted by the French customs authorities under bond, free of duty, or upon payment of the duty which will be refunded upon re-exportation of the samples. The Compagnie General Transatlantic will return the samples to the United States without charge. Embargoes against the exportation of goods will not apply to samples.

The annual commercial and industrial fair will be held at Bordeaux, France, from June 5 to June 20, inclusive. All particulars regarding shipments and space may be obtained from A. D. Straus & Co., 18 Broadway, New York City, the official representatives of the fair committee. It is suggested that interested American firms act at once; from previous experience with the exhibits for the Bordeaux and Lyons fairs, considerable delay was encountered in many cases, which prevented exhibits from arriving in time to be displayed.

Machinery Will Do World's Work Says Edison

Despite submarines and subways, wireless telephones and telegraphs, the conquest of the air, and developments in industrial chemistry, Thomas A. Edison during the celebration of his seventy-third birthday, "asserted the world is only beginning to develop."

"We have efficiency today but only in a primitive stage," the scientist said. "Our efficiency will continue to increase for the next 1,000 years."

Edison predicted the new world will be run entirely by machinery. The worker, he said, should be but the brains behind a machine. Brain power, in the form of highly developed mechanical apparatus, must supplant man power in all forms of industry, he added.

As an illustration the scientist pointed out that in the future development of machinery it would be possible to put wool into a machine and have it delivered as cloth, where now separate operations for spinning and weaving are required.

Asked about a statement of Guglielmo Marconi, quoted in cable advices from London, as asserting that certain strange wireless signals might be an attempt of inhabitants of the planet Mars to communicate with the earth, Edison declared such a development was "entirely possible."

"The world today is much more efficient than it was fifty years ago," the scientist declared, "but we do not notice it. The development has come on slowly all about us until we have become so accustomed to the new that it has become commonplace."

New Supply Division Manager for Westinghouse Seattle Office

J. G. Miles has been appointed to the position of supply division manager of the Westinghouse Electric and Manufacturing Company's Seattle office. Mr. Miles goes to his new appointment to succeed C. V. Aspinwall, now the company's representative at Spokane, Wash.

J. G. MILES

Mr. Miles has seen long service in the supply department of the Westinghouse company, serving for several years as the head of the insulation section, at East Pittsburgh, Pa.

Latin-American Trade

The grand total of international trade of the twenty Latin-American Republics advanced from about $3,000,000,000 in 1913 to nearly or quite $5,000,000,000 in 1919. The exports show an increase of nearly 100 per cent in stated value, and the imports, an increase of about 50 per cent; though it is proper to add that these increases in the grand total of values are due in a very considerable degree to the higher prices in 1919.

Armour Institute of Technology Receives Big Gift

The announcement has been made that J. Ogden Armour has made a gift of $6,000,000 to the Armour Institute of Technology, which was founded by his father, P. D. Armour, in 1892. It has been felt for some time that the institution had outgrown its present quarters at Thirty-first and Federal Sts., Chicago. On looking around for a new site its president, Dr. Frank W. Gunsaulus, selected a plot of eighty acres located at Seventy-fifth St. and Yates Ave.

When this proposition was put up to Mr. Armour he agreed to give $1,000,000 for the purchase of this site and a further sum of $5,000,000 for the erection of the new buildings. The new location is near the steel-mill district of South Chicago, which will afford excellent opportunities for visits by the students to this great industrial center. It is also within a very short distance of the lake and it is planned to add a course in marine engineering to the curriculum. The new institution will be planned for a capacity of 1,000 students.

At the time the institute was founded by P. D. Armour its aim was outlined in the following statement: "The institution is founded for the purpose of giving to young men an opportunity to obtain a liberal education. It is hoped that its benefits may reach all classes. It is not intended for the poor or the rich sections of society, but for any and all who are earnestly seeking technical education." The new plans will undoubtedly enable the institute to take a leading rank among the great technical colleges of the country.

National Metal Trades Association's Convention

The National Metal Trades Association, which has its executive offices in the People's Gas Building, Chicago, Ill., will hold a convention in New York City at the Hotel Astor on April 10 to 22. On Monday, April 19, the executive committee meeting will be held at 10 a.m. The secretaries' dinner will be given at 7 p.m. On Tuesday, April 20, 1920: Council meeting, at 10 a.m. to 5 p.m.; meeting of the local branch secretaries, at 10 a.m.; alumni dinner, at 6:45 p.m. On Wednesday, April 21: Convention, at 9:30 a.m. and 2 p.m.; buffet lunch, at 12:30 p.m.; banquet, at 7 p.m. On Thursday, April 22: Convention, at 9:30 a.m. to 2 p.m., and a meeting of incoming administration council.

Industrial Forge

News Editor

New Type of British Airplane Engine

Tests have been completed in Manchester, England, by Captain William P. Durtnall of a new type of airplane engine which will be silent, and from which the danger of fire in the air has been removed. The tests were made on a converted engine that had been previously operated on the Otto cycle system.

At present the exhaust pressure of the gases is very high in ordinary airplane engines, producing considerable noise. Under the system used in the Bowles and Durtnall engine, the exhaust gases leave the engine at ½-lb. pressure per square inch, which results in "silent" operation. With so great a reduction of the temperature, it is claimed to be impossible to get a flame from the exhaust in any circumstances. The further claim is made that cheap heavy crude oil can be used in these engines, and that full power can be produced at altitudes up to 20,000 feet.

Hawthorne, Leslie & Co., of Newcastle, are reported to have secured the rights of these engine improvements for use on the large power internal combustion railway locomotives which they are now building.

The Greenfield Tap and Die Corporation's New Officers and Directors

At the annual meeting of the stockholders of the Greenfield Tap and Die Corporation, of Greenfield, Mass., on Feb. 3, 1920, the following officers and directors were elected:

Officers—Frederick H. Payne, president; Francis G. Echols, vice president and general manager; Leon M. Lamb, secretary and comptroller; Frank A. Yeaw, treasurer; Frederick K. E. Hawks, assistant treasurer.

Directors — Frederick H. Payne, Francis G. Echols, Franklin Judge, Joseph W. Stevens, William M. Pratt, Charles N. Stoddard and Charles Allen.

Dr. Walker Heads "Technology Plan"

The new division of industrial service at "Technology" has just been placed under the direction of Dr. William H. Walker, for over twelve years head of the Research Laboratory of Applied Chemistry, and for over twenty-five years on the staff of the Institute. The success of the undertaking has already been assured by the fact that over one hundred and fifty of the country's largest industrial plants have wholeheartedly indorsed the plan and subscribed over a million dollars.

The selection of Dr. Walker is a logical choice. He received the Distinguished Service Medal, with a citation for his technical ability, industry and zeal, as a reward for the splendid work he did at the Edgewood Arsenal, Maryland, as commanding officer. He overcame labor disputes, directed over fifteen thousand men, obtained materials and completed and put in operation the largest toxic plant in existence, its output being nearly twice that of the other Allies combined.

This innovation for technical schools consists of a contract signed by the manufacturing plant and the Institute. A certain sum annually is specified upon for a certain number of years and for this the Institute agrees to give advice on new inventions, solve problems that need research and special apparatus and permit the use of its libraries of scientific knowledge.

The proposition is to bridge the gap between industrial establishments and the scientific school by making it possible for manufacturers to consult the Institute and its staff on any of the difficulties arising in their business. It is also expected to remove the possibility of losing members of the faculty by their acceptance of tempting offers to give up teaching and work in the various private laboratories scattered over the country. The scarcity of highly specialized technical men cannot be effectively eliminated if the supply is cut off at its source, and the industries of the country now have an excellent opportunity to return some of the service Technology has given them in the past.

Among the concerns which have signed contracts under the Technology plan are the American International Corporation, the General Electric Company, the United States Steel Corporation, and the American Telephone and Telegraph Company.

Delivers Lecture on Lathes for Turning Car Wheels

D. H. Teas, Chicago representative of the Niles-Bement-Pond Co., delivered an illustrated lecture recently before members of the Cincinnati Railway Club at the Hotel Sinton on "Lathes for Turning Car Wheels." In the course of his talk Mr. Teas demonstrated the various steps taken in the manufacture of wheels for locomotives, freight cars and passenger coaches. Colonel Brent Arnold, of the L. & N. Railroad, presided.

A Wireless Device That Will Ring Alarms on Other Ships

A novel wireless emergency calling device by which ships in distress can ring alarm bells on other ships within wireless range is reported by the American Chamber of Commerce in London.

The present wireless system of communication requires that an operator to hear a call must be on duty, wearing the usual telephone headpiece. The new device is said to enable any station or ship equipped with a special automatic transmitter key to call up any station or ship within range, fitted with a corresponding selective receiver relay, even if the operator is absent. The calling up is effected by a bell.

It is claimed that one of the most important uses of the devices will be to insure immediate and general attention to S. O. S. calls.

Chamber of Commerce of United States to Have Foreign Trade Department

Chauncey D. Snow has resigned as United States commercial attaché at Paris to head a newly created foreign department of the Chamber of Commerce of the United States. Mr. Snow, who went to Paris a little more than a year ago to investigate markets in France for American goods, formerly was first assistant chief of the Bureau of Foreign and Domestic Commerce.

Creation of the foreign-trade department by the United States Chamber of Commerce is the first step toward a reorganization of the chamber's machinery designed to divide the work of the chamber up along the lines of the great divisions of industry. Other departments to be instituted soon include domestic production and distribution, transportation, insurance, finance and civic development.

Americans at Lyons Fair

Seventy-five American firms are inscribed as exhibitors at the Lyons samples fair to be held March 1 to 15. The French firms number 2,100; British, 126; Italian, 105; Swiss, 68; Belgian, 15; Spanish, 21; Dutch, 12; Roumanian, 11; Czecho-Slovakia, 25. Among the American exhibitors are twenty-five shoe manufacturers and fifteen tanners and allied trades.

Coal Production

Production of soft coal for the week ended Feb. 14 amounted to 10,284,000 tons. Anthracite production amounted to 1,773,000 tons.

Trade Currents From New York, Cleveland and Chicago

New York Letter

Machine-tool developments during the past week have showed improvement in most lines, with a demand for inspection tools being strongly in evidence. Toolroom equipment looms prominently among other inquiries.

Orders appear to be increasing in size, as several $50,000 sales during the past week indicate. The greater number of sales though are between $5,000 and $10,000, but a gradual trend upward is expected from now on.

The railroad freight situation is giving dealers some concern. One dealer has thirty carloads of machine tools held up between New York and a New England point indefinitely. Another reports a large shipment held in a nearby classification yard with but little chance of being released for some time.

Less than carload lots are being refused by railroads in many places, and some dealers find this situation an effective bar to reasonable deliveries. Thirty thousand cars are waiting at Chicago to be shipped East, and there are hundreds of thousands of dollars worth of machine tools represented that are consigned to New York dealers. A number of freight embargoes also contribute to the uncertain machine-tool delivery situation.

Textile machinery is active, and numerous inquiries presage a large volume of business in this line.

Silk mills are in the market in increasing numbers for machine-shop equipment. They are showing a tendency to do their own shopwork rather than "farm" it out. A number of sales to silk mills—particularly in the Paterson, N. J., district—are reported, and the equipment called for is the best and most expensive obtainable in most cases.

Due to a number of the larger dealers changing lines recently, "floor samples" of the discontinued lines are being offered at rates considerably below prevailing price schedules for similar equipment. The Fairbanks Co. recently made a number of changes, and is now handling several popular lines of machine tools heretofore unrepresented in New York.

Cleveland Letter

Numerous inquiries with few proportional sales and negligible cancellations, sum up Cleveland machine-tool activities for the past week.

Most of the business on the books of local dealers is for delivery to the automotive trade. It is stated that this industry generally has orders booked for a year ahead, and has contracted for machine tools to be delivered over that period.

Railroad buying in this territory is booking up slightly. A few inquiries have been received, but actual orders are very light.

Local machine-tool interests are making preparations to solicit South American and Oriental trade, now that European exports are off, and considerable business is being booked for delivery to oil interests in the Tuxpan-Tampico region of Mexico.

Chicago Letter

Renewed activity is reported by all dealers, two concerns reporting such an influx of business during the past week as to insure a February total in excess of January's. Many deals which have been under way for some time are being closed. Local sales remain light. It is the wide stretch of manufacturing territory contiguous to Chicago which is doing the buying.

Washing-machine manufacturers hold the center of the stage at present as buyers. One firm last week placed orders for tools aggregating over $20,000, to be billed at the prices prevailing at time of delivery. Quantities of punching and drilling machines are wanted by this class of user, and sheet-metal-working machinery is largely in demand. Heavy-duty tools continue active, one manufacturer reporting his entire production for the year 1920 already sold, except for a few boring mills.

Tendency on the part of electric-motor repair shops and automobile repair men to place large and expensive machinery is growing. One electric motor repair man last week bought three machines totaling over $5,000, this incident being merely typical. Inability of auto makers to turn out new cars as fast as wanted has made the auto rebuilder very busy, making him a good customer of the machine-tool dealer.

Shortage of raw materials is becoming more of a problem to all manufacturers. Black steel sheets are at present particularly hard to get, and in some urgent cases it is said brass is being substituted. Some plants are threatened with a shutdown on this account.

Local building conditions remain unsatisfactory. Aside from three or four $25,000 garages, no new construction of interest to the machinery trade was announced during the week. Johnson Fare Box Co. has let the contract for the construction of its new $125,000 plant. They are going to move their old machine equipment and will not be in the market for much new stuff.

Established in New Plant

The Tabor Manufacturing Co., manufacturer of molding machines, cutters, etc., is now established in its new plant at Wissinoming, Philadelphia. This company's plant was burned at North 18th and Hamilton Sts., and the company was unable to locate on its site purchased at Nicetown, as it was taken over by the Government. The new location consists of 5 acres and a building, 100 x 350 ft., of steel and concrete construction. An addition 100 x 100 ft. has been made to the present building.

Exports and Imports Show Large Increase for January

Despite the foreign exchange situation, the trade balance in favor of the United States increased $257,000,000 in January, according to figures made public recently by the Department of Commerce. Both exports and imports showed an advance, the value of goods sent out of the country being $731,000,000, and that of those received, $474,000,000.

The exports compared with $682,000,000 in December and $623,000,000 in January a year ago. Imports compared with $381,000,000 in December and $213,000,000 in January, 1919.

For the seven months of the fiscal year beginning last July 1 exports totaled $4,594,000,000 and imports $2,768,000,000, leaving a trade balance of $1,826,000,000. The trade balance for the corresponding seven months the year before was $2,099,000,000.

Gold imports for the seven-month period amounted to $38,000,000 as compared with $14,000,000 in 1919, and exports $319,000,000, against $23,000,000 last year.

Exports of silver for the same period amounted to $122,000,000, compared with $179,000,000 in the corresponding period the year before.

Gold exports for the month of January amounted to $47,758,038 and imports to $12,017,551. Silver exports for the month totaled $24,627,678 and imports $8,863,251.

Steel Shortage in Great Britain

"British users of steel billets are in hard straits for adequate supplies," says Trade Commissioner Wilbur J. Page. "A large South Wales firm appealed to for supplies reported that freight cars sufficient to supply only half the required quantity of pig-iron coal could be obtained, and that it had to cut down its production of steel billets accordingly.

"The shortage is assuming alarming proportions. One of the largest structural engineers in the Midlands is held up on nine-tenths of his contracts for lack of steel. In the northeast a large steel works reports that it has 20,000 tons awaiting delivery, but cannot secure freight cars. The stoppage of American supplies of steel has caused great difficulties to firms which for several months past have been depending almost entirely on foreign steel. This shortage has been particularly felt in the lines of flat strip for tube making.

"Galvanized sheets are most difficult to get. Sample lots of galvanized sheets are bringing as high as £39 ($189.79) per ton. Many of the large producers state that their full production has been booked well into the spring. Carbon crucible steel producers in the Sheffield district report strong developments in the export demand. South American and South African markets are buying freely, while France and Italy are also placing considerable orders."

Advertising the Foreman Who "Spilled the Beans"

From two widely separated sections of the country, from two distinct types of industries, come accounts of good results accomplished by advertising the names of foremen in whose departments accidents occur as well as those whose departments show clear records.

The Halcomb Steel Co. of Syracuse, N. Y., publishes prominently in its plant organ, under the heading of "Who's Who in Safety," each month, the names of all foremen in whose departments there were no accidents during the previous month. Directly opposite, under the heading "Those Who Spilled the Beans," are published the names of the other foremen, with the number of accidents charged to his department after each name. The Corn Products Refining Co., Chicago, last October conducted a safety drive among all its plants, at the close of which a bulletin was posted showing the name of every foreman in whose department one or more accidents had occurred, together with the number of accidents in each department.

Discussing the effect of such publicity, Grover Kingsley, safety engineer of the Halcomb Steel Co., writes: "This has proved a stimulus to good safety work in a great number of instances. Foremen want to keep their names out of the 'Who Spilled the Beans' column. Contrary to expectations, this sort of publicity does not create antagonism to safety, and I attribute this principally to the humorous phrase used to designate foremen whose departments show accidents."

C. J. Alger of the Industrial Relations Department, Corn Products Refining Co., writes: "Opinions from the various plants differ. Of course, the victorious plants are very much satisfied with the plan. On the other hand some plants reported that this posting of names makes some foremen feel that the good work that they accomplished during the drive was not appreciated. My personal opinion is that if the foremen are warned as to the manner in which their names are to be published in the event of accidents in their department during the drive, it certainly would have a tendency to cause them to exert their utmost efforts. We feel that the results obtained more than offset any possible criticism on the part of a few foremen."—*National Safety News.*

Page Steel and Wire Acquired by American Chain

The American Chain Co., Inc., of Bridgeport, Conn., has purchased the control of the Page Steel and Wire Co., with mills at Monessen, Pa., and Adrian, Michigan.

It is the intention of the American Chain Co. to continue the business of the Page Steel and Wire Co. as heretofore, taking only its surplus product. The latter company's plants consist of openhearth furnaces, rolling mill, wire mills, as well as fence factories.

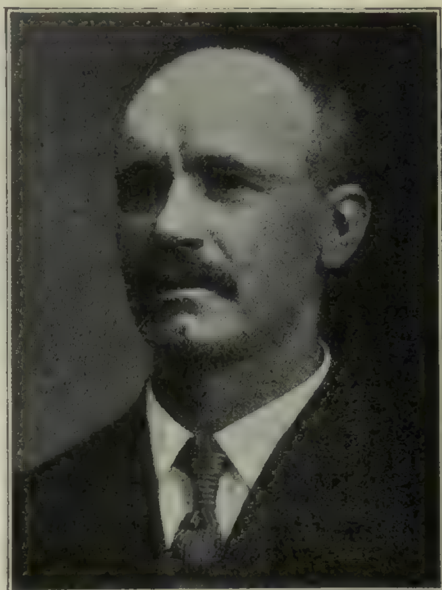
The new officers elected under the reorganization of the company are: Walter B. Lashar, president; William T. Morris, vice president; Wilmot F. Wheeler, treasurer; John E. Carr, assistant treasurer, and William M. Wheeler, secretary.

E. C. Sattley, general manager of the Page company, will continue in that capacity with offices in Pittsburgh, Pa.

The American Chain Co. has its general sales offices in the Grand Central Terminal Building, New York City, and district sales offices in Chicago, Boston, Philadelphia, San Francisco, Portland and Pittsburgh.

John Hettich

John Hettich of the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, superintendent of milling-machine construction, died Jan. 27, 1920. He entered the employment of this company, July 27, 1903, to take up the duties of foreman of one of the departments. He held this position until July 19, 1918, when he was promoted to the position he was holding at the time of his death.



JOHN HETTICH

The Platt Iron Works Has Been Sold

The Dayton Malleable Iron Co., Dayton, Ohio, has purchased the plant of the Platt Iron Works Co., located in North Dayton. The purchase includes 10 acres of ground on Herman Ave. Immediately after the completion of the deal the announcement was made that the Gartland-Haswell-Rentschler Foundry Co. was formed to lease the plant and operate it. Gordon S. Rentschler, of Hamilton, is president; M. F. Gartland, of Marion, Ind., vice president, and John C. Haswell, of Dayton, secretary-treasurer. Peter V. Gartland will be general manager. The Dayton Malleable Iron Co. will retain the other property for its own use.

Advertising Engineers Opens Offices in New York City

The Advertising Engineers, Inc., 50 Union Square, New York City, has opened an office for the purpose of carrying on a business as conselors for advertisers of engineering and technical products.

Curtis F. Columbia will act as Eastern manager. He was formerly publicity engineer for the New Jersey Zinc Co. and the United States Gypsum Co., and has for a great number of years been connected with the metallic industries. He is a member of the American Society of Civil Engineers, American Society of Testing Materials and Princeton Engineering Association.

Associated with Mr. Columbia are Virgil G. Marani, M.E., former building commissioner of Cleveland; Victor Hugo Halperin, Ph.B., formerly advertising manager of the General Fireproofing Co.; F. W. Leggett, E.E., director of publicity of the Bell Telephone Co.

Personals

J. HOBART BRONSON, president and treasurer of the Oakville Co., Waterbury, Conn., has resigned as president of the Citizens' National Bank of Waterbury.

RALPH G. FARRELL, official of the Bridgeport Screw Co., Bridgeport, Conn., has been appointed a director of the Connecticut National Bank of Bridgeport, Conn.

JOHN K. WILLIAMSON, head of the Porcupine Co., Bridgeport, Conn., maker of the "Porcupine" boilers, has been made a director of the Connecticut National Bank of Bridgeport, Conn.

P. J. CONNOR, formerly special representative for the International Machine Tool Co., Indianapolis, Ind., is now associated with the E. L. Essley Machinery Co., Chicago, Ill., as its sales representative.

F. J. HOUGH has been appointed superintendent of the Collins Co., Southington, Conn., manufacturer of edge tools, etc. This vacancy was made by the death of C. H. Smith. Clair M. Elston has been made assistant superintendent to succeed Mr. Hough.

FRANK O. WELLS, after forty-seven years' association with the Greenfield Tap and Die Corporation and parent organizations, has resigned his office and sold his holdings in the corporation. Mr. Wells will, however, remain with the corporation in an advisory capacity.

J. L. LAURENCE, formerly representative of the Director of Air Service in the machine-tool section for the Director of Sales Office of the War Department, has resigned from that position to join the sales division of J. T. Ryerson & Sons. Mr. Laurence will be in the New York office and will have charge of the sales in Massachusetts, Connecticut and New York.

Business Items

Charles Austin Hirschberg, Inc., advertising counselors, has announced that it is now located in its permanent quarters at 426 Sun Building, 150 Nassau St., New York City.

The Simplex Tool Co., Woonsocket, R. I., manufacturer of toolroom specialties and the direct-reading micrometer, has announced that it will increase its floor space and equipment.

W. M. Cowan and W. B. Alford have organized the Cowan-Alford Machine Corporation at Macon, Ga., to manufacture a machine for boring. Mr. Cowan and Mr. Alford are the joint inventors of this machine.

The Danbury Foundry Co., Inc., Danbury, Conn., has been incorporated with a capital of $25,000 to manufacture castings, etc. The incorporators of the new company are R. J. Hausin, E. Hausin and W. H. Cable, attorney.

W. D. Reeves and Paul D. O'Kelley have organized the Reeves-O'Kelley Machine Co., and have opened a shop at 45 Auburn Ave., Atlanta, Ga. They will make a specialty of gear cutting and repairs of automobile parts and machinery.

The Electrolabs Co. has consolidated all its offices at 2635 Penn Ave., Pittsburgh, Pa., and in the future all correspondence should be addressed to the Pittsburgh office. A branch office will be maintained at 30 Church St., New York City, room 313.

The Hartford Tool Works, Inc., Hartford, Conn., has been organized to deal in machinery, tools, etc., and will commence operations immediately. The capital of the new company is $75,000. The organizers are A. A. Engstrom and A. M. Engstrom, both of Newington, Conn., and E. G. Nelson, Hartford, Conn.

The Cincinnati Automatic Machine Co., Cincinnati, Ohio, has purchased from the Windsor Machine Co., Windsor, Vt., the manufacturing, selling and patent rights of the Gridley automatic multiple drilling machine. This company proposes to manufacture this machine along with its multiple-spindle automatic machine.

The J. N. LaPointe Co., manufacturer of broaching machines, New London, Conn., has opened a branch office at 11 Harper Ave., Detroit, Mich., in connection with which a stockroom and repair shop is maintained as well as a warehouse in which is carried a stock of the company's broaching machines. This Detroit branch is in charge of Wm. L. Nicholls.

The Bridgeport Castings Co., manufacturer of castings, etc., which recently purchased the old plant of the Bridgeport Tube Works, North Ave., Bridgeport, Conn., had its plant completely destroyed by fire. The company is now engaged in rebuilding the plant and expects to be in operation soon. The Bridgeport Castings Co. was recently organized and incorporated with H. B. Houghton, president; E. P. Quinn, secretary and treasurer.

The Erie Crucible Steel Co., of Erie, Pa., makes the announcement of the appointment of the Cleveland Steel Supply Co., Cleveland, Ohio, as its agent for the Cleveland district. C. E. Schnibbe is manager of the latter company and was formerly with the Halcomb Steel Co. for twelve years, five of which he was connected with the company's Cleveland branch as salesman. In March of last year he severed his connection with the Halcomb Steel Co. and organized the Cleveland Steel Supply Co.

The Golden Co., exporter and importer, 405 Lexington Ave., New York City, announces that it is the sole and exclusive American agent for Société Genevoise d'Instruments de Physique, makers of comparators for the gaging of steel balls, ball bearings and machined parts of every description; also universal measuring machines, reference gages, scientific instruments and dividing engines for cylindrical, conical, circular and linear work.

The Connecticut Tubing Co., 556 Capital Ave., Hartford, Conn., has been incorporated to manufacture tubing, etc. The officers of the new company are: Walter B. Lashar, president; Bernard I. Ashman, vice president; E. L. King, secretary and treasurer; A. E. Oldroyd, assistant treasurer; J. B. Camplin, assistant secretary. Mr. Lashar is president of the American Chain Co., Bridgeport, Conn., and is also president of the Pratt & Cady Co. Mr. Ashman is a real-estate operator; Messrs. King, Oldroyd and Champlin are connected with the Pratt & Cady Co., Hartford, Conn.

New Incorporations

The Eastern Shear Co., of New Haven, Conn., has been incorporated to make and deal in scissors, shears, cutters, etc. The capital is $100,000, and the organizers are L. M. Molloy, T. F. Calahan and C. E. Moore, all of New Haven.

* * *

The Duval Tool Co., of Central Falls, R. I., was recently incorporated to manufacture and deal in machine tools, etc. The organizers of the company are Ovila Liscault, 73 Fuller Ave., Central Falls, to whom communications should be addressed, and James P. Duval and Ernest Tessier, both of Central Falls.

* * *

The Standard Safety Manufacturing Company, Inc., 265 Park St., New Haven, Conn., has been incorporated with a capital stock of $60,000, to make and deal in safety devices for machinery, etc. The officials of the company are: President, G. M. Egglesston; vice president, Charles Becker; secretary, E. C. Regan; treasurer, C. S. Oswold. The concern, it is reported, will commence operations soon.

Obituary

HAROLD McGILL DAVIS, publicity manager for the Sprague Electric Works of the General Electric Co., died on Monday, Feb. 16, 1920, at his home at Seventy-Third St., Brooklyn, aged fifty-nine years.

JAMES GAYLEY, internationally prominent as a metallurgist, and a former vice president of the United States Steel Corporation, died at his home in New York, Feb. 25, 1920, after an illness of several weeks. Mr. Gayley at one time was president of the American Institute of Mining Engineers.

WALTER P. PHILLIPS, former president of the Columbia Graphophone Manufacturing Co., Bridgeport, Conn., died at his home in Vineyard Haven, Mass., on Jan. 31, 1920. Mr. Phillips was born in Grafton, Mass., in 1846. He was the inventor of the Phillips code for telegraph operators, and was at one time engaged in the telegraph business in New York and Providence.

Short News Notes

The American Implement Co., Elyria, Ohio, is planning the construction of a new plant for the manufacture of small tractors.

* * *

The Doelger & Kirsten Co., Milwaukee, manufacturer of metal-working machinery, will build a two-story machine shop addition, 90 x 200 feet.

* * *

The Motor Castings Co., Milwaukee, organized last summer, is placing its new gray-iron shop at Fifty-sixth St. and Greenfield Ave., West Allis, in operation. The plant will specialize in castings for the automotive industry.

* * *

Marion Machine Foundry and Supply Co., Marion, Ind., has recently completed four units of a factory. They are the assembly building, warehouse, foundry and an office building.

* * *

The Case Manufacturing Co., Jackson, Mich., is making plans for a new factory.

* * *

The American Enameling and Stamping Co., Bellaire, Ohio, is preparing to make extensive additions to its plant.

* * *

The Lewis Manufacturing Co., Massilon, Ohio, makes the announcement that it has commenced the production of switches and switch boxes.

* * *

The Steinwender-Stoffrege Coffee Co., St. Louis, Mo., is planning to install its own can-making plant.

* * *

The Winslow Bros. plant, located on the Belt Line Railroad, which was one of America's heaviest shell producers during the war, has been sold to M. C.

(*Continued on page 538b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Lathe, "Ideal" Geared-Head Engine.
Springfield Machine Tool Co., Springfield, Ohio.
"American Machinist," Feb. 19, 1920.

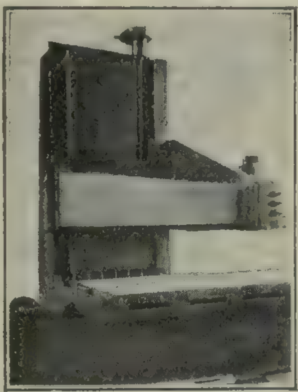
Size, 14 in. x 8 ft. It is motor driven, has rapid change gears, relieving attachment, taper attachment, oil pan and pump. Geared head is of selective type having twelve mechanical changes of speed; is provided with ball bearings throughout, with exception of spindle journals, which are adjustable. Back gears may be used for the cut and without disengaging half nuts; tool may be returned at a speed ten times as fast as cutting speed. Relieving attachment will cut from two to twenty-six flutes per revolution of spindle; will relieve right- or left-hand threads both external and internal.

Truck, W. & I. Sixth-Wheel Trailer.
Warren & Irrgang Co., Springfield, Mass.
"American Machinist," Feb. 19, 1920.

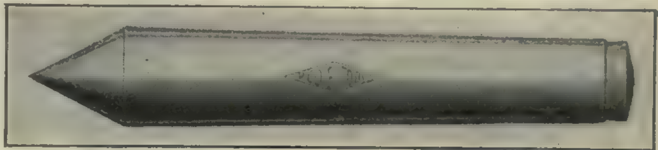
Truck is made in three stock sizes, with capacities of two, three and four tons, respectively. The 30 x 72-in. size has 12 x 3-in. wheels and will turn in a 4-ft. circle. The 40 x 120-in. size requires a 6 ft. circle to make the turn and has 14 x 3-in. wheels.

Planing Machine, Open-Side.
F. R. Patch Manufacturing Co., Rutland, Vt.
"American Machinist," Feb. 19, 1920

Specifications: Planes, width, 48 in.; height, 48 in.; table length over all, 15 ft. 6 in; width, 44 in.; length of bed, 23 ft. 4 in.; down feed, 9 in.; floor space length, including table travel, 32 ft.; maximum height under rail, 50 in.; horsepower required, 15 to 25; crossrail motor, 2 hp.; net weight of machine without motor, approximately 40,375 lb.



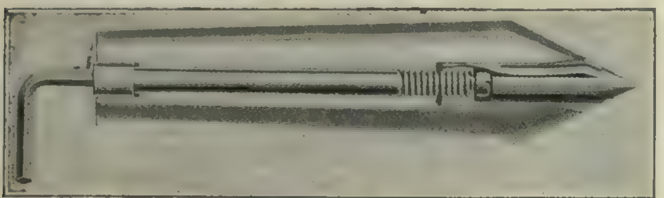
Centers, "Red E" Lathe.
Ready Tool Co., Bridgeport, Conn.
"American Machinist," Feb. 19, 1920.



The high-speed-steel point of each center is electrically welded to the nickel-steel body and extends back about one-quarter of the length. The advantages claimed for these centers are long life; no tendency to burn or freeze to the work, and that a machine equipped with them can be run faster and more steadily. The center is made in all standard sizes and tapers, suitable for lathes and grinding machines.

Centers, Improved Lathe.
Senn Tool and Machine Co., 90 Shelby St., Detroit, Mich.
"American Machinist," Feb. 19, 1920.

The body of the center is of machinery steel, carbonized. The outside taper and collet hole are both ground to size. Collet is



made from tool steel and is hardened and ground. Screw is of cold-drawn steel and is cyanided. The center point is of high-speed steel and is heat-treated. Small socket wrench is furnished with each center. The center is manufactured in all standard sizes and tapers, and the parts are interchangeable.

Chucks and Cutters, Woodruff Keyway.
Scully-Jones & Co., Railway Exchange Bldg., Chicago, Ill.
"American Machinist," Feb. 19, 1920.

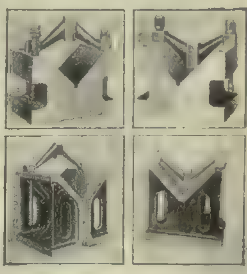
Designed especially for the milling of keyways for Woodruff keys. The chucks are hardened and ground and can be furnished to fit all standard tapers. The cutters have squared shanks and are furnished in all standard sizes to fit Woodruff keys.

Riveting Rig, Liberty, Bottom.
Liberty Tool Co., Munsey Bldg., Baltimore, Md.
"American Machinist," Feb. 19, 1920.

When used for ship riveting is attached to ship's bottom by a single bolt that passes through the center swivel bracket. Riveter held at end of radius arm in cylinder bracket which is supported in a yoke and adaptable to any riveter. The round radius arm is supported at two points upon convex rollers mounted in crossheads. These may be screwed up or down by crank handles at ends of the brackets. The device ordinarily works on a radius of 10 ft.; is operated by one man. Yoke on the end of the radius arm is tapped for 1½-in. standard pipe so that it can be equipped with any length of radius arm. Full-length radius arm is furnished with each rig.

V-Blocks, Taft-Peirce.
Taft-Peirce Manufacturing Co., Woonsocket, R. I.
"American Machinist," Feb. 19, 1920.

Made in two styles, as illustrated; the solid type in the 4-in. size and the skeleton type in the 6- and 8-in. sizes. These three sizes are intended to meet all conditions met in shop practice. The blocks are furnished in pairs. In each case the V is central with the sides. The 4-in. block is made of tool steel, hardened and ground. Sides are undercut to permit the use of clamps for holding the blocks in place. The 6- and 8-in. sizes are provided with a slot in one end and in the base, as well as one bolt hole in the base and one in the end, for clamping the blocks in place.



Clip, paste on 3 x 5-in. cards and file as desired

Short Trade Notes

(*Continued from page* 538)

Rosenfeld of Cleveland, Ohio. Mr. Rosenfeld, who is connected with McCool Co., of Cleveland, makes no announcement as to his intentions for the future. The lathes, which are largely Amalgamated equipment, are being offered for sale.

* * *

Lindstrom, Smith & Co., Cleveland, maker of electric specialties, and the Tuthill Spring Co., manufacturer of auto springs, have both let contracts for new factories, to cost, respectively, $125,000 and $200,000.

* * *

The Plamondon Manufacturing Co., machinery builder, is beginning construction of a quarter-million dollar plant on the southwest side, Cleveland, Ohio.

* * *

Republic Blow Meters Co., Cleveland, has commenced the construction of its new plant.

* * *

The Federal Machinery Sales Co., 12 North Jefferson St., Chicago, has added to its line, as sole agent, the product of the Universal Boring Machine Co., of Hudson, Mass.

* * *

The Columbia Enameling and Stamping Co., Terre Haute, Ind., is planning to increase its present capacity. This company expects to occupy its new building some time this fall.

* * *

W. E. Ackerman, of Wheeling, W. Va., is the head of a new concern being organized to make can machinery. The firm will be a combination of the Ackerman Manufacturing Co. and the Whittaker Glessner Co., of Wheeling.

* * *

The Dunning Heating Supply Co., Milwaukee, expects to move into its new factory in a short time. New equipment throughout is the policy adopted.

* * *

On completion of its naval-gun contract, the Savage Arms Co. will convert its Sharon, Pa., plant into the production of motor-car axles and bearings. It is said that production in the new line will be under way soon.

* * *

The Hayes Wheel Co. (steel wheel division), of Jackson, Mich., will build and equip another unit equal in size to its existing plant.

* * *

The Jackson Motors Corporation has completed buying of a large equipment list, and will be out of the market for most lines for about six months.

* * *

The Williams Test Clamp Co., of Cleveland, has rented additional space for the production of the "Outlook" Wind Shield Cleaner.

* * *

The D. D. Clark Manufacturing Co., of Salem, Ohio, has been acquired by the W. H. Mullins Co. of the same place. The Clark line of conveying apparatus will be continued by the Mullins Co. on a larger scale, and a department for building closed auto bodies will be established. Two new buildings are under construction to house the added features.

* * *

A new plant to be devoted to cream-separator production is to be built shortly at Renfrew, Canada, by the Renfrew Machinery Co. The company has authorized a substantial appropriation for mechanical equipment.

* * *

The Western Electric Co., of Chicago, plans to increase production in several departments 100 per cent.

New Publications

Engineering Machine Tools and Processes. By Arthur G. Robson, A. M. I. Mech. E., L. C. C. Beaufay Technical Institute. 307 pages, 8 x 5½ in., illustrations, clothboard covers. Published by Longmans, Green & Co., 4th Ave. and 30th St., New York; also London, Bombay, Calcutta and Madras.

This book has been written for the benefit of students of engineering. In Chapter 1, measuring tools are described as well as the details of periodic and progressive errors of the micrometer screw upon precision work. Under the heading of "Lathe Details and Tool Design," the research work of Dempster Smith is of importance to students. Improvements upon lathe beds, taper-turning arrangements, graduated disks upon slide screws and indicators for registering position for "picking up" the thread in screw cutting are mentioned. A large variety of lathe tooling operations is described in Chapter 3. The treatment of tool steels and tools, with reference to recalescence points, pyrometers, hardening baths, electrical furnaces, hardness tests and high-speed tool steel is dealt with in Chapter 4. There is a comprehensive chapter upon threading tools, threads and hand reamers in Chapter 5. The durability and cutting powers of dies for holders are given much space. Chapters 6 to 10 deal with drilling machines, milling machines, precision grinding machines, shaping, planing and boring, and capstan and turret lathes. The capabilities of high-speed tools and results achieved by these machines are investigated, and many types of milling operations are shown, together with short notes upon special milling jigs. In discussing grinding machines, reference is made to magnetic chucks, grinding allowance charts, grinding wheels and the grinding of hollow spindles. The capacity of turret and capstan lathes is dealt with, and the methods of "laying out" the tools are illustrated. In the chapter upon "Methods and Trigonometry of the Toolroom," there is a correlation of calculations and workshop processes, with the use of jigs emphasized. In Chapter 12 helpful calculations are introduced while in the last chapter upon "The Properties and Strength of Materials," the results of tests are tabulated and plotted, and the necessary deductions are drawn. Finally there is a collection of formulae and tables.

Trade Catalogs

Automatic Multiple-Spindle Drilling Machine. The Cincinnati Automatic Machine Co., Cincinnati, Ohio. Catalog, pp. 16, 6 x 9 in. This catalog gives illustrations and a description of the Gridley automatic multiple-spindle drilling machine which this company recently purchased from the Windsor Machine Co., of Windsor, Vt.

Hex Semi-Automatic Milling Machine. The F. C. Sanford Manufacturing Co., 2060 Fairfield Ave., Bridgeport, Conn. Circular, 5½ x 8½ in. A two-page circular describing the automatic milling machine for milling spark plugs.

Car Dumpers. The Wellman-Seaver-Morgan Co., Cleveland, Ohio. Bulletin No. 49, pp. 15, 11 x 8½ in. This bulletin gives several illustrations of the W. S. M. car dumper in various plants and it also shows blueprints of these machines.

Demountable Truck Body. American Truck Body Co., Martinsville, Va. Bulletin No. 26, 3⅞ x 8⅞ in. A general description is given in this bulletin of the Fontaine demountable truck body, also its specifications and price.

Metallurgical Patents. The Chemical Foundation, Inc., 81 Fulton St., New York City. Pamphlet, pp. 70, 6½ x 9½ in. This pamphlet gives the aims and purposes and the reasons for the organization of the Chemical Foundation. It presents reports made to Congress by A. Mitchell Palmer and Francis P. Garvan, Alien Property Custodians. A prospective of this organization is outlined in the last four pages.

Rolling Mills. Standard Machinery Co., Auburn, R. I. Catalog, pp. 65, 6 x 9 in. The illustrations in the catalog show the general design and construction of its machines, and a description is also given. Dimensions are given of each rolling-mill machine.

Price List. J. L. Lucas & Sons, Inc., 3 Fox St., Bridgeport, Conn. This small circular gives the prices of its products such as gear cutting, grinding and milling machines, hammers, lathes, etc.

Computers. Computer Manufacturing Co., 25 California St., San Francisco, Cal. A folder giving the mechanical details, construction and use of the Ross computer; also its price.

Machine Tools. Pedrick Tool and Machine Co., Philadelphia, Pa. Catalog, pp. 96, 7½ x 10½ in. A catalog describing and illustrating the machinery for use in railway shops, shipyards, general machine shops and industrial plants. Specifications are given of each machine.

Forthcoming Meetings

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of Eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

The National Metal Trades Association will hold a convention at the Hotel Astor, New York City, on April 19 to 22, 1920. H. D. Sayre is the secretary.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Pa., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The Second Annual Aëronautical Exposition of the Manufacturers Aircraft Association, Inc., will be held at the Seventy-first Regiment Armory, 34th St. and Park Ave., New York, on Mar. 6-13, 1920. S. S. Bradley, 401 Fifth Ave., New York City, is the general manager.

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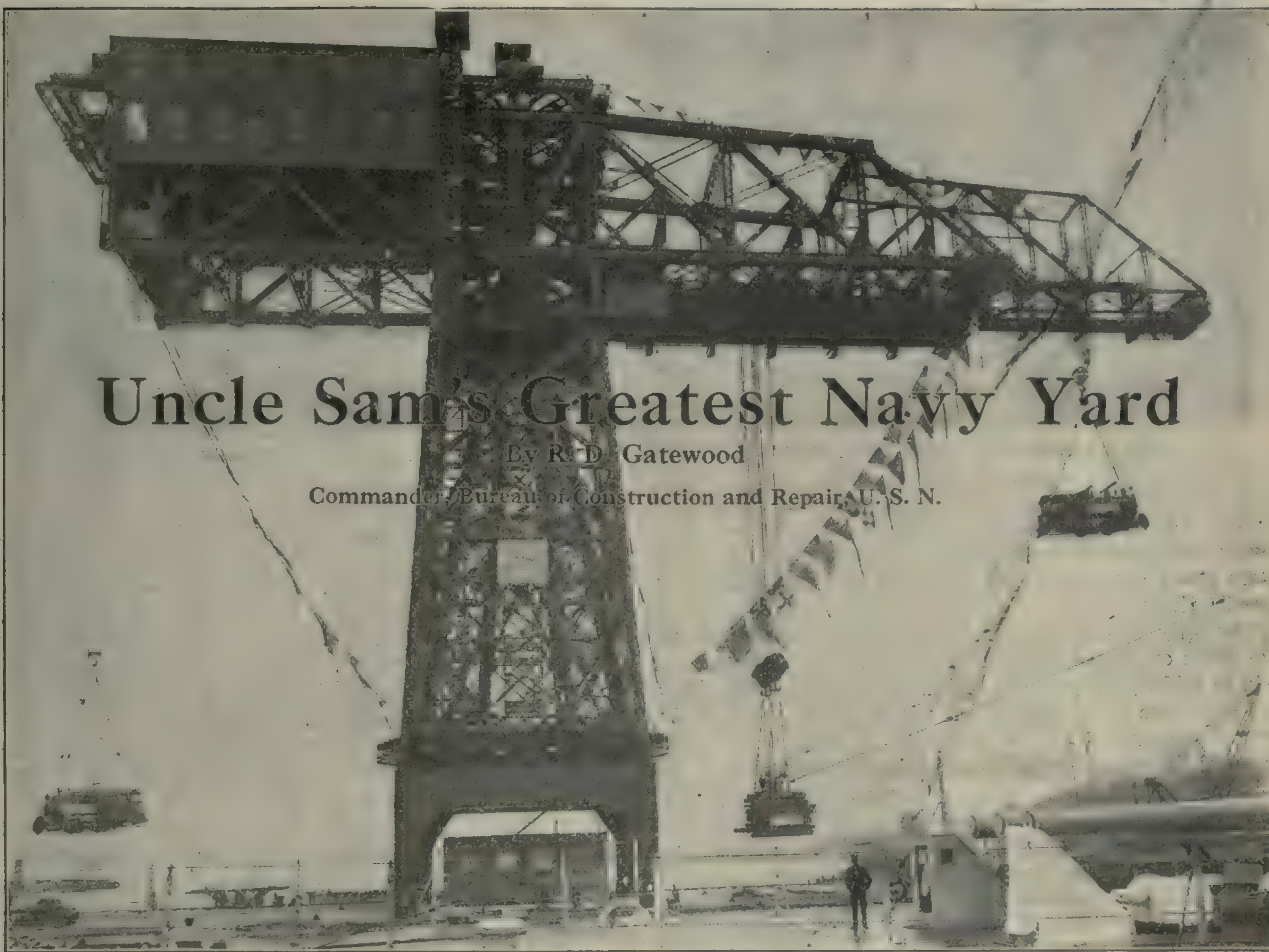


Uncle Sam's Greatest Navy Yard

By R. D. Gatewood

Commander, Bureau of Construction and Repair, U. S. N.

The growth of naval activity during the war is exemplified by the expansion of the manufacturing facilities of the Philadelphia Navy Yard, better known of old as "League Island." During the past two and one-half years over $25,000,000 were expended in its development, this being approximately double the total previous cost for the sixty years of its existence up to June 30, 1916. And the end is not yet.

THERE is nearly always abroad in this land of ours a certain steady murmur of criticism against projects involving any considerable expenditure of public funds. Sometimes this criticism is directed toward the worth or worthiness of the project itself, but more often against the quality and quantity of the return obtained by the Government for its money. Criticism of this latter sort has been particularly rampant during and since the war, and it may therefore be refreshing and just as well for variety's sake, if for no other reason, to mention briefly at least one conspicuous instance where the Government has obtained full worth for its money, and where the resulting plant is one that even so great a nation as our own may well feel proud to possess.

The Philadelphia Navy Yard has grown during the war to be incomparably the greatest naval station of the United States. This fact is not known or appreciated even by the citizens of Philadelphia, owing to certain war-time restrictions still prevailing, preventing access to the yard by the general public. In all the sixty years since the establishment of the yard up to June 30, 1916, the total expenditures for improvements had only been $13,700,000. During the last two and a half years over $25,000,000 has been spent in enlarging and developing the facilities of this great shipbuilding and repair plant, and to those familiar with this, or indeed any of our major naval stations before the war, it will seem, when seen again, entirely transformed. The old structures, the little group of red-brick shops and offices, the wooden residences, formerly constituting what was considered a large navy yard, are now quite dwarfed by the many new ones that have been erected, and the completed project will aggregate $35,000,000.

The main street of the city, Broad St., passes through the center of the yard and to the east and west of it the built-up area now extends for a mile in either

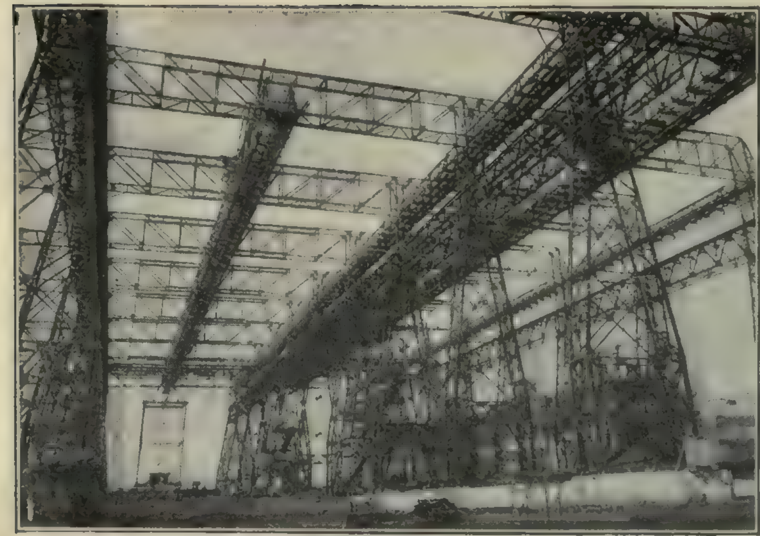


FIG. 1. THE TWO STEEL SHIPWAYS

FIG. 2. NEW STRUCTURAL IRON SHOP

direction, where before the war it was limited to one or two blocks either way. Where forty vessels formerly represented the maximum number tied up to its piers there are now more than one hundred and forty vessels there.

The only way to get a real idea of the magnitude of the plans on which the yard is constructed is to take a trip in a Navy "blimp" or seaplane. Looking west along the Delaware River waterfront one sees the "fitting-out" pier, a structure 1,000 ft. long, 100 ft. wide with 35 ft. of water at mean low water—easily the longest and finest pier on the river. Its cost was $785,000. At the outer end of this pier great concrete caissons resting on footings sunk to a depth of 75 ft. sustain the massive weight of the huge crane named "The League Island." This crane is a dominant landmark on the river front, towering higher than an 18-story building and capable of lifting a 14-in. turret, with its guns in place, out of a battleship and placing it if necessary at a height greater than that of the Brooklyn Bridge. An idea of the strength and capacity of this million-dollar lifting device, the largest crane in the world by more than 100 tons, is afforded by the fact that on test it lifted a load of 440 tons and swung it over more than a 100-ft. radius (see headpiece). It will also handle 50 tons at 190 ft. from center. Its cost was approximately $850,000.

Continuing westward along the river front we see something of the big scale of what may be called "The New Yard," which is to be devoted primarily to shipbuilding. The new drydock, now in process of construction and about 60 per cent complete, much resembles a section of the Panama Canal. Its depth and width are equal to the locks of that great waterway, and the railroad tracks along the top, the concrete-mixing plants, derricks, cranes, shovels and chutes all help to heighten the impression. This drydock will take any ship that can pass through the locks of the Panama Canal; that is, a vessel 1,000 ft. long, 110 ft. beam with 43½ ft. over the sill at mean high water. It is being constructed under unusually adverse conditions, owing to the large amount of water encountered in the excavation. It has been necessary to inclose the dock in a box of sheet-steel piling with intermediate cross-walls to keep the water out. The dock contains 200,000 cu.yd. of concrete. The pump well is 200 ft. long and 50 ft. wide with a depth below the ground of 90 ft. The cost, including two 50-ton traveling dock cranes, will be $6,500,000. The only other drydocks of equivalent dimensions are the ones at Boston, Norfolk, Panama and San Francisco.

Still further to the west are the two new steel shipways, shown in Fig. 1, as large as any of their kind in the world, intended as they are for the building of two of the great battle cruisers upon which work is about to begin. These cruisers, 875 ft. long overall, will be about 25 per cent longer and heavier in displacement than any vessels ever before constructed in this country. The extreme height of the steel superstructure of these building slips above the ground is 180 ft. Each slip is provided with 10-ton cranes spanning half the width of the slip and a 40-ton crane spanning the entire slip. The crane rails for 40-ton cranes are 135 ft., and for the 10-ton cranes, 152 ft. above the ground. The crane-runway superstructure is now being extended to its full length of 1,000 ft., and a light crane runway will be carried out over the ground at the head of Slip No. 3, to handle bulkheads and other fabricated material. The cost of these slips with crane runway extension, including keel blocking, will be $2,800,000.

Alongside of these slips extend the glass walls of the new structural iron shop, Fig. 2, a building 700 ft. long and 300 ft. wide and including a structural shop and smithery. The most westerly bay has a second story to provide a mold loft 700 ft. long and 100 ft. wide. Material will come in at the waterfront end, pass through the shop and go out at the north end, directly to the shipbuilding ways. The cost of the building and cranes was $1,835,000; machine-tool equipment and foundations, $955,000 — a total of $2,790,000.

FIG. 3. NEW MACHINE-SHOP BUILDING

FIG. 4. THE NEW FOUNDRY

Laid back slightly from the waterfront and directly at the inshore end of the fitting-out pier is the new machine shop, Fig. 3. This building is 325 ft. long and 130 ft. wide, with a main bay 80 ft. in width and a height of 70 ft. to crane rails. It is designed for two 150-ton traveling cranes, but at present is equipped with only one such crane. The cost of the building and cranes was $660,000; tools and foundations, $425,000—a total of $1,085,000. The complete project includes a 350-ft. extension of the building toward the waterfront, with one additional 150-ton crane. This shop can then handle all the large machine work of capital-ship construction.

Not far away is the new foundry, Fig. 4. This building is 642 ft. long and 160 ft. in width, with a central bay of 80 ft. designed for two 80-ton cranes with a height of 63 ft. to crane rails. At the present time one 80-ton crane is installed. The cost of the building and cranes was $1,150,000; furnaces and equipment, $300,000—a total of $1,450,000.

This foundry can produce steel castings weighing 5,000 lb. and iron castings up to 200,000 lb. Additional equipment for the melting of steel is to be provided, and such castings up to 20 tons, required in the erection of a capital ship, will be produced in this foundry.

To the west of the foundry an entire new power plant, Fig. 5, has been constructed to meet the increased demands for power which will be occasioned by the construction of capital ships, the operation of the new dock and the existing and projected general development of the yard. This is a plant of the most modern type, with adequate capacity to meet the needs of the yard for various power services. Many new devices for speeding up production are available here, one of the novelties being a double-action coal chute and conveyer that empties the contents of a carload of coal, crushes it, and carries it up on to belt conveyors into a concrete hopper of 2,200 tons' capacity whose contents will be fed automatically to the furnaces below. When equipped to its full capacity, the plant will have a nominal boiler-horsepower of 9,600 or 19,200 hp. at 200 per cent rating, 29,000 cu.ft. per minute of compressed air and 12,000 kw. of electrical energy. A coal-storage plant to the west of the power house is capable of storing in excess of 10,000 tons. Funds already provided for this plant, including coal storage, but not including the power distribution systems connecting the plant with the various shops, piers, etc., aggregate $2,800,000.

To the east of the foundry is a new three-story concrete building, now in process of erection, for the new pattern shop and pattern storage. This building is 400 ft. long, 108 ft. wide, and, when completed, will cost about $750,000.

FIG. 5. POWER PLANT WITH COAL AND ASH CONVEYOR

Various other structures of lesser importance than the foregoing have been completed in this portion of the yard to the west of Broad St., each essential to the building of a first-rate, fully equipped shipyard; and the aggregate cost of which will total several million dollars. Among these should be mentioned two small shipways costing $75,000, from which four mine sweepers, steel vessels 190 ft. in length, have been successfully launched and completed; a galvanizing plant; an acetylene plant, and a locker building adjacent to the new structural shop, costing $270,000; a stowage yard, costing $150,000, for 40,000 tons of steel for battle-cruiser material; a charging station for submarines and a permanent storage-battery building, costing about $200,000; a new boat shop, costing $380,000; a new roundhouse, costing $80,000; and various temporary buildings, costing $525,000, with a total floor area of 800,000 sq.ft. to accommodate the enormous quantities of stores handled during the war and the material removed from the many ships being placed out of commission and in reserve.

FIG. 6. ONE OF THREE PERMANENT STOREHOUSES

East of Broad St. the improvement is no less notable. On what were formerly drill grounds, fields and mosquito swamps there are now storehouses, hospitals, barracks, aircraft factory, etc. Some idea of the storehouse problem at this yard may be gained from the statement that the value of material stored here, exclusive of aircraft material, is over $50,000,000. Three large modern reinforced-concrete storehouses, Fig. 6, thoroughly fireproof, with a floor area of over 1,000,000 sq.ft., have been erected at a cost of $2,500,000.

The buildings of the concentration camp, erected at a cost of $1,650,000, provide accommodations for 6,000 men and constitute, with their roads and boardwalks, a little "city" within the yard, complete in itself.

The new hospital, costing $1,040,000, consists of a number of neat-looking gleaming white concrete buildings having a capacity of 1,000 beds.

Readers of the *American Machinist* have already enjoyed reading of the truly remarkable performance of the naval aircraft factory at this yard, the only *naval* aircraft factory in existence, and the only aircraft factory in the United States that received no adverse criticism in the post-war investigations. The plant was started in August, 1917, and within two months from the time of commencement of the work machinery was in actual operation. The original factory has been greatly expanded and at this time the entire plant includes 21 acres under roof. The first flying boat produced by this factory was actually in the air four months from the time ground was broken. Up to the time of the armistice, 187 flying boats or seaplanes had been assembled, representing a value of $4,500,000. The cost of the plant improvements aggregates $5,775,000, or a total, with machine-tool equipment, of $6,150,000.

In addition to many other structures, such as garages reservoirs, roundhouse, dispensary and the new radio towers, Fig. 7, there have been added to the yard power-distribution systems for the distribution of electrical energy, compressed air, steam, fuel oil, city reservoir water and Delaware River water, sewage and drainage. Many new streets have been made; old streets widened and repaved; railroad trackage more than quadrupled; many additional locomotives, cranes and motor trucks have been purchased to supplement the transportation equipment.

The grass plots, lawns and flower beds that formerly made the yard a sort of park, have almost disappeared, and this great inland naval station has come into its own. So busy are the streets and avenues that at many of the crossings sailors act as "traffic cops," and the total number of inhabitants of the yard during the day, counting all employees and the sailors and marines on ships and in barracks, is not far from 40,000. The yard has thus been converted into a veritable "naval city," but where formerly the warships were the chief points of interest, now the shops and equipment have become the chief attraction. Though warships of all types, sizes and ages are berthed at its docks, they are merely incidental, from the visitor's point of view, to the vast industrial expansion resulting from the war.

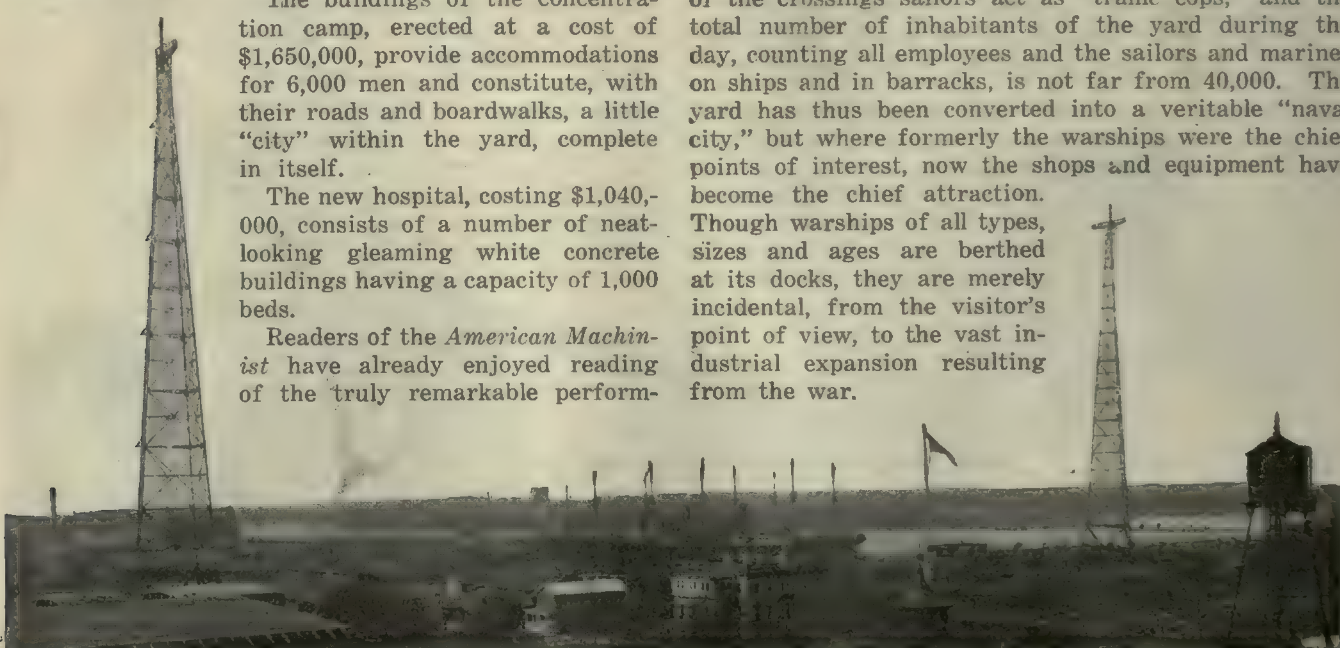


FIG. 7. THE RADIO TOWERS

Brazing Steel Tubes and Sheets

EDITORIAL CORRESPONDENCE

Credit for the information contained in this article belongs to F. Grotts, chief metallurgist of the Curtiss Aëroplane and Motor Co. It is the result of a large number of experiments, together with his practical experience in handling these materials in every-day work. The data cannot fail to be of value to all having similar problems.

Although both electric and oxy-acetylene welding have made great strides within the past few years, there still remains a field for brazing in certain kinds of work. Airplane manufacturers favor it for many of the fittings, because of the lower temperatures which can be employed and the decreased danger of injuring the material by overheating.

Two brazing materials are used; one having an analysis of 80.0 per cent copper, 9.3 per cent lead, 0.1 per cent iron, 1.25 per cent impurities, and the remainder something over 18 per cent zinc. The other brazing material has from 58 to 60 per cent copper and the remainder zinc. The first material, containing 80 per cent copper, is preferable, as when this is used the steel can be treated afterward without inquiry to the brazed joints.

Brazing vs. Welding or Soldering

Brazing, as distinguished from welding or soldering, may be said to be the joining of two pieces of higher fusing metals, such as iron, steel, or copper, by the use of a lower fusing copper-zinc alloy; although in the case of iron or steel parts, pure copper is sometimes used. The parts to be joined are heated a little above the fusing point of the brazing metal, while a flux, such as borax, which will fuse and dissolve all the metallic oxides present, is used with the brazing metal so that the metal melts and runs into the places where the union of parts is desired. The parts are then allowed to cool in air, after which the joint is finished by removing the adhering flux and superfluous brazing metal.

Brazing is also referred to as "hard soldering," in distinction from soft soldering, in which a tin-lead alloy is used. The use of silver solder is also called hard soldering in some places, although it should be referred to as silver soldering.

The brazing metal or the metal which is used for forming the joint is often called spelter, particularly when it has a low copper content. This, however, should never be less than 55 per cent copper, as any further reduction greatly weakens the alloy. The ultimate strength of a brazed joint depends on the strength of the brazing metal forming the union. The stronger the brazing metal that can be used the stronger will be the joint.

The most satisfactory fluxes for brazing with a copper-zinc alloy are borax and boric or boracic acid. The latter is to be preferred because it contains no water of crystallization and melts without foaming or frothing. Borax contains a large amount of water of crystallization, and as this is driven off in the first heating it is apt to froth violently, causing the flux to be blown off by the torch or flame. Unless a flux is used which instantly dissolves the oxides as they form on the metal, the brazing metal will not flow freely, interfering greatly with the securing of a good joint.

Copper and brass have the peculiarity of dissolving their own oxides, and this interferes with the flow of the metal. Brazing spelter should be clean metal; that is, free from dissolved oxides and impurities in suspension.

Experiments indicate that the iron content can be considerably higher than 0.1 per cent without damage. But although percentage of allowable impurities appears high, brazing by the acetylene torch, with metal containing 83 per cent copper, showed a greater tensile strength in a number of cases than the steel which was brazed. Pure copper is inferior to good brass as a brazing metal. It requires a considerably higher temperature, with increased labor and danger of burning the steel. It does not flow as well as brass and the finished joint is weaker.

One of the main things in making a good brazed joint is to have the parts hot enough so that the brazing metal flows freely, but not sufficiently hot to burn the metal. This requires special care in the use of the acetylene flame, particularly with light-gage tubing. Cases have been found in which the tubing was melted through and the hole covered with brazing spelter. On the other hand, if the temperature is not high enough the brazing metal forms a coarse, granular and brittle structure which makes a weak joint. By taking more time in heating, good results can be obtained.

Acetylene Flame Best

In all the experiments made, the strongest joint was produced by the acetylene flame; the gas fire was next, and the dip-brazing method proved the weakest. This was, no doubt, due to the fact that, as dip brazing is ordinarily practiced, the steel does not become any hotter, and probably not as hot, as the molten brazing metal. Dip brazing should therefore be used only for joints in which there are large surfaces in contact, such as the reinforcement of tubing and similar construction. The average increase in strength of acetylene-brazed joints over fire-brazed joints was 8½ per cent.

Steel parts to be brazed should be free from any adhering foreign matter and from scale. The ordinary film of oxide does no harm. The sandblast should not be used for cleaning, as the rough surface which it produces greatly interferes with the flow of spelter, and, in the effort to overcome this, the workmen may easily overheat the steel, which results in cracks and unsatisfactory joints. Pickling with acid is also unsafe; it is difficult to remove the last traces of acid so completely as to prevent subsequent corrosion.

Cleaning a brazed joint involves removing the black iron oxide or scale, the fused borax, and the excess spelter. The sandblast is perfectly satisfactory for this work, except where more brazing must be done afterward. For removing excess spelter a small electric or pneumatic hammer, fitted with suitable chisels, will do a better job than filing. Abrasive belts, properly arranged, can do most of the work of polishing after excess spelter has been removed. The borax can be

removed with a hot solution of carbonate of soda, which has no bad effect upon either brass or steel.

The effect of the temperature required in the brazing process is to anneal the steel to which it is applied. If the steel has been tempered or hardened by such cold working as rolling or drawing, brazing will reduce its tensile strength and increase its ductility.

Experiments with Brazed Joints

The tables show the results of a series of experimental joints made with different brazing metals, the acetylene torch being used for heating. The flux was a mixture of five parts boracic acid and two parts borax, mixed to a paste with water and applied wet to cold metal, and with zinc chloride used in a similar way. Table I gives the resulting tensile strength. The weakness of the work using the zinc chloride can at least be partly attributed to the fact that the flow of brazing metal was very poor, so that the joints were only partly covered.

TABLE I. STRENGTH OF BUTT-BRAZED JOINTS

Exp. No.	Brazing Metals	Boric Acid Flux Load	Boric Acid Flux Lb.Sq.In.	Zinc Chloride Flux Load	Zinc Chloride Flux Lb.Sq.In.
1	Wire 116-1	6,840	31,500	2,590	11,900
2	Wire 116-2	6,410	29,500	3,070	14,100
3	Wire 116-3	7,650	35,000	1,900	7,700
4	Wire 116-4	6,760	31,000	3,170	14,400
5	Wire 116-5	6,880	31,750	3,000	13,800

Table II shows the results of brazing with different metals, also using the acetylene torch.

TABLE II. RESULTS OF BRAZING WITH VARIOUS METALS

Exp. No.	Brazing Metal	Load	Lb.Sq.In.
6	Brass No. 128-1	5,990	25,500
7	Brass No. 126-2	6,170	28,400
8	No. 128-3	6,220	28,600
9	Copper and brass equal parts	6,790	31,300
10	Copper 2 pt. Brass 1 pt.	7,050	32,500
11	Copper, sheet	6,870	31,800
12	Scrap cud brass	670	3,090
13	Spelter (condemned)	9,080	41,800

Table III shows the result of brazing in a gas fire, using sheet copper, while Table IV shows the joint secured with an acetylene torch, with three different silver solders.

TABLE III. RESULTS OF BRAZING IN GAS FIRE WITH SHEET COPPER

Exp. No.	Metal	Load	Lb.Sq.In.
22		7,300	33,700
23		6,500	29,800
24		8,190	38,200
25		7,650	35,200
26		8,650	39,800
27		2,800	21,000
Average		7,180	33,200
28	116-1	9,370	43,100
29	116-2	6,980	32,100
30	116-Soft	10,550	47,500
31	116-4	9,700	44,600
32	116-5	10,970	50,500*
33	128-3	10,690	49,300
34	11-Tobin	10,720	49,400
35	10-Soft	10,990	50,000*

* Steel parted.

The joints brazed in the gas fire, using copper-zinc alloys, with boric-acid flux, nearly all exceeded the maximum strength of the steel used. With copper-zinc brazing alloys, boric acid leaves little to be desired as a flux. It makes no difference how it is applied as long as a sufficient amount is fused on the joint to insure a complete cleaning of the metal.

TABLE IV. TEST OF JOINTS MADE WITH SILVER SOLDER

Exp. No	Metal	Load	Lb. Sq.In.
36	Silver No. 1	8,590	39,500
37	Silver No. 2	10,020	46,000
38	Silver No. 3	11,561	53,200*

* Steel parted.

The effect of heat-treatment on brazed joints shows some interesting results. The bars tested were ½-in. hexagon steel and were butted together for brazing, in order to test the tensile strength of the joints. One-half of the bars were heat-treated by heating to 1,600 deg. and quenching in oil, after which they were reheated to 900 deg. before testing.

The brazing metal used was made by melting together 6 lb. of copper and 1½ lb. of zinc, under a borax flux, and allowing the mixture to cool in the crucible. This ingot was then sawed in two, and one of the halves remelted and poured into a bar. Tests of each half showed as follows:

	Copper	Zinc	Iron	Bismuth	Lead
Ingot	81.74	18.20	0.06	Trace	Trace
Bar	82.60	17.30	Trace	Trace	Trace

This indicated that the zinc decreases with subsequent melting and also that the iron practically disappears.

The tensile strengths are shown in Tables V and VI, which show that the torch brazing is considerably stronger than that made in a gas fire. Heat-treating increases the strength of the joint over 5,000 lb. per square inch for the welds made with the torch, while the joint which was brazed in the fire was only increased 750 lb. per square inch.

TABLE V. STRENGTH OF COPPER-ZINC BRAZED JOINTS

Exp. No.	Torch Braze Load	Torch Braze Lb.Sq.In.	Exp. No.	Fire Braze Load	Fire Braze Lb.Sq.In.
39	10,390	47,500	45	7,150	32,900
40	7,800	35,800	46	9,610	43,200
41	9,070	41,700	47	9,470	43,600
42	10,390	27,500	48	11,280*	51,500
43	6,880	40,000	49	7,150	32,900
44	10,420	48,000	50	7,860	36,200
Average		43,416	Average		40,050

* Steel parted.

TABLE VI. EFFECT OF HEAT-TREATMENT ON BRAZED JOINTS

Exp. No.	Torch Braze Load	Torch Braze Lb.Sq.In.	Exp. No.	Fire Braze Load	Fire Braze Lb.Sq.In.
51	10,280	47,400	57	9,130	42,000
52	12,220	56,100	58	8,580	39,500
53	10,980	50,500	59	8,550	39,500
54	9,380	43,100	60	10,030	46,000
55	10,820	47,400	61	8,960	41,000
56	10,300	47,400	62	7,950	36,800
Average		48,650	Average		40,800

Another brazing mixture of eighty-five parts copper and fifteen parts zinc, similarly remelted so that the zinc content was reduced about 2 per cent, gave a much weaker joint, as did another mixture, consisting of 305 parts copper, sixty-two parts zinc, and four parts tin The tests show that joints made with the acetylene torch were distinctly stronger than those made in the gas fire; that brazing metal containing 83 per cent copper and 17 per cent zinc gave the strongest joints, and that heat-treatment of joints brazed with acetylene gave a marked increase in strength.

Analysis of the metal in the joints shows that the acetylene torch reduces the zinc content of the metal 6 per cent, while the gas fire reduces it only 2 per cent. The difference in composition, however, does not account for the difference in strength; in fact, the reverse would be expected, since the strength of copper-zinc alloy normally decreases as the zinc content decreases through this range of proportions. Joints brazed with a metal almost identical in composition with that of the metal in the acetylene joint after brazing showed very inferior results. Whatever the cause, there seems to be no doubt that this is so.

The Evolution of the Workshop—VI

By H. H. MANCHESTER

The 17th Century marks the first break in the power of the guilds and the beginning of the factory system, due to the widening use of water power and the consequent improvement in machinery. Most of the important advances are still coming from Italy, although some of the proposed schemes are rather visionary.

(Part V appeared in Feb. 26 issue)

IT MAY have been noted in our two previous articles that the most important of the new machines of the later Middle Ages and 16th Century originated in Italy. The engineers also, of whom we have had most to say, including Marianus, Leonardo da Vinci, Biringucci and Ramelli, were Italian.

The first of the engineers of the 17th Century was likewise an Italian, Vittorio Zonca, whose machine book, "Nuova Theatro," was published at Padua in 1607. While a comparatively small work, it is important in several fields besides our own, and for us is highly interesting. It depicts the interiors of several shops for sharpening and burnishing weapons and tools. In each case this is done by means of grindstones, but in one illustration, the grindstones are run by horse power; in another, by water power, Fig. 33; and in a third, by a hand machine. Zonca also illustrates pulverizing and stamp mills driven by water power.


FIG. 33. A CUTLER'S SHOP OF 1607

At about the same date we read of an iron-cutting method being patented in England by Sir Bevis Bulmer. This machine was to be driven by water and used for cutting iron into small rods to serve in the making of nails. The device seems not to have been perfected, but there is a notice that a slitting mill of a cruder design had already been set up in England by Godfrey Bochs of Liege, Belgium. This and several other notices of the period in regard to iron-cutting devices leave little doubt that this method was already in successful use. In England, an improved slitting machine to be used in nail making was patented in 1612 by Clement Dawbney. A few years later, a renewal of his patent was strenuously objected to by the guilds of nail makers, but after a little delay it was again issued Dec. 11, 1618.

Possibly the first combined rolling and stamping machine for metals was a small French one that was used for the production of coin in 1615.

This brings us to an important German compilation, the "Theatri Machinarum" by Heinrich Zeising. This consisted of six parts published between 1612 and 1636. The parts all dealt with machines of one sort or another. Few of them were original with Zeising, who copied his subjects from wherever he could find them, but on this account they are none the less important as showing what devices were thought worthy of consideration at that time. The first book, published in 1612, dealt with building construction; the second, printed in 1614, with water devices; and it is not until the third book, issued in 1618, that he touches our field. Here we find water power applied

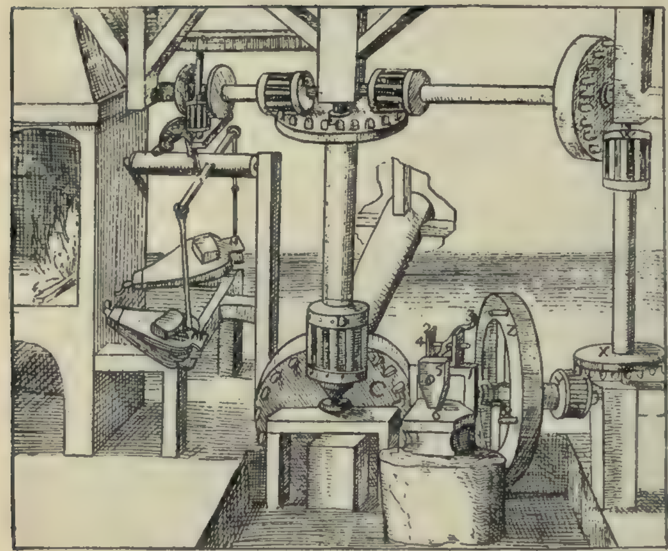


FIG. 34. MACHINE SHOP WITH POWER APPLICATIONS

to various kinds of sawing, stamping, and pulverizing. There is a good cut of the bellows and tilt hammer being worked by power, Fig. 34, and of two series of grindstones on shafts connected with belts and being driven by water power. The fourth book, published in 1629, includes several pictures of lathes, copied more or less directly from Besson.

While most of the work of Salomon de Caus in his "Les Raisons des Forces," published in 1615, had to do with other subjects, he shows a waterwheel being applied to sawing, boring, and to blowing bellows. He also includes a picture of a lathe being turned by hand power with the aid of a wheel and belt. In another section of his work he illustrates the rolling of lead by means of a simple hand machine, which in appearance reminds one of a clothes-wringer.

As if to remind us that the most novel ideas were still coming from Italy, Giovanni Branca, in 1629, published at Rome his work "Le Machine," which contains several amazing designs. One is of a small rolling machine being driven by a wheel which is turned by the hot air from a fire. One suspects that the power would have to be greater than that indicated in Fig. 35 to accomplish much practical work. Another really wonderful picture is a turbine being turned by steam, and used to drive a stamp mill, Fig. 36. Still another unexpected idea is that of a furnace being blown by air which is driven out of large jars by means of rising water. These three engravings must be considered as subjects not yet in practical use, but are of great theoretical importance.

As an antidote for the impression produced by the machine books which we have been mentioning, it is well to observe that Jan van Vliet's engravings of industry which were produced about 1630, still picture work as being done by locksmiths and other metal craftsmen entirely by hand, and there is little doubt that they portray the typical shop of the period.

A fairly good conception of the machines then considered available may be drawn from the "Theatrum Machinarum Novum" or "New Theatre of Machines," by Georgius Andreas Bocklerium and published in 1661. The first plates show the waterwheels and wind mills for grain, and it is not until plate 33 that we find grindstones driven by a belt from a shaft which is turned by an ox. There are also several pictures showing two shafts connected by a belt driven by a waterwheel. On each shaft are two or more grindstones for sharpening tools. Bocklerium, or Boeckler, gives a good illustration of the interior of a smithy or a cutler's shop, showing the furnace, various tools, and four grindstones on a shaft turned by a waterwheel. This book includes, likewise, one of the best illustrations of an early tilt hammer and bellows both run by the same waterwheel, Fig. 37. The idea was evidently to make it possible for one man to do the work in the smithy. There is also a cut of a hand machine for boring gun barrels, of another for sawing, and of water mills for sawing and log boring.

One very important general characteristic of industry in the 17th Century, one which affected the workshop as much as any other field of labor, was the gradual decay of the guild system. There is no doubt that after a greater or less control of industry throughout 500 years, the guilds in the 17th Century began to lose their grip on the various trades.

There were, however, two new sets of conditions with which the guilds had to meet. One was the enterprise born through the discovery and settlement of the New World. In many cases the craftsmen preferred the glamor of high adventure in this new field to the more prosaic tasks of the shop. The second great change, and one which affected the guilds more directly, was the introduction of water power. As machines driven by the waterwheel became larger and more complicated it required more capital before a journeyman could

FIG. 35. A REMARKABLE HOT-AIR POWER PLANT

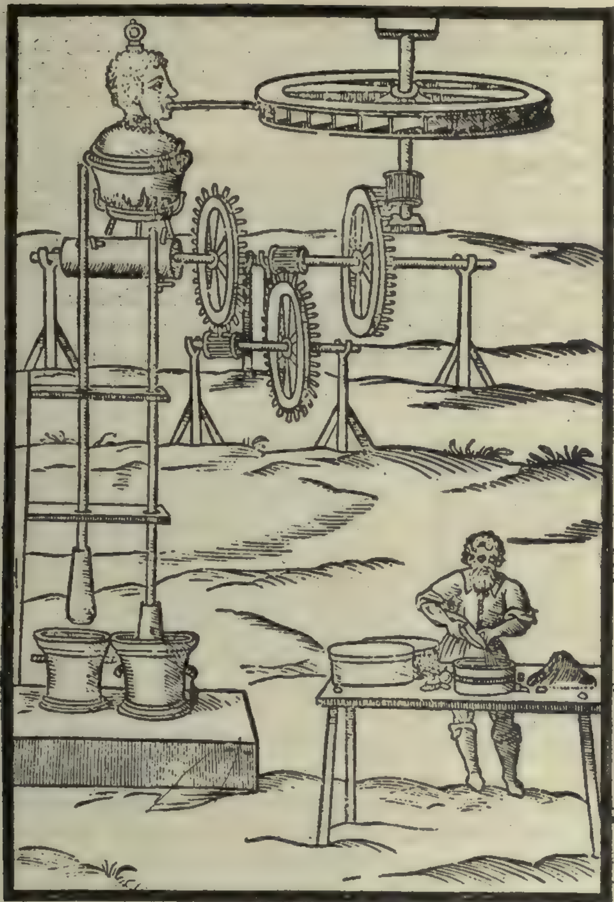


FIG. 36. AN EARLY STEAM TURBINE

set up as a craftsman, and what is probably more important, the most profitable location for the new mills was often no longer in the cities where they would have been under the control of the guilds, but by the side of some out-of-the-way waterfalls in the country where they were outside of the jurisdiction of the city guilds.

A strong corroboration of this is the fact that during this period we find many new mill towns springing up in the neighborhood of some waterfalls or rapids.

A sign that the guilds were losing control over the organization of industry may be seen in the fact that they were no longer shooting forth branches in the form of separate trades, but were combining the smaller crafts for mutual protection into one guild. Thus, at the beginning of the century, at Kingston upon the Hull, it was agreed that the "goldsmithes, smythes, pewthers, plumbers, glasiers, painters, cutlers, musicians, stationers, bookebinders, baskitmakers shall from hence forth be but one entire company."

But it must not be overlooked that the new conditions which the guilds apparently failed to meet, were the expanding conditions of prosperity and that they failed to take advantage of opportunities. The increased production by machines and the profitable enterprises of the New World increased both wages and prices, and the guilds could not compete. These increases are illustrated by the fact that in England the wages of the artisan increased from about 50 to 112 pence between 1575 and 1700, while the workman who ran the new machines received more, and those who could build them, still more.

To take the place of the guild system in the new mills not under control of the old organizations was ushered in the beginning of the factory system. The proprietors through the use of water power and machinery so increased their production that they could pay wages high enough to draw workmen even to these more inconvenient places.

Among the comparatively new machines of the latter part of the 17th Century were Thomas Hale's rolling mill for lead plate in 1670, and Thomas Harvey's engine patented in 1678 for drawing iron into all sorts of rounds for bolts and the like. In 1683, Maundrell and Williams received a patent in England for making hollow tin balls, and the next year, in France, Castaing was given a patent for a money-rimming machine. In 1666, the Acadèmie de Royale des Sciences began to preserve the patents of the year which were later published in a series of volumes.

An Early File-Cutting Machine

It is not until 1699, however, that we find any cuts included with a direct bearing on shop work. For that year we find the illustration, Fig. 38, of a machine run by water power for cutting many files at a time. This was done both by a blow with a chisel, and by drawing a sharp cutter across the metal from which the files were cut.

In 1698 several illustrations of machine shops appear in the work of Christoff Weigel. One of these, Fig. 39, illustrates a number of tilt hammers run by water power; another depicts a hand machine for wire drawing; and a third, a hand machine for boring gun barrels.

In 1697 John Houghton described under the caption "A Note of Late Improvements" a recently developed

FIG. 37. A ONE-MAN SMITHY

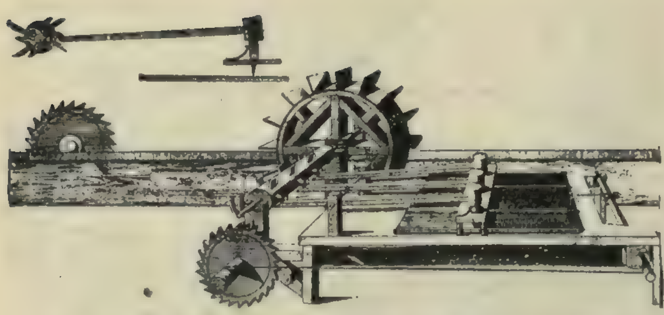


FIG. 38. WATER-POWER FILE-CUTTING MACHINE

combined rolling and slitting mill in Straffordshire. This runs as follows:

"Those they intend to be cut into rods are carried to the slitting mills, where they first break or cut them cold with the force of one of the wheels into short lengths; then they are put into a furnace to be heated red hot to a good height, and then brought singly to the rollers by which they are drawn even and to a greater length; after this another workman takes them whilst hot and puts them through the cutters which are of divers sizes and may be put on or off according to pleasure. Then another lays them straight also whilst hot, and when cold binds them also into faggots and then they are fit for sale."

FIG. 39. A SHOP EQUIPPED WITH WATER-POWER TILT HAMMERS

Enlarging an Automobile Piston

By C. M. Starr

Wishing to make four new pistons for an automobile engine and being unable to get castings from the manufacturer, we made a corebox by cutting one of the old pistons in half lengthwise, and then turned up a wooden pattern from which we secured four castings.

In the hurry to get the pistons finished one of them was turned a trifle too small and when filed up was found to be 0.004 in. undersize. To avoid having to get a new casting and do the work all over again, I attempted, with success, the following method of enlargement:

I heated the piston slowly in a forge to a red heat but not hot enough to scale it, turning it constantly in the fire all the while to heat it evenly. I then quickly transferred it, head end down, to a heavy faceplate on the floor and laid a disk of steel on the cup end; then with a short-handled 8-lb. sledge I struck it, lightly at first, then harder, giving the disk ten or twelve firm blows. I then reheated the piston and repeated the hammer blows, after which I banked it in ashes and let it cool slowly.

When cold it measured about 0.015 in. larger than it was before, and about 0.011 in. larger than the cylinder bore; thus I was able to take a light skimming cut across it in the lathe and file it down to a perfect fit as good as other pistons. The piston was faced off at both ends, of course, before the operation of upsetting and also the disk was faced true on the underside. The piston being of cast iron it might not occur to the average mechanic that anything could be done except to make a new one, but this scheme worked out easily and without any difficulty.

Probably if it was not for the ring grooves, old pistons could be renewed in this manner by first plugging the wristpin holes with steel plugs and possibly, if the grooves were filled by squeezing split rings into them from either side, they could then be upset as above.

The operation would take far less time than making complete new pistons.

What Is a Machine Tool?

By F. J Deacon

An expert, under cross-examination, declined to specify the dividing line between high-speed and slow-speed elevators, saying by way of explanation that "it is a difficult matter to determine when a kitten becomes a cat."

For a similar reason, the dividing line that separates machine tools from other machines lies within the twilight zone.

We all cheerfully agree that certain machines, flippantly known as millers, shapers, slotters, etc., are machine tools, but we are inclined to look askance at other machines, such as presses, rolling mills, punching and shearing machines, testing machines, bending and straightening machines, spinning lathes and many others. As to woodworking machines, we would certainly be scandalized at the thought of classifying any of them as machine tools.

Webster defines a machine tool as "A machine for cutting or shaping wood, metals, etc., by means of a tool." The Standard dictionary states that it is "A machine for doing work with cutting tools, as a lathe, planing, drilling, rabbeting or tenoning machine; also a forming machine."

These definitions do not conform to common usage of the term "machine tool," and it can be safely predicted that no two prepared lists of so-called machine tools would match.

Who is willing to furnish a complete list of all machines that should be classified as machine tools?

The Labor Problem

By HARRY TIPPER
Business Manager, Class Journal Co., New York City

Here is a jolt for the one-man, one-machine, one-motion production expert. We have been so enamored with some of the results of modern production methods that most of us have not stopped to consider where all this is leading us. This word of warning from one of the clearest thinkers on industrial problems is very timely.

WE ARE almost overwhelmed in industry today by the speed with which the labor problem has come upon us. We hardly know why we should so rapidly have passed from a state of apparent unity into a state of such disorder. We cannot see what is back of these very imperative demands of the labor leader or what is back of the political strife within the labor organization itself and we are unable to visualize the difficulties that industrial owners and managers are having in retaining even a tithe of the incentive or a tithe of the interest that formerly we supposed we had from our workers.

We have to go back a little to get at the beginning of the picture. About two centuries ago the socialistic idea of political government was born in somewhat indefinite shape in France. It crossed to England early in the nineteenth century and became very strongly embedded in the political creed of a large part of the population there. It transferred itself to Germany and reached Russia, changing its conditions with the character of the country it entered. A little more than a century ago the economic idea of trade unionism was born in the north of England, on the borders of Scotland. It carried itself all through the industrial population of Great Britain, into France, into Germany, to a very small degree into Russia, and was transferred to the United States, each time changing its complexion because of the character of the population.

The socialistic idea is the only political program which has developed without any serious change and which has grown and defined itself. I want to impress this upon you because the things that we are seeing today are the results of that constant organized development which has taken place only with those two general creeds.

For seventy-five or eighty years the trade unionism idea has been very virile. It is the only economic program which has consistently developed along orderly lines from the germ to the full-fledged idea of today without any particular change. This latter idea developed coincidentally with the factory system. It is not that labor troubles began then, but the trade union idea as a collective body of labor organized for its own protection began during the early part of the nineteenth century and its development to the point of a strike practically coincided with the transfer of the mill from hand labor to the use of steam. To the workers, the trade union represented protection in the way of friendly benefit among themselves, mutual advantage, mutual insurance, mutual death benefits and protection *against* the employer. I want to emphasize the word "against," because this is warfare we are talking about and always has been.

The trade union had ample reason for its existence. The history of manufacturing in Great Britain from the beginning of the nineteenth century to 1865, and in this country from the Civil War, for twenty years, is not a history of which any present-day owner or manager of an industry could be proud. In fact, the early history of Great Britain is an appalling record of extreme exploitation economically, just as extreme in its exploitation as any despot ever was politically. This is what sowed the seeds of suspicion and consolidated the creed of action that we are finding today in our industrial life. The disease is an old one. It has been working consistently and regularly and has been developing for nearly a century. It is not possible that we can, without study, cure it or find a solution. We must charge ourselves as industrial leaders, industrial managers and professional men with a great defect. We have not studied it. In the course of a search through the bibliography of production, of scientific management, of motion study and all such books, I have failed to find any volume which discusses the human side rationally or as anything but that which is secondary to the equipment. It is true that in individual cases here and there, in England, in this country and in the other industrial countries, the practice of a single manufacturer appears to have developed an orderly human organization; from a moral obligation, as in the case of Cadbury, Ltd., in Great Britain, or perhaps from a keener and more far-sighted policy in a business sense, as in the case of Filene in the United States. We have in both countries perhaps 100 individual instances of manufacturers who have studied the human side in relation to their own factories. The present conditions are the logical outcome of the history of the case. We have not provided the worker with any other picture of industry than the one he has secured through his union organization. In fact, we have deprived him of much that he had had in his work before industry became a manufacturing system.

When I was a boy in England I had the privilege of seeing hand labor pass away in the town where I was brought up. The hand cabinet maker had a big job because he did everything from choosing the wood to the final assembly of the work. We have gradually shrunk that man's job to almost nothing in 100 years, and we have not provided him with any other important mental or intellectual stimulus of a controlled or educative character. Our educational system provides no education in industry, industrial necessities or development; our teachers are not provided with any information concerning it; our business men take no interest in it. As a rule our colleges are not practical. They are without any intimate knowledge of the history, growth, character or efficiencies of the present industrial organization. Thus, in the ranks of the workers we have had on the one side the steady, persistent promulgation and development of the trade union and socialistic theories, while on the other there has been no education as to the character and necessities of present industrial and political organization to offset this, or at least none worth mentioning.

*From a paper given before the Pennsylvania Section, Society of Automotive Engineers.

In this country the conditions are serious because our population is not homogeneous. In Great Britain they can do things that we cannot, because while they are sharply divided as to their political ideas, nevertheless they are a homogeneous people and there is a certain traditional background of political understanding and development that, for the moment, serves to erect a common basis from which the discussion can start. But we do not have this. We have millions of people whose history is one of fighting authority, who have never known authority except as an oppressive instrument and whose whole tradition for centuries has been that the only way to establish liberty is to fight for it. These people we have not educated to any other kind of authority, and yet we are amazed at what they do against authority at the present time.

I have a friend who is a Pole; he is a very great thinker. I made that remark to him the other day and he said, "You are right, Tipper. I have to remember that it is wise to compromise. My instinct is to fight because my forefathers have been fighting for generations and generations back." I know a labor leader in New York, a Russian from the borders of Poland, who told me that at six years of age he was sent out to watch so that he could notify his father and father's friends, who were in rebellion, when the authorities were coming. Such people have no idea of authority, discipline or liberty as we know it under a well-ordered government, and we are at present without any means of educating them. We have not studied, considered, or thought of the subject. We must frankly admit that while labor was reasonable in price or plentiful, we did not care much where it came from or what happened to it.

Why We Are Inefficient

This is the background against which we must consider the industrial organization of today. It must be concluded that an industrial organization is not efficient which will neglect the most important factor for production. The management must realize that orderly labor, whether brain or handwork, has the only real value, and that wealth is nothing but the surplus of past labor, at present invested in future production.

What is this change that has transpired? We know that years ago labor had an interest in its work, no matter what the work was. We know that human beings have a natural incentive for occupation. We know that it ought to be possible to co-operate decently to produce something, and that there must be fundamentals of organization which can be applied to these cases. It is apparent that the unions are not effective, nor are the manufacturers' groups any more so. Today the unions are losing their discipline because of their great size and power. So long as they were not powerful and were fighting against a larger power, they maintained discipline within their own ranks, but when they ceased to be the smaller and became the larger power the division in their own ranks appeared on the surface and their unity was shattered. This must always be true where an organization is built from a sense of demand and not from a sense of obligation, no matter whether concerning an employer group or a union.

In the course of the last five years I have checked up the action of both sides in nearly 3,000 strikes in Great Britain and this country, for I have no brief for one side or the other; they are equally unjust, in my opinion. I have seen very few instances where the union would not break its contract if the advantage was sufficient, and I have seen just as few instances where the individual manufacturer would not similarly break away from his group. In fact, the great fear of any manufacturers' group when combined is that some firm will weaken, and the great fear of the labor union is that individuals will weaken. No national or international collective body can heal the industrial unit which is split up by opposing ideas when the only possible solution comes from a co-operative effort to produce the same thing. How, then, are we going to attack the problem? There is no present solution. This is true because the disease is too old and too deep-seated, but there are present possibilities of an improvement which will afford a basis for future solution. There is no question that men once affected with an idea until it begins to operate may move to their own destruction in spite of everything. This they have done time and time again in the history of the world, and we must improve the situation if we are going to avoid disorder and destruction in the course of this movement.

The Functions of Organization

In this connection I want first to examine the industrial organization in two ways, one of which is the way mentioned in my paper; but before doing so I want to point out the functions of organization. In every human group organization there are two functions, the function of doing things and the function of agreeing upon the rules under which they shall be done. The first is the operating or executive function, and the second is the legislative and judicial function. In small organizations both of these functions can be operated by the same machinery of organization because the discussion does not need to be formal; it occurs continually in an informal way, the agreement is reached by such discussion, and the operation continues by the loyalty which is exercised through that same means. In regard to the operating or executive functions, great power lodged in an executive and prompt obedience to such power by subordinates are required. An executive must decide thoroughly and execute rapidly and continuously, which means one man power, and there must be ready obedience to such power to get the execution in force and finish the operation. Legislative work does not require immediate operation; it requires rather full, free and frank discussion and a complete agreement, for, unless the rules under which men shall work are agreed upon, the work itself will suffer by this lack of agreement, and at some point the lack of agreement will divide the organization.

Because industry is a magnificent organization, it has survived many of its failures, but the reason for the trade union—and the manufacturers' group has to oppose that trade union—is because the individual organization offers no legislative possibilities and cannot provide any agreement with its workers. It can only promulgate to them, it cannot agree with them. With an organization of 10,000 men working in the same factory and spending the major portion of their waking hours there, with their individual likes and dislikes and disagreements, a legislative requirement almost as big as that of a city is created. Immense numbers of people are employed outside to legislate for these workers during their relaxation and entertainment hours; but there is no machinery to legislate for them in the real meaning and purpose of their lives. It is because of this that the union has grown to be a very inefficient and clumsy

weapon, a substitute for a united industrial organization for fulfilling both functions in order and as they should be fulfilled.

An Incentive Necessary for Production

Secondly, every piece of work must carry its incentive within itself, and this incentive must be continually a somewhat larger mental necessity. I defy any man to stick continually to a piece of work that has no mental stretch in it, that does not offer some necessity for movement in the intellect, without either going crazy or becoming a Bolshevik. Yet we have continued for years, for a whole century, in fact, to decrease gradually the dimensions of a man's job. While we have increased his conveniences, his possibilities of ambition and his desires, we have *decreased* his job because in the old days when a man had a trade he had it and not an infinitesimal portion of it. He had to study his trade and did not become a routine machine tender with four motions to make 500 times daily.

I went into a leading electrical equipment factory a while ago. I was standing by a white-haired man. His age rather interested me. He was punching plates, just pushing them into the machine and punching them. I asked, "What is that plate?" He replied, "That is P-X-111." I said, "You do not understand me. I asked 'What is the plate'?" He said, "I have just told you." "My question was wrong, then," I continued. "What do they use it for?" He answered, "I do not know." I said, "How long have you been here?" He replied, "Twelve years."

Now, nobody can tell me that this man's incentive could possibly be in that job at the end of twelve years, nor can anybody tell me that it was other than mentally demoralizing, because it was restricting the mentality. No man ever thinks very much unless he has to in his daily occupation, because the habit of thinking is a hard one to acquire, and this man was not developing. Yet this man had the vote, the political power to overturn the government tomorrow, and we have pushed his job down to such dimensions that he has no incentive for real thought.

I do not believe it is possible to get production under such conditions. Why was it that during the war we got such wonderful changes in production? We did not change the machinery very much. I did not hear that such a very large number of inventions on machinery came out during the war, or that they so changed the operations of industry. But here is a case in England, mentioned by Lord Leverhulme, of five units making 3,000 pieces each day. They had to move the plant. They inaugurated a teamwork campaign with competition between the teams and gave such extra incentive in the way of money reward for that teamwork as it deserved. Then they added the patriotic incentive, and where a total of 15,000 pieces were made with five units, by moving over one unit the four remaining units still made that number. Next, by moving over one more unit the three units still made 15,000 pieces. Finally they were able to maintain production with only two units.

In this country, the incentive provided during the war by patriotic work and by extra monetary rewards increased production with the same organization in a number of well-authenticated cases, from 50 to 200 per cent. An incentive to work is a production question. How shall we provide it? We must do this to secure efficiency. In the printers' strike in New York City we could have afforded to pay those men all they were asking and grant them shorter hours if we could have provided that production incentive, but failing in this we could not afford it, because we could not transfer the increased cost. That incentive is the principal necessity of production. Production is not a matter of machinery. It is about time that we abandoned this idea. Throw away the old bibliography that begins and ends with machinery. Production is a matter of humanity and of human understanding, with machinery fitted to human beings and not with human beings changed into machines.

Shifting Men to Increase Production

I have an interesting case indicating that the day of courageous experimenters has not yet gone. I suggested to a friend of mine recently in connection with this one-man, one-job proposition the idea of incentive and what could be done to capture it. I said that it is partly a matter of organization, of giving the man a chance for expression, partly a matter of partnership and partly a matter of the work. I said that I did not believe that twenty-five years hence we will consider this one-man, one-job proposition a scientific proposition at all. It may take fifty years, but we are going to get at it seriously and experiment with it and demand a change.

Three or four weeks afterward he said to me, "I have been thinking about that matter and I had a very interesting illustration. We have in our mills a job of grinding chemicals on the pulverizing mill and the man has to change the pressure according to the sound of the mills. At one of our mills we had a man who was particularly sensitive to sound and who did this fairly well. We had no trouble for three years. One day I heard that the mill was out of business and that we would not get any more shipments from it for a year. I went out to see the man who was operating the mill. I had made up my mind that I could not stand that job myself, and I thought that the man was in the same box. I talked with him when I arrived and when at the point where I thought we understood each other I said, 'Tom, why did you smash that mill?' He looked at me and seemed to wonder whether he ought to say anything or not, and then said, 'I was not feeling good that morning, and I wanted the noise to stop.' 'Well,' I said, 'that's all right, Tom; I guess I agree with you; I would grow tired of it, too, once in a while, but I have arranged that you will take Bill over here from the packing room and train him to do your work just as well as you can, and you are going to take half time here and half in the packing room. The packing room is nice and clean, there is no noise in there, and any time in the morning that you do not feel like staying at the mill because you do not like the noise you go out into the packing room and let Bill come in here."

The final result was that my friend said to me subsequently, "I have taken on about five other departments and switched them around. I have the men in the packing room doing all of the six different jobs there. I rotate them around the whole six, and we are getting twenty-five per cent more work. I suppose that I [illegible] not notice the real effect for a year or two yet.

Such may not be the solution, but it suggests something. Mr. Beecroft told me that one man who began that method in one or two departments of an engine factory in Great Britain started a man to grinding crankshafts and fitting them to bearings. Next he had the same man make the bearings. He said their accuracy and speed were better, and the men were more con-

tented. I do not know, but it seems to me very human that they should be.

Everything that the psychologists and the medical men say to us is absolutely against the extreme concentration of mental and physical activity upon a few motions. When training workers in the textile factories where women were working under the most cruel operating conditions, I have seen girls become hysterical and have to be taken out within the first six days of their training, who absolutely became sick on account of the very high tension caused by that constant necessity for repetition at a single given second. You know how they must relax to escape from it when they get out, and the intensity of their emotional relaxation outside is the necessary protection provided by nature to get them away from that intensity of concentration in their work. I believe this is not good production. I am sure it is not good human production, and I believe it is making a race of men who are not capable politically of self-discipline, self-government and real sound judgment.

Need for Publicity and Education

Education is another point, publicity education. Business has been too secret. It was nobody's business what a manufacturer did or what he made or how he made it. Least of all was it the employee's business to know this, and yet the manufacturer now complains that the employee does not understand. Well, how in the world could he? Where can he get understanding? There is in the United States no school, no public school, where he can get it, because nobody in industry has supported the schools. They do not know anything about it.

A manufacturer in a small town where he has been a power for thirty years was giving me his opinion of the character of the workmen he is now getting. I asked, "What is the public school system in your town?" He said, "I do not know." "Well," I continued, "What is the curriculum?" He answered, "I have never thought about it." "Do you know any one on the school board?" "No; I did know one of the police, a friend of mine, but most of them are politicians and I do not know anything about them." I said, "Did you ever run a night school in your place?" "No," he replied, "I thought about that this last year or two but I did not do it." I said, "Where can your fellows get the information? You never publish any statements about it. You never take the time to tell them about it, and they do not know whether your overhead is camouflaged or whether it means expense. They do not know what your stock is. They do not know whether you have printed pieces of paper and sell them for money or have an obligation on it. They do not know, and they have been born and brought up, from the time that they have been youngsters, with the tradition of the trade union idea which tells them that the manufacturer is logically and seriously unjust, and that they cannot trust him. There is just enough of record in the history of the thing so that they have the chapter and verse to remind them continually about it, and you have never done anything serious to combat this. It is true that you have established a few hospitals which the labor leader said came out of what ought to be wages. It is true that you have established a few playgrounds and activities of that kind, with the same comment from the labor union, and it is true that there have been established occasional night schools to train employees better for their work, but it is not true that attention has been paid to the manufacturers' necessity that the workers should know. They should know because they are in the majority and have the majority vote. Unless we are to have a government by the unintelligent and ignorant, which is the worst and most unjust government that could possibly threaten anybody, we must increase the intelligence, judgment and capacity of the skilled men who are working with their hands and the brain-workers, so that we can get a more co-ordinate understanding of the industrial problem."

There is not any question in my mind that production as a science is just beginning. We must gather together in industry; we must listen to what the medical men have said, and they have said some very pertinent things on the character of fatigue, on muscular movement, on the fatigue effect of continued rapid muscular movement, and on the mental system and its necessities. And we must think about the psychology of the problems because our production depends not upon the amount of brawn a man has or the capacity of a machine, but on the thinking that the man does in connection with his machine and his work. Our present and future problem is a human problem, the governing factor of production. You know enough about equations to realize that when the governing factor is left out the remainder of an equation might just as well be thrown away.

The Discussion

W. M. Newkirk: I have attempted at times to get our superintendent to try shifting the men around, and I always met with the objection that they cannot get started at it, that they lose a part of their pay for two or three days or even for a few weeks before they get used to it, and they always fight the initial move. I know it to be a good thing if you can once get it started. I wonder if you can give us any pointers as to how to lubricate the start.

Mr. Tipper: That is always the difficulty with new things. The inertia which has to be overcome is the hardest thing. The average man will not accept responsibility and we have to start it. Only a few experiments have been made in this direction; the lack of experiments in this direction is almost amazing, but in one or two cases it has been started by taking a particular problem that developed itself and operating on that problem. It obviously takes about fifty times the analysis to route men properly that it does to keep them still. It is comparatively a very easy thing to put a gang of machines together and then fit a gang of men to those machines, but to take a number of men and fit the machinery operation to them is an entirely different story, and I do not wonder that the men balk at it. If we have not studied human nature very particularly, except as every man knows it, of course, this is a hard job. It takes far more analysis and keener judgment. To avoid confusion and get the results of related work is a very difficult job. I do not think as much rotation is needed as would seem to be necessary to the man who has not studied it. Just take two or three matters which are closely related, that will provide variety of muscular and mental activity and utilize the results of previous work in its relation to the other work that a man gets. If a man can just see the results of his work he has gone quite a distance. The reason it was wise to put the man who had been grinding crankshafts at work on the bearings of the engine is because the results of his grinding came right out when he fitted them up. These results also fitted right back into his previous work, and with the three jobs it gave him more than nine times his former horizon and three times the

change in his position, his mentality and his physical concentration.

But you will have a hard time in trying to put this over with anybody. A man will transfer his responsibility of thinking if he gets a chance.

Small Beginnings Essential

It is the inertia against experimenting that is the hard job. None of these things is half as hard when you get down to it as appears on the surface. You look at the whole shop and say, "I cannot do that!" when if you would take two or three men that are a problem, work it out with them and get their help you would probably hit upon the practical scheme. I have no faith in this large national conclusion. It never got anywhere or never did anything in human affairs, and that is the reason why I have no faith in the industrial conference at Washington or the international labor conference. You cannot settle things for 1,000,000 people by one conference. You have to settle it with a few people here and there, and when you have a fair proportion of those problems solved your big questions are automatically settled. If you start with one thing in a particular corner of the shop and settle it, by continuing this you have the shop running smoothly on a diff rent plan before you know it. That is the only way that I can see to get it done.

C. A. Musselman: Have you been up against this problem? You know that in the printing business there are a number of unions, including those in the composing room, bindery and press room. We have attempted some shifts but the unions object.

Mr. Tipper: That is to be expected. The only point there is this, how well off are we at present? We are trying to evade an issue, because we do not know whether the frying pan is a little cooler than the fire. We are in the frying pan and have been in it for a number of years and the fire gets a little hotter right along. The question is, are we going to jump out into the fire or on the grate. We are afraid to try, we have temporized and temporized with this question and we have waited right along and never done anything about it.

The unions do not want a solution because they are not nearly so much interested in solving the problem as in maintaining the strength of their rights; neither is the manufacturers' group. I will guarantee that any salaried official would hate to see a solution of the labor union that did not come through his association. He is behind it in the virility and capacity of that group and cannot think of any solution outside of that and he is against anything that tends or appears to break up that organization. But how are we off today? The leader says, "Don't do it," and the men do it, at least a sufficient number to embarrass us. In the printers' strike in New York City we are in the position of the innocent bystander who got into the trouble. We have nothing to do with the case. Certain unions have refused to do what the central union has requested them to do. The same thing is true in Great Britain. I am watching these cases by reading the London papers every week. There is a standing agreement which the iron founders' unions and the manufacturers have had for a board of arbitration for twenty years, but three units decided to strike in the face of it. The longshoremen struck without their leaders. Fully fifty-nine out of sixty strikes that occur at present are unauthorized and mostly unapproved. What is the use of considering the opinion of a union that cannot discipline itself? The only unit is the factory that the men are working in. You cannot split it and heal it by a national or international agreement. It cannot be done. You have to start the experiment in your own shop and take the troubles as they come, just as you have taken the present troubles as they came.

It is over two years since the I. W. W. started work at Toledo very strongly. Their organization there is almost as large as at Detroit. The strike at the Overland plant at Toledo had been due for six months. It was authorized six months before it touched Toledo. There was nothing which the Overland people could do to prevent that strike. The organization of that strike antedated the company profit-sharing by a great many months. That strike, like the organization of the steel strike, was going on for six or eight months and some of it was fifteen months in organizing.

It may be interesting for you to know that the radicals of all the Russian and Soviet societies in New York and the I. W. W. have 2,500 paid lecturers today in the United States of every race that is important industrially as workers, and that they have 40,000 active workers in the city of New York, and they have closely organized and intertwined headquarters in every industrial city. If you are known at Fifteenth St. in New York City, you can get all the material to strike in any industrial city in the United States within a week after they have passed upon all the credentials.

The Importance of Traditions

I should like to add just one point to that while I think about it. I made the point in my speech, and I am afraid it has been overlooked, that you did not get the significance of it, the traditions of these people. You know yourself how strong your traditions are, how much stronger they are than your recent reasoning, that on the very slightest occasion your tradition governs your sentiments, your reasoning goes by the board. There are millions of people in the United States who have no traditions except that authority is something to be fought, and they are fighting that authority here just as they fought it at home, where they had good reason for that fighting. They have been fighting for centuries in one way or another the authorities who have been forced upon them. You cannot destroy that condition; you must expect it to operate in all the councils of labor in this country, with little attempt at Americanization and with a background which is so strong. I have just told you that in every race there are lecturers constantly inflaming that sentiment as a part of their present program. I have seen them inflame the racial sentiment with things that happened a long time ago.

Russell Hoopes: The subject has been very interesting. We are a small organization and keep very closely in touch with our men. Whenever troubles come up we try to solve them then and there. We try to do just as Mr. Tipper had said, get into human touch with them, but believe we have failed to a very large extent. I have recently read a book with which probably most of you are more familiar than I, "Man to Man," by John Leitch. It probably throws more light on what Mr. Tipper has been telling us than anything which I have picked up lately. Does it not shed considerable light on these problems?

Mr. Tipper: Yes, John Leitch has done much valuable work. He has operated what perhaps is, up to the present, the most successful of the four different systems of providing legislative machinery in your own

organization. There are four systems, the House and Senate plan that is John Leitch's, operated after the political plan of the United States, which makes it simple and easily understood; the joint council plan which was promulgated by John D. Rockefeller but which was in use in an indefinite way previous to that time; the joint committee plan which is a rather different plan from the joint council, and then the union plan which is the importation of the Whitley idea from Great Britain.

Mr. Leitch's plan is very successful. He is very sincere and thorough, wise enough not to take on more than he can do, and wise enough to see, and to oblige the manufacturer and the workers to see, that this can only be done because of an element of confidence and trust and that it will take some years to work it out. It is worth looking into. His book is good. It is one of the things which offers a possible and a probable basis for a solution of our troubles, at least a marked improvement in the labor situation, if we can take hold of it wisely, patiently and with a full understanding that we are not giving the benefactions but are actually trustees in the case; and provided—and I want to make this proviso because I have run up against it so much—provided it is properly promoted and understood when put into operation.

How Not to Introduce a Plan

One of the largest companies in this country put in such a plan. It spent nine months looking over these plans and decided which it wanted before putting it into the shop, and then it put in the plan. It promoted the plan in an organization of over 20,000 employees, including about fifteen races, with one notice in the different languages that looked as much like a summons to a police court as anything I have ever seen, and one booklet which began, "Nothing hereinafter provided abrogates the right of the company to discharge a man," and so on. The benefits were in the back of the book. It put the whole plan over in that promotion and it has, of course, had trouble as a result. There was no common basis of understanding, and if you pitch a lot of men into an organization for which they have not been prepared you are going to have extreme demands, confusion and discussion and get nowhere and do nothing for a long time. You can avoid that if the thing is properly prepared and understood. On the other hand a company that I know spent two years with a plan somewhat similar to this of John Leitch. Its promotion was very effective because time and energy and brains were spent in preparing the plan.

Mr. Musselman: I should like to know if Mr. Tipper's investigation and experience have taught him that when the factories attempt to better the conditions of the men it results in the focussing of the unions upon their efforts, bringing disaster rather than benefit.

Mr. Tipper: There is no question that from time to time a change in the organization of a manufacturer's plant to furnish a better means of providing an organization has brought the unions down on it, but I want to point out the fact which still remains that there are plants in this country that have not had a strike in ten or twenty years, not because of special machinery, but because of the character of the human contact within the plant. Plants which have been using some special organization for eight years have never had a strike, and others which started the organization not long before the war did not have a single strike in the whole war. The allegiance which you can create in a plant for the employer is stronger than any other allegiance, if you can get it, and you can stand any other disaster if you can get that. If you cannot get that, all other disasters are going to overtake you anyway, because after all what the workman wants is not the affair of his class in Chicago when he is a New York man. It is the settlement of his own individual and collective problems in his own establishment, his own kind of work, that he desires. It is true that there are a certain number of floaters, but in most establishments these become settled or solidified.

The Experience of the Needle Trade

There is no more radical bunch than the members of the needle trade in the United States. They are very largely Eastern Europeans, but include a large number of Russians. In New York City they are the center of the radical societies. There is a large company in Cleveland that had the John Leitch plan in operation four years ago. It has this same class of labor very largely, which is the poorest one to do anything with, since it has a naturally rebellious background of fighting authority. During the war there was a strike in the needle trade at Cleveland. The committee of workers in the plant to which I refer wired Washington to leave them out of consideration altogether; they were not on strike, were quite satisfied and did not want to be included in any way. They wired twice, and then some of them were called in as witnesses before the War Labor Board. Then they sent a committee down to Washington to see the Secretary of Labor, to make sure that they would not be included in the decision which meant an increase of wages in the general trade.

Mr. Hoopes: This is a very interesting question, and in my own experience I have perhaps come as closely in contact with employees as anyone here. Hoopes Bros. & Darlington has been in business for over fifty years. We have one of the older generation still living who is active at eighty-five years of age. There has been a close contact all the time with the employees, and I can truthfully say that we have never had a general strike in the whole organization. We have had a strike in one or two departments that lasted probably a few hours, but as for a genral strike or being out even half a day we have never known what it is. I attribute this largely to the personal touch we have had with our employees. I ought to qualify that by saying that the plant is located in a rural community of good old stock. We do not have to bother about foreign workers and we get a good class of labor. Both those things have produced good results.

G. Walker Gilmer, Jr.: What Mr. Tipper has said is bound to be of interest to everyone employing labor. I am a laborer myself because my firm employs me to labor. We have troubles which have never gone far enough to get into the strike stage, but we realize that we have not the efficiency which we had several years ago and should have today. Just how we can get that interest of the employee is a question that is naturally concerning us, and we have from time to time discussed it. We have our foremen's meetings regularly to discuss just such questions and how they are going to be solved. Mr. Tipper says it is now a question of warfare. I do not believe that is right, and it is not exactly a period of unrest. It is rather one of misunderstanding. A few years ago the manufacturers did not understand each other; consequently, each thought when the other fellow was going after his business pretty hard he was going

to cut his throat. They got together and began to believe that each man is honest, and we are, and so is the laborer, I believe. Generally speaking, I believe that the laborer is opposed to striking. The difficulty is that he has been listening to propaganda carrying out the old belief with which a great many of them came to this country feeling that it was up to them to fight somebody and they did not have anybody to fight but the employer, and they are doing that. They are not fighting altogether in an organized manner at the present time, which shows that there is a lack of understanding even in unions. There is really only one remedy that I know of and that is the counter propaganda of education. A great many firms are working on it at the present time. It is not new. It will take years for it to amount to anything, but I believe that we will get results. There is no disease that is widespread which has ever been cured in a short time. We have just learned that the Surgeon General of the Army has cured yellow fever. He has been working on it since 1897 or 1898. He started in Cuba, I think. Possibly he has cured it. We can cure the misunderstanding which exists in labor today if we can understand labor and make labor understand us.

I believe that it is possible by changing the men around from one position to another to educate them and interest them by the use of publicity or rather pamphlets and possibly pictures, showing the connection of their work with the work of the various departments and also with industry in general, showing the connection between my plant and some other man's plant. There is much that can be done, but it has to be worked out slowly.

Why Conciliation Fails

Mr. Tipper: I just want to add one more point in conclusion, a thing brought up a little inferentially. Of course it is a misunderstanding, but that misunderstanding is war. Manufacturers said competition was cutthroat when it was not organized by friendliness, and there is no organization by friendliness between labor and capital today. Both sides are more concerned with strengthening their outposts than finding a solution, and that is the reason why, when they went down to Washington, they adopted the group vote in conference. They could not conciliate. Gompers could not conciliate because he had to strengthen his organization. That is a type of war; it may be the forerunner of a more serious type of war if it is not understood and measures taken to spread the understanding. That is what we have to do, and everything that I have said tonight has really been in a measure the spreading of understanding. We cannot do much spreading unless we understand something ourselves, and I want to recommend as my last thought that you take notice of the statement of a friend of mine who said, "There are a number of people who study but who do not think." That is the reason we accept the traditions of the past and study without questioning, because we take the textbook "as is" without thinking whether we agree with it or not. We want study on this, yes, but we want understanding which is the motive of study. If we get understanding we will move, but if we merely study and do not get understanding we will not move.

M. C. Dittmann: How can we expect the operator of a machine to see the possibility of his becoming readily proficient in handling a different type machine from the one he has been accustomed to handle for a long time, when we employers, who are supposed to have a much broader vision than the operator, have difficulty in reconciling the possibility of a man who has become trained in the operation of a certain type of machine being able to switch over to a somewhat different type of machine? I should think this would be particularly difficult if the operator was working on a bonus system of reward, whereby he was paid so much for each piece and on his regular machine was making a certain amount above his minimum wage. Would he not consider that if he was shifted over to another type of machine his wages would fall off, due to his inability to produce, for the time being, at the same rate as was possible on his regular machine? On the other hand, if in offering an incentive to him to change over to the other type of machine, we gave him the same average wage that he had been earning on his regular machine, how are we going to offer him the incentive to reach the point of efficiency, or better, on the new type that he had reached on his regular machine? When we carry him along at his average previous earnings he merely has to run along without exerting any particular effort, for he is guaranteed his previous average wage and why should be exert himself to produce more work when he is getting paid what he previously earned?

The Need for Diplomacy

Mr. Tipper: That is a very acute and practical question, and it can be answered in two ways: First, it is not likely that in 100 per cent of the cases, it will be necessary to change a man's job immediately. Nevertheless that is not the answer to the question. The formal method of doing a thing, the decision of a plan, is usually the poorest method of starting it with human beings. It is like saying to a man, "I am going to shift your job today and next week I am going to talk it over with you." I have got to sell him that shift. If I say to him, "Bill, you are a good man. I think you have a little more capacity than just this job, and I have a little problem here. I wish you would shift yourself over to this particular proposition and see if you cannot straighten it out for me," I can capture his interest and get him working on the job. He does not know that there is any shift. He is merely helping me out. If it is valuable for him to change his job, it demonstrates itself to him and to me without any formal demand that he remove himself from this plant and go over there. There is a tremendous amount of inertia to overcome. We do not like to move until we reach a certain stage of responsibility. After that we move automatically, because that responsibility has bred the habit of movement in us, but before that we have great inertia; and, as your intellectual capacity decreases or the necessity for it decreases, your desire for movement decreases. When you do not use the muscles they become so weak that you cannot use them after a while. The same is true of your mentality. It is painful to bring it back into actual existence and usefulness, just as in the case of a sleeping limb it is painful to bring it back to usefulness. Some of the pain is going to occur, and I do not believe that in every case it will be possible to change the whole proposition, or any single job, as a formality; but I believe that you can find out much and discover the changes that are valuable if you will approach it not as a formal but rather as an informal proposition. I believe in never revolutionizing any organization. It is a painful process and it takes so much longer to get the balance; the pendulum is always swinging too far.

You can only do it by evolutionary methods. To find out, you have to begin, and the best way is to begin informally with a problem as it comes up. If you do it that way, I think that you can get over much of the difficulty, although you are bound to have some.

MR. DITTMANN: Assuming that you have 100 men operating a particular type of machine, had you considered taking each of these men as an individual case or do you believe that the record the first half dozen or so of these men make in this change of operation will be sufficiently convincing and enough of an incentive for the others to agree to change over to a different type of machine?

MR. TIPPER: I think it is better not to start with too many men at first.

MR. DITTMANN: I am assuming taking one at a time.

MR. TIPPER: If you take one, two or three men and give them sufficient time so that they are finally efficient in two or three men's jobs, as a problem they will sell it much better than you, if it really answers the purpose and gives an added interest to the men, an incentive. By taking the problem of one or two this itself will bring you finally a demand on the part of others, and the more intelligent man will demand it first because he will see the value of it. I think that there is no other way to do it. I would not counsel anybody in any of these changes to proceed as though this thing was a formal plan. I do not know how it will work out in the next generation or two. I simply point out that we have stultified a man over what he was 100 years ago, and we cannot continue to do that without producing a nation of brutes before we get through. We must turn around and I do not think that it is wise to go too fast the other way. Otherwise, we will get utter confusion and disorganization instead of an orderly progress of organization.

Extending the Use of Precision Gage Blocks

By ROBERT COATES

It seems to me that the increasing use of precision gage blocks for checking up work opens a fruitful field for discussion on methods for extending their range of use without destroying their value as precision measuring tools by subjecting them to excessive use or abuse.

With some firms precision blocks are as yet in the luxury class and in no immediate danger from use. Others treat them with the same awe and reverence that was accorded the micrometer about thirty-five years ago.

Some firms may have surplus sets (I'm not checking up malefactors of great wealth) but most of us figure we are lucky if we can get the use of one set occasionally; therefore, the problem is: How can we extend the use of a set without destroying its value as a standard, or temporarily reduce the range of combinations by having some blocks tied up on work in the process of construction?

One of the most convenient aids I have found to use in conjunction with the precision blocks is the adjustable parallel. This is a standard tool made in a variety of sizes, the range of which can be increased by the addition of extension pins screwed in on one edge and the ends of the pins ground parellel with the adjustable base.

This method gives very good results in locating the position of holes in dies, jigs, etc., on the lathe faceplate when used in combination with the conventional 90-deg. angle piece, the internal faces of which are located at predetermined distances from the axis of the spindle.

In using precision blocks for locating the position of work on the faceplate or some substitute that has been set by comparison with these tools it is always well to remember that it does not follow as a natural sequence that the hole made will be in the exact location. This is due to the fact that the location was determined when the spindle was at rest and that the hole was made when the spindle was running and probably out of dynamic balance; therefore, if you use blocks or a substitute set, counterchecking, prior to finishing, the hole to exact size, is always desirable.

I would further add that the adjustable parallel is very convenient for measuring snap gages during process of grinding and its near relative, known as the adjustable planer and shaper gage, possesses the same latent possibilities for larger work. This may serve as a suggestion for some of the budding Johannsons to get out precision adjustable parellels provided with means to receive extension rods of various lengths.

Setting the Milling-Machine Vise in Alignment

By J. A. RAUGHT

On page 356 of the *American Machinist*, under the above title, John A. Grill gives out a bit of information that is to some extent misleading because of the fact that in setting a milling-machine vise, the in and out feed should not be depended upon if one expects the work to come square. The in and out feed is seldom, if ever, perfectly square with the ways of the table, especially after wear has been taken up by tightening the gib.

If Mr. Grill wants to set the vise at a right angle to the table ways let him get a square that he knows to be perfect, place the beam against the solid jaw of the vise and hold it there with a block of wood between it and the movable jaw, with the blade lying parallel (or nearly so) with the table ways; then he may proceed to line up the blade by means of a reliable dial indicator.

If an indicator is not available, inside micrometers are next to be desired, and as a substitute for them use a pair of outside micrometers just as you would the inside tool. If none of the three articles are available, use a piece of quarter-inch drill rod rounded at the ends as a length gage.

Run the table back and forth nearly the full length of the blade of the square, taking all measurements from a single point at each end.

If the work is of such a nature that it requires the in and out feed only, the solid jaw of the vise should be set parallel or at right angles to the in and out ways, as the case may require, by cranking the table in and out and using the square in the vise as before; or a parallel as he shows in his cut, depending of course on which way he wants to stand the vise.

I also beg to disagree with Mr. Grill when he says that the micrometer can be held firmly in the way shown without injuring it if good judgment is used. A micrometer should never be pinched between two pieces of metal unless the pieces are well padded with felt.

Forging Mechanic's Hand Tools

BY J. V. HUNTER

There are many mechanic's hand tools, used extensively in connection with general steel and machine assembly, that are made by forging. The simple and accurate forging methods used by one shop in the production of such tools are described and illustrated in this article.

MANY manufacturing and erecting plants maintain more or less of a force in their blacksmith shops to produce small lots of hand tools to meet their current daily needs, though usually such tools could be purchased at less cost from a tool manufacturer who has specialized in this work.

In the forging shop of the Ketler-Elliott Erection Co., Chicago, Ill., power hammers are exclusively used

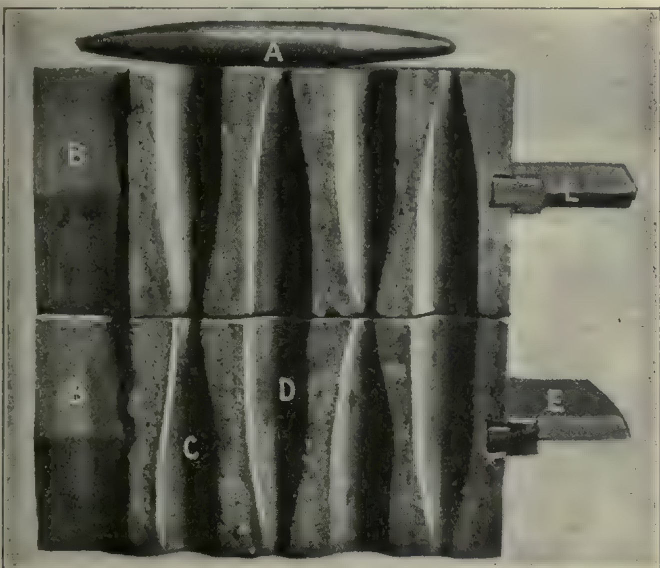


FIG. 1. DIES FOR FORGING DRIFT PINS

for tool forging, each hammer being well equipped with suitable dies for the work upon which it is engaged.

Among the simplest tools forged are the drift pins that are used in connection with the erection of structural steel work. A sample of the common form of drift pin, *A*, Fig. 1, is seen lying on the pair of hammer dies which were used for its production. These pins are worked from the end of a bar which is heated in an oil furnace.

The smith for his first operation draws down the forward end of the bar between the tapered flats *B*, and then rounds it up to a conical form in the pass *C*. Gaging the length from a fixed stop on the far side of the hammer he starts to draw the inner end of the drift pin as shown in Fig. 2. A few blows of the hammer with a quarter turn between each blow partly draws the taper on the inner end, and this is then finished in pass *D*, Fig. 1. The nearly completed pin is cut from the bar by the hot chisels *E* dovetailed into the ends of the dies, after which it receives a few finishing blows on each end to straighten and finish it. The other two passes in this pair of dies are for forging a smaller pin.

Two classes of pneumatic-hammer chipping-chisels with either forged or machined shanks are furnished by these shops. The former type is of the greater interest because one rarely thinks of forging work being done to close enough limits for this purpose.

One of the forged chisel shanks is shown in Fig. 3 at *A*, together with the dies in which it was produced. The operator handling this work under a Mayer trip hammer is shown in Fig. 4, and it is possible to gain an idea from this of the method of feeding the chisel blank through the guide plate *B*, Fig. 3, attached

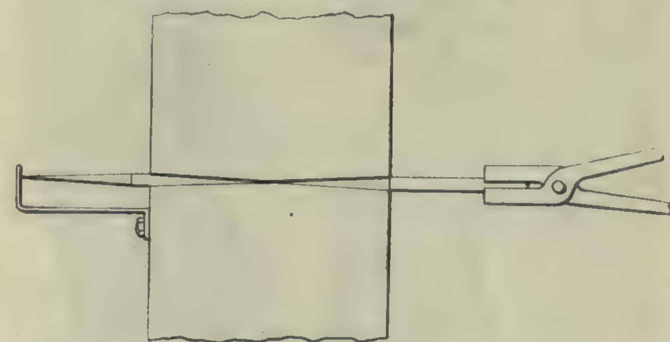


FIG. 2. GAGING STOCK FOR PINS

to the front of the lower die. For the first operation the smith breaks down the shoulder *C* in the left pass *D* of the die. In doing this the piece is inserted clear to the back of the tong's jaw, and the nose of the latter is then held flush against the face of the

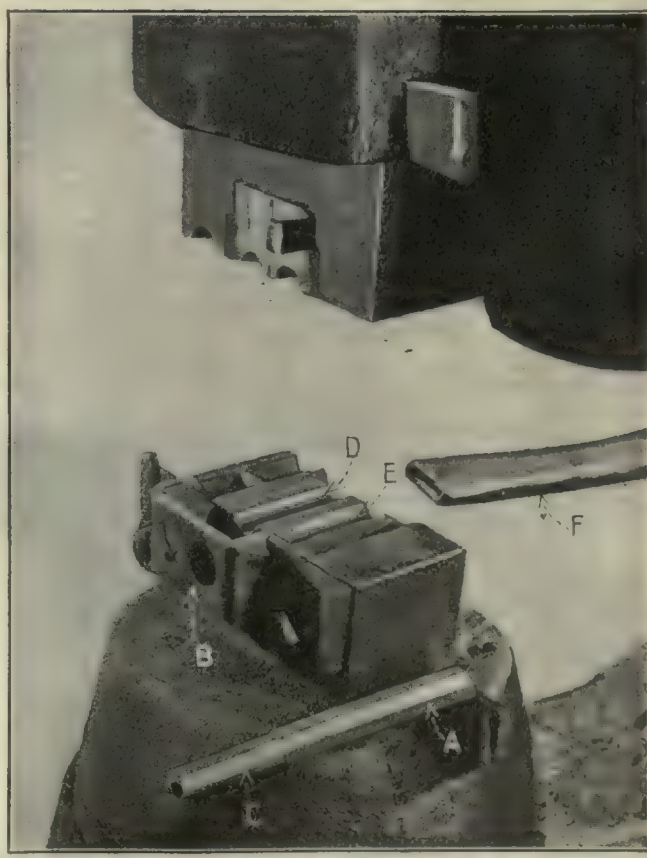


FIG. 3. HAMMER DIES FOR SHANKS OF CHISELS

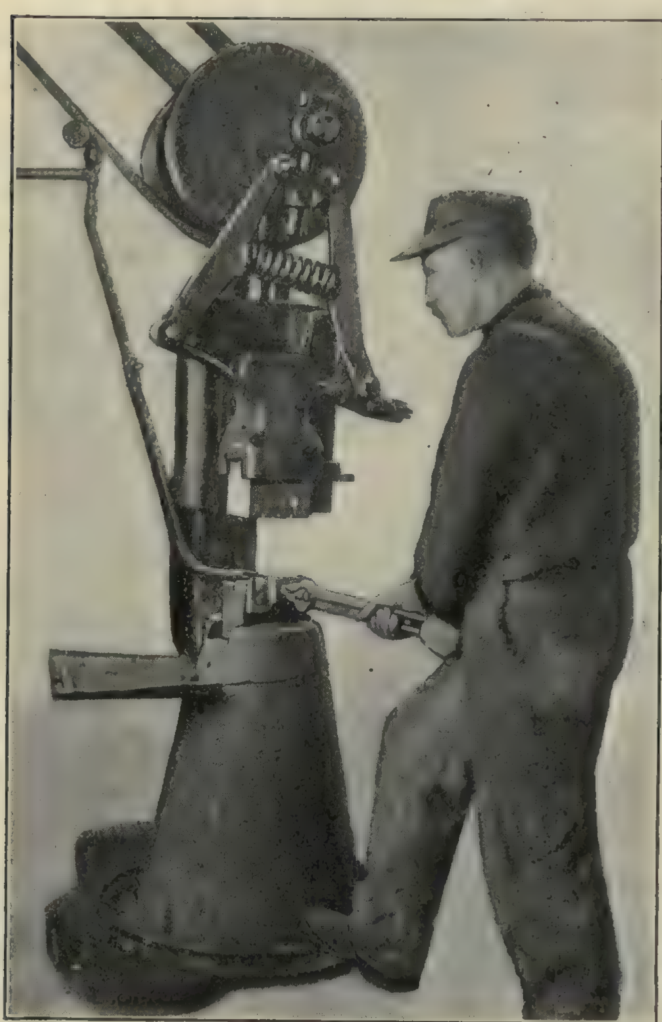


FIG. 4. OPERATOR FORGING CHISEL SHANKS

guide plate which thus acts as a gage during the breaking-down operation so that the correct amount of material will be used to form the shank. The shank is then inserted in the pass E where a number of blows are used to work the hexagonal section into form, and the round shoulder on the rear end of the pass draws that portion of the shank more closely to size. A strong blast of air from the pipe F is constantly used on the dies to keep their surfaces free from scale.

At a nearby anvil the smith cuts off the excess length of the shank with a hand hammer and hot chisel, and the a few more blows are given between the hammer

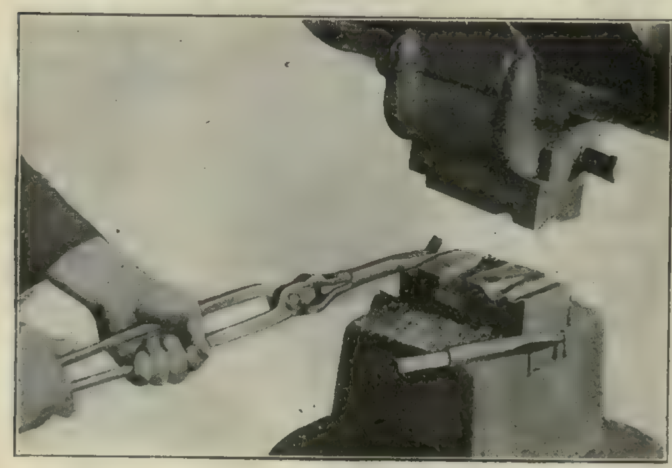


FIG. 5. SHEARING ENDS OF FORGED CHISELS

dies, turning a different side up for each, to insure that it will be close to the required size. The smith tests the forgings with a "pass and not-pass" ring gage in which the necessary allowance has been made to provide for the shrinkage of the steel on cooling.

The cutting end of the chisel is forged under a Bradley hammer, the dies being illustrated in Fig. 5. These have several passes with different degrees of

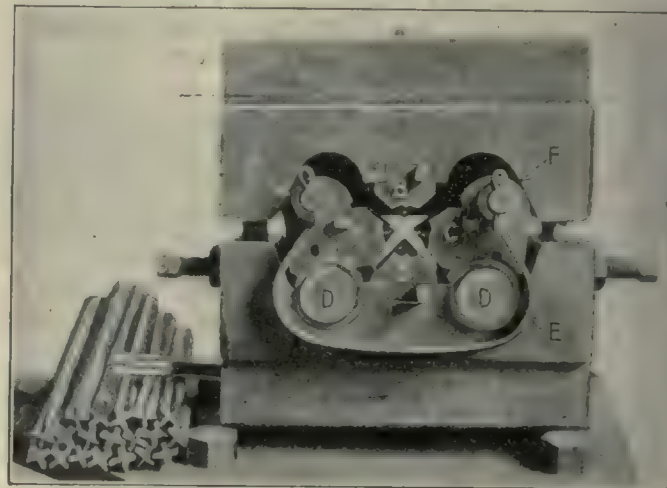


FIG. 6. FRONT VIEW OF DIES FOR STAR CHISELS

taper so that they are suitable for making several types of chisels. At the left of the dies, the smith is shown holding the forged blank on a small nicking chisel that is provided to cut off any excess protruding from the end.

An unusual pair of dies for forming star chisels under a Nazel hammer is illustrated in Figs. 6 and 7 together with some of the chisels produced at A. In action the dies depend upon both direct stroke and side thrust, utilizing the former to do the greater portion of the work, while the side thrust, which is more a matter of providing support for the sides of the star, is obtained by means of swinging arms actuated by the down stroke of the upper die.

The forging work is done by the inserted dies B, Fig. 6, carried on the main bodies of the upper and

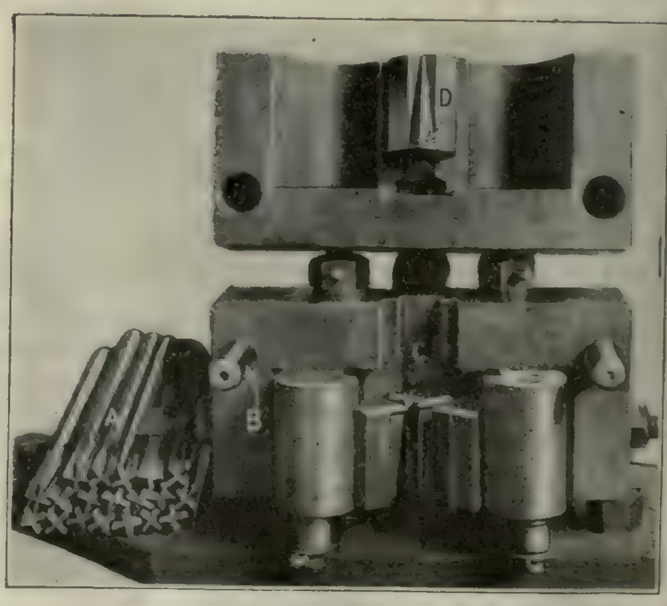


FIG. 7. INSIDE FACES OF STAR-CHISEL DIES

lower die blocks, which actually form the imprint, and thrust out the sides of the star. Then the chisel is given a quarter turn and worked further forward into the dies, and as this is done the side-thrust dies *C*, carried on the swinging arms, maintain and further shape up the imprints previously formed.

FIG. 8. FORGING BLANK FOR RIVET SETS

The swinging arms are fastened to the lower die block by means of the heavy pin *D*, and in addition have a half-round bearing directly upon the lower die block to prevent the hammer blows from shearing off the pins. When opened, the arms stand in such a position that the inclines *F* in the top die can catch them on the down stroke and draw them with a smart blow in upon the work. When the upper die rises, the loop spring *E* throws the arms into the open position.

In the view of the working faces of the dies, Fig. 7, it will be seen how relatively heavy the arms have been made, in comparison with the die inserts, to insure them against the possibility of breakage. Heavy dowel pins *B* have been provided as an aid to keeping the dies in correct alignment. In operation the smith feeds the hot bar into the wider or front end of the dies, giving it a quarter turn between each blow, and feeding it rapidly back as the imprint is deepened and worked to greater length. When fully formed, a slight further advance carries the end to the hot chisels *C*, where it is trimmed. At the same time a bevel edge is formed on each wing of the star by the bevel *D* behind the hot chisels, so that only a small amount of filing is required to put the cutting end in shape for use.

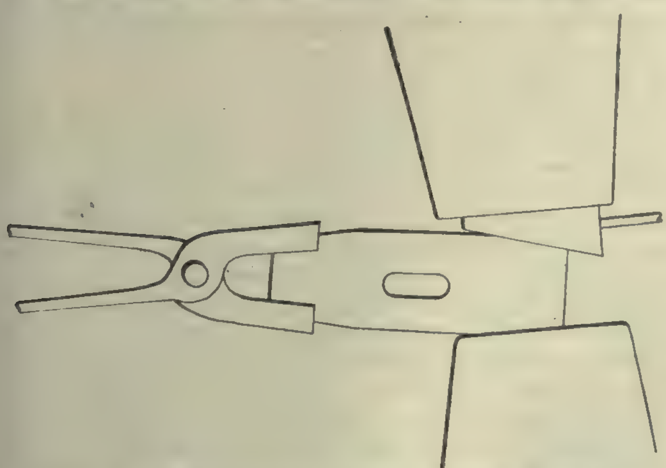


FIG. 9. METHOD OF DRAWING SLEDGE TAPERS

Rivet sets for air hammers are forged from bar stock under a Bradley hammer using a set of two-pass dies. The first pass is used for breaking down the stock and roughing to shape; and the second pass, shown in operation, Fig. 8, finishes the forging complete ready for shearing from the bar. The forgings require several machine operations for completion, including the turning of the shanks to size, turning to shape and grinding after hardening for an accurate fit in the "air-gun."

FIG. 10. PUNCHING HOLES IN SMALL SLEDGES

Small sledges and heavy rivet hammers are forged under a Nazel hammer. Special dies have not been provided for this work and in order to draw the taper on each side of the forging it is necessary to use a taper flatter of double the angle required for one side, as illustrated in Fig. 9. The hole is hot punched, and in Fig. 10 the helper is shown holding the die ready to slip under the forging so that the hot slug may be forced through into it. After punching a slightly tapered drift is driven into the hole, first from one side and then from the other so that the hole will taper in both directions, from the middle, and make it possible to attach the handle more securely.

Converting a Shaping Machine to a Power Hacksaw

By J. A. Raught

Some eighteen or twenty years ago a man with whom I am well acquainted had an old shaping machine that was so badly worn and so poorly designed that he had decided to consign it to the scrap heap; but being in need of a hacksaw he reasoned that in this old machine he had about everything necessary but the bow-frame. Therefore, he had one forged with a long bar and attached it to the left side of the rear end of the ram. A T-shaped forging fastened in the toolpost served as a guide for the frame of the saw.

Although several modern saws have been installed in this factory, the old-timer has never been displaced because of its capacity, its accuracy and ease of manipulation.

Notices and Claims Under Compensation Acts—II

By CHESLA C. SHERLOCK

The matter of reporting accidents having been disposed of in Part I, the equally important point of filing a claim for compensation is taken up in this article. The author brings out forcibly the need for close observance of the prescribed rules and points out some pitfalls for the unwary.
(Part I appeared in last week's issue.)

IN THE previous discussion we found that it was necessary under the workmen's compensation acts for the injured workman to give the employer notice of the accident or injury within a certain specified period of time fixed by law, varying in the respective states from 10 to 30 days. We found that this notice of accident or injury was a period of limitation and that it absolutely fixed a condition precedent, in the majority of cases, which must be complied with by the workman before he could hope to receive compensation for his injury.

In the present discussion we are to consider the decisions dealing with the necessity of the workman filing a claim for compensation upon the employer. And in order that the employer may not fall into the error so many people do, it must be remembered that the giving of notice of an accident is not in any sense the filing of a claim for compensation. They are two separate and distinct duties resting upon the injured workman and they are two very neccessary steps in the matter of going about getting a compensation award.

There is a period of limitation placed upon the time when a workman can file a claim for compensation, just as there is a period of limitation placed upon the time when he can give notice of accident or injury, and the reasons for this limitation are very similar to those given for the notice of accident.

This much is settled at law: The portion of the statute requiring the workman to file a claim for compensation is mandatory and it is absolutely impossible for a workman to hold his employer for compensation unless he has filed his claim within the time specified by the statute. Formerly the courts were disposed to treat this provision lightly and they did not hesitate to stretch a point in favor of the workman, but you do not find them taking any such action today. More attention is being paid to the technical provisions of the statutes, as is invariably the case in a well settled system of jurisprudence. In the beginning of things, we do not have the technicalities to notice that we do when the system settles itself into well ordered practice.

As in the previous discussion, the cases mentioned herein are all new, none quoted being more than two years old, and some have been decided within the last six months.

In Illinois the court held that the statute requiring claims to be filed within six months was mandatory and could not under any circumstances be dispensed with, and that no right of action in favor of the injured workman exists without proof that such claim was filed within the time limit fixed by the Act.

In a Michigan case it was shown that the injured workman had twice stated, in answer to inquiries by the Industrial Accident Board, that he did not propose to accept compensation, but expected to bring an action against the employer under the Federal Employer's Liabilty Act. No claim was filed until 13 months after the happening of the accident and then only after he had been denied recovery under the Federal Employer's Liability Act.

The court set aside an award of compensation in favor of the employee made by the commission, saying that the statutory provision relative to notice of claim within six months affected not only the right, but also the remedy of the employee. Said the court: "The condition of giving notice of a claim for compensation, controlling the right to demand the same, is clear. . . . Perhaps the legislative rule ought to be changed, a question for the legislature. But I can see no difficulty in such a case if the right to compensation under the Michigan law is preserved by notice, although the right may be doubtful. If the case falls within the Federal statute, the remedy under that statute is exclusive; if within the Michigan law, the Federal law has no application. But if a right under the Michigan law is claimed, notice of the claim must be given within six months after the injury is received."

When workmen find themselves in difficulty because they have been slow in making their claim for compensation, they naturally raise the question as to when the statutory period of time commences to run, as to whether it commences to run at the time of the accident or when disability first occurs. Here we find practically the same point arising that we did under the consideration of when it was necessary to give notice of an accident.

In a New York case it was shown that under the New York statute a claim must be filed within one year after injury, or the right to compensation will be forever barred. In this case the accident occurred on Jan. 10, 1916, and the claim was not filed until Jan. 10, 1917. The employer contended that the claim was barred, as in computing time reckoned by years the day from which the time is reckoned shall be included. The court did not so find, however. It quoted from the General Construction Law, which contained the following provision: "The day from which any specified period of time is reckoned shall be excluded in making the reckoning." So the court held that as the day from which reckoning must be made is excluded, it followed that the claim had been filed on time.

Employer Mus: Be Formally Notified

Again, we find the question of the knowledge of the employer entering in and raising a doubt as to whether it is necessary to make a formal claim for compensation when the employer already has knowledge of the workmen's intention to claim it.

In a Nebraska case it was shown that the employer had knowledge of the injury but that no claim had been made by the employee for compensation within the six months as provided by the statute. The statute required that notice of the injury shall be given "as soon as practicable after the happening thereof." The employee contended that no distinction was made by the

statute between giving "notice of injury" and "making" claim for compensation, and since notice was unnecessary when the employer had knowledge of injury, no claim need be made. The court, however, held that giving of notice and making claim for compensation were distinct and separate prerequisites to bringing an action for compensation.

Said the court, speaking of statutory provisions: "It is a statute of limitations, telling the claimant having a valid claim within what time he must prosecute it, if at all. The seeming contradiction in the language in that the employer appears to be privileged to begin the suit within one year, whereas the claimant's rights might be lost by his failure to make the claim within six months, exists, if at all, in the words, not the sense. Surely, no substantial right would be denied the employer, even if denied the right to commence an action to have settled a claim against him already barred."

PROOF OF FILING OF CLAIM NECESSARY

Since the filing of a claim for compensation is a necessary step in the right to maintain an action for it, it follows that it is necessary for the party upon whom such duty rests to be able to offer proof that the claim was made in the proper manner and within the time specified by the statute.

In an Illinois case it was shown that a notice of claim for compensation was acknowledged by the general attorney of the employer on Nov. 6, 1913, and that the accident occurred on Oct. 2, 1913. The court held that the introduction of the general attorney's letter showed *prima facie* that the employer and general attorney received notice before Nov. 6, 1913. In the same case it was held that the production of the notice of the claim in the court on the demand of the employee's attorney positively proved that the employer or attorney had received notice.

In a California case it was shown that the applicant had, within six months of the injury, filled out an information blank concerning his injury, but had not filed formal application for compensation until after the expiration of six months.

The court annulled the commission's award, saying: "In the matter now before us the commission was asked to do nothing judicially by the request for a rating. That request sought no action on the part of the commissioners whereby they might bring the adverse parties into court or might acquaint themselves with the facts either from personal examination or by reports of their own experts. It did not ask that the employer or the surety be required to present any defense either might have, and, as a matter of fact, neither was called upon to appear and defend until many months later."

In a Massachusetts case the question was raised as to whether a claim can legally be filed by an attorney for the claimant. Said the court: "The claim for compensation filed by the attorney for the dependents on July 21, 1915 is the one relied on; and it complies with all the requirements of the statute. It states the time, the place, cause and nature of the injury; it is signed on behalf of the dependents by the attorney who represented them at the hearing, and it was filed within six months after the death of the employee."

In an English case the applicant claimed that she had filed her claim for compensation within the regular specified time by addressing and mailing a letter to her employer and that she had so addressed and mailed two separate letters. The employer showed that four clerks opened and sorted the mail as it came in and offered two of them to testify that no such letter had arrived. A search of the employer's files also disclosed that nothing had come. Lord Cozens-Hardy, M. P., who is the English authority on workmen's compensation, in trying the case, said: "No doubt a letter properly addressed and posted raises a presumption that it is received. It is only a presumption which may be easily rebutted."

While he seemed to have his doubts as to whether the letter had been in fact written and posted, he finally decided to resolve the doubt in the favor of the claimant and award her compensation, but he threw out a strong hint that it was going "against the grain" to do it and that henceforth more adequate proof of making claim would have to be offered.

The above quotation should be expressly valuable to American employers; the fact that it is from an English case does not alter the situation, as the courts of the two countries follow each other in their decisions. It simply means that while there is a presumption against the employer claiming not to have received the letter or the notice of claim, it is a presumption which may be easily overcome by proper showing, thereby shifting the burden of proof back on the employee claiming to have posted the claim.

In a Michigan case the question arose as to whether or not an oral statement of claim was sufficient to comply with the statute regarding claim for compensation. Said the court: "Giving the claimant's testimony the most favorable construction possible, it amounts to a statement that he would have to make a claim for compensation if he did not get better. We think this is not a compliance with the requirement of the Act."

It will be observed in this decision that the court does not say expressly whether a direct statement of claim would comply with the Act, but gives the inference that an oral statement, while it might pass the test, is to be frowned upon as the statutes obviously contemplate a written notice.

Very often where there has been a delay in making a claim beyond the period of time allowed by the statute, the workmen seek to set up some justification for their delay and to obtain a ruling from the courts admitting them to an award. The courts have been called upon many times to consider this question.

In a Michigan case it was held that because a workman had suffered a severe injury to his eye did not excuse his delay in waiting beyond the statutory time to file his claim. Said the court: "The six months limitation of time fixed by the Act for claiming compensation under it is plainly expressed, with no qualifications and no latitude given, by proviso or otherwise, to the board administering it for extension of time."

In another Michigan case it was shown that the workman suffered a severe injury to his eye but did not file his claim for compensation for more than 4½ years after the original accident had happened, claiming that he had not definitely lost his sight until within six months of the filing of his claim. The court held that while the words "accident" and "injury" were not synonymous the accident produced the injury, that in point of time they were concurrent, and that as the instant case was governed by such ruling the claim was barred.

This case is a clear-cut decision on the point as to whether the workman should file his claim for com-

pensation within six months of the accident or wait until he has definitely found out what the ultimate effect of the injury will be. Many people have the idea that it is improper to move for compensation until they know exactly what the maximum disability under the injury is going to be.

There is nothing that is further from the contemplation of the compensation acts than this feeling, and if they delay too long they are very apt to find themselves outside the pale of the law. The injured workman can file his claim for compensation within six months after the injury or accident and when his case comes on he will be awarded compensation in accordance with his disability as it appears at the time, or as it appears that it will be in a maximum sense in the future. One award does not forever bar future claims, if they are justified, as is the case in ordinary actions at law.

If it appears at some future date that a greater disability has resulted from the injury than was anticipated at the time the award was made, the workman can have the case reopened and upon a proper showing he can recover the additional compensation due him, while if he waits in the first instance to ascertain what this maximum disability is going to be before moving for his compensation, he will find that he has lost every right under the acts that he ever had.

The right to reopen a case also rests in the employer and if he feels that the workman has obtained a grant which is fraudulent or in error, he can have the case reopened and upon a proper showing have the original award reduced or increased, just as he pleases.

In a Massachusetts case the workman claimed that he first learned on Oct. 2, 1916, that he had permanently lost the use of his legs, due to an injury to his back, but he did not file his notice of claim until Oct. 30, 1916. It appears that there is no specified time limit in the Massachusetts act, but that the claim for compensation must be presented to the employer within a "reasonable time" after the injury. The court held that the claim had not been presented within a "reasonable time" after Oct. 2, 1916.

In a Michigan case the court said: "The language employed to effectuate this purpose, when read in connection with the context, is unambiguous and easily understood. It means, if it means anything, that the time shall begin from the day the accident happens and the injury is incurred. To say that the time does not begin to run until the claimant is fully advised as to the extent of his injuries, as is urged, is to import something into the section which is not there. The words 'after occurrence of the same' mean the same and are substituted for the words 'after the happening thereof' occurring in the preceding sentence with reference to the giving notice of the injury.

"If one means the day the injury occurred, the other does. It would hardly be contended that the 30-day provision for giving notice of the injury did not commence to run until some time in the future, when the injured party discovered the extent of his injuries. . . . The construction which the section should receive is that the time commences to run from the day the accident causes the injury. This construction is in keeping with the intent of the legislature to create a statute of limitations, and thereby fix a time when employers could feel certain that their liability in any particular case had ended."

This decision clearly establishes the rule, and it is being followed elsewhere, that the time for filing commences to run, either in the instance of the notice of accident or the filing of the notice of claim of compensation, from the day the accident occurred, the only difference between the two being that the legislature has allowed a longer time in which to file the claim for compensation than it allowed for giving notice of the accident.

In case of disability or death which prevents the claim being filed within the specified time, there has been some question, as the statutes in many of the states expressly reserve a longer period of time, not fixed, to those who are so incapacitated as to make earlier filing of claims impossible.

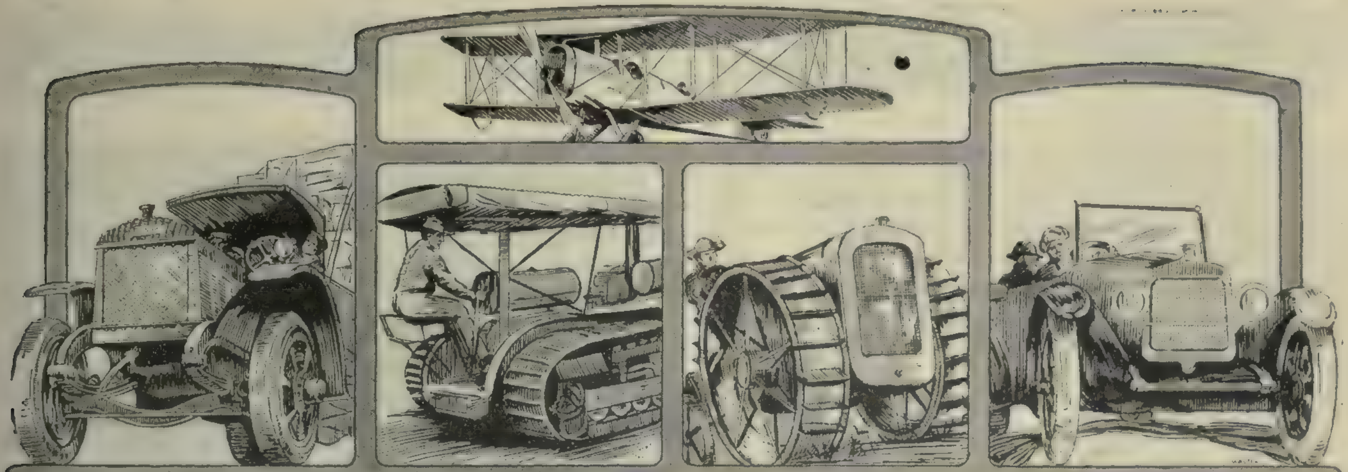
In Michigan the court said that in a case of death the claim for compensation should be filed within six months of the death of the injured workman. Said the court: "Under the plain requirement of our statute it was incumbent on the plaintiff to make claim for compensation within six months from Feb. 11, 1915 (date of husband's death). She having failed to do so, the award of the Industrial Accident Board appealed from was without jurisdiction and cannot be sustained."

This decision raises a point which goes to the whole root of the matter of claims that have not been filed within the limits prescribed by the statute. The court states that the Industrial Accident Board has no jurisdiction over a claim because it was not filed within the time limit specified by the Act, and this is exactly what the failure to file within the time specified does to all claims that might otherwise be valid.

The legislature has expressly limited the jurisdiction of the Industrial Commission to those claims which are regularly and properly filed, and unless these prerequisites have been followed, the Industrial Commission has no jurisdiction of the case, and indeed no judicial authority has any jurisdiction over the matter so as to impose an award upon the employer. There must be some limit to the authority of the commission and as to the liability of the employer, and it might as well be here as elsewhere. It is not necessarily suggested that employers should take advantage of these technicalities in order to defeat their just obligations under the compensation acts, but it is suggested, in the interest of all compensation claimants, that the employer insist upon a speedy determination of every case, and if claims have to be filed, the employer should be interested enough in the matter to insist that those entitled to compensation should file them within the time and according to the manner specified by the statute.

In the great majority of cases it is of no consequence to the employer, from a financial standpoint, as most employers are insuring their risk elsewhere and since they are paying premiums to protect their employees they should be interested in aiding the employees in every instance where it is warranted, in getting the compensation to which they are rightfully entitled. And the duty devolves upon the employer to advise the injured workman or his dependents as soon as possible after the accident as to their rights, and particularly to inform them as to the technicalities of the compensation statutes which are so apt to prove dangerous pitfalls for the unwary.

There is nothing more pitiful than an injured workman deprived of his usefulness as a wage earner, or helpless dependents who have lost their award because of ignorance of the law.



AUTOMOTIVE CONSTRUCTION

Machining Over 200 Cylinder Blocks Per Hour

By FRED. H. COLVIN
Principal Associate Editor, *American Machinist*

The large number of cylinders required for the Ford output necessitates as well as makes possible the introduction of unusual methods. The methods described and illustrated make an interesting study, particularly when it comes to deciding how far they can be used on smaller outputs.

THE machining of over 200 cylinders per hour, with a total output of over 3,400 in a 16-hr. day, makes it necessary to provide rapid and convenient means of handling the cylinder blocks between operations. Fortunately, the block is comparatively light in weight and can be handled by one man without difficulty. The main problem is to bring a constant supply of castings to the machines as needed, and also to provide means for passing them to the next operation without congestion or loss of time.

Fig. 1 gives a general view of the conveying system used in the cylinder department and shows how a steady stream of castings flows past the milling machines, which perform the first operation. Each cylinder block is mounted on a small four-wheeled truck which is carried by a loosely connected chain so that no difficulty is experienced in rounding the corners, the truck simply making contact with the raised guards on the outside. This conveyor is raised from the floor and supported on uprights so as to pass over the tables of the milling machines and to allow pas-

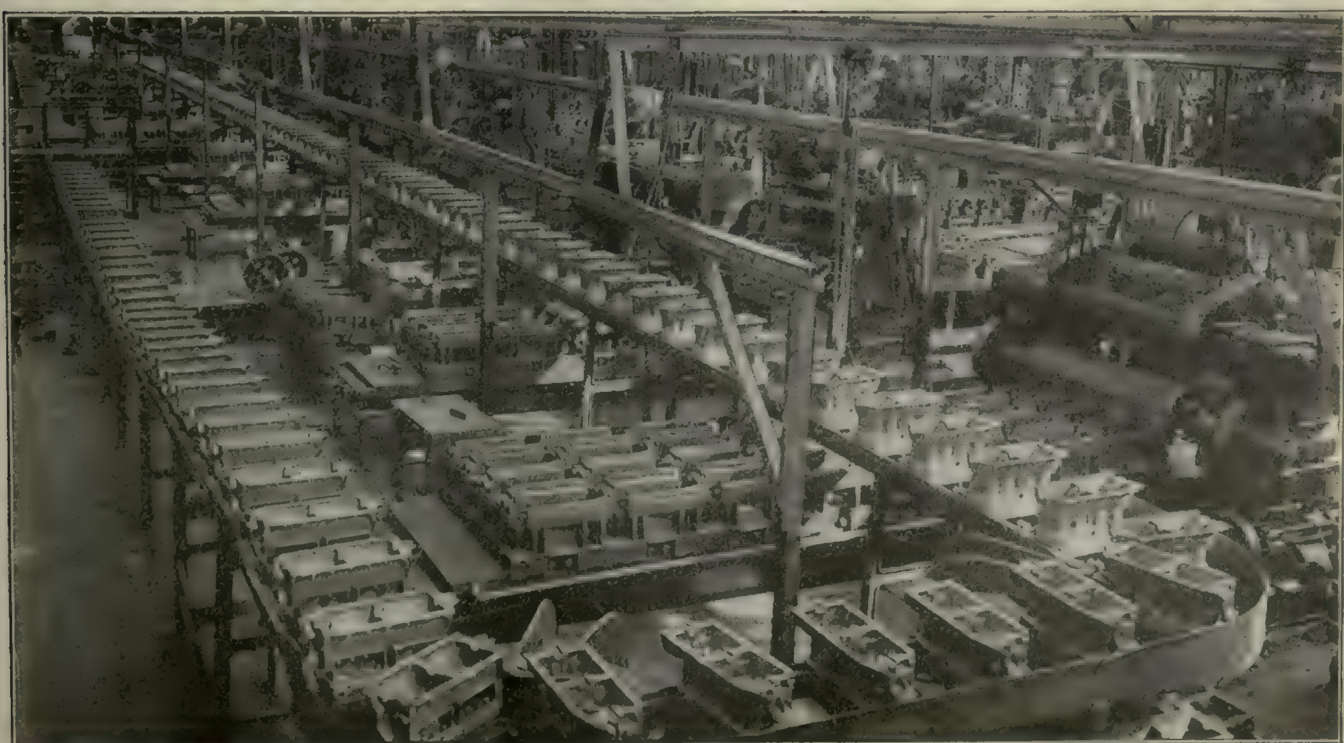


FIG. 1. CYLINDER MILLING DEPARTMENT, SHOWING CONVEYOR

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sage underneath where necessary. Rope hoists are also provided for each machine to handle castings, in loading them into place in the fixtures in which they are held. These hoists are supported on the overhead I-beams built up by the uprights and angles as shown.

Some idea of the main operations can be had from the transformation sheet, Fig. 2, in which the numbers correspond to the figure numbers in the article. However, only about a third of the total operations are shown on this sheet. The first machining operation is

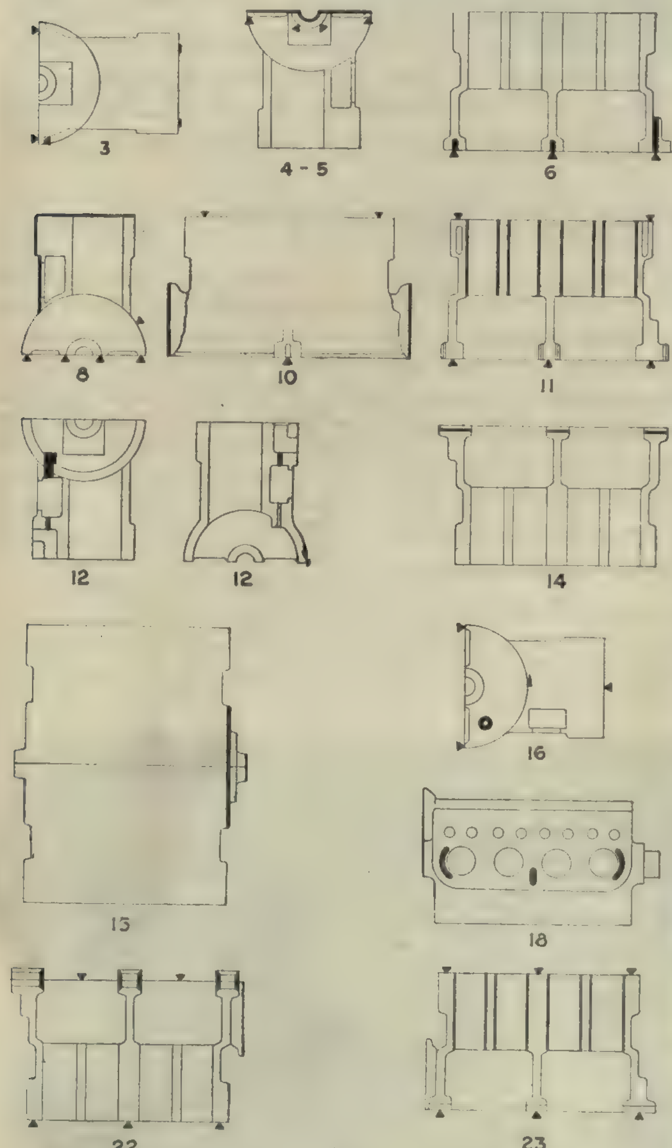

FIG. 2. TRANSFORMATION SHEET FOR OPERATIONS ON FORD CYLINDERS

to mill the four locating points shown at *A*, *B*, *C* and *D* in Fig. 3. These are projections cast on the top of the cylinder block which are afterward milled off in operation 4. They serve, however, to locate the cylinder block for the main operation of milling the base flange and the crankshaft-bearing seat.

The top of the cylinder block is placed under the yoke shown, with the locating points toward the milling cutters *E* and *F*, and the edge of the cylinder block rest-

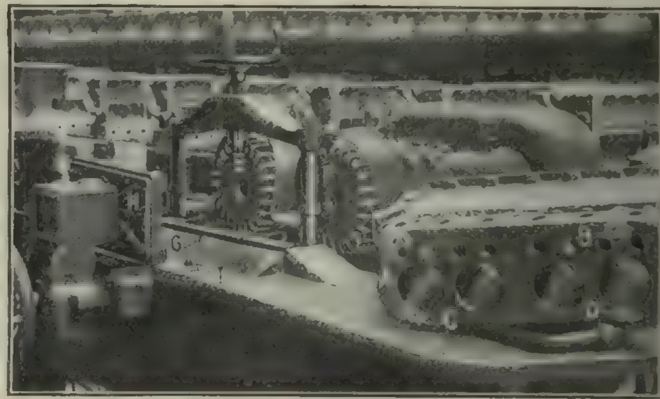

FIG. 3. MILLING FOUR LOCATING SPOTS

ing on the hardened-steel strip *G*. The clamping plate *H* fits along the base flange, forcing the flange against two locating points, one being shown at *I* and the other hidden by clamping plate *H*. This locates the bottom flange so that the four locating spots are milled parallel with the flange. All four spots are milled at one setting.

Resting on the locating points just milled, and also centered by the outside of the end bearings in the V-blocks *A*, *B* and *C*, Fig. 4, the cylinders are bolted in large gangs to the table of the planer-type milling machines shown. Details of the fixture and the work done are shown in Fig. 5.

The construction of the fixtures is shown in Fig. 5 as well as the self-clamping tongs for lowering the cylinder blocks into position, the locating points for supporting the flange, and the guard around the milling cutters. It should be noted that these machines carry both vertical and horizontal cutters. The former face off the flange, while the latter, as at *A*, mill the half-round seat for the babbitt for the three crankshaft bearings. These machines carry 32 cylinder blocks, there being eight rows of four each. Each machine handles about 35 blocks per hour.

Next comes the drilling of the six bolt holes by which

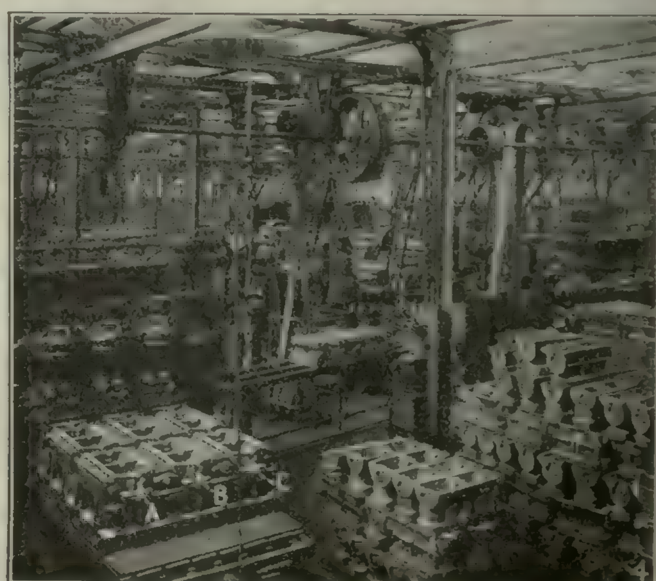

FIG. 4. MILLING THE BASE FLANGE

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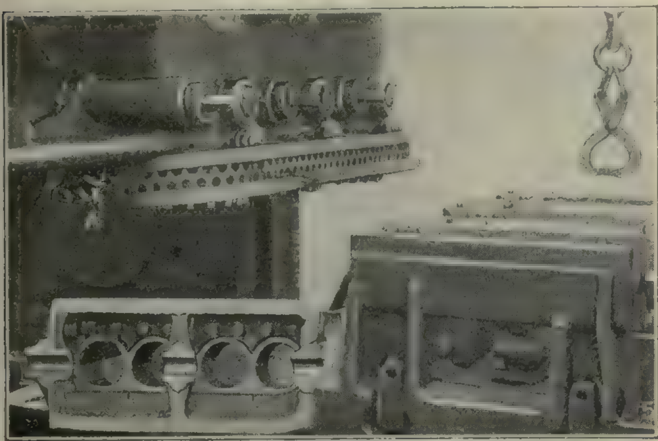

FIG. 5. DETAILS OF FLANGE MILLING

the bearing caps are held in position. These also serve as locating holes for future operations. This is done on a special drilling machine of the inverted type shown in Fig. 6. The arms *A* and *B* are simply for convenience in resting the cylinder block while it is being pushed back into position, the slides *C* and *D* supporting the outer end. The block fits this opening and is easily clamped in position by the handwheel *E*. When the cylinder is fully clamped, the cam *F* is out of the way so that the rod *G* can spring back in position and start the feed. This, however, cannot be started until the block is properly clamped. The head carrying the block then feeds down over the drills, each machine handling about 22 cylinder blocks per hour.

The two center holes are then reamed on the special machine shown in Fig. 7, these being used particularly as the future locating points. With the conveyor arrangement shown, and the ease with which these can be handled, this machine has a capacity of about 125 cylinder blocks per hour.

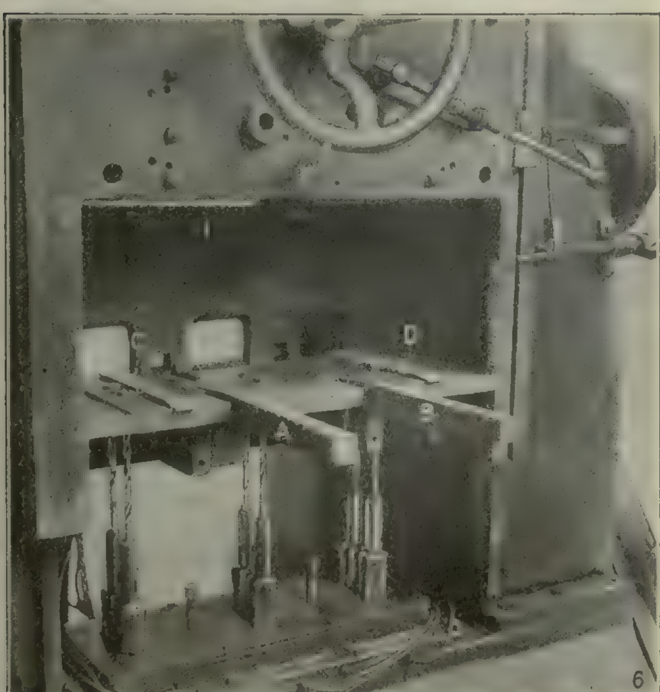

FIG. 6. DRILLING SIX BEARING CAP HOLES

Then comes the milling of the top and sides, as shown in Fig. 8. This is not an unusual operation, and several types of machines are used on this work. The latest machine is a special one which carries 32 cylinder blocks at each setting, and handles about 43 cylinder blocks per hour.

The cylinders are then rough-bored on a special four-spindle machine, after which they are water-tested by the apparatus shown in Fig. 9. This is a double testing stand and enables two men to work in very close quarters. About 50 lb. water pressure is used, and as can be seen, rapid clamping methods are provided so that the work can be handled very quickly. Each operator has a pump which enables him to apply pressure easily and rapidly.

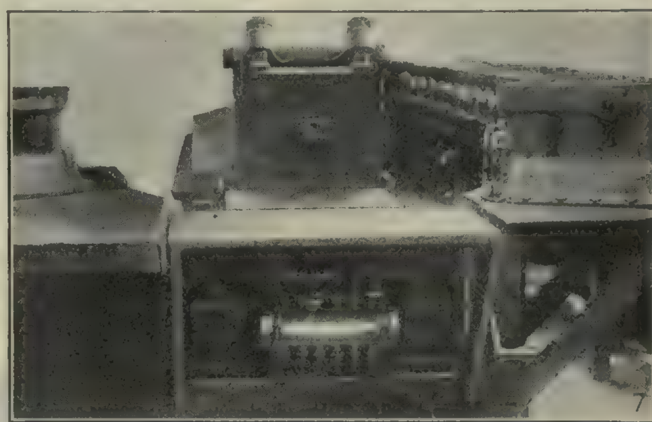

FIG. 7. REAMING THE TWO CENTRAL HOLES

Milling Both Ends of Block

Both ends of the cylinder block are then milled on the double-head milling machine shown in Fig. 10. This is a simple operation, the blocks being grouped in close order on a long table which passes between the two milling heads.

The second boring comes next, after which the third or finish-boring is done on the machine shown in Fig. 11. This operation also includes chamfering the upper end of the bore by means of the angular cutters shown on the boring bar, after which the valve-stem and valve-seat holes are roughed out as shown in Fig. 12. The first boring is done at the left and the reaming at the right. The racks for supporting the cylinder blocks are clearly shown between the two rows of machines.

Careful attention is paid to the valve-stem holes and the push-rod holes, both being carefully reamed within close limits. The valve-seat holes are cleaned out with an electric drill and are then rebored on special multiple-spindle drilling machines. Special drilling machines are used wherever it is advantageous to do so, two of these being shown in Figs. 13 and 17.

The machine shown in Fig. 13 drills 15 holes in all from three directions. The cylinder block is located by means of the guide rail *A* which fits the seats for the babbitt bearings, and the block rests on the hardened rails *B* and *C*. A cam action locks the cylinder in place.

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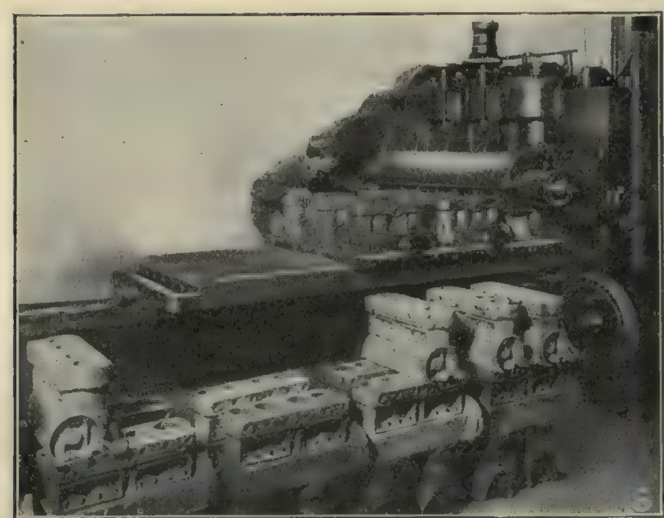
FIG. 8. MILLING TOP AND SIDES

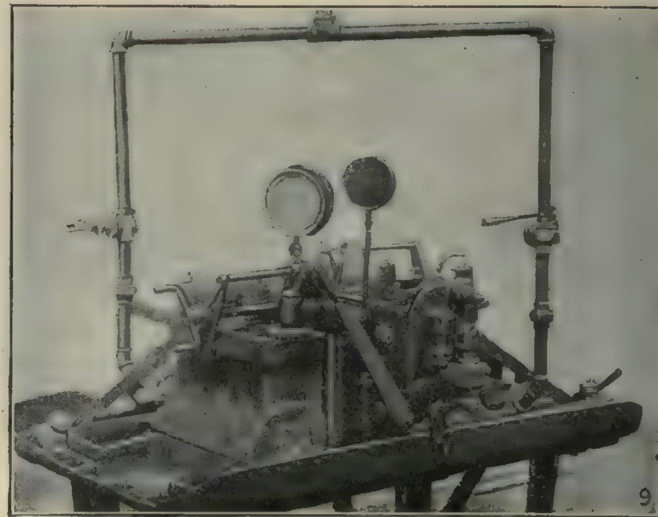
FIG. 9. DOUBLE FIXTURE FOR WATER-TESTING

The main bearings are next bored in the fixture shown in Fig. 14. The cylinder block is located by dowels and clamped down on to the steel plates shown by means of the clamps *A* and *B* which are operated by the lever *C* and the arms *D* and *E*.

The ends of the main bearings are finished with


FIG. 10. MILLING BOTH ENDS OF CYLINDER BLOCK


FIG. 12. DRILLING AND REAMING FOR VALVE STEMS


FIG. 11. REAMING CYLINDER BLOCK

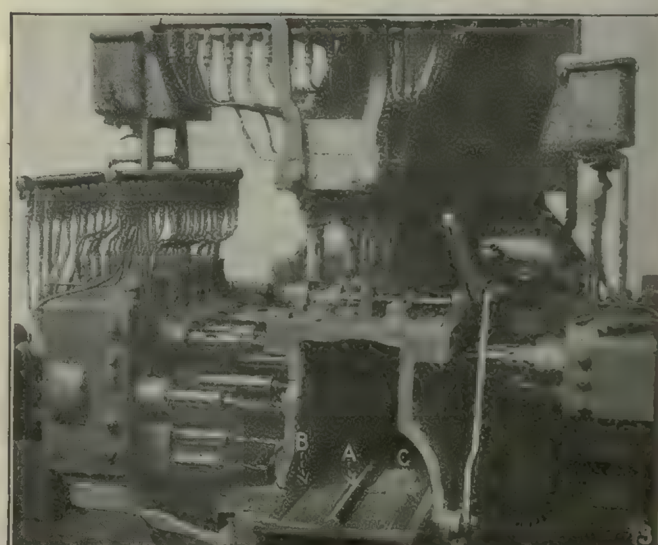

FIG. 13. A THREE-WAY DRILLING MACHINE

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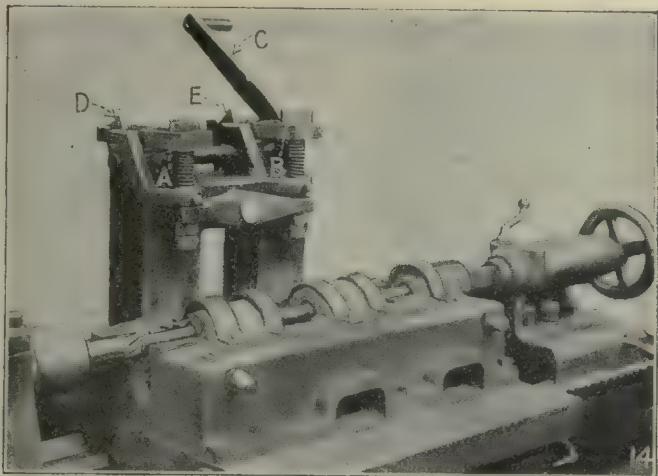

FIG. 14. BORING THE MAIN BEARINGS

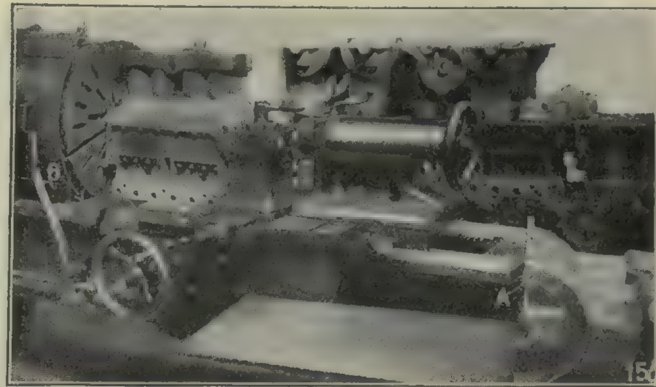

FIG. 15. TURNING END OF CRANK CASE

straddle-mills, after which the transmission end of the crank case is turned true with the bearings so that the clutch and transmission members will be exactly in line with the crankshaft. In order to insure the ends being perfectly square, two cylinder blocks are clamped on a mandrel which runs through the bearings, and both castings are driven between the lathe centers from the faceplate shown in Fig. 15. This enables two crank cases to be turned at the same time, the turned surface being shown at *A*, this being a finished cylinder block. The arm *B* and the pad *G* are simply for convenience in putting the work into the lathe, the turning operation

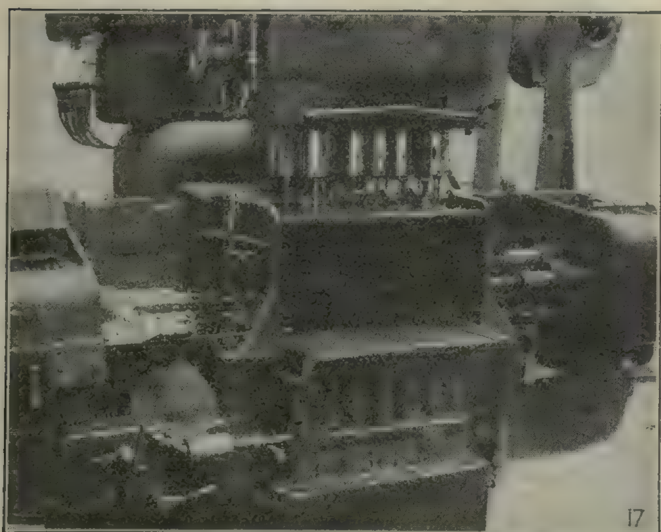

FIG. 17. A FOUR-WAY DRILLING MACHINE

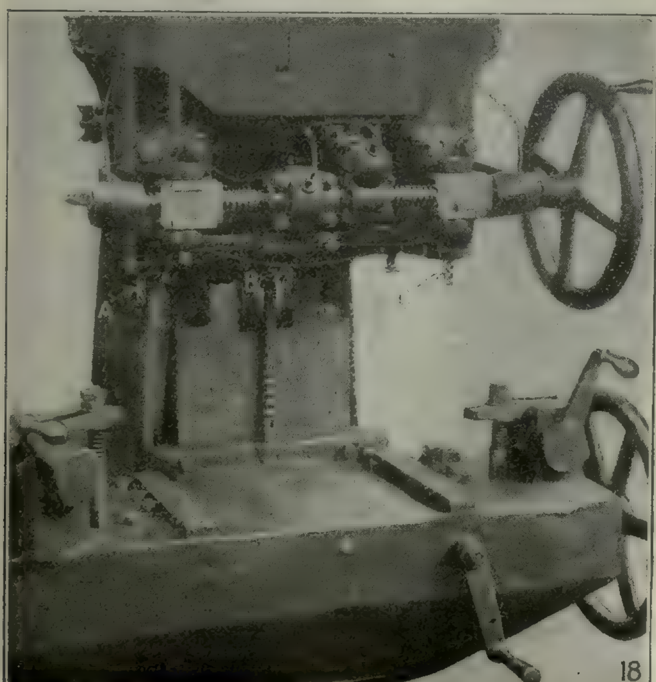

FIG. 18. MILLING THREE WATER PORTS

FIG. 19. BABBITTING THE MAIN BEARINGS

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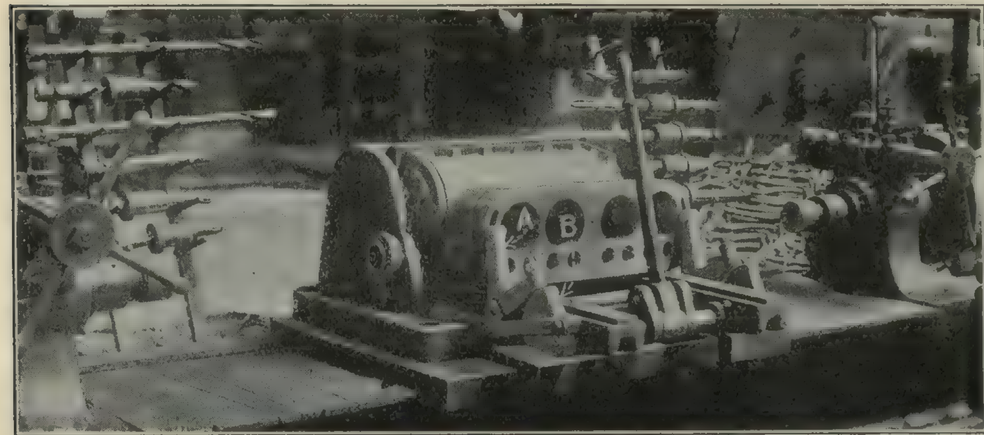

FIG. 16. BORING CAMSHAFT HOLES

being extremely simple, as can be seen. A special loading fixture is provided, and the toolpost carries four tools in a turret. These conveniences enable an operator to handle 22 cylinder blocks per hour per machine.

The camshaft holes are bored and reamed in the double-headed machine shown in Fig. 16. The cylinder block is located by the bearing bolt holes previously referred to, and clamped in position by the ingenious combination of bell crank and cam shown at *A* and *B*. The design is very similar to that used in the Ford transmission and is very effective. Eighteen of these machines are required, the capacity of each being 15 per hour. The simplicity of the fixture and the machine makes the method easily adaptable on smaller production.

The holes for anchoring the babbitt in the bearings are then drilled radially in the main bearing, after which the cylinder block goes to the special four-headed drilling machine shown in Fig. 17. This puts in the flange bolt holes, the holes for the cylinder cover studs, and holes at each end for the transmission and other attachments.

Then follows the spot-facing of the holes in the bottom flange and the counterboring of the six main bearing bolt holes, the drilling of two oil holes in the side of the cylinder, the clearance for the timing gear, and the drilling and counterboring of the holes for the water plugs, together with facing the crankshaft bearing bolt holes and spot-facing of the crankshaft cover holes.

The water slots are milled in the special three-spindle vertical milling machine shown in Fig. 18. This operation mills the three slots which make the water connection between the cylinder blocks and the cylinder head. Tho two outer slots are curved to conform to the bore of the cylinder, while the center slot is straight. The two outer milling cutters, *A* and *B*, are mounted in swinging arms so pivoted as to secure the proper radius, and a movement of the handwheel shown guides them over the full length of their travel. At the same time the central cutter *C* is moved across the cylinder to the correct distance. It will be noted that the milling cutters are of the new rapid spiral-tooth form.

Next comes the babbitting of the main bearing, utiliz-

FIG. 21. LINE-REAMING THE MAIN BEARINGS

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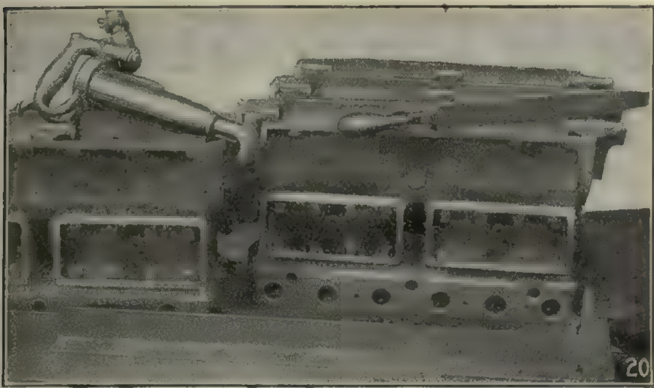


FIG. 20. PEENING AND TRIMMING THE BEARINGS

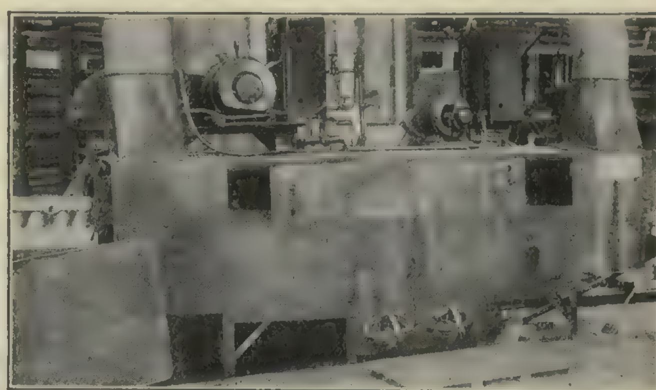


FIG. 24. WASHING THE CYLINDERS BEFORE ASSEMBLING

ing the fixture shown in Fig 19. With the cylinder block placed in position in the babbitting fixture, the arm *A* is swung down and locked into place at *B*. The blocks *C* and *D* form the cheeks or ends of the mold for the end bearing, while the pieces *E* and *F* form gates for guiding the babbitt down into the bearing around the mandrel *G*. The pin shown in the center acts as a guide and also forms an oil hole in the center of the bearing. Similar guides are provided for the other bearing and the counterweight *H* makes it easy to handle the whole thing rapidly. The surplus metal is then chipped off and the babbitt peened solidly into place by the pneumatic hammer shown in Fig. 20. The edges are also trimmed with the file shown.

Then the bearing caps are bolted into position and the bearings bored and reamed in the machines shown in Fig. 21. This also shows the conveyors on each side and gives an excellent idea of the compact way in which all the machines are located. The cylinders are then taken to the special milling machine shown in Fig. 22. The blocks *A* and *B* fit the bore of the first and fourth cylinders, while the strip *C* supports the cylinder block in the center. The cylinder is then raised so that the cutters at *D*, *E* and *F* come between the crankshaft bearings, the stops *G* and *H* limiting the upward movement. The milling head is then moved sideways in both directions by means of a lever, and the ends of the bearing chamfered to the desired radius.

Instead of grinding as is done in most cases, the cylinders of the Ford motor are finished by rolling, as shown in Fig. 23. This is done on a heavy-duty four-spindle special drilling machine which carries the rolling tools, some of these being shown at *A* in the rack beside the machine. These are revolved and at the same time forced through the cylinders, being dropped out at the lower end. This compresses the metal and imparts to it a hard, burnished surface.

There remains a small amount of tapping to be done, after which the finished cylinder block is put on a conveying belt that carries it through the large washing machine shown in Fig. 24. Here it is treated to a scalding hot bath of soda water or some other mixture, and comes out entirely free from all dirt and chips, after which it is ready for the assemblers.

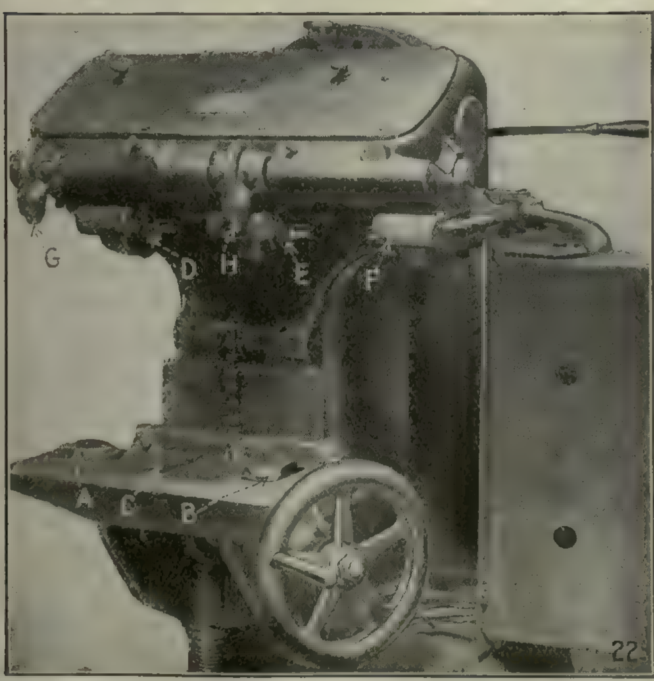


FIG. 22. CHAMFERING ENDS OF MAIN BEARINGS

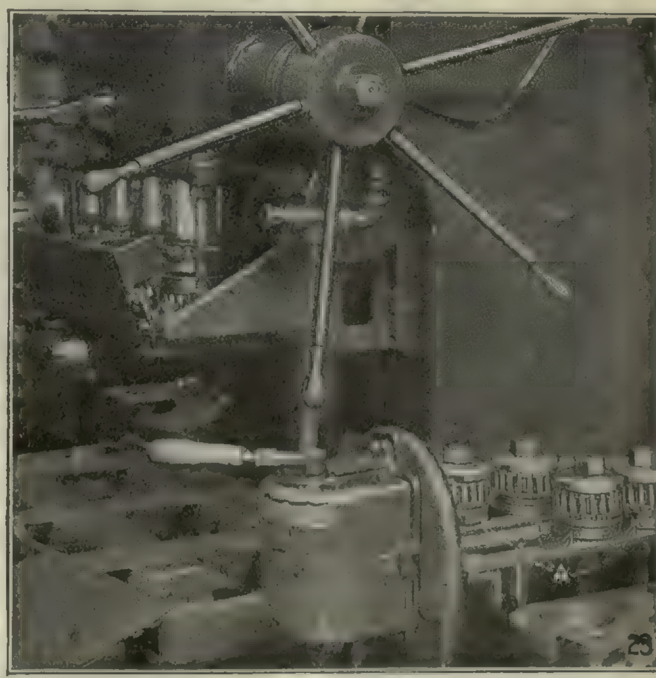


FIG. 23. BURNISHING THE CYLINDER BORES

Strangling Our Foreign Trade Service

NO more short-sighted, unbusinesslike and absolutely foolish piece of work was ever done than the cutting of the allotment for our foreign-trade service from $1,658,000 to $490,000 by the House Appropriation Committee which reported the legislative, judicial and executive bill out on February 19.

The original amount was small enough, but to have this cut to less than one-third is almost unbelievable — yet this is exactly what the Appropriation Committee has done.

J. W. Alexander, Secretary of Commerce, said in a special interview: "I do not believe the members of the subcommittee which decided to cut our appropriations for promoting foreign trade had any intention of crippling American commerce. The explanation of their action, I feel sure, is that they did not fully realize the part the Bureau of Foreign and Domestic Commerce has come to play in promoting trade."

This is certainly a very charitable view to take of the matter in the face of the fact that the Appropriation Committee undoubtedly knew that any cut in the appropriation was in direct opposition to the desires of the Chamber of Commerce of the United States of America, National Foreign Trade Council, American Manufacturers' Export Association, and hundreds of national and local business associations. It touches vitally the interests of every trade and industry. It is not economy any more than it would be for a farmer to cut to less than one-third the money he invests in necessary seed wheat.

Secretary Alexander goes on to say: "The cutting of the appropriations for the Bureau of Foreign and Domestic Commerce threatens a body blow at American export-trade development. It will mean the dismantling of the most essential part of our foreign-trade-promotion machinery at the very moment when England, Japan, Germany and France are leaving no stone unturned to increase the volume of their export business. Both England and France have just reorganized their foreign commercial service on a larger scale than ever before.

"Other countries are planning to do likewise. This is no time for the United States to throw into the discard the entire commercial attache service, almost all of the trade commissioners abroad, and the existing district and co-operative offices of the Bureau of Foreign and Domestic Commerce in fifteen American cities.

"It has taken years to develop these services to the point of efficiency which they now possess. The expenditure of money necessary to build up and maintain the field work of the Department of Commerce abroad and at home has been amply justified as I am confident thousands of American business firms, large and small, will gladly testify.

"Consider what this drastic cut in appropriations will mean: Twelve commercial attaches — men trained and ex-

perienced in commercial and economic matters — who are at present attached to embassies and legations in a dozen important foreign capitals where they are charged specifically and wholly with the promotion of American business interests at this critical period in the world's history will be withdrawn pre-emptorily within three months' time. At least fifteen trade commissioners, who are reporting on rapidly changing commercial conditions in European countries from Denmark to Austria, will have to be recalled by the first of May.

"A deliberate sacrificing of the finest foreign-trade-promotion machine any country has ever built up — one which half a dozen of our keenest competitors have sought to use as a model. The spending of money on constructive export-trade-promotion work, such as this Bureau is accomplishing, cannot be considered as an outright expenditure in any sense of the word. It should be regarded as an investment — based on the same common-sense principles which govern every individual business firm in the United States. It is so regarded by the Chamber of Commerce of the United States, by the National Foreign Trade Council, by the American Manufacturers' Export Association, and by hundreds of national and local associations of business men.

"In the same way the threatened abolishment of the Bureau's fifteen district and co-operative offices in New York, Chicago, Boston, New Orleans, San Francisco, St. Louis, Seattle, Cleveland, Philadelphia, and six other cities, will mean the elimination of a service which has demonstrated its usefulness in manifold ways.

"Each of these offices fills a genuine need in its particular district. Each office forms an important contact between the business public and the Washington headquarters of the Bureau for the dissemination of information on foreign-trade subjects. What will take their place?

"The Bureau of Foreign and Domestic Commerce is not a Bureau created by the war emergency. Its appropriations were not increased to take care of war activity and its personnel was not added to for the sake of carrying on the war-time work which is now no longer necessary.

"The Bureau has had a consistent growth over a period of eight years and there is every bit as much justification for the Government to aid and encourage by expert technical advice the American firms engaged in foreign trade as there is for the Government through the Department of Agriculture to aid and encourage the farmers of the country.

"Foreign trade is essential to preserve the economic stability of the United States. This cutting down of the appropriation for the Bureau means simply that the clock has been put back over four years.

"If the Department of Commerce in effect as well as in name is to be a department of commerce, it should be possible to increase the essential work of the Bureau of Foreign and Domestic Commerce rather than to have its activities lopped off to a point where it will be no longer possible to function properly."

All the enlightenment and influence you can bring to bear on your Congressmen will be needed to head off this pernicious legislation.

Business Opportunities in Asia

By F. R. STILL
Vice President and Secretary, American Blower Company, Detroit, Mich.

We have been hammering away at the subject of foreign trade ever since the armistice, but most of us have hardly thought beyond the limits of western Europe. This is very short-sighted, for the Near and Far East both offer golden opportunities for business. This statement from a man who has been there presents a clear idea of what must be done to win Oriental markets and also of some of the things that must not be done.

THE opportunity to do business in Japan, North or South China, Indo-China, the Malay Peninsula, the Philippines, Burma, Siam, Borneo, Sumatra, Java, Australasia, India and Ceylon váries in each of the countries named. The opportunity varies not alone as regards any one product, but it also varies as regards every American manufactured product.

An article which may be entirely acceptable in one country will not be so in another. Then again, there may be great business possibilities in one country which do not exist elsewhere; and very often, a method of doing business which in one country may have proved satisfactory, will be entirely unsuited to another. It is much the same as selling to an individual in our own country, wherein we all know that a variety of sales methods have to be employed to sell any specific article to the different people we encounter in various localities and occupations.

To do a successful export business in any oriental country, it is positively necessary to go there, carefully study the conditions, learn the requirements, temperament, habits and customs of the people and formulate a sales policy which will harmonize with what they are accustomed to; otherwise the business will scarcely amount to much, and besides a lot of money may be wasted.

To anticipate that a large or successful export business may be built up, simply through representation by any one of the many exporting houses in our country, or by the importing houses in foreign countries, is sure to result in disappointment.

The only possible exception is the sale of standard staple articles for which there may always be a heavy demand, beyond the natural sources of supply.

No manufacturer of machinery or specialties can ever hope to make much progress without having a competent resident representative on the ground to assist an importing agency, no matter how large or experienced the agency may be.

Undoubtedly the best arrangement is to select a good live importing house, having ample capital, credit and an organization capable of handling the business, regardless of volume. With this house, place a competent representative to look after the particular interests of the home office, who is to work with the agency's staff along the lines which have proved successful in building up its general business. He must have a thorough knowledge of all branches of his own line, have the initiative to tackle any problem and be possessed of such judgment as will enable him to handle the business successfully, independent of advice from the home office.

The distances are vast in those countries, transportation and communication facilities very limited and exasperatingly slow. Hence he must largely rely upon his own resources and be prepared to act promptly, decisively and correctly without guidance. Naturally this calls for a man of exceptional experience and ability. Because such men are hard to get they are not usually sent to the Far East and that is why so many concerns are not satisfied with the results they get from their efforts to build up an export business.

To make clear why these statements are true, let us consider, first North China, say from Shanghai north to Siberia. Along the southern section of this area lies the great fertile Yangtze Kiang Valley, extending west over 3,000 miles. The tributary rivers are navigable for more than 1,500 miles, passing through the most highly productive agricultural district imaginable. All kinds of minerals abound north and west of this valley. It is reported that about one-eighth of the world's coal supply is available in this part of China alone, of which less than one per cent has been developed.

There is ample labor available and of a class of intelligence far above that possessed by most of the immigrants who come to this country from Europe. The people can be taught to do anything and are possessed of a natural skill which readily converts them into finished mechanics or artisans in a very short time. It is their natural bent to do nice, neat work on anything they undertake. The greatest fault found with most of them is that they are too painstaking, thereby slowing up production when engaged in reproductive manufacturing pursuits.

Excepting in the treaty ports, of which there are perhaps a dozen, the people live in a primitive manner, not much different than they did a thousand years ago. Their wants are few. In the summer the people go

almost naked and in some sections the men do go entirely so. None of them wear boots or shoes, such as we are accustomed to. Woolen clothing has never been worn; only cotton and silk. In the cold, northern parts of the country they pad their clothing and wear several thicknesses in winter, binding their feet in gunny-sacking, tied on with bamboo reeds.

None of them have stoves or furnaces for heating their houses, as fuel is too scarce to afford such a luxury. A brick furnace is built for cooking and the smoke flue is carried under a "Kang" or bed which is usually about 9x12 ft. and built of brick. This "Kang" radiates all the heat ever provided and the whole family sleeps on top of this brick bed. The fuel is usually nothing more than dried stalks, weeds, leaves, etc., gathered from the fields, as there is no wood in China and very little coal is mined.

South of the Yangtze Kiang Valley the climate is so mild that heat and clothing for human comforts are not required. Shanghai is in about the same latitude as New Orleans, while Hong Kong and Canton are on about the same parallel as Vera Cruz, Mexico.

Working Up Trade in China

When working up trade in China, the manufacturer, jobber, exporter or importer seldom, if ever, comes in contact with the purchaser or ultimate consumer. Practically all business is done through a "Comprodore," who is a highly educated Chinese business man of means; he assumes all financial responsibility and guarantees that the customer will pay for the product according to the contract or he will bear the loss. The "Comprodore" employs a number of Chinese salesmen or "scouts," who usually bring him in contact with the prospective purchaser. The house does all the engineering work, writes the specifications, makes the estimates and draws up the contracts. The "Comprodore" acts as the interpreter and intermediary, being in fact the salesman. He is paid a commission on all sales and in turn divides what he gets with his "scouts." Few Chinamen will deal direct with a foreigner at first. It is a Chinese idea that to approach a dealer for quotations indicates a desire to purchase which will preclude getting the best price. Two Chinamen know one another's tricky ways perfectly and can bargain and haggle for days with the keenest enjoyment over little things which would drive an Occidental crazy. Our definite, direct and impatient ways of doing business are not understood by any of the Oriental races, which, if for no other reason, makes it necessary to employ very different sales methods than are used in Europe or America. Hence the "Comprodore" system, while vicious in some respects, is apparently the best adapted to the peculiar characteristics of the people in that part of the world.

The "Comprodore" system prevails all over China and is more or less in vogue all over the Far East, especially where there are many Chinese. Most of the houses in India have a "Comprodore"; also those in Java and Sumatra. Even the European banks in China depend entirely upon a "Comprodore," and a Chinese "shroff" passes on all papers and currency.

Some houses have both an "Import Comprodore" and an "Export Comprodore"; then some have one or both in every branch office and a "Head Comprodore" at the main office.

The currency all over the East is on a silver basis. For many years previous to the war the fluctuations of exchange values were very small; hence, except in cases involving very large amounts of money the difference was not of serious importance. But since the war, silver has been climbing steadily until now it is worth more than gold. While climbing upward, it has frequently advanced two or three cents one day and then has fallen back one or two cents the next; occasionally it jumps six to ten cents in a day, one way or the other. This has made necessary an entire change in the methods of banking and in the carrying of bank accounts.

Watching the Silver Market

Every house now employs a "shroff," whose sole business is to watch the silver markct. He carries an account in one of the banks of every nationality represented in the country, like England, France, Belgium, Russia, India, Japan and America. As the exchange quoted by these different countries varies from day to day or even hour to hour, he draws from one bank and deposits in another.

There are no "clearing houses" in any of the Oriental cities. There are no national banks; most of the various governments do have banks of their own and issue their own currency, but usually the latter is circulating under a heavy discount. The currency issued by the foreign banks is generally the standard medium of exchange all over the East. It is a badly jumbled up mess and affords a fine opportunity for a loss of money through trickery, fraud, accidental oversight, or knavery. With half a dozen or more standards of value, all wildly fluctuating and no two fluctuating alike, they can produce ample confusion to satisfy the most satiated gambler if he is looking for excitement. But for a business house to attempt to contend with all these difficulties by direct representation through its own organization and expect to do a satisfactory business, anywhere near commensurate with the expense incurred, can only result in sore disappointment and eventual disgust with foreign business in every form.

Selecting the Man for the Foreign Importing House

If a manufacturer does not place a competent man with a foreign importing house, as suggested above, it is doubtful if much continuous business will be done, no matter what kind of a follow-up system be employed. Such importing houses handle so many things that it is more than can reasonably be expected that all of the lines will be given proper attention and all be pushed as they should be. Naturally such things as are in the biggest demand, which carry the most profit and which are the most easily handled, will get the most favorable attention; conversely, those things requiring careful attention, involving considerable risk and which have to be forced in order to move them, will only receive attention when a customer inquires about them, and even then will seldom be given the enthusiastic sales effort they would receive from a representative direct from the manufacturer.

Many interesting examples might be recited showing how the simplest things sometimes upset business dealings most disastrously, but space will not permit. It is absolutely necessary to understand thoroughly and be guided by the fact that most of the Oriental races are uneducated, bigoted, obstinate, prejudiced and superstitious; they are perfectly satisfied with their mode of

living; they do not want much and what they get they want as they have been accustomed to getting it for generations.

Hence, to try to change their ways so as to conform to our ideas is just as futile as to attempt to alter the action of the tides. We must learn what they want, how they want it and then provide it just as cheaply and uniformly as possible; we must carry on all business transactions in their way, expecting nothing unusual in the way of honesty or dishonesty from them and employ the same business methods for protecting our interests that we employ at home. If we follow these lines nothing can prevent the doing of a satisfactory foreign business in all lines, where there is a demand for goods offered for sale; and with close attention to the business, good goods, honest treatment and good service, it will grow continuously.

Turning a Ball on a Rod, and a Radius Dressing Device

By R. Coates

I have read in the *American Machinist* from time to time a lot of descriptions on the subject of turning spherical projections on, or depressions in, the ends of rods, and have been much surprised to learn what a lot of such balls and recesses the world must need in order to justify the enormous output from the various contraptions that have been devised for that purpose.

All the articles were interesting. Some were more convincing than others. Some convinced me that they had been hatched out of a fountain pen. If business keeps up along this line we will soon have all our bars of screw stock furnished with a ball on each end.

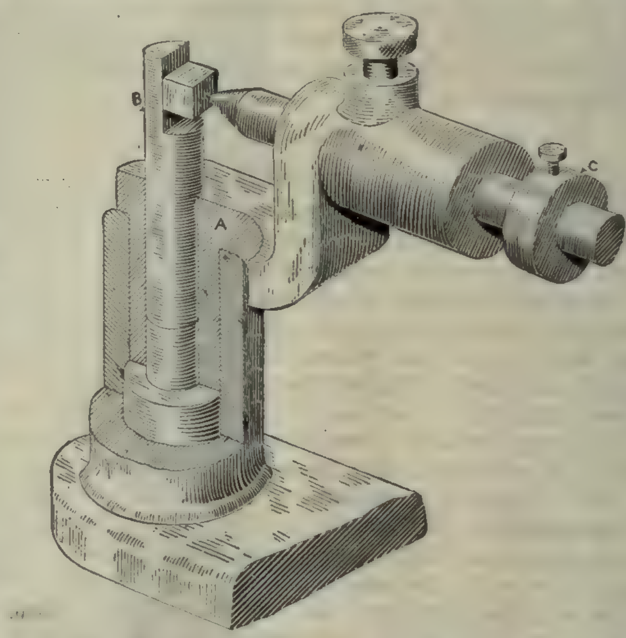
No! This is not an introduction to a treatise upon how to make a ball on the end of a rod. I have had very little experience along that line myself, and am not enthusiastic about them, although I will admit that

they are less destructive when so located than when they are projected (violently) from the end of a hollow cylinder.

Though my knowledge of the ball-on-a-rod business is slight, Mr. Dixie's article on page 743, Vol. 51, reminds me of the method used in one plant during the early stages of the war, to help along the work of grinding the ogee curves on the taper reamers used to produce some of the first cartridge receiving gages for French, English, Russian and Servian shells.

The reamers were first ground to the required taper on cylindrical grinding machines (I almost said grinders, but remembered in time that Mr. Norton objects to the term), the curves referred to being afterward ground on bench lathes with toolpost grinding attachments. The method used to form the grinding wheels was, with slight variations, substantially the same as Mr. Dixie describes.

The hand-tool-rest base that is part of the standard equipment of a bench lathe was used for the purpose of carrying a member that held a diamond holder horizontally and allowed it to pivot around a vertical axis. The drawing shows the action of the tool, but a brief description may help to clear it up. *A* is the machine-steel member, the shank of which is bored and reamed to receive the gage pin *B*, and turned to fit the hole in



RADIUS DRESSING DEVICE FOR GRINDING WHEELS

the tool-rest base. The elbow extension takes the diamond holder in a horizontal position and allows it to swing through any arc desired.

The gage pin *B* is a push fit in the shank of member *A* and its upper end is semicircular, the flat face being coincident with the axis upon which *A* turns. The illustration shows the method of setting the diamond to form a bead or convex surface on the wheel. To set the tool to turn a fillet or concave surface, the point of the diamond is brought to touch the flat surface of the gage pin and the size block placed between the collar *C* and the outer end of part *A*. The collar is then fastened by the setscrew, the gage pin pushed down out of the way, and the diamond holder advanced until the collar contacts with the boss.

This is not theoretical; I toted one for three and a half years through the big fight and it always did its bit when called upon.

That thing that looks like a lead pencil in distress is the diamond holder and the blob on the end is supposed to represent a diamond.

[We tried to have our draftsman reproduce Mr. Coates' drawing *fac simile*, but professional pride would not permit him to do so.—Editor.]


THE INDUSTRIAL RACE
WATCH YOUR STEP JOHN
LOOK OUT SAM!
DON'T STEP IN IT SAM
COMPULSORY METRIC LAW
THE HUN LINKS
WORLD TRADE CLUB OF SAN FRANCISCO
AMERICAN MACHINIST
Brey

Industrial Chile

By ERNEST L. LITTLE

THE country of Chile is one of the most peculiarly shaped of any in the world, extending about 2,600 miles along the west coast of South America and having a width of only 90 to 130 miles. All the northern section down to Voquimbo is an arid and desolate desert, without rain and vegetation, while the irregular land south of the Chacas Channel, between the island of Chiloe and the mainland, is practically uninhabited by white population. The real nation of Chile, therefore, lies between these regions, in the narrow valley between the Andes and the coast range. Here the hardy Chilean peasants, or rotos, the descendants of a vigorous race of Indians on the one side, and the Spanish conquistadores on the other, have extensively developed agriculture and stock raising, and have formed what is said to be the most homogeneous nation in South America. The population of Chile, according to the census of 1910, is 3,415,060 with an area of 292,580 square miles.

The principal source of wealth of the country has been the famous nitrate beds, which have furnished about 60 per cent of the national revenue. The prosperity of Chile depends to a very large extent upon the condition of this industry, and a lack of export demand for this product is reflected throughout the commercial and industrial activity of the country. The heavy cargoes of nitrate going to the United States and Europe have had an immense importance in building up the import trade. Not only do they bring in millions of dollars annually to the residents of the country but also supply freight on which vessels can count at all times for return cargo, thus simplifying the shipping situation.

Although Chile is a large importer of coal, large quantities are mined annually and supplied steamers for their outward voyages. The coal-mining companies have over $7,500,000 invested and produce 1,000,000 tons each year. This domestic source of power places Chile in a favorable position for the future industrial expansion of the country.

As an important corollary to coal in the development of the country, iron ore of excellent quality and to the extent of many thousand million tons is found in Chile. The ore is stated to run over 60 per cent iron with only a fraction of 1 per cent of sulphur and is very easily mined. The principal district now being operated is in the Province of Coquimbo.

While mining and stock raising and their related industrials provide occupation for a great majority of Chileans, there has been an increased development during the past ten years in manufacturing. With great quantities of iron, coal and timber, intelligent and energetic labor, numerous swift rivers for water power, and an interior nowhere far removed from the coast, Chile has become one of the chief manufacturing nations of South America, and it is quite possible that the factories may eventually rival the mines and farms.

According to the most recent statistics there are 5,722 manufacturing establishments, with 74,618 operatives and an aggregate capital of $94,257,466. The output of manufactures is valued at $107,007,418 annually.

Manufacturing centers around the Province of Santiago, which has about one-fifth of the entire number of establishments in the country with over a fourth of the capital. Valparaiso Province is next in importance and Valdivia third. The Chilean statistics classify the industries into groups according to their output and the number and capital of these are shown in the table.

Among the particular industries, that of shoemaking has the greatest number of establishments, but many of these are small. The shoemaking industry is most prominent in Santiago, but large factories are being constructed in Iquique and Valdivia. The leather used for the cheaper-grade shoes is the product of the Chilean tanneries, and this product is also used in the manufacture of trunks, valises, saddles and various other articles of leather. In the amount of capital invested the most important industry is that of grinding grain and other food products.

Although Chile must import the larger portion of its raw materials, the textile industry is growing rapidly.

CLASSIFICATION OF CHILEAN INDUSTRY

Kind of Manufactories	Establishments	Capital
Alcohol, beverages, etc	297	$8,222,433
Pottery, ceramics, and glassware	6	559,009
Foods and food preparations	807	27,601,757
Lighting, heating and combustibles	37	6,073,374
Dockyard and ship-repair stations	27	1,065,868
Clothing, etc	711	5,869,542
Wood and manufactures	676	8,558,065
Construction materials	89	1,921,780
Textiles	32	3,508,027
Metals and manufactures	805	5,933,705
Furniture	189	1,155,970
Paper, printing presses, etc	290	5,277,145
Hides and skins and manufactures	1,199	11,249,800
Chemical and pharmaceutical products	130	4,046,385
Tobacco and manufactures	98	986,076
Vehicles	188	1,063,565
Various	141	1,164,964
Total	5,722	94,257,466

The machinery for these factories came from England and a small amount from the United States.

Many industries will increase materially when better transportation and labor facilities render available some of the resources which are not being utilized. The manufacture of articles of iron and steel, although it includes a wide variety of products, such as railway materials, naval armament and other articles, will doubtless be further extended to machinery. While the increase in manufactures will tend to reduce the imports, it will, on the other hand, create a steady demand for hardware, tools, machinery and engines.

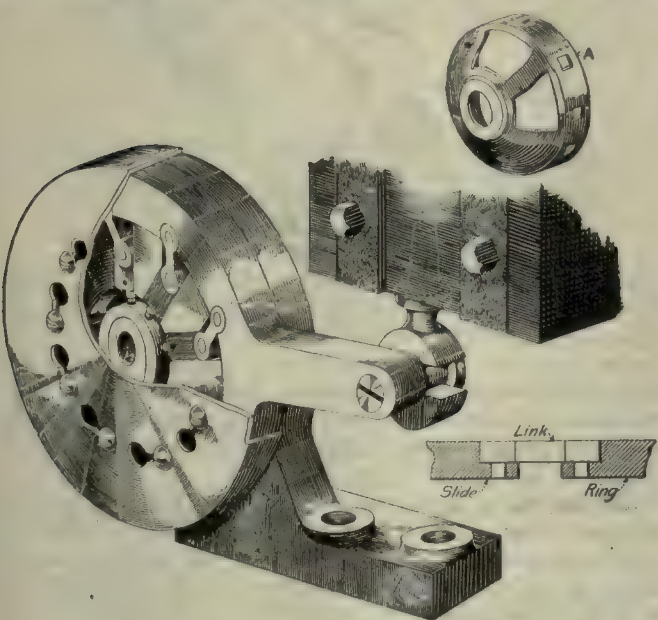
In order to introduce American products in Chile successfully, it is desirable for the manufacturer to establish connections with some import and native house with sub-agencies in each industrial center. This agency should have branches in Valparaiso, which is the chief port and commercial center of the republic, and Santiago, which is also a very large commercial center. With travellers covering the other large cities, the American exporter can be assured of proper representation. In the selection of an agent, great care should be taken to avoid granting a contract to a house representing competitive lines. A large number of importers of machinery and hardware have in the past been either German or English houses who are perfectly willing to represent an American house. Upon securing the exclusive contract from the American manufacturer, no attempt is made to merchandise his products, the American manufacturer in the meanwhile wondering why there is not a market for his products in Chile. By this policy, the Chilean importer keeps out a competitor.

A Multiple Piercing Tool

By Amos Ferber

Some time ago our shop was manufacturing a large number of gas lamps, each having four burners and mantles, all the burners being supplied with gas and air through the central tube. The part called the air shutter shell was a cup-shaped stamping of thin sheet brass which required nine small rectangular holes to be pierced in its parallel walls as shown at *A*.

The tool that was first made to pierce these holes cut but one hole at a time, the die being attached to the vertical face of an angle casting arranged to go



A MULTIPLE PIERCING TOOL

in a foot press, and a latch located successive holes progressively, after the first one had been pierced until the work had been indexed around once and all holes pierced.

This tool did not give a satisfactory division, as whatever error there happened to be was cumulative, and if the shell was slightly bulged when the punch drew out (no stripper was used) the error would be worse. Many shells were scrapped and the operation at best was distressingly slow, so the tools shown in the illustration were designed and built.

The casting had a foot at one side with bolt holes for fastening it in the foot press in an offset position which brought the end of the operating lever under the center line of the press gate. The face and periphery of the round part of this casting was finished and nine rectangular channels milled in it, radiating from the center.

The operating cam ring was forged from machinery steel, bored to fit over the casting and faced to bear against the shoulder. This ring was finished all over. Slides to carry the punches were fitted to the radial slots, their outer ends being milled as shown in the small sketch to take the connecting links.

The connecting links were of mild steel $\frac{3}{8}$ in. thick and fitted closely to the counterbored recess in both slide and ring, the thrust of the operation coming upon these bearing surfaces. The pin in each end had only the duty of withdrawing the punch from the die.

A cover fitted over the tool and held all the parts in place. This cover had elongated slots in its face and was held by button-head screws, which were the only screws in the whole device except those that held the die and the small setscrews that held the punches in the slides. By loosening the cover screws and giving the cover a slight turn it could be lifted off, exposing the works, when any slide or connecting link, or all of them together, could be lifted out.

A hook in place of the usual punch in the press gate connected with the main pin in the cam ring so that putting the tool into the press involved no setting up other than sliding it into place and dropping in the two press bolts. The die was shouldered into the casting to locate it and held to place by two fillister-head screws from the back side. A tapered central hole through the die disposed of the piercings, the operator knocking them out with a lead pencil or piece of wire in case they piled up too badly.

There was but little movement to the slides and no adjustment, so it was necessary to keep the piercing punches of just the right length, but as these were but pieces of drill rod with the end milled to the right shape, a boy could make them up by the peck. They were left soft, as is not infrequently the case with small punches for sheet brass, and gave us no trouble at all.

A single sheet-metal shell of sufficiently heavy material for the cover would have been a very difficult job to accomplish, so the latter was built up from soft cold-rolled steel about $\frac{3}{16}$ in. thick and the joints made with hard solder.

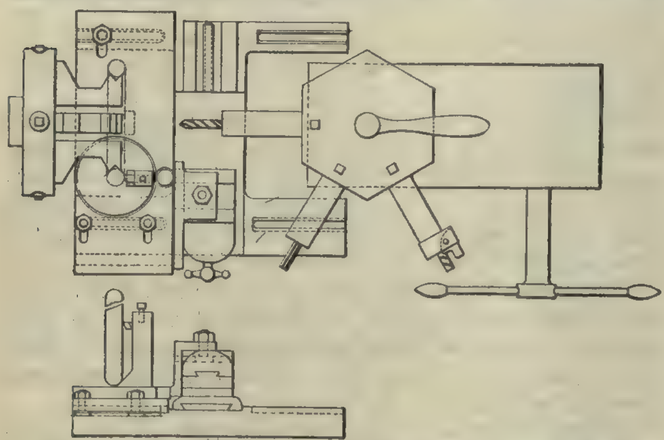
Device for Turning Handwheels

By Howard M. Bogart

Turned and formed by ordinary methods, a handwheel of relatively large diameter and small bore is about as trying a job as one will find in the lathe department. We had a number of 6- and 8-in. diameter

wheels of $\frac{7}{16}$ in. and $\frac{1}{2}$ in. bore respectively to be used on the tailstocks and aprons of lathes. They were expected to run quite true and to be symmetrical as to shape. The care required to attain this condition raised the cost out of all proportion to the importance of the parts. The method had been to bore in the turret lathe, chucking by the outside of the rim; rough-turn and form in the lathe on a mandrel, using a faceplate driver, face the hubs on a plug arbor, and polish the rims in a speed lathe.

I devised the following method which reduced the cost about 60 per cent. Extension jaws were made for the universal chuck of a 16-in turret lathe to hold the



TURRET LATHE RIGGED TO MAKE HANDWHEELS

wheels by the inside of the rims, the V's in the jaws truing the wheels laterally. The rims were turned by a circular attachment bolted to the wings of the carriage. The attachment had stops allowing 1 in. transverse movement to adjust for the two sizes of wheels. The toolpost was carried on a gear driven by an idler pinion meshing in a section of rack attached to the cross slide. Operating the crossfeed revolved the tool around the rim of the wheel. The tool was shaped to present a broad face to the cut to cause the work to spring enough to allow for a fine finishing cut when the tool was fed back. After roughing the rim, the hub was bored, reamed, turned and faced with tools in the turret, the turning tool being fed back over the rim while the turret tools were working. The short side of the hub was faced and rounded in a drill press. The rim was then cut down on a concave polishing wheel, being allowed to revolve loosely on a stud to prevent flats being ground on it, and the polishing was done in a speed lathe. This not only produced a better wheel in shorter time, but avoided distortion of the hole by the mandrel.

A Homemade Boring Mill for Large Work

By F. M. A'Hearn

The Editor's comment on page 1048, Vol. 51 of the *American Machinist*, regarding Mr. Homewood's statement about the platen running off the planing machine reminds me of a certain small machine which was subject to this complaint unless care was taken in placing work away from either end. It was also common practice to load down one end of the platen when planing a job with a heavy end, or one that overhung at one end.

This also brings to memory a type of machine where practically all work was overhanging and the adage, "If you can't swing the job swing the tool," was practiced. The sketch is drawn from memory and, as near as the writer can recollect, was the general arrangement of a crude type of horizontal boring machine used in small shops through western Pennsylvania some thirty years ago.

Some of these machines were built with A-frames for the end supports that brought the spindle to a height of about five feet from the floor line; others were of such height as to bring the spindle in line with an engine lathe. The latter type usually had a floor pit as shown in the sketch to take care of work too large to clear the floor. A number of holes in the vicinity of the business end of the machine furnished means of fastening work.

The feed arrangement was such as to furnish steady employment to the shop "cub" who, when the

THE IMPROVISED BORING MILL

tool was cutting, had to remain faithfully at his post of duty. All feed movements were inoperative when the cub discontinued turning the feed screw handle shown at the right of the bar.

The machine answered very well to the description of a pit lathe as given by a writer (Chordal, I believe) in the *American Machinist* back in the early nineties, when he said that, "The machine consisted chiefly of a belt, a few gears and a hole in the ground."

It was not much of a tool when compared with the modern "rapid fire" equipment which has superseded it; still it had the advantage of being cheaply built in the shop where it was to be used and it saved many a long haul over bad roads to the "big shop," a mighty convincing argument in itself. For, be it remembered that in those days improved highways were *not*, railroads were scarce, and the gentleman from Detroit, who builds the gasoline-propelled vehicle with an engine and a reputation, had not yet opened up his plant.

Work Together

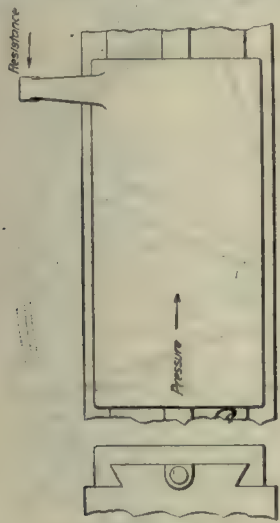
Much of the unrest of labor is due to the fact that employers do not understand their employees nor appreciate their needs. Think well of your men and your men will soon think well of you.—*Manufacturers' Record.*

Right Things Wrongly Applied

By P. A. Fredericks
Chief Engineer, Kempsmith Manufacturing Co., Milwaukee, Wis.

One meets occasionally with correct theory badly misapplied. An instance of this is the slides and gibs used on some milling machines in an effort to conform to the dogma of "narrow guides."

It must be admitted without reservation that a narrow guide or slide (meaning one narrow in relation to its length in the direction of traversing movement) is correct for loads applied in the direction of length, and especially for such loads when not central with the slide, because in such a case the tendency of the load is to



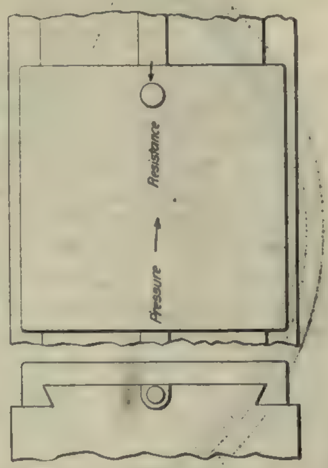


FIG. 1. WHERE PRESSURE IS ECCENTRIC TO AXIS OF LOAD, A NARROW GUIDE IS DESIRABLE. FIG. 2. WHERE LOAD DIRECTLY OPPOSES PRESSURE ALONG AXIS OF SLIDE THE NARROW GUIDE IS NOT NECESSARY THOUGH SOMETIMES DESIRABLE

twist the slide out of line with its guide, and the relative amount of such effect is, roughly speaking, determined by the running clearance, which is a fixed amount, divided by the quotient of the length over the width. Thus, as the length becomes greater and the width smaller, the final result or relative effect becomes less.

It might be noted that since the purpose of the "narrow guide" is to prevent twisting of the slide out of line, the same purpose might be served if it is possible to locate the slide central with the force. In this case the "narrow guide" becomes of small importance and it is only necessary to make the slide long enough to prevent cramping action. (See Figs. 1 and 2.)

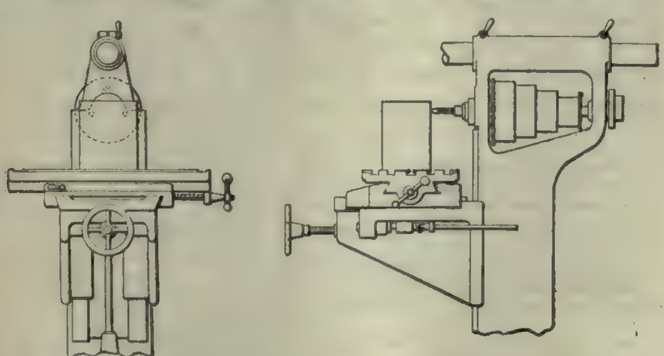


FIG. 3. IN THIS CASE A NARROW TABLE GUIDE WOULD NOT BE DESIRABLE

Fig. 3 represents the conditions in a milling-machine saddle when the machine is used for drilling and illustrates an exact example of conditions in Fig. 2. This, however, represents only a very limited proportion of the work done on a milling machine—in fact, work probably never done on any other than a toolroom machine. Let us therefore consider the usual condition (see Fig. 4) where the machine is in use with a cutter on an arbor. The pressure in this case tends to tip the saddle as on a pivot at point A and the wider the distance B can be made, the more effectively this tendency toward tipping is resisted by that portion of the saddle engaging the slide on the opposite side.

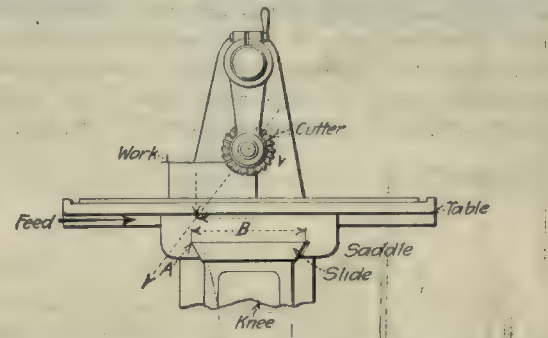
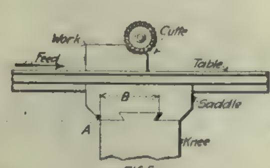


FIG. 4. ORDINARY CONDITIONS IN MILLING—IN THIS CASE THE PRESSURE IS AT RIGHT ANGLES TO AXIS OF SADDLE SLIDE AND A NARROW GUIDE IS UNDESIRABLE

Fig. 5 shows an attempt by the designer to avoid a wide slide while still obtaining a large effective resistance to tipping. Other things being equal, however, this design cannot be as effective as Fig. 4, because with any definite limit set on the width of the knee, the distance B, Fig. 5, must be less than B, Fig. 4.

Fig. 6 shows an attempt to obtain a "narrow guide" by means of square gibbing. This has two very noticeable defects. The first is lack of simplicity, there being three gibs to fit and keep properly fitted in place of one; the second is that the tendency to chatter is accentuated, for, while in Fig. 4 the horizontal component of the cutting pressure acting in conjunction with the angular surface of the slide, tends to pull down the saddle to a solid seat by sliding it bodily to the left, in the design of Fig. 6 there is no such pulling-down tendency. A certain amount of looseness must be provided in the fit of the slide, and, due to a tendency to tip or pivot around



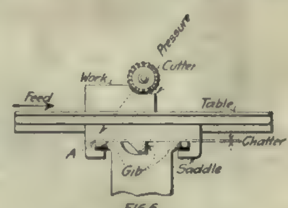


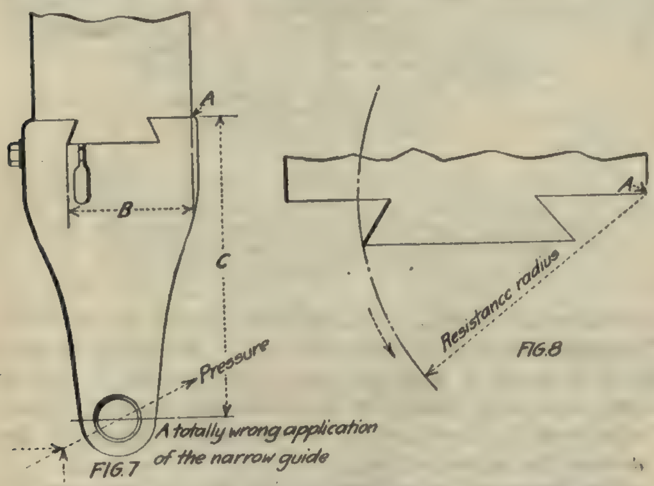
FIG. 5. NARROW GUIDE OBTAINED AT EXPENSE OF RESISTANCE DISTANCE B. FIG. 6. NARROW GUIDE OBTAINED AT EXPENSE OF SIMPLICITY

point A, this looseness is all transferred to the top of the knee between the knee and the saddle at the right as soon as the cut becomes heavy enough to overcome the unbalanced weight of the parts. Since this occurs intermittently as the cutter revolves, the result is a tendency to originate vibration or chatter.

Another misapplied "narrow guide" is shown in Figs. 7 and 8. In this case, distance C is great in relation to

that of B, and in consequence, the horizontal component of the pressure cannot act with the angular surface to force the two parts together as it does for Fig. 4; in addition to this, the metal resisting the turning or pivotal tendency around point A is very ineffectively placed to be of maximum service, being disposed at an angle to the resulting force so that the force actually gets a greater leverage against the effective resistance.

The above examples of poor conditions brought about by an effort to apply right things wrongly, are taken from present-day catalogs and advertising pages and represent efforts to improve upon earlier designs.



FIGS. 7 AND 8. WRONG APPLICATIONS OF THE NARROW GUIDE

Since no criticism is justified without an attempt to offer an improvement, the writer would suggest that in cases where the load is at right angles to the slide the principle of the "broad guide" be remembered to offset in our minds the principle of the "narrow guide." Fig. 4 represents an ideal condition, the only refinement apparently possible being to keep the cross-screw in the center where it belongs, and therefore the remedy for conditions shown in Figs. 5 and 6 is apparent.

Figs. 7 and 8 cannot be remedied except by a total change in the design, so long as width B is limited by the details of construction, which it apparently is.

Planing Wood Lagging to a Radius for a Pulley Repair

By A. W. Dilts

A few years ago, while connected with a large manufacturing establishment in the East as master mechanic, I found it necessary to change a number of heavy drives from 36- to 48-in. belts.

The drive pulleys (which were mounted on a 12-in.

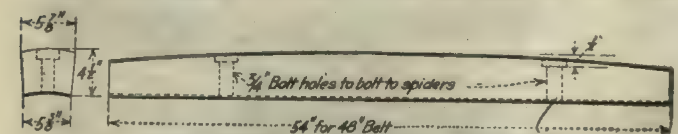


FIG. 2. THE LAGGING

diameter line shaft) were made up of two cast-iron spiders, as shown in Fig. 1, placed side by side with maple lagging bolted to them to make up the pulley rim or face. The spiders were 9 in. smaller than the diameter of the finished pulley and the maple lagging was 4½ in. thick. Fig. 2 shows the general dimensions of the lagging of which there were 80 pieces on each pulley.

In order to make the change with the least possible delay to the mill operation it was necessary to finish the lagging complete ready to bolt in place at the first convenient shutdown. This I did with the help of an old planer and the fixture shown in Fig. 3, which is a tilting fixture bolted to the planer table with a bearing on either side so it can tilt at a point representing the center of the lagging, which is shown in position. The fixture is connected by an arm to a taper attach-

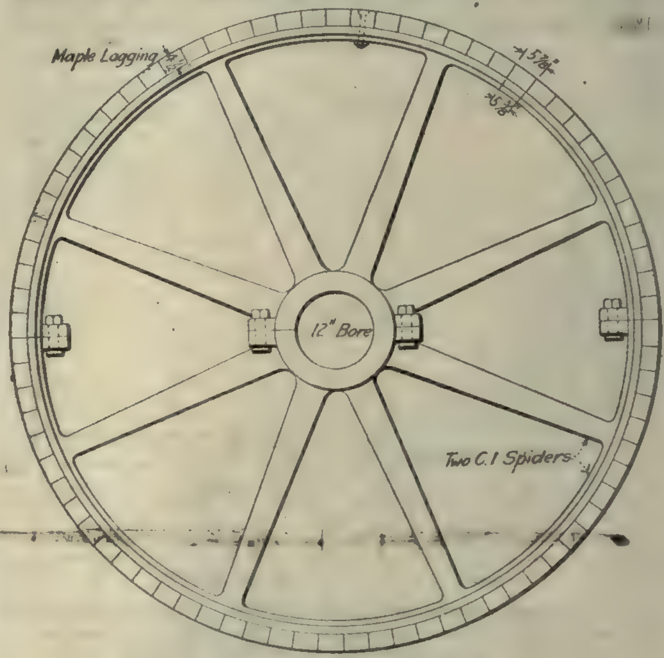


FIG. 1. THE SPIDER

ment mounted on the inside of the planer housing at the proper angle to produce the required crown on the lagging. The table speed of the planer was reduced about one-half while in use on this job.

The head of a wood-planer was mounted on bearings fitted to the cross-rail and driven by a belt from a motor located in front of, and just to one side of, the machine. This head was fitted with cutters having a radius equal to that of the pulley. The job was executed in a very satisfactory manner; the lagging was first sawed to shape and the bottom side concaved to fit the outside diameter of the spiders, then put in place on the fixture and, with one pass under the cutter, finished to size and with the proper crown.

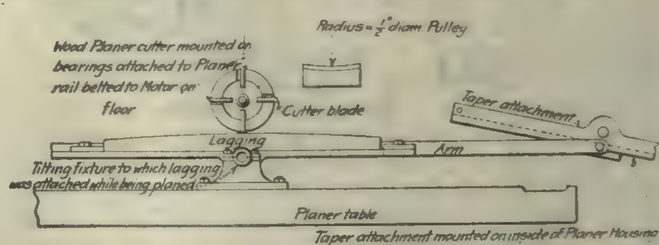


FIG. 3. PLANING THE LAGGING

This is to me a new application of the taper attachment, and I believe it could be used to good advantage on other convex or concave work, as a wide range of curves can be generated by different adjustments of the taper attachment.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs and equipment

Ryerson-Conradson No. 3 High-Power Milling Machine

The first of a line of machine tools being built by the Conradson Machine Tool Co. and marketed solely through Joseph T. Ryerson & Son, Chicago, Ill., is announced in the No. 3 high-power milling machine. This machine was designed to provide power, rigidity and convenience of operation which would adapt it to service for light and heavy manufacturing and jobbing work. The machine can be furnished in both the plain and universal types, as shown in Figs. 1 and 2 respectively. Its most striking feature lies in its helical gear drive the steadiness of which, it is claimed, will add to the life of a milling cutter. A sufficient range of speeds is provided for all regular commercial service.

The column is heavily ribbed internally, and is cast integral with the base, the latter being surrounded by a deep flange which both stiffens it and serves as an oil retainer. An unusual feature is the extension of the face of the column above the overarm to provide additional support for special fixtures.

Large bearing surfaces are provided on all faces of the knee, and in the case of the column ways, the bearing has been increased by extending the knee up to a point nearly level with the top of the table. The telescoping elevating screw is located at the center of gravity to avoid any binding action. The table has three T-slots and is surrounded by a large groove for retaining the coolant. The longitudinal table travel on the plain milling machine is provided with a handwheel extending diagonally from the side of the saddle, and on the universal machine this is replaced by a crank on the end of the table. The 60-point carbon-steel spindle runs in phosphor-bronze bearings, the front one being tapered, and both are adjustable for wear.

The drive, as shown in Fig. 3, is from a single constant-speed pulley, through a primary shaft which has the change gears on the other end that in turn drive a hollow shaft concentric with the primary shaft. This hollow shaft has two additional change gears and drives either the high- or low-speed set of helical gears on the spindle drive. This gives twelve spindle speeds, ranging from 17 to 290 r.p.m. The power from the driving pulley is controlled through a friction clutch that automatically applies a brake on the shaft when disengaged.

Eight changes of feed are obtained from the primary shaft by a chain and sprocket through a cone of gears controlled by a handwheel. Two sets of gears, operated by a lever, double the changes so that a total of sixteen feeds is obtained, ranging from 0.6 to 22.3 in. per minute. The feed screws are provided with dials read-

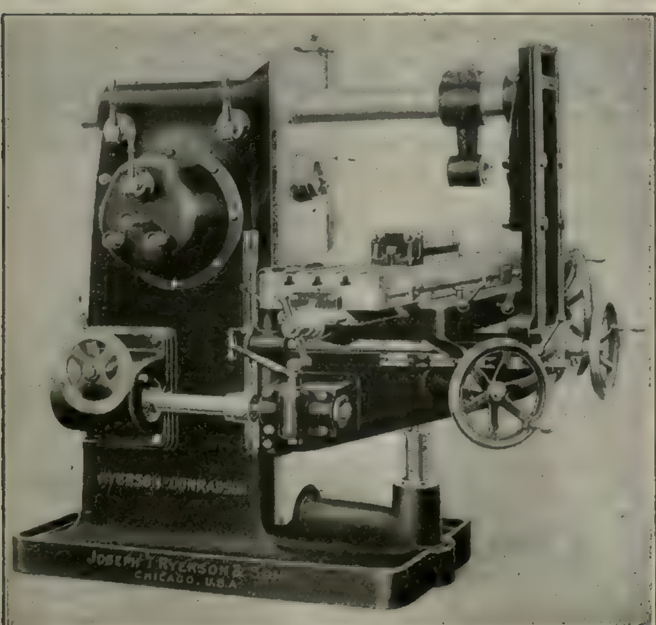


FIG. 1. THE RYERSON-CONRADSON NO. 3 PLAIN MILLING MACHINE

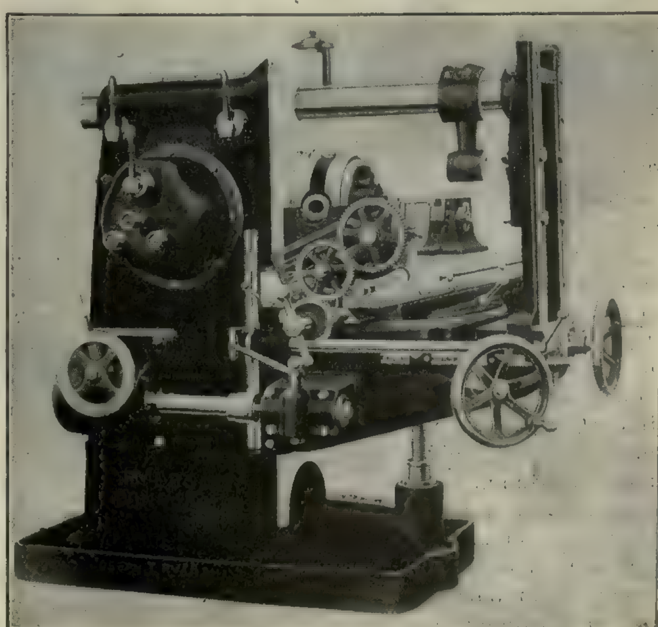


FIG. 2. GEAR-CHANGE SIDE OF NO. 3 UNIVERSAL MILLING MACHINE

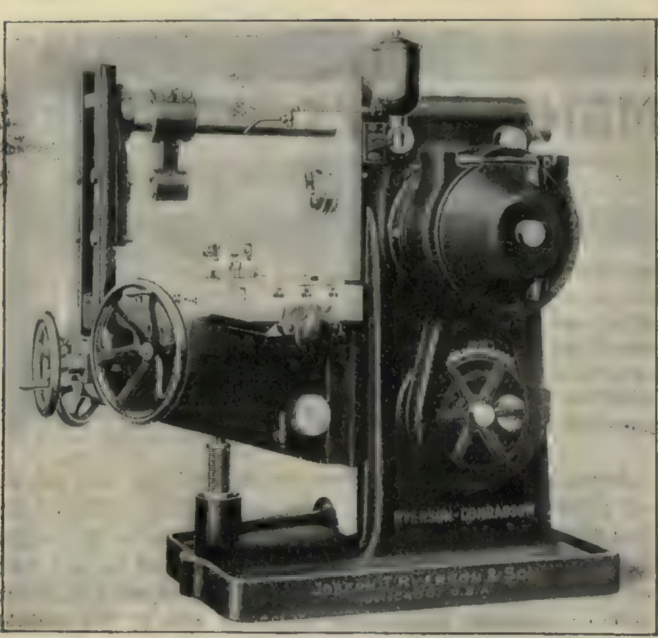


FIG. 3. BELT DRIVE SIDE OF RYERSON-CONRADSON NO. 3 PLAIN MILLING MACHINE

Specifications No. 3 Plain Milling Machine: Longitudinal movement, 35 in.; cross traverse, 14⅝ in.; vertical movement, 20 in. Front spindle bearing, 4¼ x 4¾ in.; rear spindle bearing, 3⅞ in. Taper hole in spindle, No. 11 B. & S. Distance, spindle center to bottom of arm, 6 5/16 in. End of spindle to arbor bushing, 27 in. Face of spindle to arm braces, 30⅝ in. Diameter of overarm, 4⅝ in. Table, 63¼ by 12¾ in.; working surface, 53 by 12¾ in. Twelve spindle speeds from 17 to 290 r.p.m. Sixteen feed changes from 0.6 to 22.3 in. per minute. Floor space, 76½ x 111 in. Pulley, 14 x 4 in. Speed, 600 r.p.m. Weight, 5,575 lb.

Specifications No. 3 Universal Milling Machine: Longitudinal movement, 34 in.; cross traverse, 13 in.; vertical movement, 18½ in. Weight, 5,910 lb. Other dimensions the same as the plain milling machine.

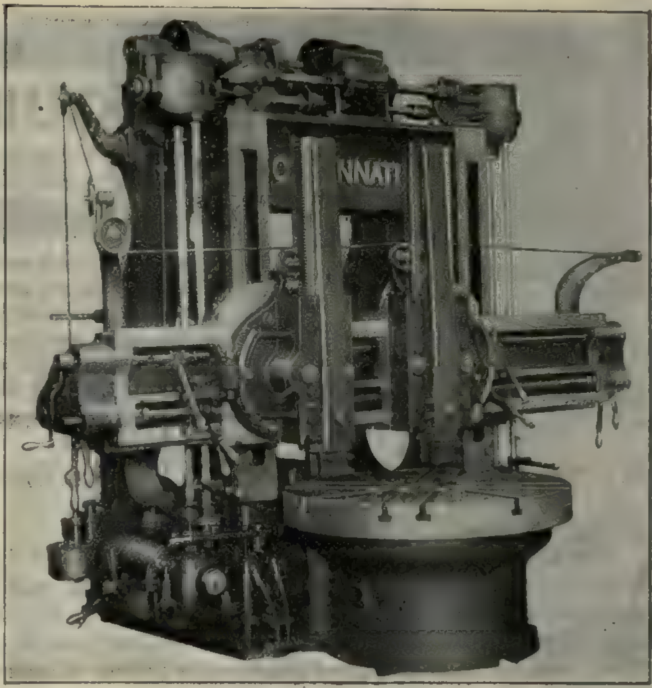
ing to thousandths of an inch. Fixed feed trips are provided for safety in addition to adjustable trips which will stop the table at any desired point. The change gears are chrome-nickel steel, while the other gears are either steel or bronze, and all are completely inclosed and run immersed in oil. All bearings are bronze bushed with the exception of the thrust bearings which are provided with SKF ball bearings.

Cincinnati Boring Mills

The vertical boring mill shown is a recent development of the Cincinnati Planer Co., Cincinnati, Ohio. The machine is made in two sizes, 42 in. and 48 in., and is classified as the "rapid-production bevel-gear type." It has a capacity for heavy cuts and coarse feeds usually found only in larger machines, and is heavily built to resist severe strain. The design follows closely to that of larger machines of the same make.

The table is driven by bevel gearing. The table spindle revolves in large angular self-centering ground bearings which do not extend below the floor line. The crossrail is arranged to be clamped both on the inside and outside face of the housing. It is raised and lowered by a power connection from the driving motor, no extra motor being required for this purpose. The heads have rapid power traverse in both directions, and are operated independently of each other and controlled by levers at the front of the machine. These levers are adjustable for height to suit the operator.

The rapid power traverse and the feed mechanisms are so arranged that they cannot be engaged at the same time. All gears are of steel and are entirely



CINCINNATI BORING MILL

Specifications: Sizes, 42-in. and 48-in.; swings, 44 in. and 50 in.; height under toolholders, 39 in.; travel of tool bars, 27 in.; diameter of tables, 43 in and 48 in.; diameter of spindle bearings, 8½ in.; number of feeds, 8; range of feeds, ½ to ⅛ in. per minute; revolution of table, 2.45 to 59.2 and 2.1 to 50.5 per minute; size of motors, 10 hp.; speed of motors, 500 to 1000 r.p.m.; weight of machines, 15,000 to 19,000 pounds.

inclosed. All bearings are automatically lubricated and the principal bearings are bronze bushed. The shafts and screws are made from high-carbon steel and are accurately ground. A safety device is provided in the feed mechanism to prevent breakage of gears in case of accident with the heads. The speed box is cast solid with the bed. Four speed changes are provided through positive jaw clutches which can be operated from either side of the front of the machine. An independent friction clutch on the first driving shaft is used to start and stop the machine. An automatic brake for stopping the table is operated from the same handle that controls the starting clutch. This, also, can be operated from either side of the machine. For belted drive or constant-speed motor drive, a three-step cone is mounted on the rear speed box shaft, giving a total of twelve speed changes. With the cone-pulley drive is furnished a mechanical belt shifter so that the operator need not touch the belt while shifting from one step to the other.

The Kempsmith No. 4 Vertical Maximiller

On page 595, Vol. 49, we described the No. 4 Maximiller, built by the Kempsmith Manufacturing Co., Milwaukee, Wis. The company is now making a vertical milling machine of the same general construction, known as the No. 4 Vertical Maximiller. Opposite views of this machine are shown in Figs. 1 and 2.

The main parts are semi-steel castings, designed to give the maximum strength. The column is well ribbed and has a web about half-way up, which both stiffens the casting and forms an oil reservoir for the speed gears.

The design of the knee duplicates that of the horizontal Maximiller, the top of which is without openings.

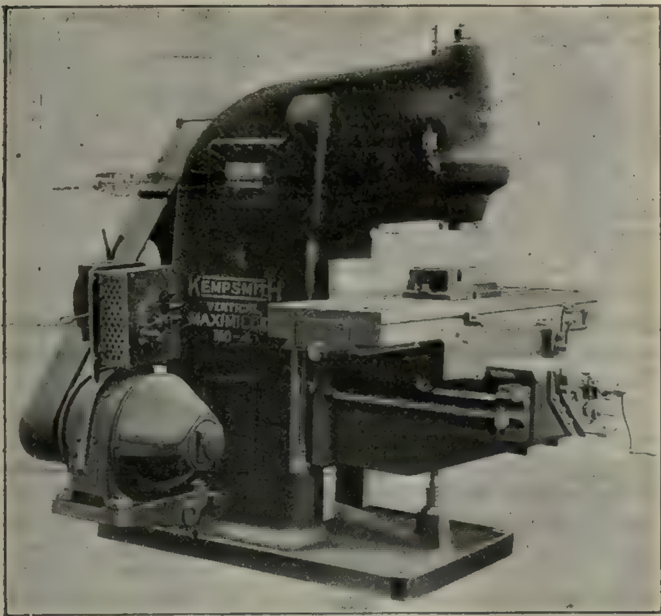


FIG. 1. KEMPSMITH NO. 4 VERTICAL MAXIMILLER (LEFT SIDE)

Likewise, the side walls are solid except for three small openings. The top of the knee has a shallow depression in it to give clearance for the crossfeed screw, located in the center to avoid sidestrain. The knee is counterbalanced by weights located inside of the column. This facilitates the vertical adjustment of the work to the cutter so that a vertical slide for the spindle is unnecessary. The elimination of this slide is claimed to add to the rigidity of the machine. The table has a working face of 70 x 18 in. and a longitudinal feed of 42 inches.

The large-diameter spindle is of alloy steel with the nose hardened, and it runs in adjustable phosphor-bronze bearings. The front end of the spindle is bored to take No. 12 B. & S. taper shanks and the hole extending through the spindle is $1\frac{1}{8}$ in. in diameter. Eighteen spindle speeds are provided, giving a range from 14 to 355 r.p.m. The shafts in the spindle train are large and of heat-treated alloy steel. All shafts in the speed transmission run in ball bearings. Large spiral bevel gears of a coarse pitch are used, giving a smooth, silent drive.

A right-hand spindle drive is used to give the normal direction of rotation for drills and boring tools. A spindle reverse has been incorporated in order to get cutting strains in the proper direction for face mills.

A hand lever at the front of the machine operates a friction plate-type clutch, which has large-diameter friction surfaces forced together by a combination toggle and plain lever movement. The clutch is easily accessible for adjustment for wear. The momentum of the spindle is overcome by a brake operating on the reverse throw of the clutch lever.

The machine is equipped with a rapid power traverse which gives 100 in. per minute travel of the table in either direction, and 36 in. per minute on the vertical and transverse movement. The controls for these movements are so located that it is unnecessary for the operator to change his position in operating any of the rapid traverse or feed movements. Safety devices are incorporated in the mechanism so that no harm will occur should the operator shift the wrong levers. Two levers control the longitudinal feed and rapid traverse, and the operator merely pushes the one required in the direction that he wishes the table to travel. The knee and saddle are controlled by a second set of two levers, and the unit which shall move is determined by push pins located close to the respective hand-feed handles.

Eighteen changes of feed are provided, ranging from $\frac{5}{8}$ to 25 in. per minute in geometrical progression. The gears are heat-treated steel and run constantly in an oil bath. Safety devices are incorporated which will slip before a destructive load comes on the feed drive but will take up their driving function again without attention as soon as the load drops to safe limits. The change in the rapid-power-traverse rate does not affect the speed rate of the cross and vertical movements, these remaining the same for all movements. The rapid traverse is available even when the spindle and feed are not operating.

A centrifugal pump of about 15 gal. per minute capacity is built into the machine for furnishing the coolant and this can be disengaged when the coolant is not required.

The gears and bearings in the entire speed and feed mechanism run constantly in oil and are splash lubricated. The balance of the oiling system is centralized at two points.

The machine is regularly arranged for single-pulley drive, and a $16\frac{3}{4}$ in. in diameter pulley takes a 6-in. belt and runs at 400 r.p.m. The pulley shaft is mounted on ball bearings and with the clutch is inclosed in a protective housing. The machine can be furnished with a direct-belted motor drive, in which case a 15-hp. motor, running at 1,200 r.p.m. is recommended.

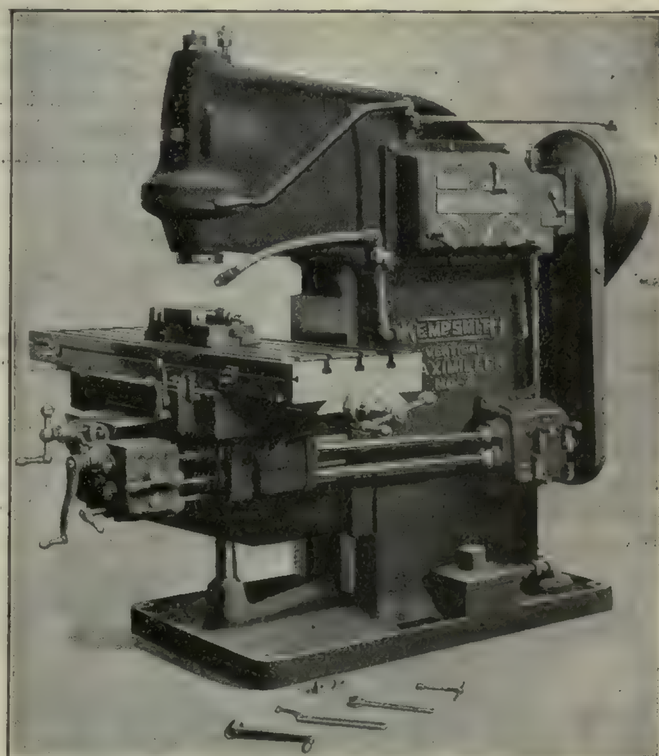
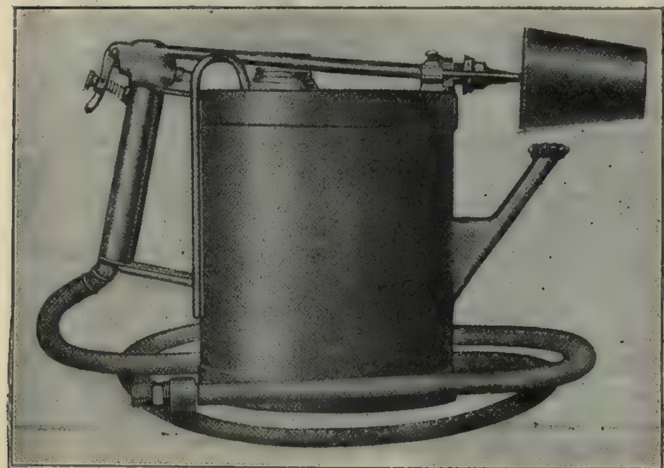


FIG. 2. KEMPSMITH NO. 4 VERTICAL MAXIMILLER (RIGHT SIDE)

Specifications: Table working surface, 70 x 18 in.; longitudinal movement, power, 42 in.; transverse movement, power, 14 in.; vertical movement, power, 20 in.; nose of spindle to table in lowest position, 22 in.; throat distance, 19 in.; spindle taper hole, No. 12 B. & S.; eighteen spindle speeds, ranging from 14 to 355 r.p.m.; eighteen feed changes, from $\frac{5}{8}$ to 25 in. per minute; rapid power traverse, longitudinal 100 in., transverse and vertical 36 in. per minute; driving pulley, $16\frac{3}{4}$ in. in diameter, 6 in. belt, 400 r.p.m.; power required for motor drive, 15 hp. at 1,200 r.p.m.; floor space, 99 x 122 in.; net weight, 11,050 lb.; weight packed for domestic shipment, 11,800 lb.; packed for foreign shipment, weight, 11,975 lb.

The Jiffy Torch

A handy torch, designed for the foundrymen's use in drying the skin of molds, is being marketed by the Mahr Manufacturing Co., Minneapolis, Minn. It is said to light instantly and to project a blue flame of intense heat any distance required from a few inches



THE JIFFY TORCH

to five feet. It burns light fuel oil or kerosene equally well, and operates by means of compressed air supplied by a hose connection. Any available source of compressed air may be used, as the amount of the pressure is immaterial.

The burner works on a principle that prevents the formation of carbon. If, however, it should become clogged from any cause it can be readily cleaned with an ordinary piece of wire. Besides drying molds the torch is useful for brazing and other purposes. It is made in two sizes of one-half and one-gallon capacities.

Ajax Upsetting Forging Machine

With a view to supplying a demand for an upsetting forging machine to withstand the increased strains due to the use of alloy and high-carbon steels, the Ajax Manufacturing Co., Cleveland, Ohio., has developed a machine of the type illustrated.

The machine retains the well-known and tried features such as the sleeve-type, phosphor-bronze, crankshaft bearings in the continuous housings of the bed; the positive die grip, insured and protected by the breaker bolt in the safety knuckle; the lock device

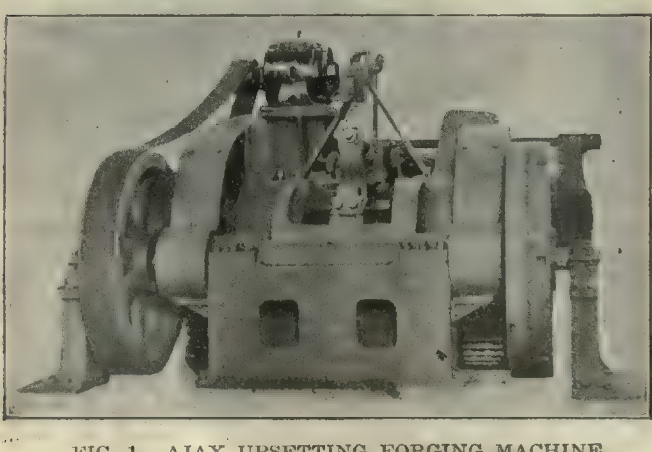


FIG. 1. AJAX UPSETTING FORGING MACHINE

which stops the dies in the wide-open position, and the header slide at the back of its stroke. To these have been added the twin-gear drive, suspended header and die slides, the collapsible self-adjusting safety pitman and a material strengthening of all parts. The new model is approximately 40 per cent heavier than the older model; the 4-in. size weighs 120,000 lb.; the 5-in. size, 155,000 lb., and the other sizes are of the same proportion.

The suspended-type slides are of increased length and operate on overhung bronze-faced bearings. The sliding surfaces receive proper lubrication and are not exposed to undue wear by the accumulation of scale and other abrasive substances.

The header slide carries a triple high toolholder, adjustable to any desired position of the grooves in the gripping dies. The moving die is carried in a box-shaped recess which is supported by the entire side face of the die slide against the backing plate during the heading operation. This prevents local wear in the

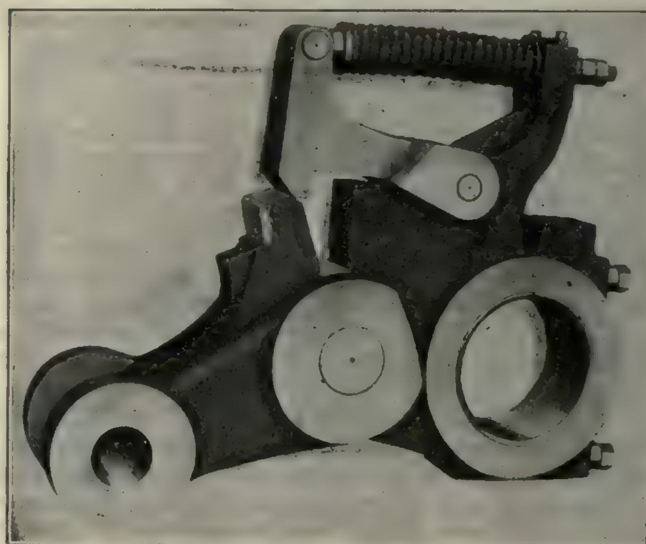


FIG. 2. SELF-ADJUSTING SAFETY PITMAN

backing plate and consequently any rocking tendency of the die slide.

To transmit the power necessary for the making of large forgings, a twin-gear drive from pinion shaft to crankshaft is employed. The driving gear on each end of the crankshaft gives equal torque at both ends of the eccentric pin, greatly decreasing the strain in this part. The crankshaft has been nearly doubled in weight.

The self-adjusting safety pitman is an improvement of considerable importance, in that it fully protects the machine against overloading the heading ram and prevents it from becoming stalled on or near center. The construction of the pitman is shown in Fig. 2, the center pin being slightly above the line of the other two so that a pressure on the ends results in a buckling tendency. This buckling is resisted up to a certain point by the latch held in place by the heavy compression spring. When the predetermined pressure is exceeded the latch jumps up, preventing the building up of additional pressure. On the return stroke the pitman straightens out, the latch drops into place and the machine is ready to continue its work without delay.

The stock gather, die opening and die height have been greatly increased. The two former make possible the production of large forgings in few operations,

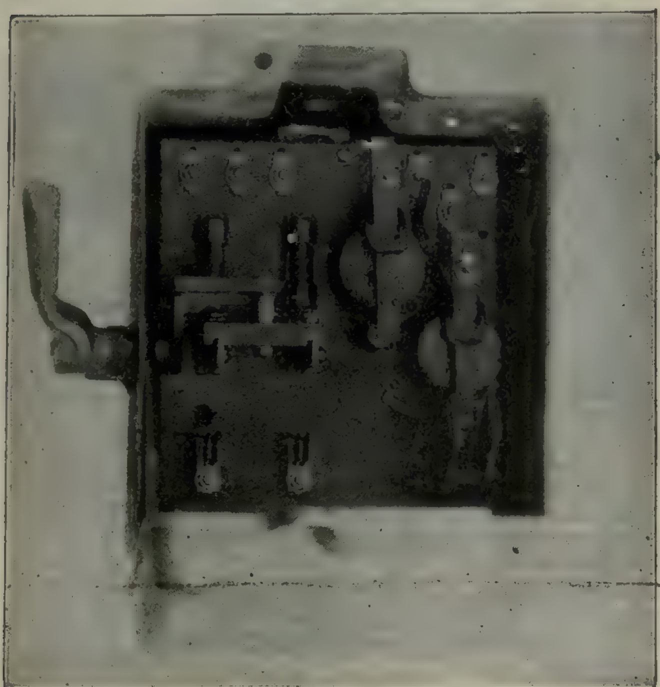
while the latter gives space for the placing of more grooves in a single face of the dies and reduces the number of die changes necessary.

Some idea of the capacity of the machine may be had from a test recently conducted at the plant of this company. A 4-in. machine, in a single blow, forged a disk 9½ in. in diameter and 1¼ in. thick on the end of a 3½-in. bar of 0.60-carbon content, at a cherry-red heat. In doing this the machine gathered 8 in. of stock and flattened it out with no tendency to stalling.

Cutler-Hammer Automatic Starter

An automatic starter of the inclosed type has recently been put on the market by the Cutler-Hammer Manufacturing Co., Milwaukee and New York.

The equipment consists of an automatic motor-starter panel of the counter-electromotive-force type completely inclosed in a cast-iron case with a hinged cover. A magnetic main-line contactor mounted on the panel

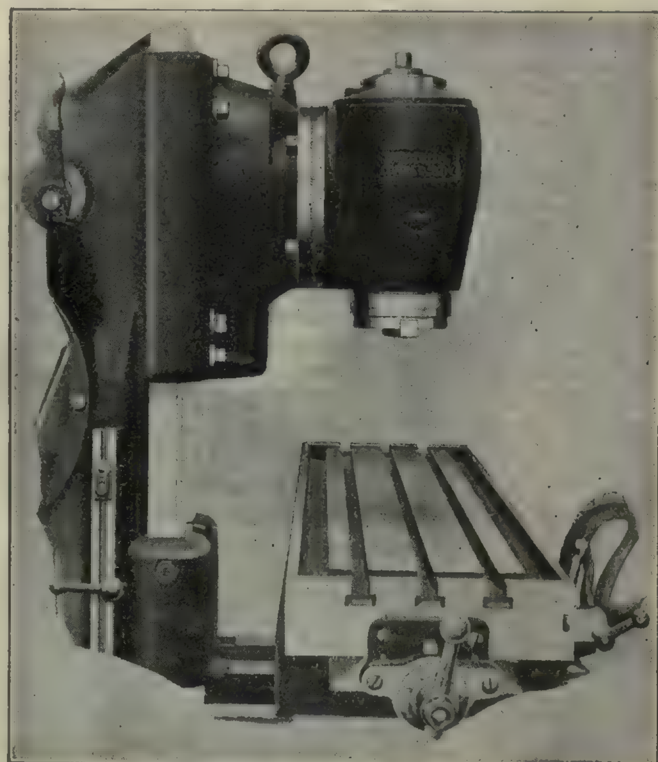


CUTLER-HAMMER AUTOMATIC STARTER

allows remote control from two push-button switches of the momentary contact type. Pressing the "run" button closes the magnetic main-line switch, thereby starting the motor with the armature resistor in circuit. The motor accelerates until it reaches about three-fourths normal speed, when the resistor is automatically cut out of circuit by the closing of the accelerating contactor, the operating coil of which is connected across the motor leads and is energized by the counter electromotive force of the armature. The motor is stopped by pressing the "stop" button or by voltage failure, which causes the main-line contactor to drop out. By using a separate field rheostat, speeds above normal can be obtained if the speed range does not exceed two to one. A common snap switch, a float switch or a pressure regulator can also be used for remote control of the motor. When remote control is not desired the magnetic main-line contactor is omitted, and the motor is controlled by a fused knife switch mounted on the panel with an operating handle outside of the case. The handle can be locked in the open position to prevent unauthorized operation. Interlocks prevent lifting the cover while the switch is closed or throwing the switch with the cover opened. When the knife switch is used, low-voltage release is inherent in the accelerating contactor. Low-voltage protection is provided with three-wire push-button control. The inclosing case is arranged for conduit wiring and can be mounted on a wall or any flat surface. This starter is for use with small direct-current motors not rated over 2 hp. at 115 volts or 3 hp. at 230 volts.

The Ryerson-Conradson Vertical Milling Attachment

The semi-universal type of vertical milling attachment, shown in the illustration, is being built by the Conradson Machine Tool Co. and sold by Jos. T. Ryerson



THE RYERSON-CONRADSON VERTICAL MILLING ATTACHMENT

Made in three types, light (1PM3); medium (2PM3); heavy (3PM3). Speed, 600 r.p.m. Pulley speed, 34-580, 17-290, 8½-145. B. & S. taper, No. 9, 11, 11. Spindle to table: plain milling machine, 13¾, 18, 17 in.; universal machine, 12¼, 16½, 15½ in. Center of spindle to face of column, 11¼, 11½, 14½ in. Weight, 250, 328, 450 lb.

& Son, Chicago, Ill. It is intended for use on the Ryerson-Conradson milling machine and is built in three sizes designated as light, medium and heavy patterns. It is clamped directly to the column dovetail, no dependence being placed on the overarm. The heavy pattern type has a spindle of the same diameter as the main spindle, and, as the taper-hole, faceplate and driving keys are the same die it is claimed that as heavy a cut may be taken with this as with the horizontal spindle.

Columbia Shaper

The shaper illustrated in Figs. 1 and 2 represents an improved design built by the Columbia Machine Tool Co., Hamilton, Ohio. The design employs the same heavy construction as formerly used with the idea of combining rigidity with strength. The machine is built

on the interchangeable basis. As an example of accuracy, the alignment of vise and table with the ram is held to a limit of 0.001 inch.

All elements governing the control are on the working side of the machine. Included in these are the quick-change feed, and the single lever for locking the crossrail to the column. The quick-change feed adjusts itself automatically to the position of the crossrail, is graduated to show the amount of feed and has a bevel-gear reverse which automatically causes the feed to act on the return stroke. Two levers control all feed changes; one regulates the amount, and the other, the direction of the feed. The changes can be made while the machine is running. A range of feed is provided that is sufficient for all classes of work; eight on the 16- and 20-in. shapers and twelve on the 24- and 28-in. machines. The cross- and down-feed screws are both provided with micrometer adjustment. The feed gears are of hardened steel, totally inclosed and run in oil.

The column guides are V-shaped the same as generally used in milling-machine construction. The column has a straight front but projects at the rear to provide a long bearing for the ram. The straight front permits a maximum back stroke when the head is set in an angular position. A wedge-shaped gib is provided to compensate for wear in the ram bearing. This is adjusted by small screws placed vertically.

The table is fully inclosed on four sides and heavily flanged at the ends. It is supported by an angular projection on the saddle and is easily removable. A revolving table of the type shown on the machine in Fig. 1 is furnished when required. This is supported in a substantial manner upon a large trunnion and has an outer bearing as an additional support. The bull gear is extra large and is carried on a large two-diameter bearing which supports it close to the center. The rocker-arm

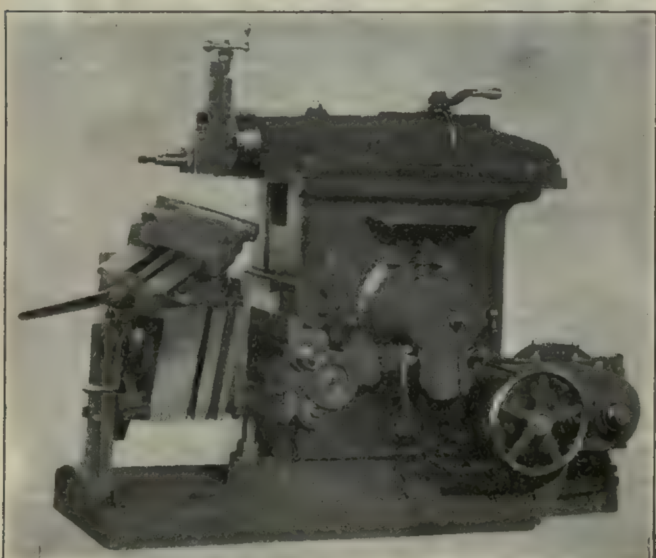


FIG. 1. COLUMBIA 16-IN. SHAPER

is heavily built and is supported at the lower end by a large shaft having self-oiling bushed bearings.

The machine is powerfully back geared, which in connection with the four-change speed box affords eight changes of speed. The speeds are arranged in geometrical progression and have been carefully calculated to afford the proper range and increments. The illustrations show the method of equipping the machine with speed box, friction clutch and brake, adapting it for either single-pulley or constant-speed motor drive. The speed box provides four changes of speed or eight in connection with the back gears. The friction clutch and brake enable the machine to be quickly started or stopped at any point of a stroke.

Net weight: 16 in., 3,000 lb.; 20 in., 4,000 lb.; 24 in., 5,000 lb.; 28 in., 6,000 lb. Crated weight: 16 in., 3,500

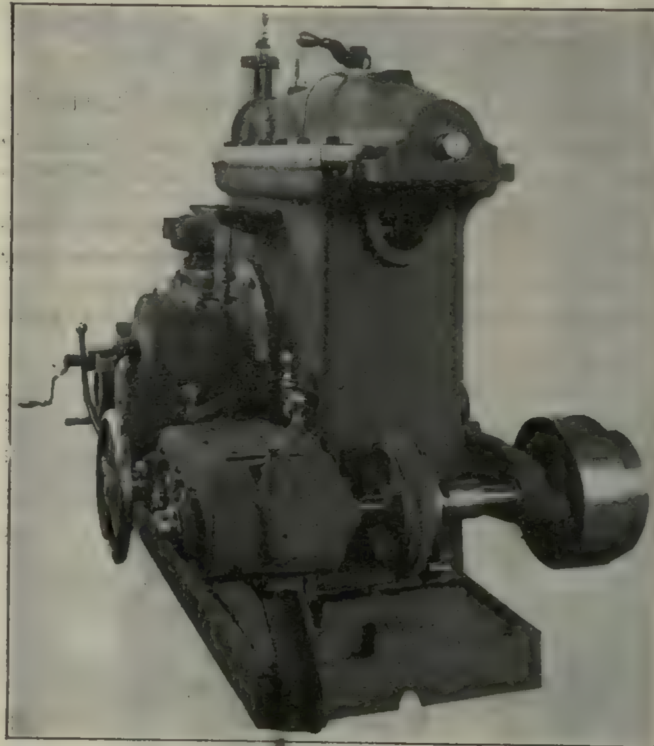


FIG. 2. COLUMBIA 20-IN. SHAPER

lb.; 20 in., 4,100 lb.; 24 in., 5,200 lb.; 28 in., 6,200 lb. Boxed weight: 16 in., 3,500 lb.; 20 in., 4,600 lb; 24 in., 5,800 lb.; 28 in., 7,000 lb. Cu.ft. (boxed): 16 in., 80; 20 in., 100; 24 in., 132; 28 in., 162.

Longer Working Hours

By H. L. Beau

As to the working-hour question of trade unions today, I should say that it would be far better for most people to work 10 or 12 hours a day than to work 6 or 8 hours as some radicals would have it. My past experience with men is that 90 per cent of them are constantly asking for overtime and many of them are anxious to work on Sunday, so I say a longer working day would stop this needless wasting of their money in hours of idleness. There would also be greater production and the sooner high prices would fall. Wages surely are good in almost every line, so let us all economize and all our troubles will soon come to an end.

Women in Industry.—The advent of the gentler sex in industry, so strongly emphasized during the war by the influx of women to the munitions factories, is still further accentuated by the casual manner in which their services are sought through the advertising columns. One local daily newspaper recently carried the following advertisement:

WANTED: BOY—Young lady wanted as office boy in downtown bank. Apply, etc.—From *Literary Digest.*

Business Conditions in England

BY OUR LONDON CORRESPONDENT

LONDON, Feb. 13, 1920.

WHILE an improvement might certainly be made, output generally is, at the worst, moderate. Coal-mining figures are more promising. There are, however, many undercurrents in the sea of labor and, again, the difficulties in the acceptance of orders, due to exchange troubles, are obvious

Estimates of the national finance position are more optimistic than until recently seemed likely. It looks as though the government expenditure will be markedly less and government revenue more than had been estimated; but it is necessary to wait a few weeks before expressing the differences in figures. Values of British exports grow too, and, as shown by monthly returns, have risen by more than 50 per cent since last September. Unfortunately, from the balance of trade point of view, import values are also steadily growing. The value of British manufactures exported in January last was £83,086,250, or more than twice the value for January, 1919. Manufactured articles imported were valued at £31,528,390 last month.

The molders' strike having ended, production in the ordinary engineering and machine shops is steadily improving as castings become available. This is almost the first strike that has been fought out since the opening of the late war, compromises having been the rule. Of course, during the whole period of the strike certain of the foundries were in operation and, after all, the strike was confined to England; that is, it was not extended into Scotland. Still, all shop schemes had to be modified and quite a considerable proportion of the works were closed. No true estimate can be made of the cost, but the workpeople returned on terms which they would certainly have obtained if there had been no strike; that is, with an increase of 5s. a week, an increase which was awarded to engineering workpeople generally as the result of the periodical enquiry. It is quite probable that on both sides a mistaken estimate was made. The workpeople apparently thought that a stoppage by the three unions concerned would very quickly end engineering production generally. On the other hand, the employers, who certainly had right on their side, quite conceivably estimated that complete drainage of the funds of the unions concerned would automatically end the strike, forgetful of the fact that loans can be obtained from other unions—indeed easily in view of the idea of solidarity among organized workpeople.

Meanwhile, many British workpeople seem to be set against the idea of payment by results. Representatives of the federation of engineering employers and of the engineering trade unions met recently to discuss the economic future of their industry, and particularly to improve conditions of employment. So far as is known (no official report was issued), after the better part of a week's discussion the members of the conference separated without arranging for a future meeting, being unable to agree on the said question of payment by results. The position is at the moment of writing thought to be somewhat ominous. The engineering unions are to ballot on the question. Objection to the premium-bonus system is marked, and many workers are demanding recompense at so much an hour for attendance, without any guarantee as to what will be done in the time. The result shows in all sorts of ways; in the Midlands, for example, it is leading in some measure to brass casting leaving Birmingham for neighboring towns, where at present a larger output per person employed can be obtained.

That production is necessary has been brought home to certain workers pretty sharply during the last few days. In North London a factory is run by Brinsmead & Sons, a firm of pianoforte makers whose name is known all over England, the concern having been in existence something like 100 years. Now a few days ago the management gave notice that the works would close in a week's time. (They are to be opened shortly for a "probationary" period.) The reason cannot be more succinctly given than in the statement issued to the effect that "*for each piano dispatched per week there are now twenty-six employees, against twelve in 1918, and six immediately before the war. The factory wages alone per piano exceed the selling price. The cost of polishing only is approximately equal to the pre-war prime cost of the completed piano, including materials." There was no quarrel with the workmen, merely inadequate production.* The case must be particularly bad as the pianoforte industry was one of the first in Great Britain to seize the opportunity to raise prices and indeed to supply inferior articles as soon as importation from abroad was stopped. The workpeople, as soon as they got their wind after the blow, blamed the new management. It is only fair to state that a number of other pianoforte manufacturers have issued a joint statement to the effect that the conditions mentioned are not general.

As is stated above, the reply of the Brinsmead workpeople was simply to blame the new management. This draws attention to a defect in the Whitley schemes for dealing with industries as a whole, which was pointed out some months ago in the European edition of this journal and is now being emphasized in other directions. While employer and employed under these schemes can meet in joint conference, there is no special place for technical and commercial men engaged in the conduct of business. Thus, while capital and labor (manual) may fairly be said to be represented, the share of mental effort in industry is not separately recognized. The general position is leading to the formation of trade unions among brain workers and private conferences are being held for representatives of branches of medicine, the law, engineering, etc. There is, in fact, a Society of Technical Engineers; one of its objects appears to be to press for the inclusion of a third body in the Whitley schemes. Other organizations are the National Union of Scientific Workers, the Association of Engineering and Shipbuilding Draftsmen, the National Association of Supervising Electricians, the Electrical Power Engineers' Association, etc. It is proposed to form a National Federation of Professional, Technical and Supervisory Workers. The same movement can be seen in France.

It is gradually becoming apparent that the continuous efforts to increase wages are really short-sighted, and that the endeavor should rather be to decrease prices of commodities. Yet some sympathy must be felt for those who take the more obvious way to meet at the moment the continually increasing cost of living.

Since the war the rise has been between 130 and 140 per cent, and it has not yet ceased, despite the promises of politicians. American readers should note that rent as a rule cannot be included in this estimate as, excepting in the case of houses quite outside the means of ordinary working people, rents are by law fixed at those which obtained at the outbreak of war. Further, bread which is sold at 9½d. really costs about 15d., the difference being made up by subsidy. Before the war 5d. or 6d. was the price. Workpeople know that large profits are in many instances being claimed and made. They know that rings and combines abound for the maintenance and increase of prices. They perceive that the so-called Profiteering Act is almost an absolute failure. They study the papers and note the dividends declared, as for instance in the cotton industry and in shipping, and they read extracts from reports of official inquiries into the wool industry and others. In plain fact, between high prices, high taxation and rising local rates, many people on fixed salaries, who before the war were comfortably placed, are now worse off than manual laborers. Very seldom have the employing classes voluntarily raised salaries in proportion to needs; "black coat" unions are the result.

The fact that rises in wages, if sufficiently continued, must imply increased prices has been recognized by certain branches of transport workers, for the union of railway-

men concerned are understood to be supporting the directors of the underground transit system of London in their demand for a doubling of pre-war fares. It is also understood that the parliamentary bill which will enable this to be done abolishes simultaneously workmen's fares. Of course, if by their action the railwaymen imply that workers should have no special privileges their action may be supported.

Meanwhile, the demand for machine tools is much in excess of supply. Labor, material and transport charges are growing. There is every prospect at the moment therefore of increases in prices; in some cases they have been announced. Indeed, if the expected increase in castings prices is made the percentage rise of prices for complete machine tools will, in some instances, be half the percentage increase in the cost of castings. The call on Sheffield for steels of all kinds is in many cases outside production capacity and both here and as regards machine tools in particular, the Far East has sent many inquiries and orders, India, China and Japan being specially mentioned. As to the European continent, trading is badly handicapped by the condition of the exchanges.

The tendency to amalgamation of interests is shown in the suggestion that Fletcher, Russell & Co., Ltd., Warrington, furnace maker, should join a furnace makers' combination called Radiation, Ltd. This combine was formed a short time ago by the J. Wright and Eagle Range, the Richmond Gas Stove and Meter Co., and the Davis Gas Stove Co. concerns.

Some Recent Machine-Shop Introductions in Great Britain

Among more recent introductions for the machine shop in Great Britain are cutting tools having shanks of mild or other steel with tips of high-speed steel, in a sense, cast electrically, not simply welded on. For this purpose the end of the shank is ground and around it is built-up a mold, carbon plates being clamped so as to form this. By means of suitable electrodes the metal is then deposited electrically. The contents of the electrode core can, of course, be arranged to suit requirements, but in this instance they are in the form of a mechanical mixture, not an alloy. In the course of a visit by a representative of this journal to the works of Alloy Welding Processes, Ltd., at Church St., Islington, London, N., the tools actually being produced at the time contained 5 per cent each of tungsten and molybdenum, 4 per cent chromium and 1 per cent vanadium. This is one of the standard mixtures of the firm. There are others and E. H. Jones, who is responsible for the process, is in fact carrying out a small research with a view to the production of special steels for cutting. The tool is used in the ordinary way until the high-speed-steel tip is ground off. A fresh deposit can then be made, but high-speed steel cannot be deposited on an existing high-speed-steel tip. This is of course but one of the applications of the electrodes manufactured by the firm named. They both supply tools and instruct their customers to make them, and a small school has been arranged for this purpose. But no manual skill is required; this work indeed is among the first undertaken by lads who are being trained as electric welders.

During the war the British Board of Trade organized a series of trade exhibitions, and these are being continued. For the current year they are being held simultaneously from Feb. 24 to March 5 in London, Glasgow and Birmingham, instead of, as formerly, in London only. Each exhibition has been arranged to have its own character according to the district. The exhibition for Birmingham is being held at a little distance outside the city; namely, at Castle Bromwich, where kiosks have been added to the aërodrome buildings in order to find exhibition space for some quantity of hardware, including smaller machine tools and engineers' and other hand tools; motor-cycles, cycles, motor-car accessories; ropes; lighting fittings of all kinds; cooking stoves, etc. At Glasgow the exhibits include chemical products, boots, clothing, textiles, etc. The London branch of the British Industries Fair, as it is officially known, is at the Crystal Palace, Sydenham, S.E., where lighter and fancy goods, such as jewelry, glassware, leather goods, toys, scientific instruments, etc., may be noted.

Reports received from Glasgow confirm those of practically every other district, to the effect that iron and steel of all kinds are in greater request than production facilities. Foundry qualities of pig iron are in special call and in Glasgow the price of No. 1 iron for export is £12 10s. a ton. It is also mentioned that Scottish makers of steel plates have again advanced prices by £1 a ton. While mentioning Glasgow, reference may be made to the shipbuilding industry there. Launches in January on the Clyde totaled nearly 40,000 tons, said to be a record for this particular month, when output is generally affected by the New Year holidays. A Glasgow correspondent mentions particularly that geared turbines appear now to be displacing reciprocating engines for cargo boats.

American readers will be sorry to note the death of Arthur Wilzin of the E. W. Bliss Co. (Paris) at Nice on Jan. 2 in his fifty-ninth year. The columns of this journal have more than once borne witness to his ability in press work, etc. His ingenuity showed itself in connection with hydro-mechanical presses, automatic body-flanging presses, automatic glass-gathering and blowing machines, etc. His flatware manufacture process was the subject of a long article in the *American Machinist* for Sept. 2, 1915.

Machine Tools Wanted by the French Commission

We announced some time ago the closing of a contract between the War Department and the French Government for surplus machine tools to the value of $25,000,000. At that time it was stated that a French commission would come to this country to select the tools and arrange for their shipment and delivery in France.

For the information of machine-tool builders and dealers we are printing the first list of the French requirements which has just reached us. It should be understood that this list shows the maximum program. The members of the commission are probably fully aware of the difficulties likely to be encountered in getting all they want from our surplus stock, particularly in view of the serious inroads made on it by the Belgian commission and by the beneficiaries under the Caldwell bill. Just what is to be done to fill the gaps has not yet been announced. If further information is desired it may be obtained from the Director of Sales, War Department, Washington, D. C.

The list follows:

MAXIMUM PROGRAM OF PURCHASES BY THE FRENCH COMMISSION

Specification Grinding Machines	Maximum Number	Manufacturers (in preferential order)
Universal Tool and Cutter Grinders	350	Brown & Sharpe
		Cincinnati
		Leblond
		Greenfield
Twist-Drill Grinders	300	Lassalle
		Wilmarth & Morman
Cutter Grinders	50	Pratt & Whitney
Tool Grinders	350	Gisholt
		Sellers
Saw Sharpeners	75	
Knife Grinders	50	
Surface Grinders (wet)	50	Reed & Prentice
		Diamond
		Pearsons-Arter
(disk)	80	Heald
(plain)	120	Brown & Sharpe
		Abrasive
Internal grinders	50	Heald
Plain grinders, 12-16 in. x 36 in.	100	Brown & Sharpe
x 48 in.	150	Landis
x 60 in.	100	Norton
x 72 in.	60	Cincinnati
x 96 in.	60	Bath
x 120 in.	30	Queen City
		Modern Tool
Universal Grinders	300	Brown & Sharpe
		Landis
		Norton

Horizontal Boring, Milling and Drilling Machines	Maximum Number	Manufacturers (in preferential order
Diam. of spindle 2 in. to 3 in.	400	Lucas
3 in. to 4 in.	500	Beaman & Smith
4 in. to 6 in.	500	Universal
above 6 in.	200	
Milling Machines		
Hand	150	Pratt & Whitney
		Fox, etc.
Duplex	30	Pratt & Whitney
		Hendey
Lincoln type	80	Ditto
Briggs type	40	Gooley & Edlund
Profiling	30	Pratt & Whitney
		Leland & Gifford
Thread Milling	150	Pratt & Whitney
Slab Millers	100	Ingersoll
		Beaman & Smith, etc.
Plain Horizontal 1	150	Brown & Sharpe
2	250	Milwaukee
3	300	Cincinnati
4	150	Cleveland
		Leblond
Universal 1	250	Kempsmith
2	400	Becker (vertical)
3	450	Van Norman
4	180	Hendey
		Osterlein
Vertical 1	40	Becker (horizontal)
2	150	Garvin
3	200	Fox, etc.
4	120	
Centering Machines		
	300	Pratt & Whitney
		Hendey
		Whiton
Saws, Machine		
Alternative (Hack) 18 in.	200	Espen-Lucas
		Atkins
		Racine, etc.
Circular 18 in.	50	Cochrane-Bly
20 in.	75	Nutter-Barnes
24 in.	50	Espen-Lucas
Band	20	
Friction 16 in.	60	Ryerson
24 in.	60	
32 in.	30	
Vertical Boring Mills		
24 in.	70	Bullard
		Niles-Bement-Pond
36 in.	100	Cincinnati
		Gisholt
42 in.	130	Rogers
48 in. and more	150	
Lathes		
Engine (toolmakers)	500	Lodge & Shipley
		Pratt & Whitney
		Hendey
		Springfield
Engine (standard) 14 in. x 6 ft.	200	
x 8 ft.	270	Lodge & Shipley
x 10 ft.	200	Pratt & Whitney
		Hendey
16 in. x 6 ft.		Reed & Prentice
x 8 ft.	250	Prentice
x 10 ft.	340	Leblond
x 12 ft.	250	American Tool
		Greaves-Klusman
18 in. x 8 ft.	250	Cincinnati
x 10 ft.	400	Bridgeford
x 12 ft.	370	Boye & Emmes
		Advance
20 in. x 8 ft.	2[illegible]0	Whitcomb & Blaisdell
x 10 ft.	300	Cisco
x 12 ft.	375	Rahn Larmon
x 14 ft.	300	Monarch
		Davis
22 in. x 10 ft.	250	Simplex
x 12 ft.	320	Rockford
x 14 ft.	400	Sebastian
x 16 ft.	320	South Bend
		Sydney, etc.
24 in. x 12 ft.	300	
x 16 ft.	500	
x 20 ft.	470	
x 24 ft.	380	
more	100	
27 in. x 12 ft.	250	
x 16 ft.	400	
x 20 ft.	350	
x 24 ft.	300	
more	75	
More than 27 in.	450	
Bench (precision)	150	Rivett
		Pratt & Whitney
Bench (standard)	100	
Axle	100	
Automatic (tread)	75	
Screw Machines (hand)	300	Brown & Sharpe
		Warner & Swasey
Screw Machines (automatic)	150	Gisholt
		Acme automatic
		Gridley
		Cleveland
Gear-Cutting Machines		
Straights	190	Brown & Sharpe
		Gould & Eberhardt
Bevels	130	Gleason
Herringbone	15	
Rack	40	Walcott

Hammers	Maximum Number	Manufacturers (in preferential order
Steam	-	
Drop	50	
Belt	20	
Pneumatic	300	Nazel
Spring	25	Beaudry
		Fairbanks
Bradley	80	Bradley
Presses		
Bulldozers	220	Ajax
		National Acme
Punching	60	Bloss
		Billings & Spencer
Drawing (weight under 5 ton)	50	Toledo
(5 to 10 ton)	25	Consolidated
		American Can Co.
Shears		
Sheet (under ⅛ in.)	180	
(⅛ to ⅜ in.)	80	
Plate	20	
Punching shear (single)	60	
(double)	40	
Universal	100	
Drilling Machines		
Radials (belt)	100	
(standard or universal), 2½ ft.	140	Cincinnati
3 ft.	280	American Tool
4 ft.	280	Prentice
5 ft.	200	Fosdick
above	50	Morris
		Muller
		Carlton
Heavy Duty	400	Colburn
		Baker
Standard Upright 16 in.	175	Cincinnati
20 in.	260	Reed & Prentice
22 in.	350	Aurora
24 in.	350	Milwaukee
26 in.	225	Barnes
28 in.	175	Rockford
30 in.	100	Snyder
36 in. and above	150	Sibley
		Silver, etc.
Post & Column	400	
Bench	100	
Rapid Sensitive 1 spindle	150	Henry & Wright
2 spindles	80	Allen
more than 2	45	Avey
		Taylor & Fenn
		Leland Gifford
		Barnes
Planers 24 in. x 24 in. x 8 ft.	100	Cincinnati
30 in. x 30 in. x 10 ft.	175	Woodward & Powell
36 in. x 36 in. x 12 ft.	250	Whitcomb
48 in. x 48 in. x 12 ft.	200	Gray
above	75	Powell
		Wilson
		Niles-Bement-Pond, etc.
Slotters		
Stroke 4 to 10 in.	425	Pratt & Whitney
		Dill Tool
10 to 14 in.	300	Niles-Bement-Pond
		Newton
above 14 in.	150	
Shapers		
Stroke 14 in.		Gould & Eberhardt
16 in.	180	Potter & Johnson
20 in.	300	Cincinnati
22 in.	320	Hendey
24 in.	360	Milwaukee
28 in.	400	Queen City
30 in.	240	Smith & Mills
32 in.	100	Steptoe, etc.
2-head	100	

Setting the Milling Machine in Alignment

By J. W. Cunau

On page 356 of *American Machinist* John A. Grill shows a method of aligning a milling-machine vise with the travel of the saddle by using a micrometer clamped on the cutter arbor to register against a parallel clamped in the vise.

My method is identical except that I use a dial indicator instead of a micrometer, and I claim that time is saved by reason of the fact that in the preliminary settings only a very short movement of the saddle is necessary to indicate the direction and amount that the vise must be moved.

The button of the indicator being at all times against the parallel, the position and movement of the latter is always under observation.

Military Engineers' Society Is Being Organized

A national association of present and former officers of engineers and civil engineers who have served in any army or branch of the U. S. Army—Engineers, Ordnance, Signal Corps, Infantry, Cavalry, Artillery, etc.—to be called the Society of American Military Engineers, is being organized by a committee in Washington appointed by the Chief of Engineers. The society's objects are to promote the science of military engineering and to foster the co-operation of all arms and branches of the service, and of civilian engineers in that science. The objects and a provisional constitution of the Society have been approved by the Chief of Staff.

A board of engineers was appointed Nov. 1, 1919, by the Chief of Engineers to consider and report on the feasibility of a technical organization of officers and civilian engineers experienced or interested in military engineering. At the same time the Chief of Engineers required a letter-ballot for or against such an organization from all officers of the Corps of Engineers and temporary engineer officers then in the service. The vote was overwhelmingly in favor of the proposed society.

The board then resolved itself into a committee on organization. Its members are: Colonels F. V. Abbott, Charles Keller, and G. A. Youngberg; Majors George P. Pillsbury, George R. Spalding, P. F. Bond, Max C. Tyler, John C. Kingman and David McCoach, and Captain Douglas L. Weart.

Following a canvass of representative opinions which showed reserve officers and others who had been in the engineering service during the war to be strongly favorable to such an organization, the committee drafted a provisional constitution and created a temporary board of directors from its membership. This constitution is already being submitted for approval or comment to individuals who are known to be interested in the organization and eligible to membership; its more important features follow:

The annually elective officers are to be a president and first and second vice presidents. The president is to be an officer of the Corps of Engineers on the active list. There is to be a secretary, an editor and a treasurer chosen by an executive committee, the first two from the regular army. A board of directors, to have eighteen members, is to be elected by the three divisions of active membership, as follows: Six by the regular army, six by the National Guard and reserve forces, and six from the membership exclusive of the foregoing two groups. There is to be an executive committee consisting of the president, the two vice presidents and not to exceed three others to be elected annually by the board of directors from its own members. Other standing committees are: Rules and ethics; auditing, finance, membership, nominations and necrology; service relations and military policies.

The annual meeting is to be held in Washington, and its date is fixed with reference to that of the American Society of Civil Engineers in order to make possible attendance of members at both meetings. The dues are fixed not to exceed $5 per year, those for the present year being $4.50.

The Society is to publish bi-monthly a journal to be called "The Military Engineer," which will supplant "Professional Memoirs" heretofore published by the Corps of Engineers.

Further information regarding the society may be secured from Col. G. A. Youngberg, Office, Chief of Engineers, U. S. Army, Washington, D. C.

Manufacturer Forms Export Company

The Walworth International Co., a subsidiary recently formed by the Walworth Manufacturing Co., Boston, to handle the export trade, is located temporarily at 39 Broadway, New York. The new company will also represent nine associated companies in the export markets, taking over the established foreign offices of the Walworth Manufacturing Co. in London, Paris, Johannesburg, Sidney, Bremen, Buenos Aires, Havana and Santiago. Officers of the international company are: W. Ayer, president, and Alfred J. Eichler, vice president and general manager. The New York sales manager is Charles Keefe and engineer J. L. Barry.

Reorganized Newark Company

A reorganization of the Slocum, Avram & Slocum Laboratories, Inc., took place Jan. 1, 1920, and has resulted in a complete change in the management of the company.

This company has recently taken over the manufacture of all "Flexite" products heretofore produced by F. R. Blair & Co., Inc., including universal joints, propeller shafts, and flexible magnetic couplings.

Their manufacturing plant is located in Newark, N. J., and the executive offices in the Woolworth Building.

Special Libraries Association Is Taking a Census

At a time when the Government is counting up its inhabitants, the Special Libraries Association is enumerating the special library collections of the country, because there does not exist at present an adequate directory of special libraries.

During the World War, when army camps and military centers were furnished with libraries for research and educational work, the men detailed to look up information for the Government were hampered by the lack of a satisfactory list of information centers which they might call upon for emergency assistance. Time and again army men could have used a directory of institutions or corporations having special information which they would permit them to consult, had such a publication been in existence.

In the spirit of co-operation, and in order to list the special information sources of the country, the Special Library Association—the national body of special librarians—submits the following questions and respectfully asks you to take the trouble to answer them. When compiled, the directory will not be used as a mailing list for advertisers, but merely for the purpose stated, namely, to have in a central place, a record of the Special Information sources of the country.

A special library has been defined as: "A good working collection of information either upon a specific subject or field of activity; it may consist of general or even limited material serving the interests of a special clientele; and preferably in charge of a specialist trained in the use and application of the particular material."

If your library comes within the above qualifications the Special Library Association will appreciate the following information from you: (1) Name of institution or company; (2) name by which library is known; (3) name of librarian or custodian; (4) can it be classified as any of the following: Financial, business, legal, engineering or technical, institutional, municipal, reference, agricultural; (5) if not, how can it be classified? (6) does it serve a special clientele? (7) would your librarian be willing to assist other special libraries to a reasonable extent?

The above data should be sent to Wm. F. Jacob, chairman library census committee, care of General Electric Co., Schenectady, N. Y., who will be grad to answer any questions relating thereto.

ndustrial Forge

ws Editor

Disposal of Surplus Machine Tools of the War Department Proceeding Rapidly

Educational institutions in various parts of the country which have taken advantage of the provisions of the Caldwell Act, allowing technical schools and colleges to purchase surplus machine tools of the War Department at 15 per cent of cost, have commented favorably upon the equipment and the service rendered by the machine-tool section of the Office of Director of Sales.

J. M. Bowlby, in charge of the educational features of the machine-tool section, said that up to the end of February, 944 schools had made inquiry regarding the details of the Caldwell law, 310 questionnaires had been returned and 5,141 coupons had been issued with which schools could make application for tools and equipment at the various district offices and supply depots.

Approximately $350,000 worth of machine tools have already been selected by the French Commission, which has contracted to purchase from the War Department about $25,000,000 worth of machine tools and equipment.

Emergency Fleet Corporation To Dispose of Vast Amount of Machinery

The sales section of the Emergency Fleet Corporation has about completed a comprehensive inventory of approximately $350,000,000 worth of machinery, shop equipment and raw materials of various kinds which will be offered for sale to domestic manufacturers and consumers.

The means for disposing of this vast amount of surplus property, which was purchased during the war to carry out the Government's shipbuilding program, is rapidly being perfected. The head offices of the section were recently removed from Philadelphia to Washington. District sales organizations have been set up in principal centers throughout the country as follows: New York, Boston, Chicago, Philadelphia, New Orleans, San Francisco, Portland and Seattle.

It is the plan of officials in charge of the disposal of the surplus property of the Emergency Fleet Corporation to sell the material as quickly as possible so that warehouses, storage yards, shipyards and plants may be made available for more productive purposes. Manufacturers will find in the surplus materials of the Emergency Fleet Corporation, officials of the sales section point out, many items for which they are now paying high prices and commodities which are almost impossible to secure under present manufacturing conditions.

While these materials were purchased for shipbuilding purposes, it is claimed that unlimited quantities of the surplus property will be found available for other manufacturing purposes.

Approximately $35,000,000 worth of such materials has already been sold since the organization of the sales section last May. The sales program, however, until now has not been very intensive.

With the completion of the inventories and appraisals of the surplus commodities, the Emergency Fleet Corporation will launch an active sales campaign.

It is the plan of the sales section to issue from time to time bulletins and catalogs informing the trade as to details regarding the description and quantities of the materials to be sold.

Demand for Commercial Credit Still Growing

"Reductions in the volume of funds employed in stock-market operations seem to have been more than offset by increased requirements from commercial and industrial sources," the National Bank of Commerce in New York declares in a discussion of the money market in the March issue of its magazine, *Commerce Monthly.* "Because of this pressure for additional supplies of commercial credit, there has as yet been no realization of the strain under which the country's banking system has been laboring."

"It is probable, moreover," the bank says, "that although increasing care is being exercised by users of credit in making forward commitments, the demand for funds for commercial purposes has not yet passed its maximum. There is, therefore, no prospect of an easing of commercial money rates in the early future."

"Further increases in the outstanding volume of credit in this country should be avoided, particularly in view of the steady outflow of gold," the bank advises, and adds:

"Any easing of money-market conditions must come from a decrease in credit requirements and not from an increase of the aggregate volume of credit. In this situation it is highly desirable that banks and business interests generally co-operate to conserve credit for essential employments and to minimize its use in non-productive activities."

General Electric Co. Establishes a Training School for Employees

Recognizing the growing demand for trained business administrators, the General Electric Co., Schenectady, N. Y., has announced a new departure in its educational system by the establishment of a business training course for college graduates without technical education. This course in business administration is also being extended to include the graduates of technical colleges employed in the company's testing department, with the idea of giving the prospective engineer a broad business background for his future work. Students taking this course will be paid by the company according to an established scale.

In many respects the new plan resembles the training schools established by such institutions as the Guaranty Trust Co., National City Bank and the Standard Oil Co., and will be conducted along similar lines, with one or two important exceptions.

The General Electric Co. now employs in its technical departments from 400 to 500 college graduates every year. Students from twenty foreign countries are represented in this enrollment.

The International General Electric Co., Inc., a separate corporation recently formed to handle the foreign business of the parent concern, is planning to establish a similar course of training for students who will represent it in the foreign field in various capacities. A course in foreign exchange will be one of the features of the curriculum.

Cotton Machinery Company Erecting New Buildings

The Saco-Lowell Shops, manufacturer of cotton machinery, etc., with offices at 77 Franklin St., Boston, Mass., is carrying on some extensive additions to its various plants. It has recently completed a one-story 160 x 200-ft. plant addition to its factory in Newton Upper Falls, Mass. Contracts for a two-story, 194 x 300-ft. reinforced-concrete foundry building at the same plant has just been awarded. This company is also building a five-story, 87 x 310-ft. concrete fireproof storehouse at the Biddeford, Me., plant. Plans are also being prepared for a two-story, reinforced-concrete and steel machine shop at the Lowell, Mass., plant. Altogether the outlay for the new buildings being erected by the company will total close to one and one-half million when completed.

Introduces Bill To Establish Standard and Decimal Divisions of Weights, Measures, Etc.

Senator King of Utah has introduced, by request, a bill to establish standard and decimal divisions of the weights, measures and coins. The bill has been referred to the Senate committee on standards, weights and measures, and it is not thought likely it will be given any consideration at the present session of Congress, if at all. Senator Reed, chairman of that committee, as has been stated in these columns previously, is opposed to all bills providing for a change in the standards of measurement from the existing English system.

The bill introduced by Senator King provides for a wholly different standard than that proposed by proponents of the metric system. It would establish the decimal system and retain the present foot, ounce, bushel and ton. A foot would be divided decimally into 10 decimal inches, 100 lines and 1,000 points. The square of a decimal inch would be called a decimal square, and the decimal cube would be transferred into a unit of weight by making a decimal cube of water at maximum density an ounce.

Proceeding from this basis 1,000 points would equal one foot, 1,000 grains one ounce, and 1,000 ounces one weight unit. The point is for fine mechanical and scientific measures, and the grain is for fine weights and the ounce is for retail trade weights. The intention is that retail trades be carried in ounces rather than in pounds and that 32 of these weight units for gross weights would equal the present ton of 2,000 pounds.

The two changes that would take place, if the bill were passed, would be the adoption of the point for fine mechanical measure instead of fractions of the inch and millimeters, the point being much finer than the millimeter, and the present ounce would become the unit for retail trades.

The primary units of the decimal system are the foot and the ounce. The ounce is derived from the foot by being the weight of the cube of the tenth of the foot of water at maximum density. The decimal notation is only of advantage, it is pointed out, when dealing with fractions or divisions of the units. It is of no utility in dealing with multiples of the unit. The decimal system, its proponents contend, affords all of the advantages of the decimal notation, held by them to be the only merit of the metric system, and likewise preserves the convenience, facility and utility which is inseparable from the customary measures of length and weight of this country.

The old common measures, including the common inch, are recognized and are not abrogated by the bill and their obsolescence, it is maintained, should be progressive except as retained in the technology of certain trades. The design, advocates of the bill say, is to improve and develop our present system and bring it into decimal co-ordination. It is not designed, they state, to interfere with the customs of trade or mechanics but to point the way to an improved relation of fine mechanical measures to the standard foot.

Those urging the change explain that Washington recommended a uniform system of weights and measures for use by the colonies in his first message to Congress and that Jefferson, while Secretary of State in 1790, made an elaborate report containing a project for the decimal system of weights and measures based upon the decimal division of the foot into inches, lines and pounds. The present bill, it is stated, agrees substantially with Jefferson's plans. It also is pointed out that James Watt, one of the first to propose a decimal system of weights and measures for Great Britain, preferred a system which would retain the present foot and ounce, and did not advocate a metric system, it is declared, as advocates of the latter have claimed in propaganda they have issued.

Man Axioms

W. S. Rogers, a very successful manufacturer, has quite different ideas from the "efficiency engineers," et al. His practical observations are dynamic. Here are but a sample of them:

I hold that the developing of men is the big thing in business.

I do not want the man who is a static machine but rather the fellow who is on the way to the top.

Workmen are individuals and cannot be treated in mass.

I hold not only that you cannot standardize a man, but that it would not be desirable to do so if you could.

Efficiency figures are not truthful records unless they take into dollars-and-cents account the cost of hiring and firing.

We do not want recommendations or references, because we are buying present and future services and not history or family record.

I hold it to be criminal to take a boy, assign him to one task and keep him at it; that is robbing the boy of all that he has—his future.—*Brass World.*

New Consulting Engineering Organization

J. C. Henriques and M. A. Stone, Jr., have organized a staff of consulting engineers, and formed the Engineering and Appraisal Co., Inc., with offices at 103 Park Ave., New York, opposite Grand Central station.

Their field of work will cover the design and construction of mills, factories, power plants and chemical works, the design and development of special machinery and the formulation of commercial propositions on which the formation of new manufacturing corporations may be based.

The Life of the National Screw Thread Commission Recommended To Be Extended

Congressman Vestal, from the Committee on Coinage, Weights and Measures, has submitted the following report:

The Committee on Coinage, Weights and Measures having had under consideration the resolution extending the life of the National Screw Thread Commission for a period of two years from March 21, 1920, respectfully reports the same without amendment, with the recommendation that the resolution do pass.

The National Screw Thread Commission was appointed under the authority of an act approved July 18, 1918. This act was amended by an act approved March 3, 1919, slightly modifying the required qualifications of the personnel of the commission and extending the life of the commission for a year. The life of the commission will terminate automatically on March 21, 1920, if not extended.

The commission is composed of two representatives of the Army, two representatives of the Navy, and four civilians, nominated by the engineering societies of America, with Dr. Stratton, director of the Bureau of Standards, as chairman.

The members of the Screw Thread Commission serve without compensation other than the regular salary of the Army and Navy members and that received by the director of the Bureau of Standards.

The purpose for which the commission was created was to investigate, formulate and, after investigation, test and, upon approval, promulgate standards of commercial screw-thread practice.

The commission has practically completed its work, which, in the opinion of Director Stratton, is a work of wide and far-reaching effect. A tentative report was prepared about three months ago.

This report has been made accessible to the engineering and manufacturing industries and which has been subjected to the final test of actual use. It appears that the work of the commission is being accepted with satisfaction by the industries concerned, but that in a few instances it has been found by actual practice that slight adjustments or variations in certain particulars of the standards submitted should be made before the report in its final form is promulgated and the life of the commission terminated.

It is believed that it would be best to keep the commission in existence for the time named so that it may pass upon any question of adjustment or modification of the proposed standards.

The committee agrees to this all the more readily in view of the fact that no expense has been incurred by the commission and that none is contemplated as a consequence of the extension of time.

Trade Currents from New York, Cleveland and Chicago

CLEVELAND LETTER

A considerable decrease in machine-tool inquiries is noted in the Cleveland and northern Ohio territory during the last week or ten days. While the majority of manufacturers and dealers believe that this is the usual lull with the turn of the month, others are disposed to consider the rush of equipment business as having "gone over the top." There have been few cancellations during the week, but the amount of new business coming in is not very large.

There is dearth of inquiries for other than standard equipment. Special-machinery requirements have filled a big gap during the last few months, and the absence of this class of business at this time is noticeable.

More tool interests continue to plan for expansion. One of the latest plans in this direction is that by the Gardner-Bryan Co., manufacturer of taps, dies, screw plates and gages. This firm plans to double its output, and has acquired a three-story concrete building at 1876 East 18th St., this city. This building occupies a plot 120 x 40 ft. It is expected to be ready for manufacturing operation by the end of March. New equipment has been installed. Three times as much floor space will be available over the present downtown location. It is planned to double the operating staff in the next sixty days. More than fifty men will be employed on each floor. Officers of the company are: President, John M. Gardner; vice president, C. E. Gardner; secretary-treasurer, R. H. Smart. Mr. Smart is well known in the East in the machine-tool trade, having been for fifteen years connected with the Greenfield Tap and Die Co., Greenfield, Mass. He resigned about a year ago from the sales managership of the small-tool department of the Greenfield firm to take active charge of the business end of the Gardner-Bryan Co. here.

NEW YORK LETTER

Speculation as to the extent of railroad buying, now that the carriers have been returned to private ownership, is the chief topic of interest in machine circles at this writing.

Nothing definite can be ascertained as to the approximate amounts that will be appropriated by the various roads in the Alleghany region for machine tools, but the Baltimore & Ohio and the Pennsylvania have been recent purchasers of small lists. The New York Central is said to have issued a small list for a subsidiary concern, but is not in the market generally.

Heavy equipment orders have been placed in good volume. The Erie ordered forty-eight steel cars from the Pressed Steel Car Co. totalling $2,500,000. Twenty engines were ordered by the Boston & Maine. Western roads are also buying heavily.

Used machine tools are enjoying a brisk run. In the New York market, buyers are unwilling to wait for new machines if serviceable substitutes are to be found for spot delivery elsewhere.

Shapers lead the demand with few offered. Lathes from 24 in. to 36 in., radial drills, all sizes, and planers are in active demand. There is some demand for automatic screw machines, but so far dealers have been able to make promise of reasonable delivery.

Pipe machines for export were represented in an $11,000 order placed with the Fairbanks Co. by Cuban interests.

The Anaconda Copper Co. will issue a machine-tool list shortly, as will the Waterman Fountain Pen Company.

Repeated calls for woodworking machinery have almost cleaned the market of this class of equipment.

CHICAGO LETTER

Quiet conditions prevail throughout the Chicago district in the machine-tool trade. Dealers, on checking up February sales, find the month to have been very satisfactory. With all concerns, it far exceeds the same month a year ago and one firm reports it as having been the best month in its history.

Such a volume of business is on back orders that every one is assured of prosperity for some time to come, but there is no blinking the fact that inquiries and new orders are falling off materially.

Financial conditions do not seem to be causing the let-up in business nearly so much as is the shortage of raw materials. This condition is particularly true in regard to steel plates and sheets, which are practically non-existent, so far as spot stocks are concerned.

Local building conditions remain quiet. Except for a few minor shop and factory enterprises, nothing further of interest has been made public.

Last week the International Harvester Co. was making inquiry for twenty-five 18-in. lathes. It is understood that its need for this equipment is immediate and temporary.

Dayton Machinery Plant To Reopen

The Recording and Computing Machines Co.'s plant in Dayton, Ohio, will soon be opened again by the owner, William I. Ohmer, who will begin the production of magnetos, generators, batteries and automobile starters.

There has been a delay in getting the plant started after its war activities on account of the nonarrival of raw materials and inability to get the necessary machine tools finished.

Besides the production of the automobile accessories named above, part of the plant will be used for the manufacture of stereopticon machines and educational films for use in the home.

Buy Tool Works

The Lone Star Motor Truck and Tractor Association has purchased the entire holdings of the San Antonio Tool Works at 113 Nacional St, San Antonio, Tex. It is stated that a $50,000 addition to the Lone Star plant on Roosevelt Ave. will be constructed to house the new machinery. Lathes, milling and shaping machines, grinding machines and special devices adapted to the use and manufacture of automobile parts are included in the equipment acquired, including drop-forging machinery.

R. Rand, trustee for the Lone Star Association, said that no change in the operation of the tool works would be made before about the middle of March, when it is expected to move the machinery and tools to the Roosevelt Ave. plant. All employees of the tool works will be retained, he added, and its regular business carried on.

Austin and Linderman Plants Have Been Combined

The F. C. Austin Machinery Co. has been incorporated to take over the business of the F. C. Austin Co., Inc., the Municipal Engineering and Contracting Co., and the Muskegon plants of the Linderman Steel and Machine Co. The personnel of the combined companies will be retained. F. C. Austin will retire from active management as president of the Linderman Co. and B. A. Linderman will assume control. The offices of the combined companies will be continued in the Railway Exchange Building, Chicago, Ill.

Promotion of Westinghouse Electric Officials

The Westinghouse Electric and Manufacturing Company has announced the appointment of a number of promotions among its officials at East Pittsburgh. Among the more important of these are the following:

Alexander Taylor, for many years manager of works, has been made assistant to vice president in general charge in all plants of production, stocks and stores.

R. L. Wilson has been promoted from position of general superintendent to works manager of the East Pittsburgh Works.

E. R. Norris has been appointed director of works equipment, in charge of machinery, tools and methods in the various plants.

C. B. Auel is made manager of the employees' service department.

Other appointments announced were: G. M. Eaton has been made chief mechanical engineer of the company; C. W. Johnson and H. W. Cope, assistant directors of engineering; C. H. Champlain and E. S. McCelland, assistant works managers; John E. Bonham, assistant to works manager; E. S. Brandt, supervisor of equipment and methods.

The following were appointed as managers of the engineering departments indicated: A. M. Dudley, automobile equipment; R. P. Jackson, material and process; F. E. Wynne, railway equipment department; and G. H. Garcelon, small motor.

Frasse Steel Works Plans Additions to Cost $100,000

The Frasse Steel Works has completed plans for the reconstruction of the present plant at a cost of $100,000, in order to allow sufficient room for the business which the works has to care for. The new works will take over the New England business of the Peter A. Frasse Co. after the first of the year. The parent corporation was a New York company, while the new concern, which markets the greater part of its products in western New England, is incorporated under the laws of Connecticut for $1,000,000.

The additions to the Hartford plant will comprise an extension of the present shop building which will be 320 x 25 ft., and a building in front of the present office; the first two stories of which will be 175 x 90 ft., while the third story is to be 75 x 90 ft. On the railroad side of the plant there is now a loading platform 320 x 40 ft., which under the new plans is to be inclosed to provide more storage space for both raw material and for the finished products which are awaiting shipment.

The output of the plant is now 26,000 tons of finished work a year, which amount can be increased to 40,000 tons. The improvements will make possible the completion of 50,000 tons of work a year.

The directors of the new Connecticut corporation are: A. E. Brion, president; R. C. Stacy, vice president; Lester Brion, treasurer; R. K. Newman, secretary; Theodore Hager, Arthur B. Mead and Fred Becker. The new works plans to sell stock to such members of the executive force who are really permanent members of the staff, and who are desirous of investing in their own company. The original company, Peter A. Frasse Co., of New York, will act as the sales agents for the Connecticut corporation in the rest of the country while the company will handle its own New England business.

When the company located in this city several years ago it was only after a long consideration of the several New England manufacturing cities among which were New Haven, Bridgeport, Springfield and Worcester. Hartford was finally decided upon because it offered all the advantages of central location and rail communication which the company wanted.

Newly Incorporated Company Takes Over the Simplex Machine and Tool Co.

The Buckeye Drill and Lathe Co., recently incorporated with a capital of $300,000 by Cleveland capitalists, has taken over the plants and property of the Simplex Machine and Tool Co., of Columbus, Ohio. The principal plant is located in Marion Road, Columbus, with other plants at Richmond, Ind., and Hamilton, Ohio. The property was taken over from the receiver of the Simplex Machine and Tool Co., which was the Guaranty Title and Trust Co., of Cleveland. The Buckeye Drill and Lathe Co. has not been fully organized, but C. D. Gibson has been named vice president and is in charge of the plants. The new company plans to dismantle the plants at Hamilton and Richmond and move the best of the tools to the Columbus plant and dispose of the others. High-speed ball-bearing drills and upright drills will be manufactured. These lines were formerly made by the Kern Machine Tool Co., of Hamilton, Ohio. Toolroom lathes in two sizes will also be manufactured.

New Incorporations

F. J. Jwiebel, Raymond Lamm and Agnes M. Cronkite, Portland, Ore., have incorporated the Protecto Manufacturing Co. and will manufacture pumping machinery, pumps, motor vehicles, trucks and supplies.

The Jones-McCord Hardware Co., Baker, Ore., has been incorporated by H. G. McCord, Floyd T. Jones and N. N. Elliott. The new corporation will handle heating materials, hardware and farming machinery.

The American Machinery Corporation, Indianapolis, Ind., was recently incorporated and will manufacture machinery and tools. The directors of this new concern are Frank E. Garvin and William E. Garvin.

Changes in Personnel at Square D Co.

Several additions and changes in the sales and advertising departments of the Square D Co., of Detroit, Mich., became effective Feb. 1. E. A. Printz, formerly district sales manager of the Chicago territory, was made sales manager, A. MacLachlan continuing in the capacity of secretary and director of distribution. D. M. Stone, formerly district sales manager of the Pittsburgh territory, was made district sales manager of the Detroit territory. J. A. Jaques, formerly in charge of the New York territory as district sales manager, was given the district sales managership of the Pittsburgh territory, and H. W. Spahn, district sales manager of the Buffalo territory, was placed in charge of New York. D. H. Colcord, formerly of the department of publicity of the Westinghouse Air Brake Company of Pittsburgh, was appointed director of research engineering.

The annual sales conference of the Square D Co. will be held at the Hotel Statler, Detroit, Feb. 16, 17 and 18.

Obituary

Philip Joseph McGuire, chief production manager of the Walter A. Wood Mowing and Reaping Machine Co., of Hoosick Falls, N. Y., died from pneumonia after an illness of less than a week, on Saturday, Feb. 14. Mr. McGuire had been with the Wood company for more than fourteen years, was deputy grand knight of local lodge K. of C., an officer in the Seth Parsons Steamer Co. and active in many city interests.

John A. Randolph, of the Westinghouse Electric and Manufacturing Co., died from pneumonia, at the Columbia Hospital, Wilkinsburg, Pa., on Friday, Jan. 30, 1920. Mr. Randolph was graduated from Syracuse University, Syracuse, N. Y., with the class of 1903. After graduating, he engaged in engineering and writing technical literature for trade magazines. Mr. Randolph was also engaged for a time in the activities of the Society for Electrical Development located in New York.

Hardy Greenwood, of Dallas, Tex., a representative of the Youngstown Sheet and Tool Co. and the J. B. Wise Co., Inc., of Watertown, in the Dallas section, died at the Sisters Hospital in Watertown from malaria on Feb. 18, 1920.

Frederick Warren, head of the Atlantic Manufacturing Co., Milford, Conn., manufacturer of screw-machine work, died Feb. 18, from pneumonia, in the Bridgeport Hospital, after an illness of less than a week.

H. M. Davis, manager of the advertising department of the Sprague Electric Works of the General Electric Co., died on Feb. 9, 1920, after a lingering illness of about three weeks.

Business Items

The Acme Special Machine Manufacturing Co., Hartford, Conn., has been organized to deal in machinery, engines, etc.

The Manufacturer's Foundry Co., Cleveland, Ohio, has been organized by William Wynn, A. Kyle, George J. Downing, B. J. Russell and E. F. Marcha.

The Bethlehem Foundry and Machine Co., Bethlehem, Pa., makes the announcement that Robert E. Wilbur has been appointed as second vice president of the company.

The Steam Auto Truck Co., Superior, Wis., has completed its plans to establish a plant in Ogdensburg, N. Y., but owing to some patent litigation the company has been obliged to cancel them.

The Baker Gun and Forging Co., Batavia, N. Y., has sold its gun business to the H. & D. Talson Arms Co., New York City. The Baker Gun and Forging Co. will continue in the manufacture of automobile parts.

The Paul Welding Machine Co., 304-306 West Water St., Syracuse, N. Y., was recently destroyed by fire. The loss is about $35,000 to the plant and about $12,000 to $15,000 worth of special tools were destroyed.

The Fernwood Manufacturing Co., Dayton, Ohio, was recently incorporated and will manufacture and sell tools, dies, jigs and machinery. The incorporators are Carl F. Kuhls, Herman C. Kuhls Jr., Henry W. Kuhls, William G. Kuhls and Bernadine E. Kuhls.

J. B. Wise, Inc., manufacturer of brass plumbing supplies and specialty parts, has completed an addition of a one-story, 40 x 60-ft. building as an addition to its plant in Mill St. This new building will be equipped as a brass annealing room and is fitted with compressed-air cranes.

The Watertown Engine and Machine Co., Watertown, N. Y., has purchased the business of the Biltwell Guard Co., also of Watertown. The operation of this new department will be handled at the West Main St. plant. Claude L. Peck, one of the former owners of the Biltwell Guard Co., has been retained as manager for the new department.

The Spacke Machine and Tool Co., Indianapolis, Ind., is preparing plans for construction of a large factory on a 23-acre site at Oliver Ave. and the Belt railroad. The company manufactures Spacke axles, the Spacke motor and the Spacke motor car. Daniel S. Brooks, Indianapolis, Ind., is the president.

The Self Locknut and Bolt Co., of South Bend, Ind., is soon to move its plant to Syracuse, N. Y., and construction of a new plant is about to be started near East Syracuse, where the company has obtained 7½ acres of land. The plant of the Maywood Wagon Co. is temporarily being put in shape for production.

At the annual meeting of the stockholders of the Eagle Manufacturing Co., Appleton, Wis., on Jan. 26, 1920, the following officers were elected: A. W. Priest, president; A. H. Meyer, vice president; R. A. Raschig, secretary; E. W. Saiberlich, treasurer; Charles Hayden, general manager, and George L. Lorch, factory manager.

The Curtis & Curtis Co., of Bridgeport, Conn., manufacturer of pipe cutting and threading machinery, etc., has recently increased its capital stock from $200,000 to $1,200,000 in order to carry on a more extensive business.

The Anderson Forge and Machine Co., Detroit, Mich., has changed its corporate name to the Jefferson Forge Products Co. and will continue the manufacturing of drop-forgings and finished crankshafts. There will be no change in the personnel.

Personals

F. J. Coyle, formerly with the Fairbanks Co., Binghamton, N. Y., is now connected with the McRae Roberts Co., Detroit, Mich., as factory manager.

R. W. Ellingham has resigned as works manager of the Heald Machine Co., Worcester, Mass., to take a similar position with the Van Norman Machine Tool Co., Springfield, Mass.

M. A. Wertman, formerly of the Dayton branch of the Biggs-Watterson Co., has been appointed sales manager of that company, with headquarters in the Cleveland branch of the company.

George H. Austin, sales engineer for the Rivett Lathe and Grinder Co., has resigned this position and is now connected with the Fairbanks Co., of New York, in a similar capacity.

L. F. Quigg has been appointed superintendent of the Franklin open-hearth furnaces and mills of the Cambria Steel Co., Johnstown, Pa. Mr. Quigg succeeds H. E. Townsend who recently resigned his position.

Thomas Stanion, director of safety and sanitation for the Aluminum Castings Co., Cleveland, gave the first of a series of ten-minute talks on "Shop Housekeeping and Safety First," before the Industrial Association of Cleveland, Hotel Olmsted, Feb. 24.

S. F. Wall, secretary and treasurer, and T. M. Olson, manager of the Michigan Tool Co., Detroit, Mich., have severed their connections with this company in order that they may give their entire time to the Continental Tool Works, which was recently organized by them.

C. D. Porterfield, formerly a representative of the Colonial Steel Co., in the New York territory, has recently joined the sales force of the firm of Alfred Herbert, Ltd., 54 Dey St., New York City, and will handle this firm's steel and small tool lines in the metropolitan district and New York State.

H. C. Seaman, associated with the E. W. Bliss Co., Brooklyn, N. Y., for more than thirty years—twelve years as secretary and treasurer and the last two or three as a director—has resigned from this company to accept the presidency of the Mid-Texas Oil and Refining Co. Mr. Seaman will make his headquarters at Fort Worth, Tex., and 379 Fifth Ave., New York City.

[The item published in our Feb. 5 issue regarding Mr. Seaman's resignation is incorrect.]

J. B. Smythe, formerly superintendent for A. O. Norton, Ltd., Coaticook, Quebec, Canada, is now with the Foss Machinery Co., as general manager of its new office and showrooms at 174 Lafayette St., New York City.

Forthcoming Meetings

The National Federation of Construction Industries will hold its first annual meeting at the Hotel Sherman, Chicago, March 24-25. John C. Frazee, Drexel Building, Philadelphia, is executive secretary.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

The National Metal Trades Association will hold a convention at the Hotel Astor, New York City, on April 19 to 22, 1920. H. D. Sayre is the secretary.

The National Chamber of Commerce will meet in Atlantic City, N. J., on April 26, 27 and 28.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21 at the Hotel Traymore, Atlantic City, N. J.

The spring meeting of the American Iron and Steel Institute will be held May 28 at the Hotel Commodore, New York.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of Eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

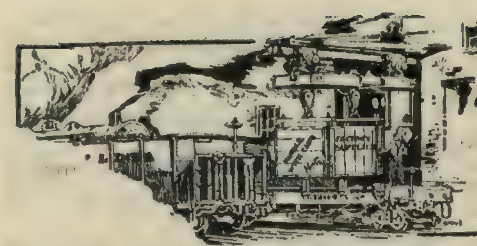
Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Maufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Pa., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting 1st Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$44.60	$39.10
Northern Basic	42.80	38.20
Southern Ohio No. 2	43.80	40.80
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	47.65	45.65
Southern No. 2 (Silicon 2.25 to 2.75)	47.70	43.20
BIRMINGHAM		
No. 2 Foundry	41.00	35.50
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	45.35–45.65*	42.50*
Virginia No. 2	43.25*	40.00*
Basic	43.00†	40.00†
Grey Forge	42.50*	39.50*
CHICAGO		
No. 2 Foundry local	43.25	40.00
No. 2 Foundry, Southern	46.60	40.50
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	43.65	39.40
Basic	42.90	36.40
Bessemer	43.40	37.40
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.97	$3.47	$4.07	$5.50	$3.97	$3.47	$4.07
Soft steel bars	4.12	3.52	3.97	5.00	4.07	3.52	3.97
Soft steel bar shapes	4.12	3.52	3.97	....	4.07	3.52	3.97
Soft steel bands	4.82	4.22	4.57	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.17	3.67	4.27	5.00	4.47	3.67	4.27

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.00	$2.90
Warehouse, New York	3.52	4.17
Warehouse, Cleveland	3.42	3.90
Warehouse, Chicago	3.52	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
Blue Annealed					
No. 10	3.55–4.00	5.57– 6.80	5.17	7.30	5.27
No. 12	3.60–4.05	5.62– 6.85	5.22	7.40	5.32
No. 14	3.65–4.10	5.67– 6.90	5.27	7.45	5.37
No. 16	3.75–4.20	5.77– 7.00	5.37	7.55	5.47
Black					
Nos. 18 and 20	4.15–4.80	6.80– 7.30	6.02	7.95	6.30
Nos. 22 and 24	4.20–4.85	6.85– 7.35	6.07	8.00	6.35
No. 26	4.25–4.90	6.90– 7.90	6.12	8.05	6.40
No. 28	4.35–5.00	7.00– 8.00	6.22	8.15	6.50
Galvanized					
No. 10	4.70–6.00	7.50– 9.00	8.22	8.50	6.65
No. 12	4.80–6.10	7.60– 9.10	8.27	8.60	6.70
No. 14	4.80–6.10	7.60– 9.10	8.42	8.60	6.85
Nos. 18 and 20	5.10–6.40	7.90– 9.40	8.72	8.90	7.15
Nos. 22 and 24	5.25–6.55	8.05– 9.55	7.12	9.05	7.55
No. 26	5.40–6.70	8.20– 9.70	7.27	9.20	7.70
No. 28	5.70–7.00	8.50–10.00	7.57	9.50	8.00

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.50	$5.40	$5.50
Flats, square and hexagons, per 100 lb. base	6.00	5.90	5.50–6.00

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	16.50	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire	
3/8, 11/32, 5/16, 1/4, 7/32, 3/16	21.00 to 30.00
No. 8, 5/32 and No. 10	
1/8	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Domestic 20c. for 1/16, 15c. for 1/8 to 3/16

Cast-Iron Welding Rods	
1/8 by 12 in. long	14.00
1/4 by 19 in. long	12.00
3/8 by 19 in. long	10.00
1/2 by 21 in. long	10.00
Special Welding Wire, Coated	
1/8	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.00	8.00	8.00
Spring steel (light)	8.00	11.00	11.00
Coppered bessemer rods	8.00	8.00	6.75
Hoop steel	4.47	6.50	4.32
Cold-rolled strip steel	11.50	8.25	8.00
Floor plates	6.55	6.00	6.27

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Galvanized	Inches	Iron Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	47%	20½%	¾ to 1½	34½%	18½%
½	51%	36½%			
¾ to 3	54%	41½%			
LAP WELD					
2	47%	34½%	2	28½%	14½%
2½ to 6	50%	37½%	2½ to 6	30½%	17½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	43%	25½%	⅜ to ½	34½%	19½%
½	48%	35½%			
¾ to 1½	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	29½%	16½%
2½ to 4	48%	36½%	2½ to 4	31½%	19½%
4½ to 6	47%	35½%	4½ to 6	30½%	18½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¾ to 3 in. steel butt welded	40%	24%	40%	31%	54%	40½%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50%	37½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 23%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	19.00	19.25	16.00
Tin in 5-ton lots	64.00	63.00	72.50
Lead	9.50	9.00	5.25
Spelter	9.50	9.625	6.75
ST. LOUIS			
Lead	8.375	8.375	5.00
Spelter	9.225	9.225	6.40

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	29.50	24.50	31@32	25.50	36.00	32.00
Copper wire (carload lots)	29.25	29.25	25.00	29.50	24.00	27.00	28.50
Brass sheets	26.50	26.50	20.50	29.00	26.00	27.00	29.00
Brass pipe	32.00	32.00	30.00	34.00	33.00	35.00	37.00
Solder (half and half) (case lots)	39.00	39.00	36.50	40.50	41.50	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	18.50
New York	23.75	19.50
Cleveland	29.00	25.00
Chicago	26.00	28.00

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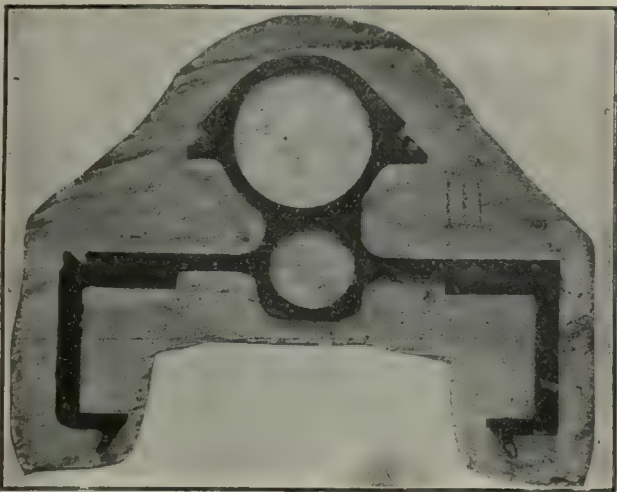


Unusual Methods of Securing Extreme Accuracy—I

By A. L. De Leeuw, M. E.

Consulting Engineer

Accurate drilling and boring of long holes is one of the greatest of shop problems. When two holes must be bored parallel, the problem increases in difficulty. This article tells how the preliminary machine work necessary to the locating and boring of such holes was performed. The illustrations show the problems clearly.

The problem of making an accurate recoil mechanism for gun carriages is a particularly difficult one, both on account of the extreme accuracy required in the component parts as well as owing to the very large amount of metal to be removed from the main, or cradle, forging. This main forging was supposed to weigh 950 lb. in the rough and 215 lb. after machining; but, due to the lack of satisfactory heavy forging machinery, it weighed from 1,300 to 1,350 lb. and it did not seem possible to reduce this weight and still make a forging which could be completely turned up. Fig. 1 and some of the other views show the irregularities in the forging. The waves or irregularities were sometimes as much as 1¼ in. in depth.

The unfinished appearance of the trunnion lugs, and the curved outlines of the forgings can readily be seen. Fig. 2 shows the large amount of metal allowed, but it sometimes happens that even with this it was barely possible to true up the trunnion. Fig. 3 shows the cross-section of the forging to which has been fastened a steel templet showing the cross-section of the finished part; the two holes shown are the result of the first operation.

Fear was expressed that, due to the removal of such a large amount of metal and to the delicate shape of the product, there would be great danger of twisting and warping of the forging after machining. It was found, however, that with the sequence of operations adopted, there was no trouble from this source. As a matter of precaution it was decided to leave a small amount of metal on the inside of the slide part to be removed after finish-boring; and, though this was regularly done, it was more than doubtful whether this operation was really necessary.

A Laying-Out Machine

As the forgings came so rough and of such uncertain dimensions, it was necessary to lay out every forging very carefully before machining. This at first required the services of a skilled man and consumed a great deal of time. As the plant was originally laid out for a capacity of 25 finished recoil mechanisms, and required 30 of these finished forgings per day to allow for waste, a machine was designed to do this laying out quickly, accurately and with unskilled help.

This machine is shown complete in Fig. 4 with details in Figs. 5 and 6. It consists of a bed, and means of shifting the forging as desired and for finally clamping it in the proper position. To obtain this position, brackets were used which could slide in grooves in the bed, these brackets carrying feeler rods which could be placed by hand, in vertical or horizontal directions, against the forging. If these rods touched the forging in any position of the brackets on the bed, then the

FIG. 1. THE IRREGULARITIES OF THE FORGINGS

FIG. 2. SURPLUS METAL ON TRUNNION

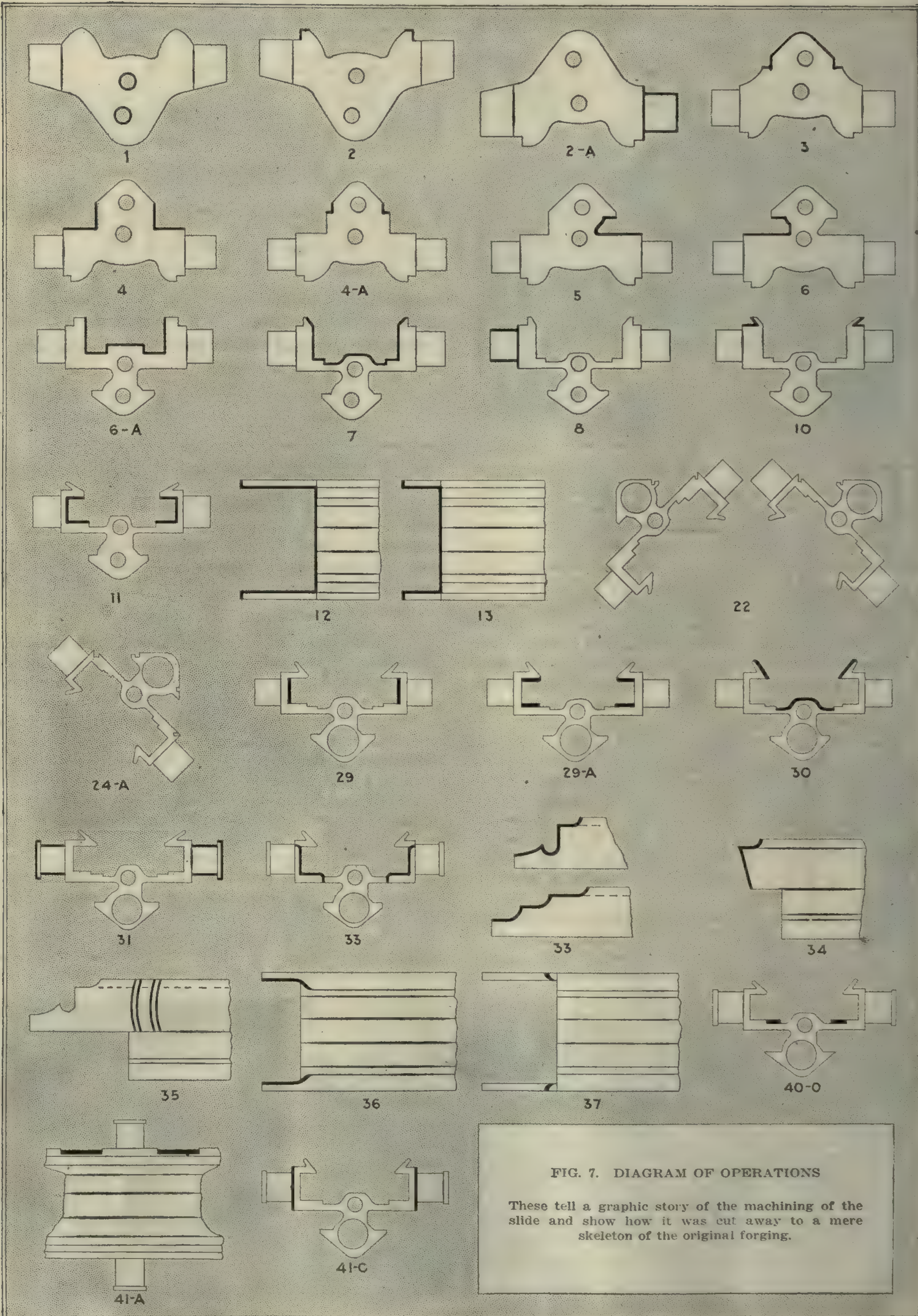


FIG. 7. DIAGRAM OF OPERATIONS

These tell a graphic story of the machining of the slide and show how it was cut away to a mere skeleton of the original forging.

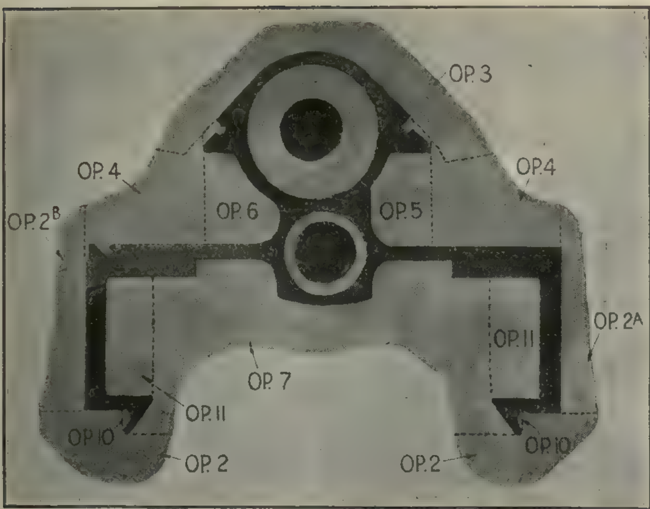


FIG. 3. METAL REMOVED AT VARIOUS OPERATIONS

forging would have sufficient metal for finishing at all points. If one of the feeler rods, when placed over or along the forging, failed to touch it, then the forging was shifted horizontally or vertically, or turned around its axis, until the rod struck.

At each end of the bed a drill head was mounted, the head containing two drill spindles, each having an independent belt drive. The feed was by hand. The holes drilled in this position corresponded with the center of the holes which finally would have to be bored through the forging and were small enough so that it was not necessary to drill them with extreme accuracy. These holes were the starting point of all the subsequent operations. Fig. 5 shows the construction of the feeler rods and brackets. The method of locating the center for the trunnion parts by means of center punch is shown also. Fig. 6 shows the drill heads and jig brackets.

The Locating Surfaces

The sequence of operations is shown in Fig. 7. The milling of the two guide strips at the bottom of the forging, operation 2, is shown in Fig. 8, where the piece is set up for operation. This operation was performed on a 24-in. milling machine with an inclined rail. The illustration clearly shows the jig and holding devices, and especially shows how the holes drilled in operation 1 were used for locating the forging for this operation. The cutting speed for this operation was 57 ft. per minute, the feed 0.78 in. and the time for finishing a piece about 2 hr. Before the milling machines were completely installed, this process was done in a planing machine, requiring about 8 hr. per piece.

After this operation the lips thus milled and the surfaces thus obtained were used as gages or control points for further operations.

Fig. 9 shows operation 2A—rough-milling the sides and the stock around the end of one trunnion. This operation was not contemplated in the original layout but the additional amount of metal of the forging made it necessary to remove some of the metal before the finishing of the sides. The method of holding the piece is clearly shown, including the hardened-steel plates against which the lips of the forging are located before milling. This operation was done on a No. 5 milling machine and required two settings, as the trunnion lug, which is practically in the center of the forging, would not allow of completing one side in a single setting. The milling machines were consequently arranged in pairs, one running right hand and the other left hand, so that one pair of milling machines could take care of a complete side. The depth of cuts varied widely with the forgings, being sometimes as much as $1\frac{7}{16}$ in. The feed was $1\frac{1}{4}$ in. per minute. The style of cutter used was the $8\frac{1}{2}$-in. high-power face-mill with an extra amount of projection of the blades beyond the body. Operation 2B is the same as the previous one but on the other side of the forging.

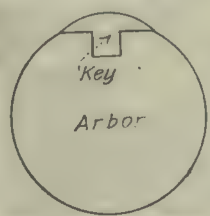


FIG. 11. KEY USED IN MILLING CUTTERS

Operation 3 is shown in Fig. 10 and consists of shaping the top of the forgings. This was done on a 24-in. horizontal machine with inclined rail and interlocking cutters. The cutters were kept as small as possible but were nevertheless 8 in. in diameter. This was caused by the fact that the arbor was 3 in. in diameter and further, that a deep section of metal had to be cut. In these cutters and in all gangs of cutters for heavy work, a cylindrical key, as shown in Fig. 11, was used. With this key no trouble was experienced in getting the cutters on or off the arbor.

Where a Light Cut Breaks Cutters

Fig. 12 shows operation 4 which was done on a double-spindle 24-in. machine with vertical heads, using a cutter which was 5 in. in diameter and 4 in. high. The

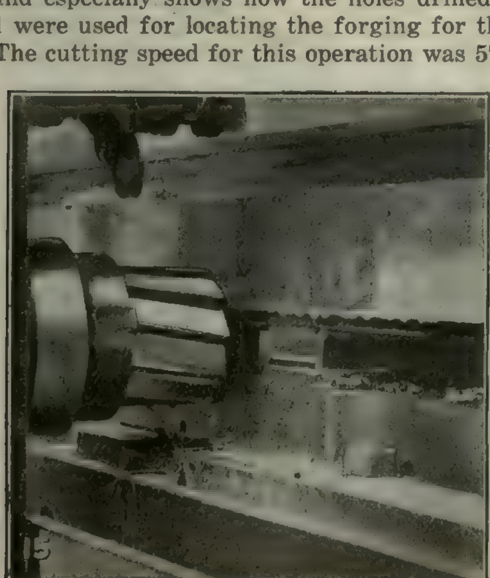


FIG. 15. FINISHING THE SIDES

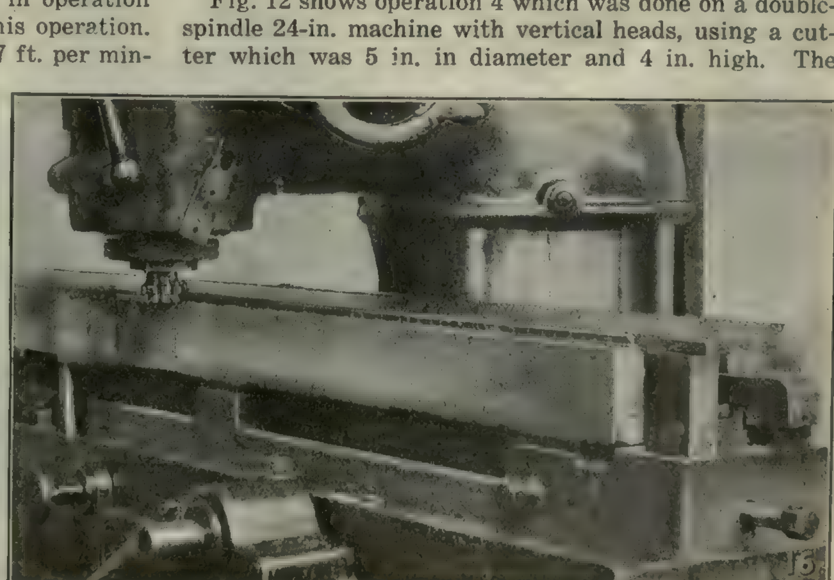
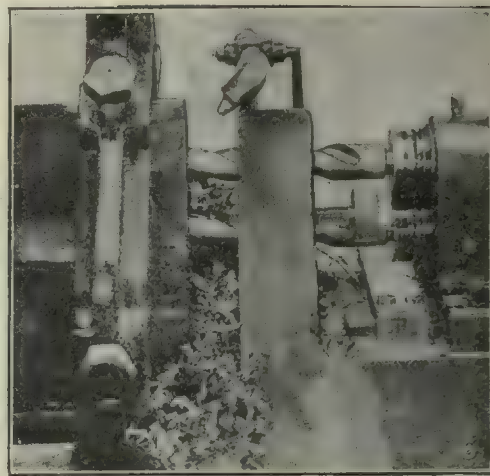
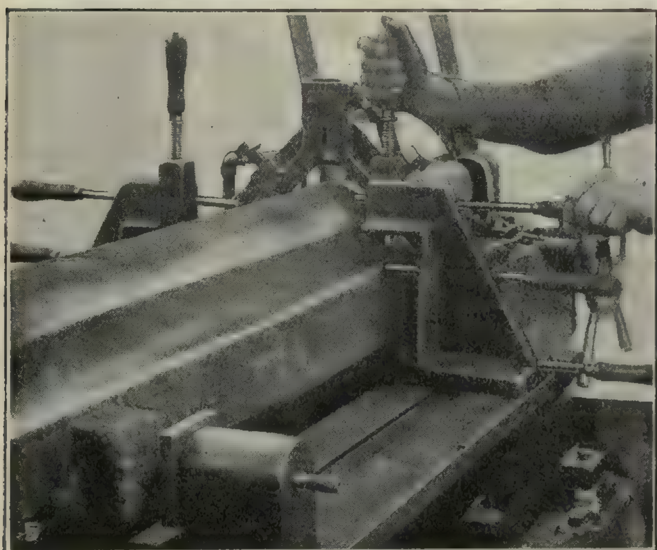
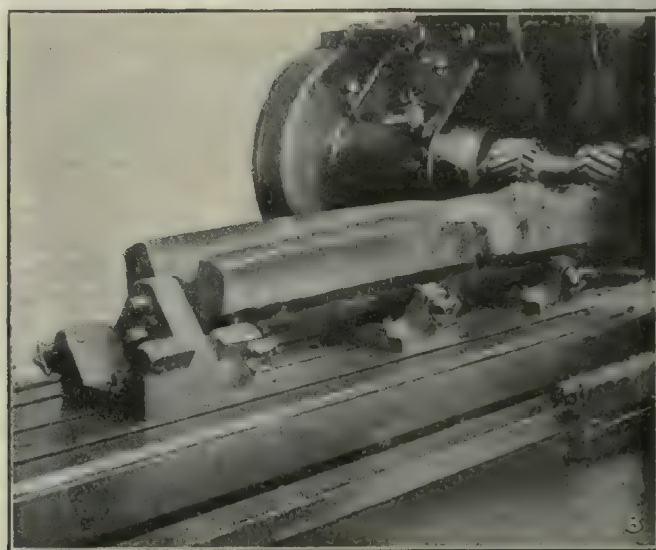
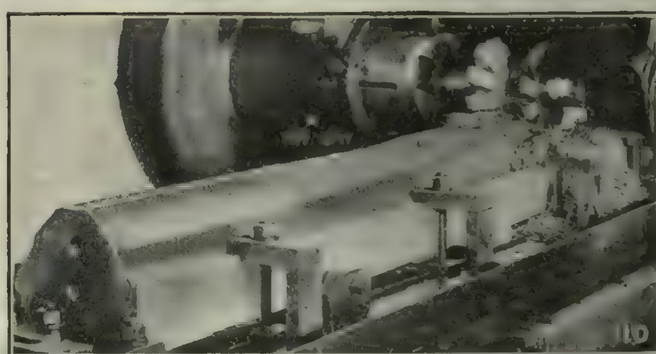
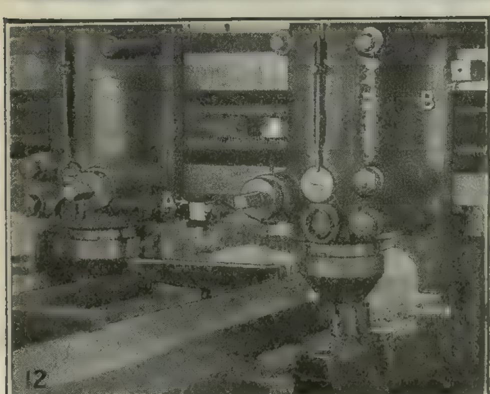


FIG. 16. UNDERCUTTING THE LIP

FIGS. 4, 5, 6, 8, 9, 10, 12, 13 AND 14. NINE INTERESTING OPERATIONS ON ROUND SLIDE

Fig. 4—Machine for laying out forgings. Fig. 5—How the machine is used. Fig. 6—Drilling the two pilot holes. Fig. 8—Milling the locating surfaces. Fig. 9—Removing material from side. Fig. 10—Milling the back of forgings. Fig. 12—A heavy milling cut. Fig. 13—Undercutting the sides. Fig. 14—Milling out the channel.

illustration will show how extremely heavy this cut was. It also shows the peculiar style of stub arbor used, as it could not be expected that any ordinary kind of arbor would stand up under this heavy duty.

By a misunderstanding of the instructions, the men in the shop divided this operation into two cuts, and invariably broke the cutter or arbor, or both, on the second cut. When, however, the entire amount of metal was removed in one cut there were no breakages. This was due to the fact that the metal to be removed lying immediately back of the body of the cutter prevented the cutter from pulling itself into the cut. It will be noticed that stops were provided on the cross-rail to keep the heads from moving under the cut. Two of these are shown at *A* and *B*. The illustration shows clearly how the pieces were clamped and how two pieces were done at one setting. It also shows the steel water guard around the table.

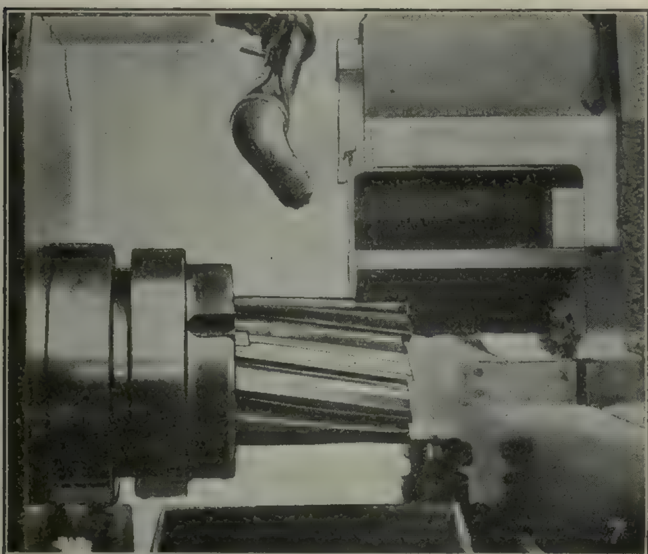


FIG. 17. SLOTTING THE END

Fig. 13 shows operations 5 and 6 which are different only in the shape of the section of metal removed. Operation 5 was done with a relieved cutter held by means of a stub arbor and used as an end-mill. Operation 6 was done in a similar way except that the cutter was made in two parts and interlocking. The reason for this difference was that the surface made by operation 6 had to be corrected within narrow limits, whereas the surface made by operation 5 did not require such accuracy and the variation of thickness of the cutter due to sharpening would not cause trouble. It was found necessary to introduce an extra operation before operations 5 and 6. This operation is shown in Fig. 7 as 4A and consisted of beveling the end of the piece where the cutter is to enter. Without this precaution the cutter was apt to pull itself into the cut, though there was no danger of such a mishap after the cutter had once entered.

A Heavy Milling Operation

Operation 7 consists of removing practically all of the metal from the inside of the forging. This was done on a 24-in. horizontal milling machine, using interlocking cutters. As it proved to be extremely difficult to get sufficient cutters for this operation, and as the first cutters obtained were not correctly made, it was decided to split this operation, for the time being at least, into operations 6A and 7.

It will be noticed that operation 6A can be done with ordinary milling cutters, which of course, could be made in a relatively short time, and without the use of a large backing-off machine. This left much less metal to be removed by the special cutters, and made it possible to do the finishing operation, No. 7, at higher speed and feed and with less wear of cutters than if the entire amount had been removed in one cut. However, if cutters had been available, it would have been more economical to take one single cut with cutters as in Fig. 14.

Operations 8 and 9 are the rough-finish-milling operations along the sides of the piece and around the trunnion, Fig. 15. These operations are similar to operation 2A except that less metal must be removed and consequently a smaller cutter can be used. This operation was done on a No. 5 machine and as the table travel was only 50 in. and the length of the piece to be milled from 69 to 70 in. it was necessary to mount the piece in a sliding fixture. Fig. 16 shows the cutting of the lip of the forging by means of a relieved end-mill. This lip is made of very delicate shape and to men not versed in the mysteries of ordnance design, it would seem that the gun would shoot equally far and straight with a square lip. However, as the design had to be followed, the special milling cutter was used on a No. 5 vertical milling machine and the piece was mounted on a sliding fixture which is quite clearly shown.

Operation 11 requires the removal of a considerable amount of metal; only $\frac{1}{32}$ in. was left on the inside of the forging for finish-planing. This can be seen in Fig. 7. The central guide running lengthwise of the forging limited the size of the cutter, as it was further necessary to make some little allowance for the sharpening of the cutter and the consequent reduction in diameter. This, on account of the forging, limited the stem of the cutter to not more than $1\frac{1}{8}$ in. As it was evident that an arbor of $1\frac{1}{8}$ in. in diameter could not possibly resist such a heavy cut, the arbor was made $1\frac{1}{8}$ in. only at the point where it passed the lip of the forging; while immediately after this point was passed, the arbor widened out and followed closely the outline of the forging so that the portion which was $1\frac{1}{8}$ in. in diameter was only about $\frac{3}{8}$ in. long. This proved so successful that no breakages occurred.

This cut was taken in a No. 5 vertical milling machine using a sliding fixture. Operations 12 and 13 are shown in a general way by Fig. 17. These operations consist in milling off the end of the forging and then milling a gap through the center part. This gap was 2 in. deep at one end of the forging and 4 in. at the other. After these operations, the forgings were 69 in. long while the length between the gaps was 63 in. This operation was done on a No. 5 machine with an end-mill.

An End Key Best Here

In doing such extremely heavy work it was necessary to drive the cutter with a key at the end of the mill rather than with a regular key on a stub arbor. The regular key has a tendency to split the mill. In all these operations the fixtures were provided with setting pieces which were 0.010 in. below the desired surface, and feelers with a thickness of 0.010 in. were used for setting the cut. In cases where it was necessary or advisable to run the machine while setting the cutter, a feeler of copper was used. However, this was avoided as much as possible for safety's sake. In all milling operations large amounts of cutting compound were flowed over the cutter.

Internal Lapping and Laps

By Gustave A. Remacle

I have read with interest Mr. Pusep's article on internal laps, published on page 712, Vol. 51, of *American Machinist*, and the present article is largely supplementary to his treatment of the subject.

The simple lap mentioned by Mr. Pusep and here shown in Fig. 1 may be used for enlarging a hole where accuracy of form is unimportant. This type of lap is most often used for lapping dowel-pin holes which have become smaller in hardening. For such work a small degree of inaccuracy in the form of the hole is of little consequence and since this simple lap can be made cheaply, the use of it for this purpose is general. I use a hardwood wedge in preference to one of metal, because wood is elastic and elasticity makes for speedy lapping, though at the expense of accuracy.

For the purpose of lapping long holes which must possess no bellmouth, or for the purpose of lapping a piece of such form as the piece shown in Fig. 2, lead laps are best suited. When I speak of a hole as having no bellmouth, I mean such holes as are required in gage work.

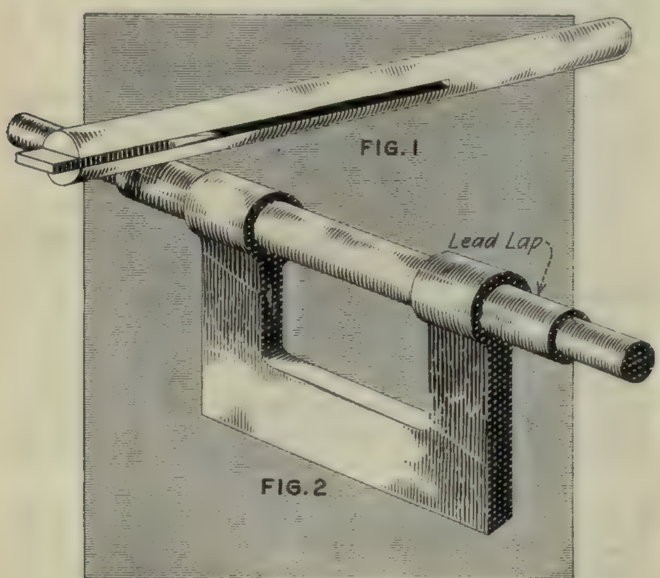


FIG. 1. COMMON TYPE OF SMALL LAP
FIG. 2. LEAD LAP WITH MANDREL

The type of lap shown by Mr. Pusep on page 712, Fig. 2, is, as he claims, excellent for removing metal. It should not be used for gage work however, because the springiness of the lap has a strong tendency to produce a bellmouth.

In Fig. 3 is shown a type of lap which I use when lapping gages, the diameters ranging up to ⅜ in. The size of the lap and the facilities at hand determine which of the three forms is to be constructed. If the shop facilities permit, I prefer making the lap at *A*.

This lap contains three slots. The wedge is made of drill rod and tapered like a needle. The slots should be quite long, say, 1¼ in. for a lap ¼ in. in diameter. A small hole is drilled to a depth beyond the farther extremity of the slots, and a larger hole, which is a sliding fit for the rod of which the wedge is made, is drilled to a depth indicated at *a*. It will be noted that point *a* is midway between the extremities of the slots.

When I cannot slot the lap with a circular saw, I make it as shown in *B*. In this case a jeweler's saw is used for cutting a slot through the center between the two cross holes. When the lap is of such size that a hacksaw may be used, I make it as shown at *C*. In this instance I slot from the end of the lap and put on a collar to hold the ends together.

For laps *B* and *C* there is only one hole drilled for the wedge. This hole is drilled to point *a* and the wedges are made of drill rod filed on the end to a wedge shape.

When holes must be precisely located and accurately lapped as to form, or when very small or tapered holes must be lapped, I revolve the piece in the lathe and grind or lap them with a diamond charged lap.

In closing I wish to touch upon the subject of terminology in relation to grinding, lapping and stoning. When discussing these subjects I am often at a loss as to which term to use. If I wish to sharpen a threading die, and I hold the die in a vise while rubbing a carborundum stone on it, I am stoning the die. If I hold the die in the bench lathe and mount the same carborundum stone in a grinding attachment, am I grinding or stoning?

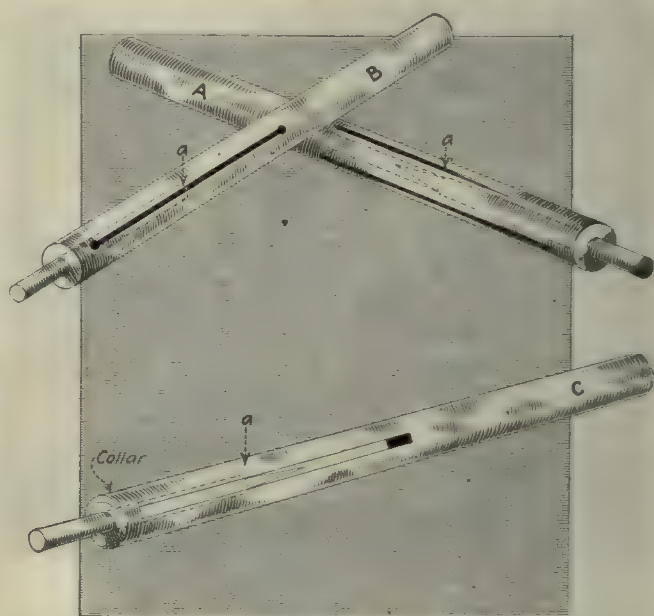


FIG. 3. VARIOUS FORMS OF LAP FOR SMALL HOLES

When I charge a lap with diamond dust and revolve it rapidly while applying it to the job, am I grinding or lapping? An emery wheel, when revolving and applied to work, is grinding; but I have seen mechanics apply a piece of broken grinding wheel to a piece of revolving hardened steel; in such instance, were they stoning or grinding? And, if an oilstone were applied to a piece of revolving steel, would the act be termed, "stoning?"

Holding Slip Bushings

By Henry R. Bowman

I note the criticism by Mr. Freeman on page 326 of the *American Machinist* regarding the method of holding a slip bushing by means of a capscrew.

In a box jig it has always been the custom in my experience either to cast feet on the corners of the jig body and machine them, or spot face to a uniform depth with an end mill and provide buttons to act as feet. The height of the feet should be enough to give clearance between the table and bushing heads, cover plates, straps, etc.

Some Operations on Caramel Knives

BY DONALD A. HAMPSON

This article describes the methods adopted for getting out a job that was a little out of the ordinary, using only such equipment as was available in the shop, together with a few fixtures and devices that could be made in the toolroom from parts of discarded machines.

OURS is what is called a small shop—one of those that is supposed to be capable of handling any kind of manufacturing or special work at the same price (or less) as the big fellow, for the same quality of work. Naturally, one must resort to ways and means to keep tool charges down, for there is never a certainty of a repeat order.

The job in question was the making of knives for a caramel-wrapping machine; said knives, despite the comparatively soft nature of the material they cut, having a rather tough proposition with which to contend, and they have to be made very accurately and tempered with extreme care in order to make them stand up to their work.

Fig. 1 shows the knife, 24 of which constitute a set. They are held by the shank in a cutter head so that the cutting edge is vertical, and the caramel is forced out between the parallel adjacent sides of a pair of blades, each pair in turn doing the work. In the operation there is not only the direct thrust of the cut but a side strain as well. The knife is made of Intra steel.

The first step in the manufacture is to cut off the sections from the bar steel. A dozen bars are placed in a vise and two dozen pieces severed at a cut by using three saws on the arbor of a milling machine. The use of wide saws was found to be a measure of economy because they do not "run," that is, creep to one side under the forcing of the cut, and because they cut squarely across the pieces are all alike and to exact size, which is of importance in subsequent machining operations. When thin saws are used there is a saving of steel in the first place but this is overbalanced by a single cut which runs a few thousandths and thus condemns 20 pieces.

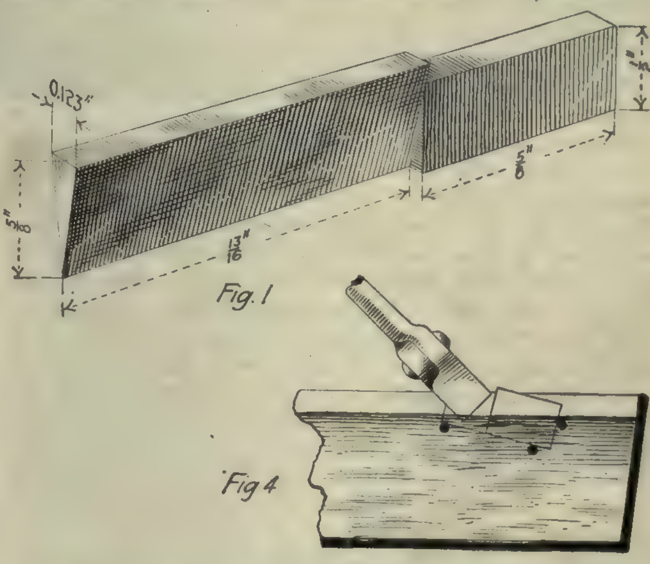
Tool-steel bars vary considerably in all dimensions, a fact that affects these knives in the thickness of the shanks, which must be to exact measurement in order to enter and yet fill the slots in the cutter head, and they must be flat so that they may be rigid under working stresses. These requirements cannot be met by the unfinished bar nor by any rough-grinding or offhand methods, so the process naturally adopted is milling.

Fig. 2 is an illustration of the fixture and set-up for this work. The only part not shown is the pair of 4-in. straddle-mills. These are collared to mill the pieces to exact size, 0.123 in., and once set up correctly the thickness can be forgotten for the next five thousand pieces; even the boy that loads the machine cannot make them vary in size.

The rotary magazine of the fixture is mounted on a 2-in. shaft set in substantial bearings with liberal surfaces to maintain the fit endwise. The shaft is rotated by the worm and gear shown, the drive being through the pulley and belt from the countershaft. It will be noticed that the regular table-feed belt is off; the table is locked in such a position that the passage of the blanks between the straddle-mills machines a little more than enough for the shanks. Setscrews for fastening the knives in the magazine are located on the side away from the observer. The boy who runs the job is provided with a socket wrench (and nothing else) to fit the screws, and he takes out each finished piece as it appears and sets in a blank. Each blank rests against a pin, locating it for depth, and is confined against the thrust of the cut by the sides of the slots cut in the ring.

The blanks projecting from the ring may be readily seen in Fig. 2 and while at first glance it might seem that there was much waste space between each pair, the output has been so satisfactory that there has been no attempt to make any change.

When the pieces are milled on the shanks and to exact length, these two known surfaces are used to



FIGS. 1 AND 4. SHAPE OF THE CARAMEL KNIFE, AND METHOD OF QUENCHING

work from in milling the blade. A fixture was made for each of two machines that are set close together, so arranged that one operator has a working, or rather a storing, table in proximity to both. One machine mills the first taper side and the other the second side—an arrangement that gives 15 knives to each round trip, and the operator has time to do the necessary burring.

This milling brings the blade down to a thickness of $\frac{1}{32}$ in. at the edge, with a limit of a few thousandths less. The thickness at the edge has to be maintained very near the "set" point or the metal will tear out under the cut and at that the cutters need sharpening every day in order to do the cleanest work.

Considering the nature and shape of the piece, this milling cut is quite heavy and ample means of holding the knife against it must be provided. In the fixtures, a clamp abuts against the end of all the blanks, drawing them tightly against a shoulder at the other end. Over the shanks a strap, with notches at the

proper angle, is laid, with a thin strip of soft packing under it holding the blanks down securely. The working floor of each fixture is formed by two cast-iron strips, one each of the width of the shank and the blade, and each having notches of correct space and angle to support the shank under the clamp and the blade under the cut.

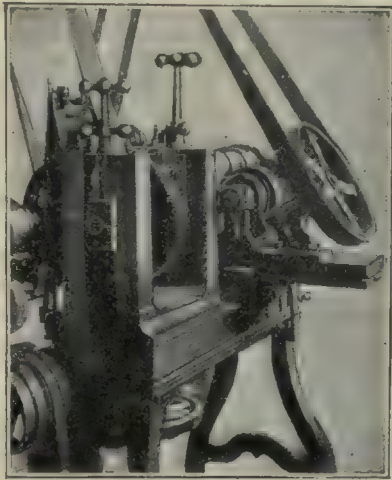


FIG. 2. SET-UP FOR MILLING THE SHANKS

Fig. 3 shows the gas furnace used for hardening, and the way in which it was arranged to make the work convenient. Set up at a good height, it allowed the tank for the quenching to be placed beneath at a height that shortened the time from fire to water to a minimum. Burners on each side of the furnace heated a double row of blades as fast as a man could handle them, and fixtures on the hearth located the blades so that the heat struck the thick backs first.

The quenching tank is 6 in. deep and is filled mostly with water; this gives a good body of coolant and supports one-eighth of an inch of fish oil on the surface which the blade passes through as it is dipped. As shown by Fig. 4, rods in the tank locate the piece while it is being dipped and the level of the oil and water is maintained to the right height to give the hard edge with soft back so much desired—a hard edge for all reasonable wear of the blade, supported by a tough back and shank. This arrangement of an oil film on top of water has worked out very nicely, supporting the theory of its use in furnishing a liquid of oil tempering qualities which the blade strikes as it comes from the furnace and through which it passes to the water which cools it off.

Lacking pyrometer equipment, it was necessary to experiment and, from the results, to simplify the regulation of the furnace as much as possible. Then a conscientious man was trained to judge correct heat by the eye. It was found that the file test was conclusive, supplemented by placing an occasional blade in a vise, held by the shank, and testing the amount of bond it would stand before breaking. No separate tempering operation was performed because none was needed. The body of water in the tank was sufficient to produce uniform results; the hardener guarded against local overheating by moving the blades along the rods as they cooled.

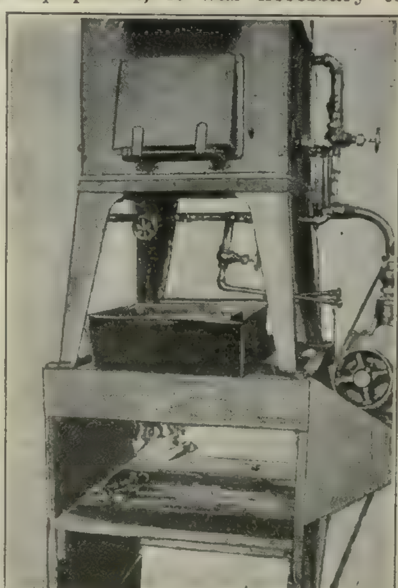


FIG. 3. THE HARDENING AND TEMPERING OUTFIT

After hardening, the blades are given a sawdust bath to absorb the oil and make them ready for the grinding, which latter is done as shown in Fig. 5, by running them over the top of a wheel of 1-in. face. In the illustration, the dresser is set up on the machine for sharpening the wheel and truing it. As the blades are ground to a thickness of 0.004 in. at the edge, the necessity of keeping the wheel in shape becomes apparent and the dresser has satisfied that necessity entirely. It is simply a hardened piece of tool steel with a ½-in. hole through it and having both a thread and flutes cut on its face, producing several hundred points equidistant from the center. The grinding fixture may be raised and lowered so when the dresser is attached to it, it is lowered carefully until the dresser touches the wheel and trues it up.

When the dresser is taken off, the fixture presents a flat top, along which a holder, carrying two blades, is moved, each blade passing over the wheel, which just covers the surface to be ground and no more. A few passes over the surface of the wheel grinds away the metal of the blade until the holder passes smoothly along the surface of the fixture, at which point the grinding of that side of the blade is finished. This finger-pressure feeding has proved more satisfactory than might be imagined and as fast as consistent with dry grinding. The finished blades are smooth, straight, and uniform.

FIGS. 5 AND 6. FINISHING OPERATIONS
Fig. 5—Truing the grinding wheel. Fig. 6—Oil stoning the edge by power

Following the grinding, the edge must be stoned to almost razor sharpness. Three-quarter-inch square India oil stones were first employed for this purpose, the knives being held by a special fixture in a bench vise.

An improvement on the hand oil-stoning operation was effected by the construction of the device shown in Fig. 6; this device doubling the production on the most particular operation of the process. It reversed the order for hand work in that the stone moves and the work is stationary. As may be seen, the oil stone is held in a cross-head driven by the crank; the stone traveling between U-shaped guides, on the beveled top surfaces of which is laid the holder carrying one blade. The workman stands before the machine and applies the holder first on one beveled surface and then on the other; his sense of touch quickly tells how much to bear on, greater or lesser pressure being obtained by sliding the holder farther up or down the incline surface. Though skeptical as to the possibility of doing this part of the work by power, all doubt was removed by the time the first dozen blades had been run off.

XIX. Examples of Welding Jobs*

Little attempt is made in this article to explain in detail how the welds have been made as they all come under rules already given. The examples will be helpful, however, in revealing the possibilities of the gas torch as a welding tool.
(Part XVIII was printed in our Jan. 29 issue.)

THE way a crack to be welded is V'd out or plates are beveled, has already been outlined, but it will be well to elaborate a little on the methods of doing this work. On steel or wrought iron, the beveling may be done with a gas cutting torch. On other metals, such as aluminum or cast iron, the gas cutting torch cannot be used, although the metal may be roughly melted away. Sometimes the work is of such a nature that the bevel may be ground, either with a stationary or a portable electric grinding machine. On cast iron, a sledge and a handled chisel is often the cheapest and quickest way, and in nearly every case it is superior to melting the metal away with a gas torch.

A very satisfactory beveling tool for all-round shop work, is an electric or a pneumatic chisel such as shown in use in Fig. 201. This may also be used for taking off surplus metal after welding, although a portable electric grinding machine is usually preferable.

On work like the propeller blade shown in Fig. 202, the slots may be cut with a saw or a milling cutter and the pieces left may be knocked off with a hammer. This bevel might also be chipped, ground or melted off, as the occasion or equipment at hand demanded or made advisable.

An engine cylinder grooved out and ready for preheating, is shown in Fig. 203. In a case of this kind the grooving may probably be best done by using a sledge and handled chisel for the easily reached parts, and a pneumatic chisel for the rest. However, this largely depends on the size of the work and the judgment of the workman. Fig. 204 shows the cylinder welded and ready to be smoothed up.

A badly broken four-cylinder block is shown in Fig.

*For the author's forthcoming book, Welding and Cutting. All rights reserved.

FIG. 201. AN AIR CHISEL MAY BE USED EITHER FOR GROOVING OR FINISHING

FIG. 202. PROPELLER BLADE PARTLY BEVELED FOR WELDING

FIG. 203. CYLINDER GROOVED OUT FOR WELDING

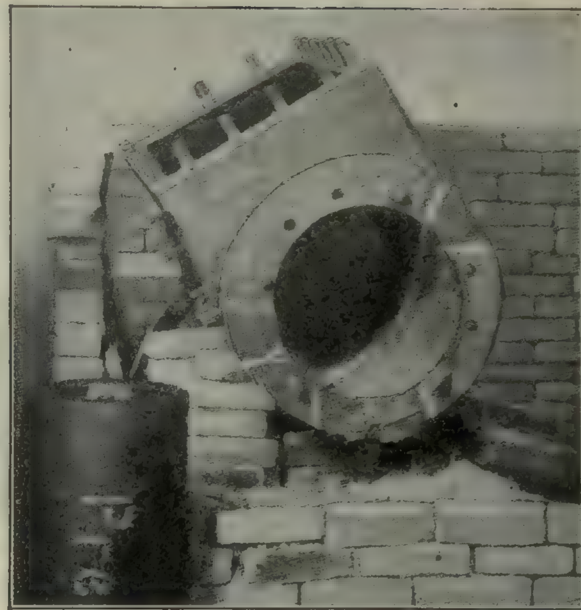


FIG. 204. THE CYLINDER AS WELDED

FIG. 207. WELDING AND PREHEATING

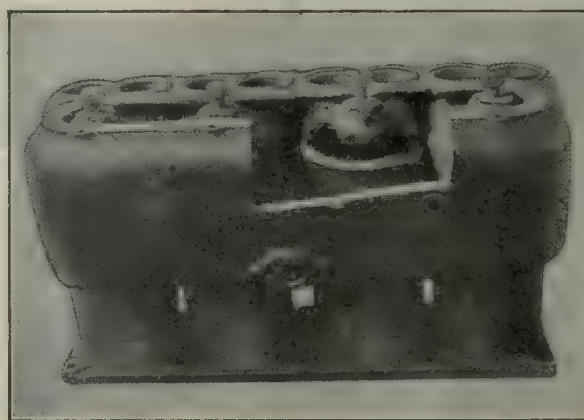


FIG. 205. BROKEN AUTOMOBILE CYLINDER

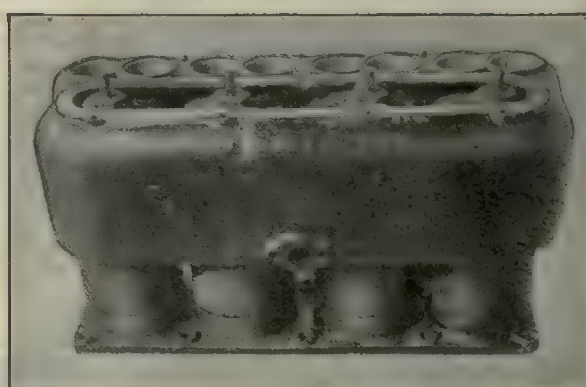


FIG. 206. THE FINISHED WELD

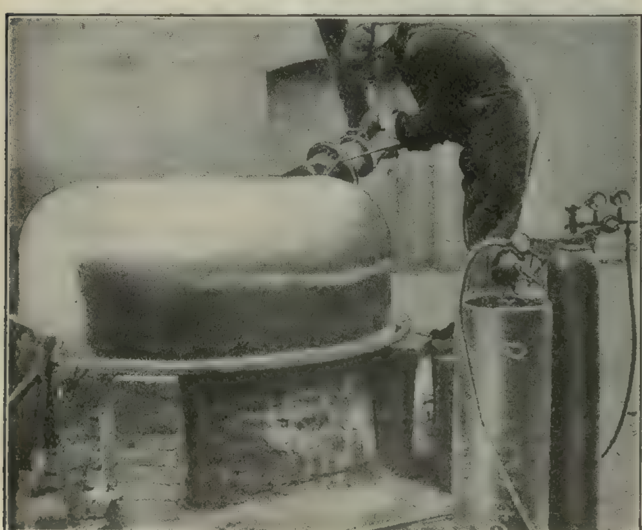


FIG. 211. PREHEATING AND WELDING A LARGE KETTLE

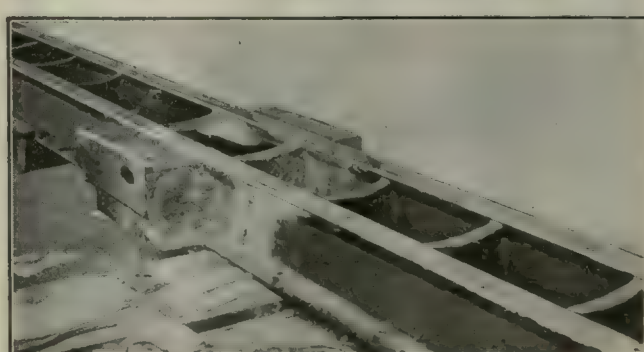


FIG. 213. WELD ON LARGE PLANING-MACHINE BED

205 and the repair, in Fig. 206. The actual cost to weld this job was less than five dollars. The method of procedure has been previously described.

In Fig. 207 a welder is shown working on a job while a helper is tending to the preheating of another. The method of welding through a hole in a large sheet of asbestos not only keeps the heat in, but protects the operator as well.

FIG. 217. BROKEN PRESS FRAME WITH BREAKS BEVELED

In Fig. 208 is shown a badly broken aluminum upper crank case and the repair. Work of this kind often comes to the shop that caters to the automobile trade. Another repair of interest to the garage man is shown in Fig. 209. The cost of putting in a new frame in this 5-ton truck would have been at least $600. The weld was finished and guaranteed for $25.

The welding of a tire for a 15-ton truck wheel, 10 in. wide by 2¾ in. thick, is shown in Fig. 210. The preheating was done in a large blacksmith's forge. In this connection, the welder must get out of his head a very common idea that preheating is only needed to take care of expansion and contraction. It is just as valuable in its way, for saving expensive welding gas. This is the reason for preheating the large tire, since its shape and nature precludes any expansion or contraction troubles provided the welder has even ordinary skill.

In the example shown in Fig. 211, which is a kettle 5 ft. 6 in. in diameter and 1⅛ in. thick, preheating is absolutely necessary in order to take care of the expansion and contraction. The crack was around the outlet and was 22 in. long. The welding time was 1 hr. 45 min., in addition to the time it took to preheat the kettle the required amount.

FIG. 218. THE WELDED PRESS FRAME

The welding of a 7-in. crankshaft for a 200-hp. internal-combustion engine, is shown in Fig. 212. The finished weld is shown in the insert. The work was finished and the crankshaft put back in service inside of 30 hr. The section of the shaft added was oversize to permit machining for alignment. Preheating in this case saved a considerable amount of welding gas. The improvised furnace also made slow cooling possible.

Welding Broken Machine Tools

The planing-machine bed, shown in Fig. 213, was cracked through on one side close to the housing boss. The job was finished without serious disalignment, but under ordinary circumstances such a repair would not be recommended unless means were at hand for refinishing the ways and possibly other machined surfaces. As a war-emergency repair, however, it proved satisfactory. The redemption of a similar casting, damaged while still in the rough, might also be a money-saving proposition in some cases.

FIG. 220. WELDING TEETH IN A LARGE GEAR

The punch-press frame shown in Fig. 214, outside of its size, does not offer any serious welding difficulties, as any possible distortion can be taken care of by subsequent adjustment. The welds made in this particular case were 12 in. in thickness, and the total time taken to get the press back in service was 38 hours.

The saving of defective castings may often prove a very important item to the shop management. In Fig. 215 is shown a lathe bed, weighing 900 lb., which came from the foundry with sand holes in the pan. These were easily filled up.

Another lathe bed, sand-cracked where the bed leg joined the pan, is shown in Fig. 216. The casting weighed 1,750 lb. and was saved from being scrapped by 27 min. of welding work.

A broken frame of a punch press is shown in Fig. 217. This frame was 4½ ft. high, 2½ ft. wide and from ¾ to 1¼ in. thick. It weighed 500 lb. The welder's time on the work was 8½ hr.; helper's time 8½ hr.: oxygen used,

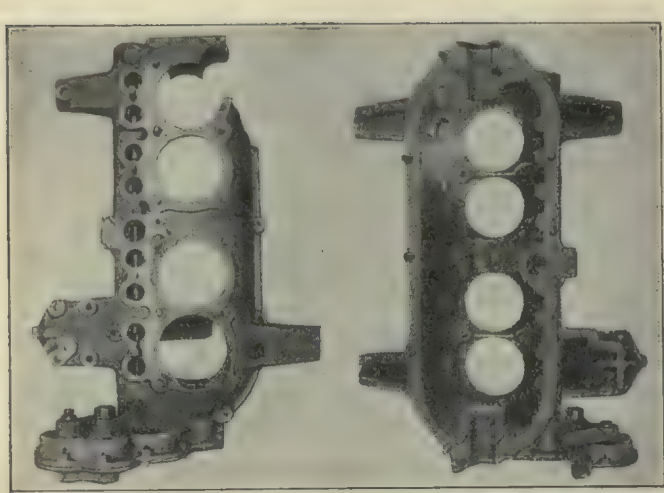


FIG. 208. BROKEN AND REPAIRED ALUMINUM CRANK CASE

FIG. 210. PREHEATING AND WELDING LARGE TRUCK TIRE

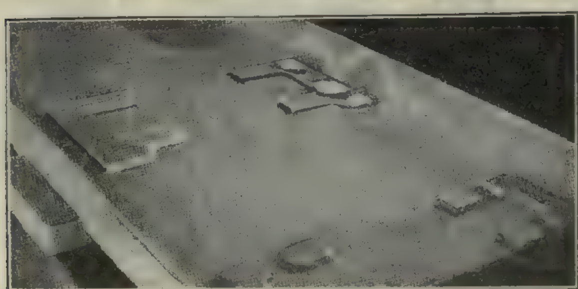


FIG. 215. WELDED BLOWHOLES IN LATHE PAN

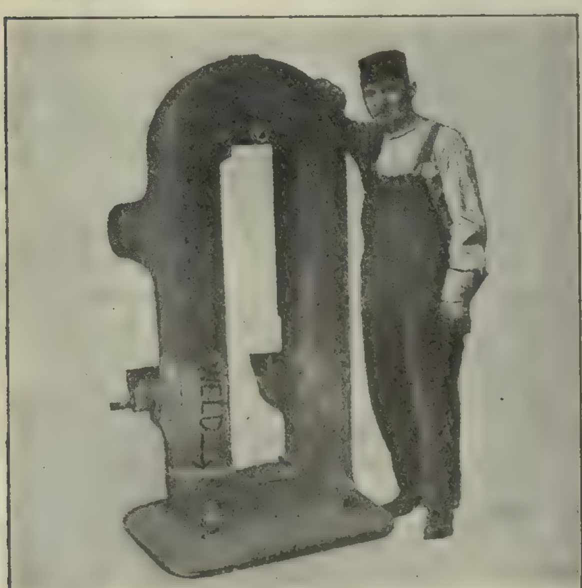


FIG. 219. ANOTHER WELDED PRESS FRAME

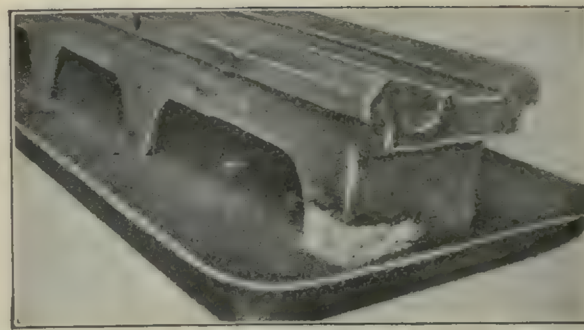


FIG. 216. WELDED CRACK IN LATHE BED

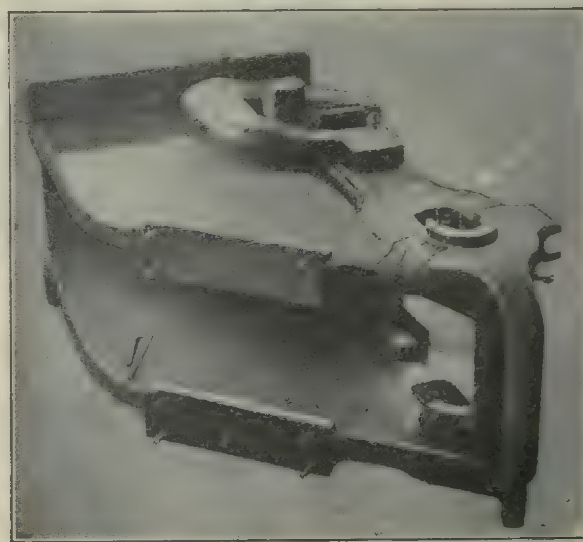


FIG. 214. BROKEN PUNCH-PRESS FRAME

FIG. 209. WELDING FRAME OF 5-TON MOTOR TRUCK

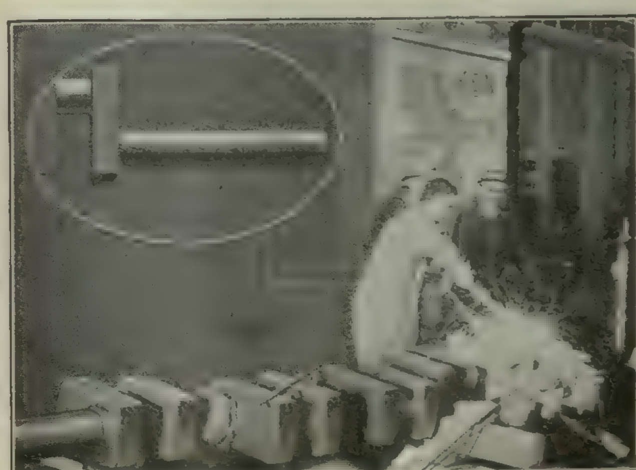


FIG. 212. WELDING A LARGE CRANKSHAFT

425 cu.ft.; acetylene used, 327 cu.ft.; cast-iron filler, 4 lb.; preheating, 4 hr. with gas at a cost of 60 cents. The total cost today can be computed by taking the present cost of labor and supplies and multiplying by the figures given. The finished job is shown in Fig. 218. An Oxweld torch was used.

A much simpler, and in fact almost an ideal piece to weld, is shown in Fig. 219. The frame is 12 x 12 in. at the break.

Ten teeth were broken out of the gear shown in Fig. 220. The gear was 8 ft. in diameter and the teeth 10 in. long, 3 in. high and 3 in. thick. It is seldom necessary to preheat in a case of this kind except to save gas, but care should be taken to keep the heat in as much as possible.

A practical man would at once question the advisability of trying to repair a pulley broken as indicated in Fig. 221. This pulley is 7 ft. in diameter and was completely welded in 12 places as indicated, and ready for service in 48 hr. The work was done so well that the rim ran practically true, except for about $\frac{1}{4}$-in. side play. This particular case was a war-emergency job, but sometimes such a repair job is of vital importance at the present time, for such a pulley can seldom be replaced by a new one without considerable delay.

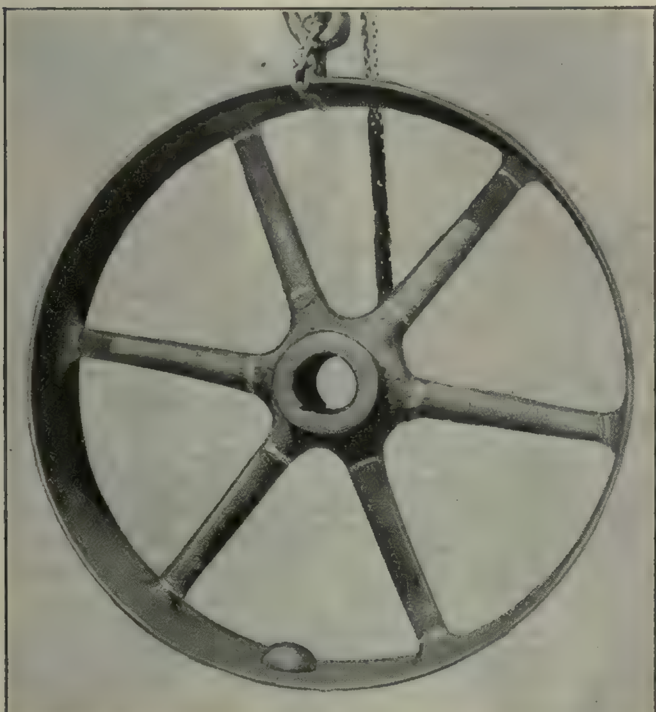


FIG. 221. A LARGE PULLEY WELDED IN TWELVE PLACES

In many instances broken locomotive frames may be quickly repaired with the gas torch without dismantling, and the engine put back into service in a short time. Such a repair is shown in Fig. 222. This job took altogether less than 24 hr. from the time the engine was run in until it was on the road again.

The gas torch is almost as useful for welding around a shipyard as it is in a railroad shop. Fig. 223 shows a 4-ton forged-steel rudder frame broken as indicated by the arrows. The break has already been beveled out for welding. The cost was about \$60 as compared with about \$1,400 for a new frame, and the time taken was a fraction of what would have been required to obtain a new one.

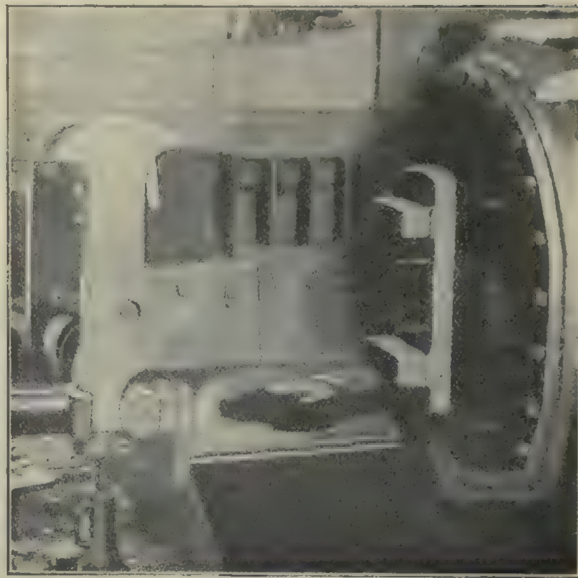


FIG. 222. A WELDED LOCOMOTIVE FRAME

On many large jobs, where considerable preheating has to be done, the discomfort of the welder may cause defective welds or even complete failure. Sometimes asbestos screens can be used; at other times it is necessary to shift welders every few minutes. Two suggestions that may be helpful in certain cases are here given. H. Howard suggests the use of an "air screen" as outlined in Fig. 224. A row of small holes is drilled in a pipe of convenient size to attach to the air hose. The other end of the pipe is closed. This contrivance is placed across under the torch and held by a clamp or a weight in such a position that a curtain of swiftly moving air passes between the hot casting and the operator. The device affords protection from the heat and does not interfere with the manipulation of the torch or obstruct the view of the operator.

This device, while useful for certain jobs, has disadvantages, as it does not follow the movements of the operator. J. R. Cumming suggests the one shown in Fig. 225. A $\frac{1}{4}$-in. air pipe is fastened to the gas torch by a light iron clip. The air pipe is connected by a light hose to the air supply. By the exercise of a little ingenuity in making this attachment, an operator can keep his hands and face reasonably cool on many jobs that would otherwise make him exceedingly uncomfortable.

The way to prepare seams in boiler and tank welds

FIG. 223. RUDDER FRAME READY FOR WELDING

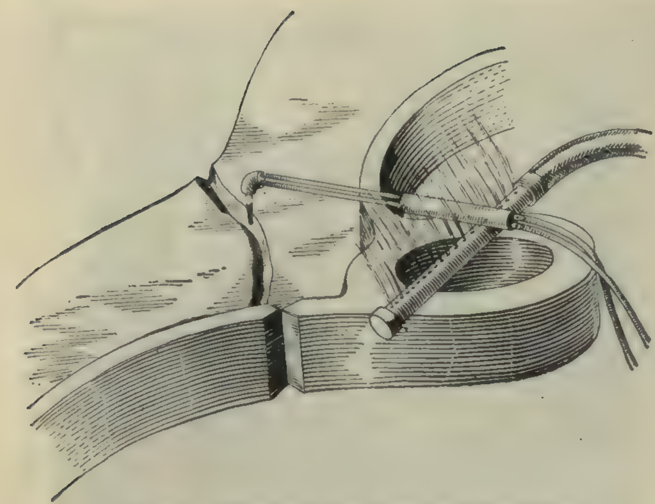


FIG. 224. COOLER FOR USE IN WELDING

FIG. 225. ANOTHER COOLING DEVICE

has already been shown, and only one example will be given. Fig. 226 shows a tank which in use has to stand a pressure of from 200 to 300 lb. It is 4 ft. in diameter and 5 ft. long. The shell is made of ⅝-in. plate and the dished bottom of ¾-in. plate. The longitudinal seam is welded, and the bottom welded to the shell in 6 hr., at less than the cost of riveting, and no caulking is needed

There have been extensive tests on the strength of gas-torch welds on boiler plate and the following results are given by the Oxweld Company:

No. of Specimen	Dimensions	Area in Sq.In.	Breaking Load	Stress per Sq.In.	Efficiency of Weld
1	1.522x0.393	0.598	25,130	42,000	84%
2	1.554x0.380	0.592	23,000	42,800	86.6%

This efficiency is figured on the basis of 50,000 lb. per square inch as the ultimate tensile strength of the material, elongation $\frac{3}{16}$ of an inch in 2 in. as welded, or about 9.3 per cent.

The average of a number of similar tests taken at random from a considerable list was 79 per cent.

FIG. 226. A WELDED TANK

A comparison between the cost of welding and riveting shows that up to certain thicknesses of plate, notably ⅜ in., welding is cheaper per lineal foot than riveting. On heavier material than this, however, the cost is usually about the same as good riveting practice.

FIG. 227. ELECTRIC RAILS AND WELDED ON BOND

The speed and cost per foot of welding with an Oxweld torch for different thicknesses of plate are:

Thickness of Metal, In.	Lin.Ft. per Hour Welded	Cost per Foot
⅛	20	$0.04
$\frac{3}{16}$	15	.06
¼	10	09
⅜	6.5	.23
½	6.0	.27
⅝	4.5	.35
¾	3.0	.60
1	2.0	1.20

This table is compiled from results obtained from actual shop practice. The price of oxygen is figured at 2 cents per cubic foot, acetylene at 1 cent and labor at 30 cents per hour. Other gas and labor costs can readily be substituted to meet any local conditions.

FIG. 228. BOND WELDING OUTFIT IN USE

Electric rail bonding, such as shown in Fig. 227, is very easily done with the gas torch. Fig. 228 shows a welder at work on a job of this kind. The apparatus used is mounted on a special truck so as to be easily moved along the rails from one joint to the next requiring bonding.

FIG. 229. BUILDING UP WORN PARTS OF LARGE PUMP

FIG. 230. WELDING PODS ON STEEL-MILL ROLLS

The filling up of blowholes, cold shuts and cracks in castings of various kinds is well known to most foundry workers, but the building up of worn or over-machined parts is not so familiar to the general run of mechanics.

A good example of the reclaiming of an expensive casting worn in service is shown in Fig. 229. This is the casing of a circulating pump. A strip of metal about 3 in. wide and $\frac{3}{8}$ in. thick had to be built up around the entire inside edge of the casting. The work was done by two operators working as shown. The added metal was then ground smooth enough for the purpose and the casing put back in service.

Building up worn pods on steel-mill rolls is shown in Fig. 230. A rough brick furnace is built around the end to be welded and charcoal used to heat up the work to save gas. The welding in this case was done with

FIG. 231. BUILDING UP OVER-MACHINED CHAIN LINKS

thermalene, but any good gas outfit may be used with goods results.

The large chain belt links, Fig. 231, were cut undersize on the corners and were reclaimed by building up as shown.

Aluminum automobile transmission or other castings often come through slightly defective. To recast them would mean a duplication of costs in cores, molds, han-

FIG. 232. FILLING BLOWHOLES IN AN ALUMINUM GEAR CASE

FIG. 233. BRASS RUDDER FRAME SALVAGED BY WELDING

dling and turning, which would mean a considerable loss. They are welded—the holes filled with similar metal from a "filler-rod" as shown in Fig. 232—at a cost of but a few cents each and they pass inspection as being as good as perfect castings.

Through error four cast-brass U-plates for rudder frames, Fig. 233, weighing 1,000 lb. each, were made 6 in. too long.

To repour these plates would have held up some important work and the expense, including change of pattern, would have been very high. The mistake was quickly and economically corrected by cutting 6 in. out of each as shown by the illustration and welding the frames together again.

Machining Rudders for Troopships

By ALBERT FISCHER

In the building of ships during the late war, emergencies arose that necessitated the production of certain complete components at places far distant from the point of their assembly. In this article the author tells in detail some of the methods used in making the cast-steel rudders for 8000-ton troopships in a shop located more than 350 miles from the yard where they were built.

THE rudders for the 8000-ton, Class B troopships built at Hog Island, Philadelphia, Penn., were steel castings, each rudder being composed of two castings, an upper and a lower riveted together. The machine work on both parts of the rudders was done at the plant of the Turner-Fricke Manufacturing Co., Sharon, Penn.

The first operation on each of the parts was to place them on layout tables and line them up in the usual way to determine whether they were straight and would finish to the dimensions called for at the places to be machined. If they were all right, the customary lines were marked on them for the guidance of the workmen in future operations. The upper half was mounted on a large floor boring and milling machine, Fig. 1, and the surface milled off, leaving the long key or tongue *A* an integral part of the casting.

The hole for the rudder stock was bored taper at the top of the casting and straight at the bottom, and as the tapered part was on the other end it was necessary to reset the casting for this operation. As the machine used for facing the joint was already set up for that operation, and as another like machine was included in the shop equipment, it was deemed best to transfer the work to the second machine for the boring operation and use the first machine, as set up, for machining the joint on the same part of the next rudder.

The set-up for boring the rudder-post hole is shown in Fig. 2. This operation also includes counterboring for the spacing ring, machining the seat for the nut and laying out the center bore for the keyway. Fig. 3 shows the boring machine and the bar used.

For cutting the keyway, the work was placed on a large floor plate, Fig. 4. A planing fixture was inserted and clamped in

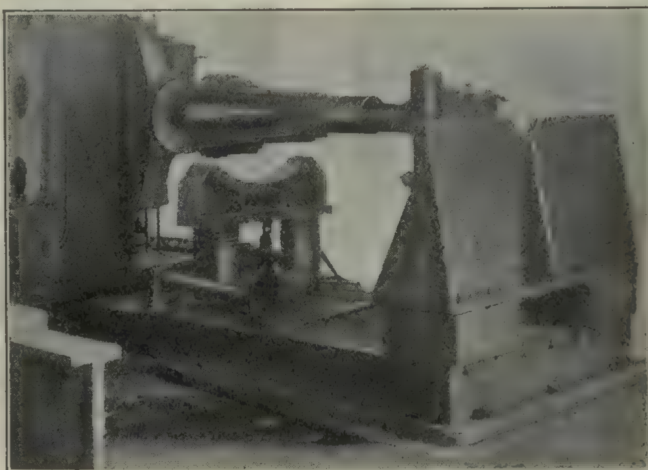


FIG. 3. THE MACHINE AND BAR FOR BORING THE RUDDER-POST HOLE

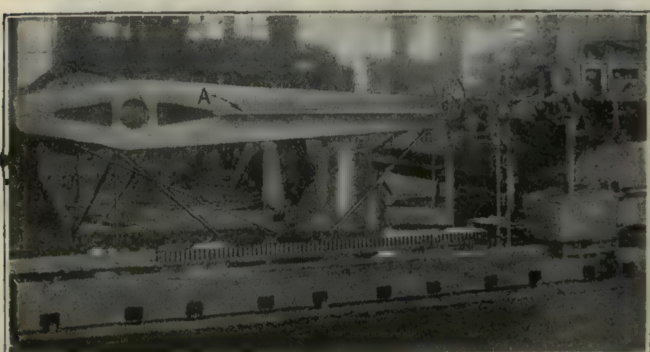


FIG. 1. MILLING THE UPPER HALF OF THE RUDDER

FIG. 2. SET-UP FOR BORING THE RUDDER-POST HOLE

FIG. 4. RIG FOR CUTTING THE KEYSEAT

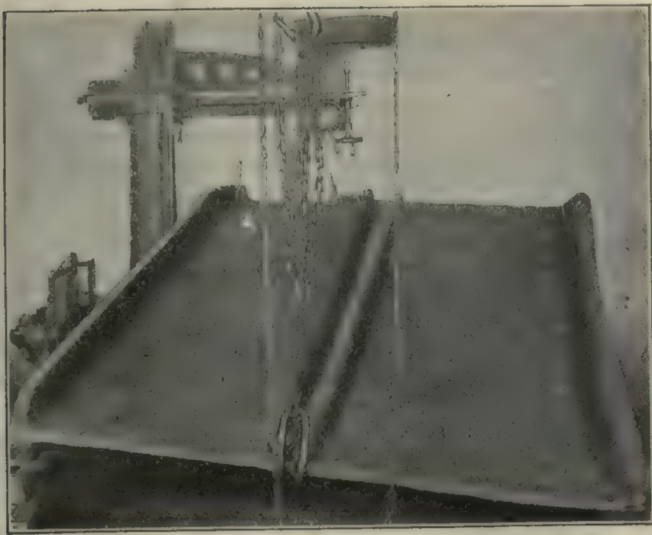


FIG. 5. DRILLING FOR THE COVER PLATES

the hole, and the tool-carrying ram driven from the platen of a 24-in. planing machine placed in the rear, connection for driving being made between the two by a rod.

As cover plates to protect the nut were required and were to be attached with thirty-two $\frac{3}{4}$-in. Navy-bronze screws, a further operation of drilling and tapping was necessary. This was done in a radial drilling machine as illustrated in Fig. 5, in which one of the cover plates can be seen at *A*.

Drilling and Countersinking

Drilling and countersinking the eighty $1\frac{1}{4}$-in. rivet holes in the flange was done in a radial drilling machine, Fig. 6, in which the jig used is shown at *A*. This jig is also used for drilling the lower half of the rudder, being made reversible for that purpose. As the casting was too high to go under the arm of the drilling machine, a pit of the necessary depth was dug alongside and the casting lowered into it.

The lower half was laid out, as previously described, and the joint machined on a 60-in. planing machine. As this machine was not wide enough to allow the work to pass between the uprights, one of them was removed and the end of the crossrail blocked up. Planing was done by the side head attached to the upright that was left in position.

The whole arrangement will be apparent from a

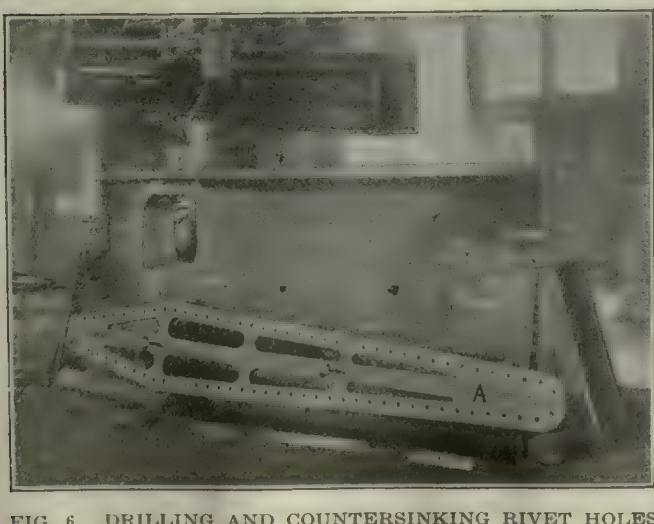


FIG. 6. DRILLING AND COUNTERSINKING RIVET HOLES

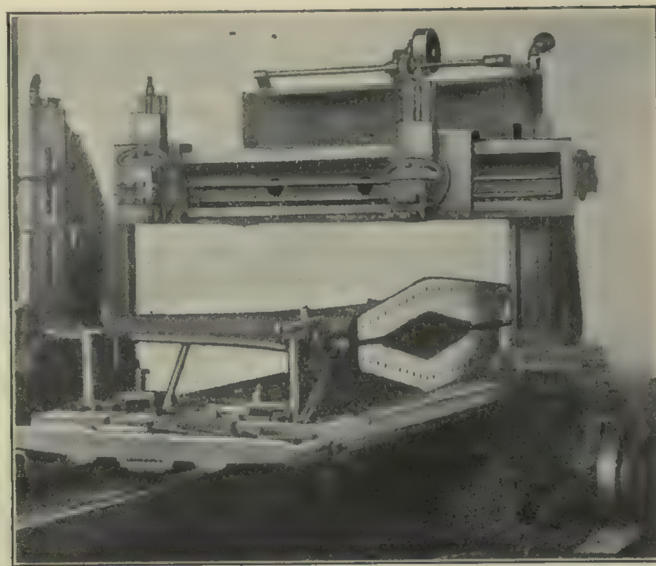


FIG. 7. PLANING THE LOWER HALF OF THE RUDDER

glance at Fig. 7. Other operations on surfaces to fit the upper half of the rudder are the same as performed on that part and need no further description.

Referring to Fig. 8, the rudder is here shown assembled for inspection. The lower half was stood up in a pit provided for the purpose and after being leveled by the machined surface was braced by the adjustable struts as shown. The upper half was placed in position and the two parts bolted together with bolts through the rivet holes in the flanges.

A plumb line was dropped through the rudder-stock hole and centered by spiders in the usual manner. This was used to check the squareness of the machined surface in relation to the hole. A straight-edge long enough to extend over both ends of the rudder was then

FIG. 8. THE RUDDER ASSEMBLED FOR INSPECTION

placed on the top and centered by the hole. Plumb lines were hung from each end of this close to the casting. This was used to check the alignment of the two parts and to show if the rudder would hang plumb within the requirements. Finally the gage *A*, Fig. 8, was put in the hole to check both the taper and straight holes as well as the size and position of the keyway.

For convenience in handling, the rudders were shipped in two parts and riveted together after they arrived at the shipyard.

Day-Work *versus* Piece-Work

By W. D. Forbes

Not long ago a man said to me, "Smith's shop is run on the day-work plan and he tells me that for the last year he has turned out more work that way than he would have done had he been doing piece-work." Now, I am not well acquainted with Smith's shop, but I know that it is a manufacturing proposition; in other words, the work is repetition production, and I am sure that while the men are paid by the day they are, as a matter of fact, doing piece-work camouflaged.

If I were to go to that shop I know I would find that while there might be no piece-work there would be a very clear understanding that the work on the various parts to be made must not take longer than a certain amount of time, and if a workman did not get out the work in the prescribed time he would not stay in the employ of Smith.

The difference between making and manufacturing is too well understood to be discussed here, as far as the actual work goes, but the real difference is shown in the balance sheet. That is, "making" is a proposition that may or may not be profitable, and whether it is or not is generally not known until too late. On the other hand, "manufacturing" on a piece-work system allows the balance sheet to show if a profit will be made or not. To put it in another way, piece-work gives a known condition while day work makes for uncertainty.

Of course, if work is being done for a customer at day-work rates then the amount of work done by the men will, or should, show a profit, but a day-work system for manufacturing is just as bad as the absurd "cost-plus" idea that our Government entered into during the war. The assertion that Smith's shop was doing better than it had been, does not by any means mean that the shop was doing a fair amount, nor does it follow that it would not do better if the piece-work system was introduced and properly carried out.

The unions object to piece-work on the mistaken ideas that a man will work so hard under the system that he will break down early in life, and that in doing a big day's work he puts someone out of a job.

In some trades there can be no doubt that a man can overexert himself to his permanent injury, but in the machinist's trade this is not possible. Physical effort is not necessary in machine-shop work today; yet there is a very clear effort to make people believe that because a machinist turns out a lot of finished work in a day that he is all tired out.

No matter how hard a machine tool works, the runner of it does not have to turn a hair. Sitting or standing at a lathe or planer takes a certain amount of strength, but for a man in good health the only strain is that of monotony, and we can not get entirely away from fatigue if we have to work for a living.

The real objection to piece-work can not be fairly laid at the door of the workman, but rather to the outrageous conduct of short-sighted proprietors who have constantly cut the piece-work prices, even when an agreement had been entered into that no cuts would be made, and this naturally engenders a feeling in the heart of the workman that he will not get fair treatment. Conditions often arise to make it absolutely necessary to reduce piece-work prices, and in such cases I have found workmen perfectly willing to accept a change. They do so, however, always with the feeling that they could not hope for fair consideration if new conditions were to arise which would justify an upward change. It is always a downward change for the workman, so as a matter of precaution he keeps some force in reserve to use when it comes to a pinch. With this feeling it is evident that no peak production can be obtained and maintained. I will assert that no manufacturing shop, run as Smith's shop is run, is making its proper output.

Charts for Design of Tension Bolts and Screws

By George W. Childs

Referring to the article under the above title by Captain H. M. Brayton on page 890, Vol. 51, of the *American Machinist*, I do not agree with the Captain's statement, "I believe the chart shown in Fig. 2 should be on every engineer's desk." It would be interesting to me to know how many designers and engineers will follow his advice and make one. I believe that the majority of men in the above professions can compute mentally close enough for all practical purposes the total load a bolt will withstand, knowing the fiber stress of the material in pounds per sq.in. of which the bolt is made. I am also of the following opinions:

1. That a majority of the men in the professions named carry in their gray matter the number of threads per inch for each size of bolt generally used in machine construction.

2. They know that the depth of a U. S. standard thread is equal to three-fourths of the pitch of the thread.

3. Knowing the above they are capable of computing quickly and close enough for nearly all purposes the diameter at the bottom of the thread.

4. They also know that the diameter at the bottom of the thread is equal to the diameter of the bolt minus (approximately) 1.3 $\times$ pitch of thread.

5. They know how to compute the fiber stress per square inch to which the material will be subjected, having the diameter at the bottom of the thread and the total load that the bolt will have to withstand.

6. If they cannot do any or all of the above mentally, quickly and close enough for all purposes, they know that nearly every engineer's handbook contains tables of bolts and nuts in which the diameter at the bottom of the thread is given and the rest is easy.

I believe the majority of draftsmen, designers, etc., have among their data sheets a blueprint table of U. S. standard bolts and nuts in some form or other which gives the information referred to.

[The author is in error in his statement that the depth of the U. S. S. thread is three-fourths of the pitch. It is equal to the pitch $\times$ 0.64952.—Editor.]

US ARMY ORDNANCE NEWS

Machining Problems Solved in Gun Making—IV

By J. V. HUNTER
Western Editor, *American Machinist*

As gun designers have not held to generally accepted forms of machine design in working out breech mechanisms, the ideas that toolmakers have gained from experience with standard machinery parts need radical revision to conform to these peculiar shapes. The fixtures used in this shop look simple after they are constr·icted, but all the problems were not easy of solution.

(Part iii appeared in our January 15 issue)

THE reader will gain a better knowledge of the production demands for some of the breech mechanism parts of the 4.7-in. rifle, model of 1906, if these are briefly described. The views, Figs. 53 and 54, are therefore given to afford a general idea of the appearance of this portion of a modern gun mechanism when the breech is respectively open and closed. Fig. 53 shows the operating lever *A* which closes the breech when swung to the left. After the block carrier *B* has been closed against the breech face of the gun, a trip block is released which permits the operating lever to swing still further to the left. As it does so, the pinion *C* on the inner end of the lever works on a bevel sector on the rear of the breech block *D* and causes it to revolve one-eighth of a turn until the interrupted threads are completely locked in those of the gun breech. While the gun stands open, the loading tray *E* lies on the breech threads for protection against bruising, but when the breech is closed the key *F* is tripped and the loading tray revolves with the breech block and occupies a space in the sectors.

The lanyard end of the trigger shaft is shown at *A*, Fig. 54, and the shaft itself extends up through the firing-mechanism housing *B*. The outer end of the shell-case extractor *C* is pivoted so that it knocks out the shell case when the breech has been swung far enough open to bring the lug *D* in contact with the outer end of the extractor, thus causing it to swing on its pivot. A more complete view of the breech mechanism is shown in Fig. 55, and this is supplemented by Fig. 56, which shows the block carrier at the right and the breech block at the left. The bevel sector by which the latter is rotated by the operating lever appears at the bottom.

The other main parts contained in the breech mechanism are shown in Fig. 57. Two sides of the operating lever *A* are shown, and as this is shaped from a solid forging, the great amount of work required for its completion can be imagined. The loading tray *B* shows the convex surface which lies next to the gun body; next to this is the trigger shaft *C*; the hinge pin *D* connects the block carrier to the gun body. Other

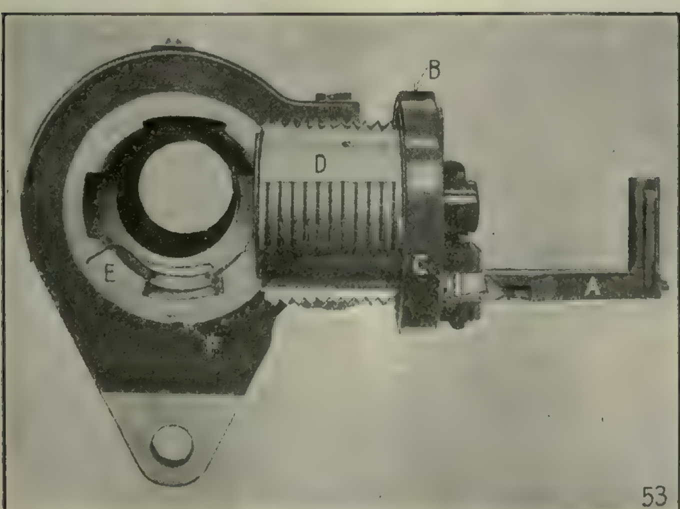


FIG. 53. VIEW OF OPEN BREECH OF GUN

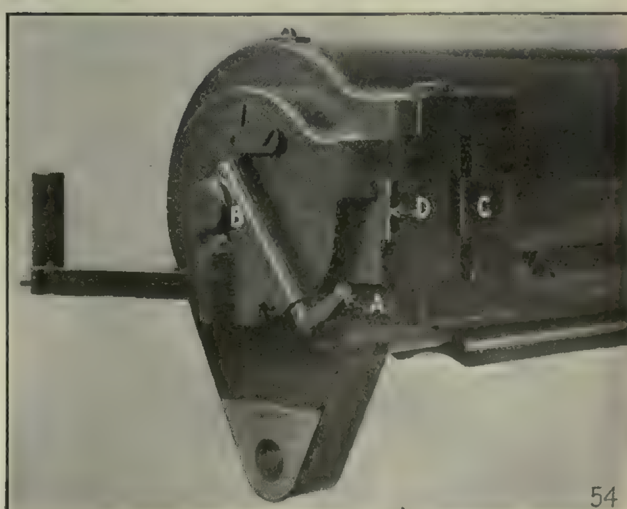


FIG. 54. GUN WITH BREECH CLOSED AND LOCKED

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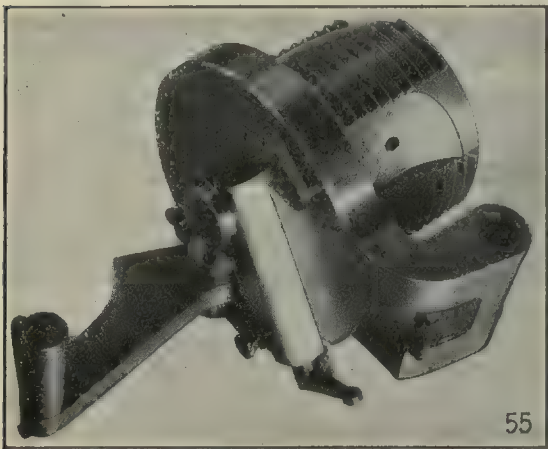

FIG. 55. BREECH BLOCK AND MECHANISM

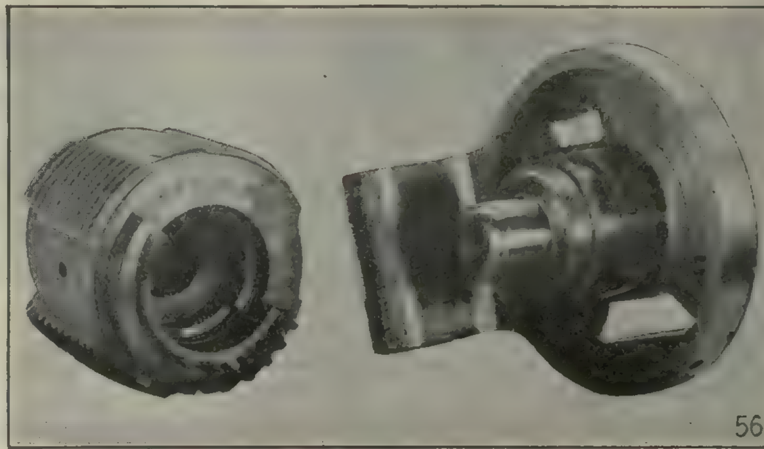

FIG. 56. BREECH BLOCK AND BLOCK CARRIER

parts are the extractor *E*, which shows its pivot trunnions; the lever catch *F*, which locks the operating lever, and the firing lock case *G*.

The small parts used in the mechanism are all included in Fig. 58. Among them *A* is the vent bushing; *B*, the lever-catch pivot; *C*, the lever catch; *D*, the block latch; *E*, the firing pin; *F*, the operating-lever pivot; *G*, the pallet; *H*, the block-stop support; *I*, the lever-catch screw; *J*, the tray latch; and *L*, the firing-pin spring. Some of the other parts shown are, *M*, the firing pin sleeve; *N*, the trigger fork; and numerous small springs and screws used in the assembly.

The locking hoop comes to the shops of the Northwestern Ordnance Co. as a roughly machined forging, Fig. 59, and the early operations on this part are to fit it for shrinking on the gun body. These operations

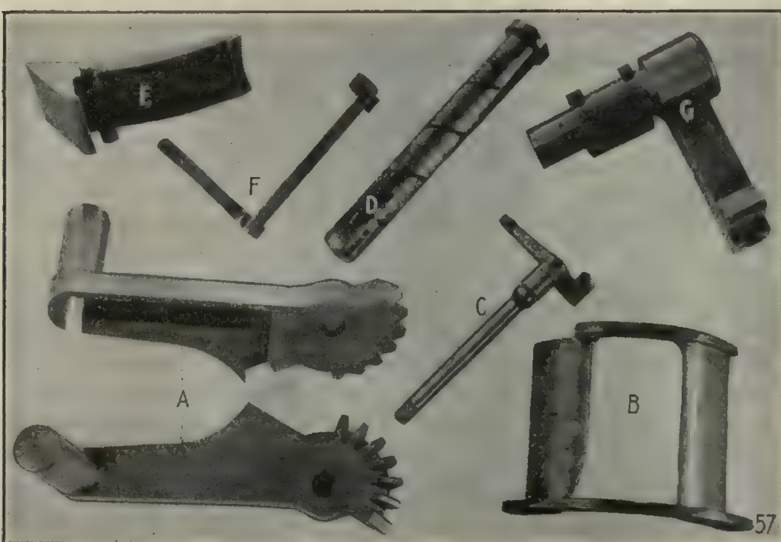

FIG. 57. OPERATING LEVER, LOADING TRAY, FIRING LOCK CASE AND LARGER PARTS OF MECHANISM

FIG. 58. SMALLER PARTS OF BREECH MECHANISM

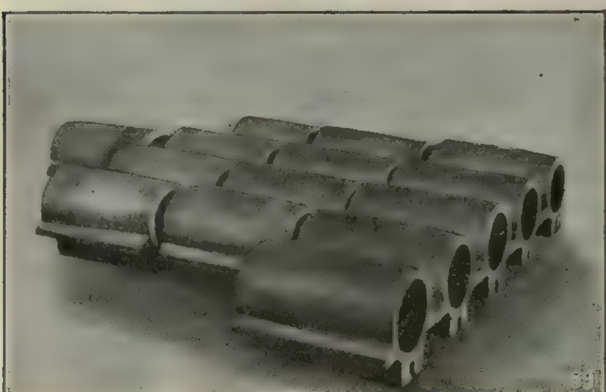

FIG. 59. THE ROUGHLY MACHINED LOCKING-HOOP FORGINGS

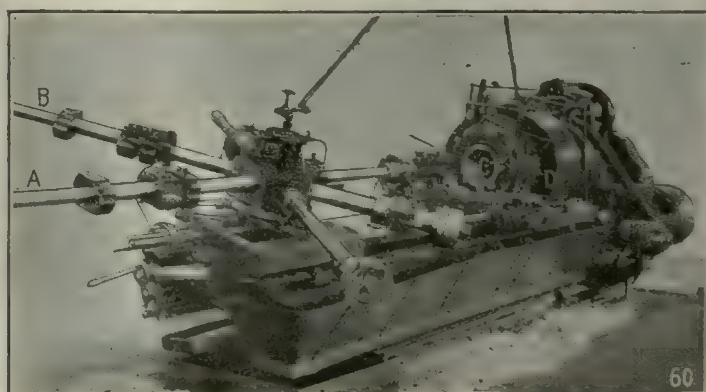

FIG. 60. GISHOLT TURRET LATHE FOR FINISHING BORE OF LOCKING HOOP

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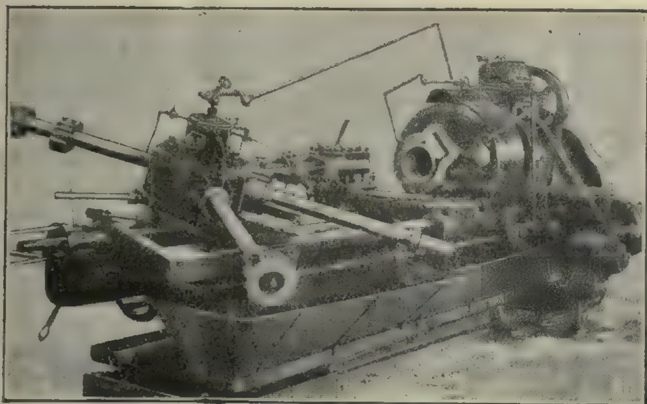


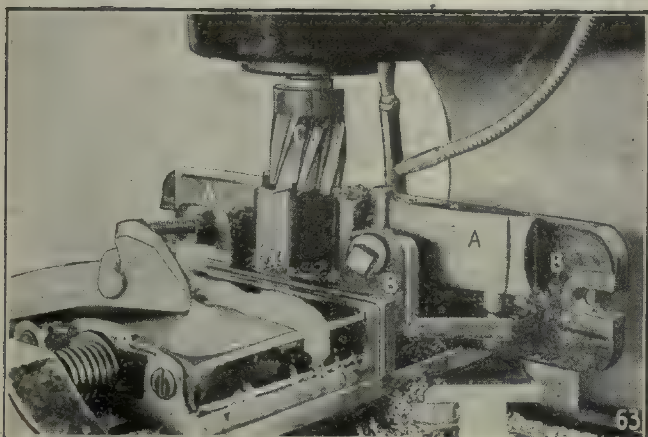


FIG. 61. TURRET LATHE FOR OPERATIONS ON FRONT CLIP. FIG. 63. MILLING SIDE OF EXTRACTOR

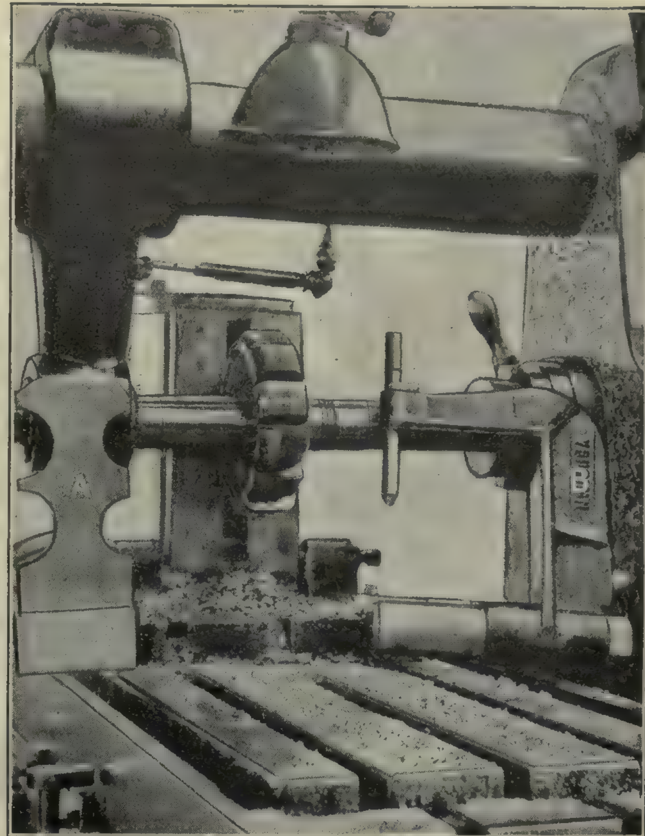
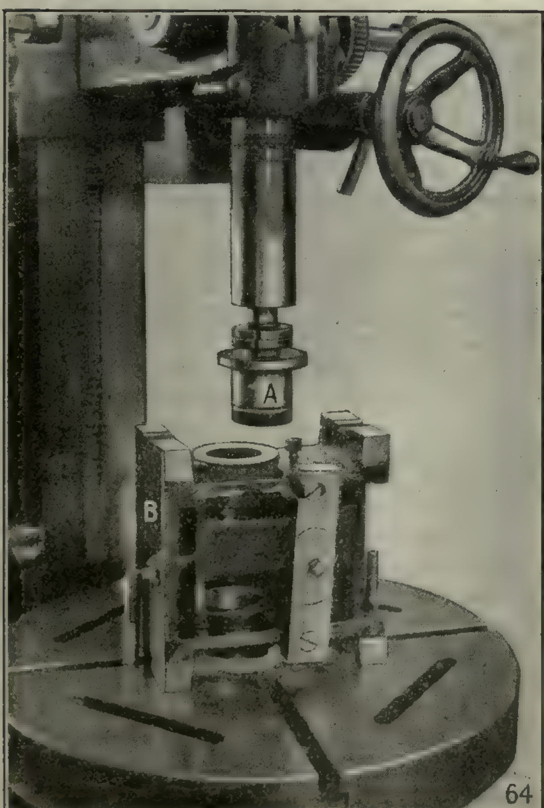


FIG. 62. MILLING GROOVE IN BASE OF FRONT CLIP



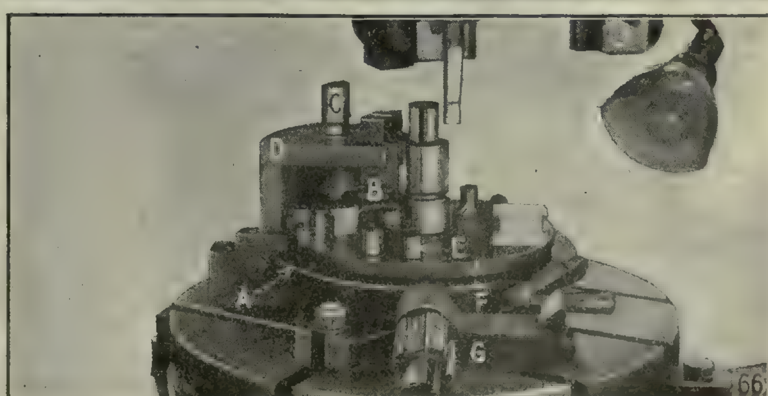


FIG. 64. END MILLING TRUNNIONS ON EXTRACTOR SIDES. FIG. 65. TURRET LATHE SET-UP FOR OPERATIONS ON FIRING LOCK CASE. FIG. 66. INDEXING DEVICE FOR FINISH SLOTTING OF SECTORS OF FIRING LOCK CASE

ARMY ORDNANCE NEWS

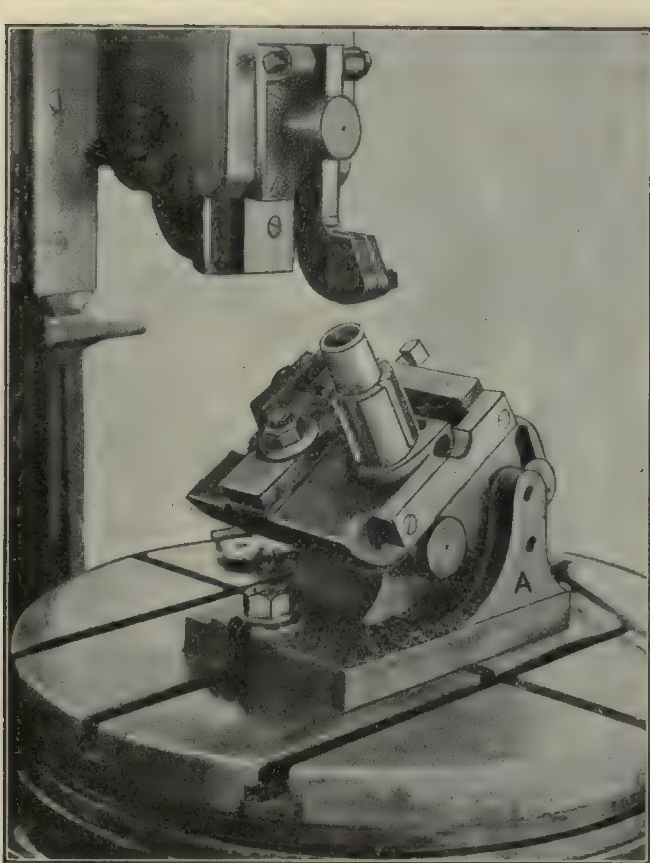


FIG. 67. TILTING FIXTURE FOR HOLDING CASE ON TABLE OF VERTICAL SLOTTER

are completely finished on the Gisholt turret lathe, Fig. 60, which is shown with the complete set of boring bars and tools set up in its turret. Even the very accurate flat thread by which this part is held to the gun body is produced in this setting and is cut by the two tools *A* and *B*. This forging is approximately 20 in. long and it is necessary to hold it in the special pot-chuck *C*, which runs in the cat-head ring *D*. After this part has been shrunk on the gun body, the machining operations to finish it are considered as a part of the machining of the whole gun body.

The Work on the Front Clip Forging

The work on the front clip forging is very similar to that on the locking hoop and is done in a Gisholt turret lathe using the set-up shown in Fig. 61. After the lathe operation, a heavy groove is milled in its lower face in the manner shown in Fig. 62. It will be noted that there are two gages *A* and *B* used in connection with this work.

The extractor forging *A* is held in a special fixture *B*, Fig. 63, and the sides finished to the trunnion by means of an end-mill *C*. A later operation on these trunnions finishes them with the hollow-mill *A*, Fig. 64, in a Cincinnati-Bickford drilling machine. The box-like fixture *B* holds the extractor forging during this operation.

The firing lock case, which comes as a heavy rough forging, is machined on its face, turned and bored on the Gisholt turret lathe. Fig. 65 shows the complete set-up of tools used in the turret for completing this operation. After a series of minor operations the sectors are milled, but as the milling cutters must clear, it is necessary to finish the lower portion of these sectors on a vertical slotting machine which is shown in Fig. 66.

This operation uses an indexing type of fixture *A* which holds the piece partly in a recess and which is clamped down by the piece *B*. The indexing is accomplished by a hollow pin *C* which passes down through the bracket *D* and slips over the studs *E* in the top surface of the plate *F*. One of the finished parts is shown lying on the machine table at *G*.

Another slotting operation on the same part is illustrated in Fig. 67, which shows the method of mounting the forging in a special tilting fixture *A*, so arranged that it can be set at the several angles required.

Gloves Withstand High Voltage

Some day when you are walking along a "main-traveled" road where traffic is piled back as far as one can see and linemen are repairing a broken wire, stop and watch them work. The gloves they wear tell a unique story. Probably the line they are handling is "alive," and carrying electric current enough to cause instant death; yet they pick it up, twist it, splice it as nonchalantly as though handling fishing tackle. They are able to pick up the live wire because of the rubber gloves they wear.

Did you know that these gloves are today made according to rigid specifications completely standardized and that no purchasing agent dare buy rubber gloves until he has thoroughly tested them? No glove can be marked with the manufacturer's name or with the size in such a manner as to injure it in any way. The gloves must each be more than 14 in. long and the average thickness not less than 0.06 in. They must have a tensile strength of 1,200 lb. per square inch and bear having 2 in. of their surface stretched to 12 in. without a rupture. The gloves must be capable of withstanding the application of 18,000 volts without puncturing.

The dielectric test is made by immersing the glove in a pan of water with the glove nearly full of water. The water inside and outside of the glove forms the electrodes. These are conveniently connected to the testing transformer by means of a chain suspended within the glove and by direct connection to the retaining vessel.

After the gloves are purchased, rigid inspection is insisted upon; they are subjected to periodic high-voltage tests weekly or monthly, cleaned with soap and water and stored in cold, dark places. They are marked by serial numbers and their history kept.

Should one of the linemen you have been watching puncture his gloves, death may result. The perfection of linemen's rubber gloves is one of the silent romances of the electrical industry. They are as important in the day's work as the steel helmet in battle. Today linework is a hundred times safer than formerly, for now when a line is deadened the switch is usually of the modern safety-inclosed type and no other person but the man on the line holds the key that locks the disconnected switch.

Quantity Production of ABC Washing Machines

BY J. H. VINCENT

This article is descriptive of a modern plant that is devoted solely to the production of labor-saving machines for household use. Some of the methods of production, together with many of the jigs and fixtures used, are illustrated and described.

ONE of the manufacturing industries which has made very rapid strides during the past two years has been built up about the production of labor-saving machinery for household use.

The Altorfer Brothers Co., Peoria, Ill., manufacturer of washing machines, has recently occupied a large new factory. This factory is remarkable for the excellence of the lighting facilities afforded, which the reader may judge from the fact that nearly all of the views used in the illustration of this article were taken on a cloudy day; sometimes while rain was falling outside,

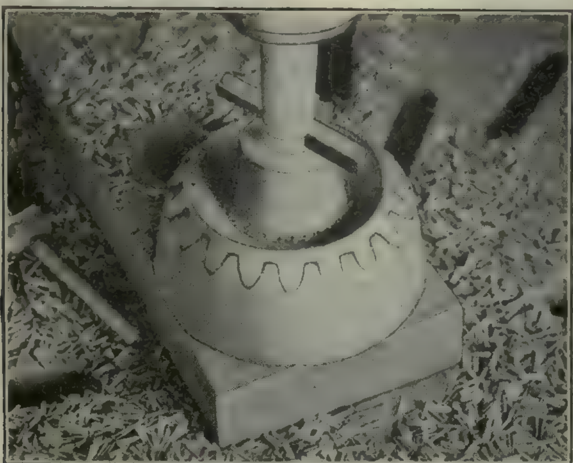


FIG. 1. FACING OFF HUB OF BEVEL GEAR

and even then with unusually short exposure for interior work.

Most of the material to be used in the construction of the machines is received at the farther end of the shop, where it is sorted, counted, inspected and stored in bins. Some of the castings require grinding in addition to that received at the foundry, and this work is taken care of by a convenient grinding department.

To some extent possibly the rapid machining of parts is due to the simplicity of many of the fixtures which are used. As an example, take the bevel gear for the wringer drive, Fig. 1, which at a previous operation has had its hole drilled. In the operation shown a matrix jig is used for holding it while the hub is being faced. A similar method was used in jigging this when the hole was drilled.

The parts of the machines are designed with a view to keeping the machining operations at a minimum, which proves a great aid in the reduction of manufacturing cost, and the consequence is that the majority of the operations are handled on drilling machines. Single-spindle drilling machines are used in most instances and with these are used jigs which have been designed for permitting rapid placing and removal of the work.

Another simple jig for holding a cast gear blank while its hub is being drilled and reamed is shown in Fig. 2. This utilizes a three-jaw chuck, the jaws *A* of which have a small movement controlled by a cam and operated by the hand lever *B* at the right.

More complicated castings require box jigs such as shown in Fig. 3, the work *A* being the base of the gear reduction box. Pulling out one of the pins *B* releases the clamp *C* so that it may swing down pivoting on the other pin *D*, enabling the work to be inserted or removed. When in position the work is clamped by the screw *E*. Two holes are to be drilled, as will be noted, and angle irons *F* have been clamped to the table of the drilling machine so that the jig may be slid back and forth to bring either one of the bushings under the drill. Another box jig, Fig. 4, for holding a casting of irregular outline is handled in the manner similar to that just described.

Gang drilling machines are used where it is possible for the operator to take care of more than one spindle at a time, one of which is shown in Fig. 5, drilling connecting-rods. Three-lip drills are used, together with a very simple form of jig. A gang drilling machine, Fig. 6, is shown using hollow mills for machining the bosess on the end frames of washing machines.

OTHER MACHINING OPERATIONS

As has been pointed out, the drilling operations make up the majority of the work and the lathe operations are in the minority. One of the lathe operations, Fig. 7, boring a large bearing hole in a bracket, shows the box form of fixture for holding the work, while the boring bar and finishing reamer are shown on the revolving turret. Cut gears are used in the majority of cases for the reduction and transmission of power through the machine.

One of the operations is in connection with the segment used for the reversing motion on the barrel in the interior of the washing machine. This segment is less than one-quarter of a circle and the periphery and sides are finished by milling in the machine shown in Fig. 8. In holding this casting its hub is slipped over an arbor *A*, while, at the same time, a finished lug *B*

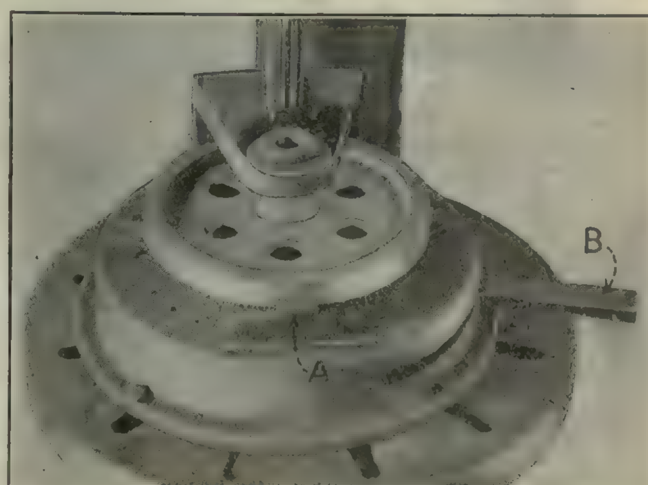


FIG. 2. JIG FOR CENTERING GEAR WHEEL

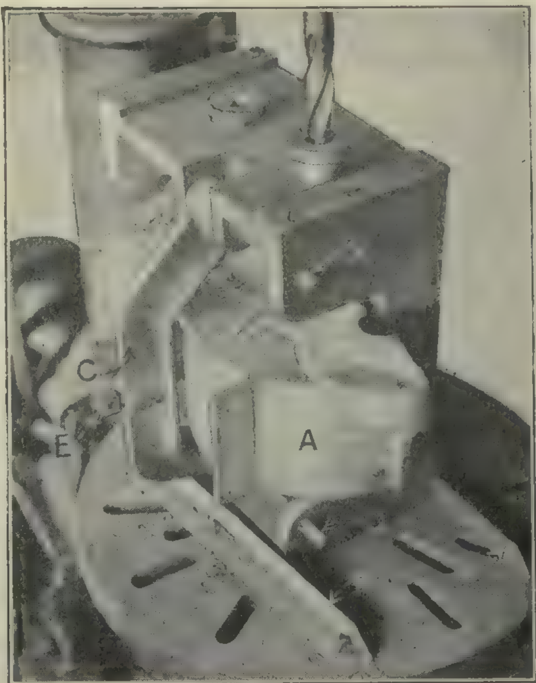


FIG. 3. DRILLING MAIN GEAR CASE

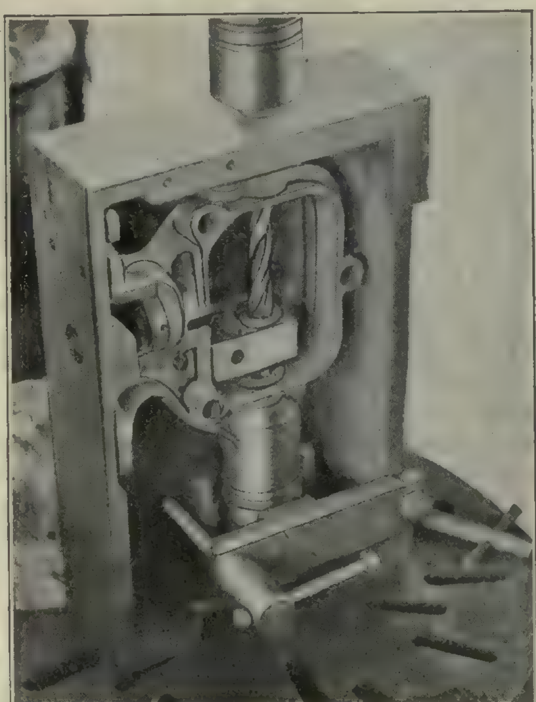


FIG. 4. JIG FOR DRILLING WRINGER-GEAR HOUSING

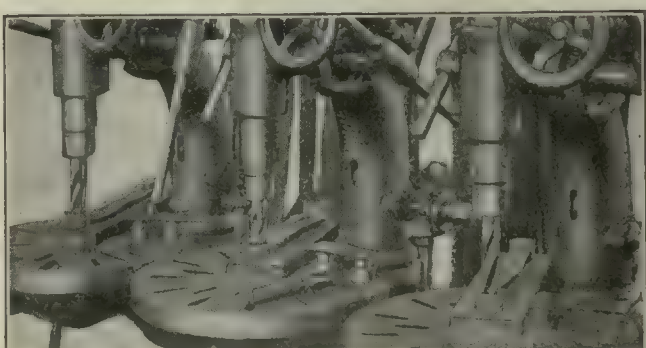


FIG. 5. FINISHING HOLES IN CONNECTING-RODS

FIG. 6. HOLLOW-MILLING HUBS ON MACHINE FRAMES

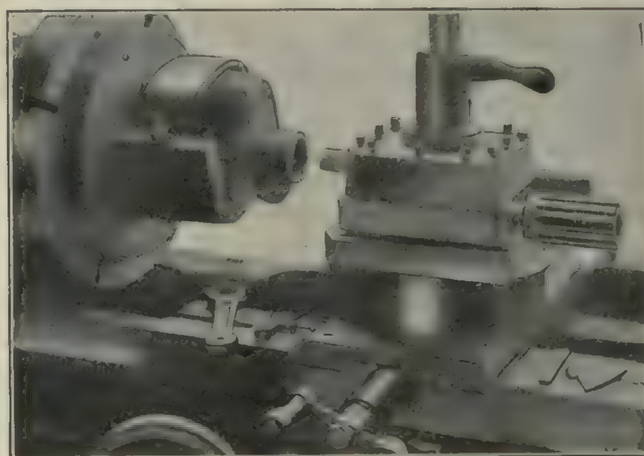


FIG. 7. SIMPLE TURRET LATHE OPERATION

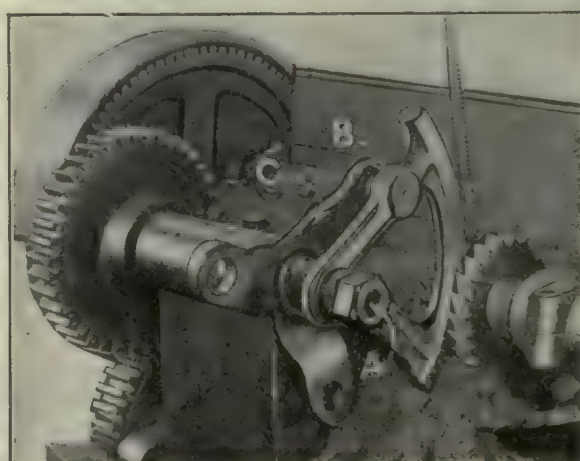


FIG. 8. FINISHING OUTSIDE OF ROCKER-ARM GEAR

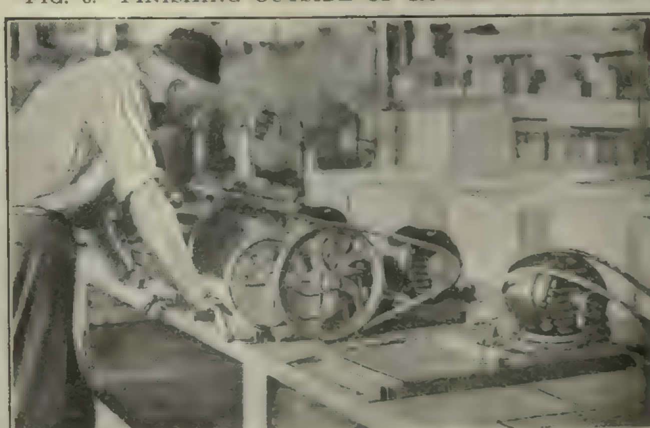


FIG. 10. TESTING GEAR-REDUCTION UNITS

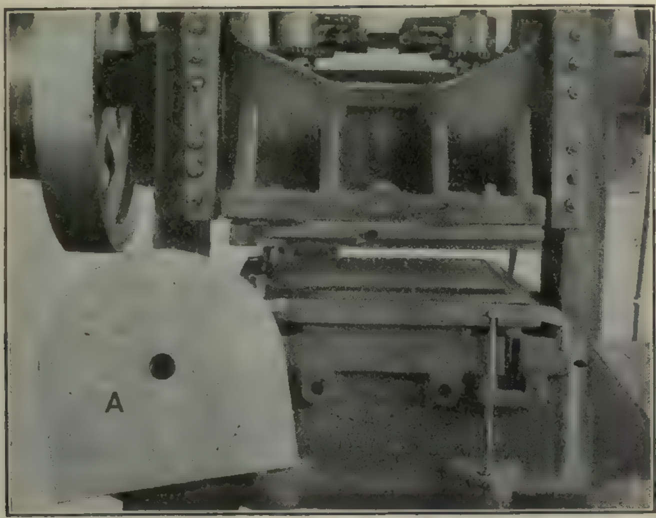


FIG. 9. MACHINE FOR BLANKING AND FLANGING TUB ENDS

on one of its arms slips into a hole which is provided in the three-arm spider *C*.

The frames used for the construction of the washing machines consist almost entirely of sheet-metal sections which are riveted together. The punching of these sections in quantity is done by a Williams & White multiple punching machine. The sheet-metal work is also handled under heavy presses and the Toledo press, shown in Fig. 9, is set up with the necessary combination die for blanking and drawing the flange on the ends *A* of the tubs.

Assembling Operations

The assembly of all small units is completed before they pass along to the main assembly station, and such units as the gear-reduction device shown in Fig. 10 are assembled complete and given a test for smooth and quiet running before they progress beyond this portion of the plant. Each of the testing stations is provided with a small power motor of the same size and type as that used on the washing machine. The tester, as he receives each completed gear box, clamps it in one of the holding fixtures which may be noted along the edge of the testing table and subjects it to several minutes' running while he examines it thoroughly for any defects of workmanship or assembly.

The assembling and riveting of the machine frames constitute another assembly unit, the sections being riveted in part by means of a punching machine.

Some of the assembling operations are carried on in several lines running lengthwise of the shops, and one of these is shown in Fig. 11. The assembly track carries the work about 20 in. off of the floor so that the workman is not compelled to stoop over in placing any of the parts.

The organization of this assembly has really made this a sort of two-unit affair because the bench seen at the left of the illustration is lined by workers, each of whom is engaged in assembling some unit part. As fast as these are completed they are placed in bins beneath each section of the bench or on the floor underneath the main assembly track. At the same time the worker who is placing this part on the machine has his station directly opposite so that there is no transportation required along the length of the assembling floor.

FIG. 12. PAINTING HOOD FOR METAL-TUB MACHINES

The assembly of the metal-tub-type washing machine is completed before painting. It is then taken to the painting hood, shown in Fig. 12, where it is pushed onto platforms which can be raised at the will of the operator by means of pneumatic hoists so that he can readily get at the bottom and all sides of the machine. The piston of this pneumatic hoist permits the machine to be revolved at will as each side is finished. The reader will note that the wringer mounted on the bracket above the machine at *A* is carefully covered by means of a heavy cloth hood to prevent its being marked up by the paint, which is sprayed on by means of an air-brush.

All of the actual painting is performed by one man, who keeps two helpers busy

FIG. 11. WASHING-MACHINE ASSEMBLY BY PROGRESSIVE STAGES

FIG. 13. PAINT-SPRAYING HOOD BUILT ACROSS ASSEMBLY TRACK

in pushing the machines onto the lifting platforms, covering the rollers, and removing the finished machines as fast as they are painted. The large exhaust pipe, exhausting directly into the open air, is provided with a motor-driven fan.

One type of machine is provided with a wooden tub, and as it proceeds through assembly it reaches the point where a paint-spraying hood, Fig. 13, has been built over the assembly track. The painter opens a swinging door at the right and pushes an assembly frame onto a pneumatic lifting platform, then raises it to the required height for spraying on the aluminum finish.

Wood Base Not Painted

The natural-finished wood base is covered with a sheet-metal cover plate *A* which prevents it from being damaged by the paint spray. Upon completion of his work, the painter opens a door at the left and pushes the frame out again onto the assembly track to pass on the concluding operations.

The final assembly on this type of washer is shown as it passes down the track, Fig. 14. After completion of assembly and inspection the machine slides down the sloping track, in the near foreground, so that it reaches the floor level without the necessity of any lifting on the part of the workmen. It then goes to the inspection department where it is run under power for a certain period of time to insure that all parts are in good working order.

FIG. 14. FINISHING ASSEMBLY OF WOOD-TUB MACHINES

Revolving Drum for Testing Boxes

By George F. Paul

To help trim down the national annual loss, estimated at $200,000,000, which might be saved by more perfect methods of packing and boxing, the Government has established the Forest Products laboratory at Madison, Wisconsin. Here has been developed a special box-testing machine, hexagon-sided, that revolves slowly, being run by an electric motor. Whatever packages are to be tested are packed as for regular shipment and placed in this drum.

Devices within this drum cause the packages being tested to follow a regular cycle of drops. Thus, each package drops on its sides, on its top, ends, edges, corners and falls flatwise on a projection like the corner of another box. These drops are planned to reproduce the customary hazards of transportation. A compression-on-edge test is made to simulate the heavy static pressure to which a box is subjected when it stands in the lower tiers of a pile; a steady and constantly increasing pressure, measured in pounds, is applied along any edge, the opposite edge being diagonally through the box in a direct line with the pressure.

In making the revolving drum tests the observer makes note of when and where the container began to weaken and records how that weakness develops until the contents cannot be held. These tests show, for instance, the various causes of nail failure, such as too few nails, nails too short, nails too light, nails too heavy, nails with heads too large or too small. The tests show whether the material in the sides, top or bottom is too thin or not. If it is too thin, the shocks of the drops will pull the wood from the nails, or the wood may split or break across the grain.

Through a study of the various kinds of woods under changing conditions boxes can be built that are practically free from all objectionable features, combining strength, lightness and durability. The studies being made at Madison combine practical experience, which is a knowledge of what lumber is available, and of box factory practice, with accurate scientific tests made on the package itself, packed as in actual service and subjected to strains that approximate actual conditions.

General Data on Automobile Motors

By FRED H. COLVIN
Editor, *American Machinist*

THE facts that have been condensed into the accompanying tables show the trend of motor design and of manufacturing practice as represented by over 20 builders. They show the tendency toward higher-speed motors in passenger cars, nearly all in this series now using over 2000 r.p.m. as a maximum, with a few builders going to or over the 3000-r.p.m. mark as shown in Table I. This table also shows the prevalence of the use of two valves per cylinder, only one of the motors listed using four. There are, however, a few other motors using four valves and one at least which uses three—one inlet and two exhaust valves. Valve diameter varies considerably, the larger valves not always being in the high-speed motors as we might expect. Valve lift is fairly uniform, $\frac{5}{16}$ in. being the prevailing amount almost regardless of diameter.

The Cutting Speeds and Feeds

The cutting speeds and feeds used in cylinder boring are of special interest. They vary greatly as can be seen. The same is true of the amount left for finish-reaming or grinding, where 0.010 in. may be said to be the average. In some cases, however, the amount is much less than this, while in a few instances it is five and even six times as much.

Tolerances do not vary so widely but piston clearances in cylinders run from 0.001 to 0.013 in. Part of this variation doubtless depends on where the piston diam-

TABLE I. CYLINDERS FOR PASSENGER AND TRUCK MOTORS

	General Data					Valves						Machining				Finish Dimensions		
								Diam.		Lift								
Maker	No. Cylinders	R.P.M.	Hp.	Bore	Stroke	Casting	Per Cylinder	Inlet	Exh.	Inlet	Exh.	How Bored	Cutting Speed, Ft.p.M.	Feed per Rev.	How Finished	Allow for Finish	Tolerance	Piston Clearance in Bore
Autocar	2	2000	18	4 3/4	4 1/2	Singly	2	2	2	5/16	5/16	Hor.	88-R	0.013	Ground	0.010	....	0.004
Chalmers	6	....	45	3 1/4	4 1/2	Block	2	1 1/2	1 3/8	5/16	5/16	Hor.	129-F	0.015	Ground	0.005	±0.0005	0.005
Chevrolet	4	....	..	3 11/16	4	Block	2	1 5/16	1 5/16	7/32	7/32	Vert.	57	0.034	Reamed	0.015	0.002	0.003
Continental	4	2000	34	3 3/4	5	Block	2	1 43/64	1 43/64	0.3075	0.370	Vert.	....	.....	Ground	0.010	+0.002 / −0.000	0.005
Continental	4	1500	40	4 1/8	5 1/4	Pairs	2	1 51/64	1 51/64	0.294	0.306	Vert.	....	.....	Ground	0.010	+0.002 / −0.000	0.005
Continental	4	1500	45	4 1/2	5 1/2	Pairs	2	2 1/64	2 1/64	0.3045	0.367	Vert.	....	.....	Ground	0.010	Fitted	0.003
Continental	6	....	..	3 1/4	4 1/2	Block	2	1 1/2	1 1/2	5/16	5/16	Vert.	....	.....	Ground	0.010	+0.002 / −0.000	0.001 / 0.005
Continental	6	2000	55	3 1/2	5 1/4	Block	2	1 1/2	1 1/2	0.3055	0.337	Vert.	....	.....	Ground	0.010	+0.002 / −0.000	0.001 / 0.005
Dodge	4	2600	24	3 7/8	4 1/2	Block	2	...	...	0.312	0.312	Vert.	....	.....	Ground	0.010	....	0.003
Falls	6	2400	23	3 1/8	4 1/4	Block	2	1 1/4	1 1/4	9/32	9/32	Vert.	90	.....	Ground	0.005	0.001	0.003–4
Franklin	6	....	25	3 1/4	4	Singles	2	1 5/16	1 5/16	9/32	9/32	Vert.	32	0.015	Ground	0.018	0.001	0.003
Hudson	6	2800	76	3 1/2	5	Block	2	1 13/16	1 13/16	5/16	5/16	Vert.	45	0.062	Ground	0.005	+0.001 / −0.000	0.0035
Hupmobile	4	3000	..	3 1/4	5 1/2	Block	2	1 5/8	1 5/8	0.3155	0.3155	Vert.	40	0.055	Ground	0.008	−0.001	0.0025
Kelley-Sp'gf'ld	4	1400	30	3 3/4	5 1/4	Block	2	1 11/16	1 11/16	5/16	5/16	Vert.	....	.....	Ground	0.010	0.001	0.003
Kelley-Sp'gf'ld	4	1400	40	4 1/2	6 1/2	Pairs	2	2 1/2	2 1/2	3/8	3/8	Vert.	....	.....	Ground	0.010	0.001	0.003
Light Mfg. Co.	4	2400	31	3 1/4	4 1/2	Block	2	1 3/8	1 3/8	9/32	9/32	Hor.	50	0.018	Lapped	0.0015	+0.001	0.003
Locomobile	6	....	..	4 1/2	6	Pairs	2	2 1/8	2 1/8	5/16	5/16	Vert.	....	.....	Ground	0.012	....	0.0025 / 0.003
Lycoming	4	2000	35	3 1/2	5	Block	2	1 1/2	1 1/2	19/64	19/64	Vert.	50	0.031	Ground	0.012	0.0015	0.0025
Maxwell	4	....	..	3 5/8	4 1/2	Block	2	1 1/2	1 1/2	0.197	0.197	Vert.	....	.....	Ground	0.05	....	0.013
Mitchell	6	2000	40	3 1/4	5	Block	2	1 7/16	1 7/16	0.2747	0.2747	Vert.	....	.....	Ground	0.005	±0.001	0.003
Moline-Knight	4	2200	40	3 3/4	5	Block	..	Sleeve valves.....			......	Vert.	50	.....	Ground	0.010	−0.0005	0.010
North American	4	2400	..	4	5 1/4	Block	2	2	2	5/16	5/16	Vert.	....	.....	Reamed	0.020	±0.001	0.004
Oakland	6	3400	44	2 13/16	4 3/4	Block	2	1 1/4	1 1/4	5/16	5/16	Vert.	50	0.04	Reamed	0.0625	±0.001	0.005
Oldsmobile	8	2600	56	2 7/8	4 3/4	Block of 4	2	1 1/8	1 1/8	5/16	5/16	Vert.	....	.....	Reamed	0.040	±0.001	0.005
Packard	12	....	3	3	5	Block of 6	2	1 13/32	1 13/32	5/16	5/16	.....	80	0.015	Ground	0.012	+0.001	0.001
Pierce-Arrow	6	2500	48	4 1/2	5 1/2	Pairs	4	1 1/2	1 1/2	3/8	3/8	Hor.	30	0.125	Ground	0.018	+0.0005 / −0.001	+0.003 / −0.002
Pittsburg	4	1800	20	3	4 1/2	Block	2	1 1/4	1 1/4	1/4	1/4	Vert.	35	0.003	Reamed	0.008	+0.001	0.003
Premier	6	2400	27	3 3/8	5 1/2	Block	2	1 13/32	1 13/32	5/16	5/16	Vert.	Sleeve 75 / Block 98	0.011 / 0.156	Ground	0.012	0.001	0.005
Rutenber	6	2500	45	3 1/2	5	Block	2	1 5/16	1 5/16	5/16	5/16	Vert.	....	.....	Ground	0.010	0.001	0.003

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eter is taken. The clearance at the body or lower end of the skirt can be very slight, while the clearance at the upper end must be considerably more, to allow for the increased expansion due to the heat at the head end of the piston.

Block castings are used in nearly all of the motors listed. A few builders stick to the casting of cylinders in pairs, but the block of four or six is common practice in most shops. The design of two of the motors requires single cylinders. In all the motors but one, the blocks are of cast iron. In this, the Premier, a Lynite block is used with cast-iron sleeves or liners for the cylinder walls proper. While it is generally believed that there is some tendency in this direction, this is the only example in the list.

Pistons and Piston Pins

Table II shows the piston practice as far as data has been supplied. Cast iron still predominates as a material but the desire for lighter motors and higher speeds seems bound to result in an increased use of aluminum alloys. Increased expansion has introduced new problems and the alloy selected has not always been of the best mixture for the purpose, but the advantages of lighter pistons seem bound to force a solution of this problem even if it has not already been found. It must not be forgotten, however, that some of the English and French builders use extremely light pistons of cast iron, and though the walls seem so thin as to be frail, they are used successfully in some cases.

The width of the grooves is remarkably uniform, $\frac{3}{16}$ in. being almost universal. A clearance of 0.001 in. between the rings and grooves is also fairly common.

TABLE II. PISTONS FOR PASSENGER AND TRUCK MOTORS

Maker	Diameter	Tolerance	Clearance	Lgth.	Material	Grooves			Sequence of Operations			Rings		Piston Pin		
						Width	Clearance	Tolerance	Bore	Turn	Drill	No.	Style	Diam.	Height	Held in
Autocar	4.746	0.0005	0.004	4 25/32	C. I.	0.3127	0.0002 0.0012	0.0005	1	2	3	4	Concen.	0.124	4.464	Piston
Chalmers	3 1/4	0.001	0.005	4	Lignite	3/16	....	0.001	1	2	3	3	Conc.	13/16	1/16	Piston
Chevrolet	3.686	0.002	......	3 5/8	C. I.	0.189	0.001 0.003	0.0005	1	3	2	3	Eccen.	0.85	3 5/16	Rod
Continental	3 1/2	0.002	0.001 0.005	4 1/16	C. I.	3/16	0.017	0.0002	1	2	3	3	Eccen.	7/8	3 1/16	Piston
Continental	3 1/2	0.003	0.002	4 1/2	C. I.	3/16	0.054	0.0005	1	2	3	3	Eccen.	1 5/32	3 1/4	Piston
Continental	3 3/4	0.003	0.002	3 3/4	C. I.	3/16	0.011 0.031	0.0005	1	2	3	3	Eccen.	1 5/32	3 7/16	Piston
Continental	4 1/8	0.003	0.002	5	C. I.	3/16	0.037 0.057	0.0005	1	2	3	3	Eccen.	1 7/32	3 13/16	Piston
Continental	4 1/2	0.003	......	5 5/8	C. I.	3/16	0.038 0.058	0.0005	1	2	3	3	Eccen.	1 1/16	4 1/8	Piston
Dodge	3 7/8	....	0.003 0.0025	4 3/8	C. I.	3/16	0.001	....	3	2	2	3	Eccen.	0.8125	3.656	Piston
Falls	3 1/8	0.001	0.003 0.004	3 1/2	C. I.	3/16	0.001	0.0003	2	1	3	3	Eccen.	3/4	2 13/16	Rod
Franklin	3 1/4	0.001	Taper from 0.003 -0.011	4	Magnalite	0.1895 to 0.1905	....	0.001	3	1	2	3	Special	7/8	2 7/8	Rod
Hudson	3 1/2	0.002	0.0035	4 1/16	C. I.	0.1885	0.0005 0.001	0.0005	..	..	..	3	......	1.0927	3.0625	Rod
Hupmobile	3.247 3.248	+0.000 —0.002	0.001	3 1/16	C. I.	0.1870 0.1880	0.0015	±0.0005	..	..	..	..	......	0.865	2 13/16	Rod
Kelley-Springfield	3.7455 3.7460	0.0005	0.003	5 3/8	C. I.	0.249 0.250	0.002	0.001	..	..	..	3	.....	1.245 1.250	3 5/16	Rod
	4.4965 4.4970	0.0005	0.003	6 1/8	C. I.	0.249 0.250	0.002	0.001	..	..	..	3	.....	1.207 1.213	4	Rod
Light Mfg. & Fdy.	3 1/4	0.001	0.0035	4	C. I.	3/16	0.0005	0.0005	2	3	1	3	......	3/4	3	Piston
Locomobile	4 1/2	±0.0005	0.015– 0.003	5 1/2	C. I.	1/4	0.0005 0.001	0.001	2	1	3	3	Eccen.	1 1/8	4 3/8	Piston
Lycoming	3 1/2	0.0015	0.004 0.0065	4	C. I.	3/16	0.0005 0.001	0.0005	1	2	3	3	Eccen.	7/8	3 1/4	Piston
Maxwell	3.612 3.622	+0.0005 —0.000	0.013	3 1/2	C. I.	3/16	+0.0005 —0.000	0.0005	..	..	..	..	......	0.749	3 1/4	Rod
Mitchell	3 1/4	±0.0005	0.0025 0.0035	4	C. I.	3/16	0.001	+0.001 —0.000	..	..	..	..	......	0.983	2 7/8	Rod
Moline-Knight	3 3/4	0.002	0.009 0.010	4 1/4	Alum.	3/16	0.0005 0.0013	0.001	1	2 and 3	4	3	......	1.00	3 1/2	Piston
North American	4	....	......	4 3/4	C. I.	3/16	0.001	+0.001 —0.000	1	2	3	..	......	1.00	3 3/8	Rod
Oakland	2 13/16	0.0005	0.005	3 9/16	Alum.	3/16	0.0015	+0.005	1	2	3	..	Eccen.	0.6675 0.6680	2 7/16	Rod
Oldsmobile	2 7/8	0.004 0.005	0.004 0.010	3 1/8	Lynite	0.1885 0.1895	0.001	0.0005	1	2	3	4	......	0.668	2 17/32	Piston
Packard	2.997 2.998	0.0005	0.002	2 7/8	C. I.	0.18657	0.00075	0.0005	2	1	3	3	Concen.	0.75	2 3/4	Piston
Pierce	4 1/2	+0.0005	0.002 0.003	5.406	C. I.	1/4	0.001	+0.0000 —0.0005	2	1	3	3	Concen.	1 1/8	4	Piston
Pittsburg	3	0.002	0.003	4 1/2	C. I.	3/16	0.002	0.002	1	3	2	3	......	0.861	2 11/16	Piston
Premier	3 3/8	0.0005	0.016 0.005	4	Lynite	3/16	0.0015	0.0005	2	1 and 3	4	3	......	0.8593	3 3/16	Piston
Republic	3.4975	±0.001	0.002	3 7/8	C. I.	0.1865 0.1870	0.0015	0.0005	..	..	..	..	Eccen.	1.0625 1.0635	3 1/8	
Rutenber	3 1/8	0.001	0.003	3 1/8	C. I.	5/32	0.001	0.0005	3	1	2	3	Concen.	3/4	2 13/16	Piston

Machining the Pistons

In machining the piston the boring of the skirt seems to be the first operation in most cases, although quite a number turn the outside as a starting point. Only one on the list bores the hole as the first operation.

The preference for eccentric and concentric rings is about equally divided, the angular joint being by far the most common. As most motor builders use commercial rings instead of making their own, it is not easy to give much detailed information along this line. Quite a ma-

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jority of the motors have the pin fastened in the piston and have the bearing in the rod. The practice of clamping the pin in the rod and having the bearing in the piston has many advocates, however. The piston-pin diameter varies considerably and apparently without regard as to whether the pin is held in the rod or in the piston.

Connecting-Rods

The connecting-rod data are also interesting as shown in Table III. The greatest uniformity occurs in the length of the rods, the center distance being twice the stroke in most cases, with variations in both directions.

The question of proper diameter and lengths of crankpin bearings has evidently reached no recognized solution. A study of these dimensions, and the relation between the two, shows a great variety of ideas on the subject.

Many small rods have the babbitt for the crankpin bearing cast into the rod itself, but rods for larger motors generally use the separate rod bearing or "brass."

This however is quite apt to be of bronze with babbitt lining (or "bronze-backed babbitt—B.B.B." as it is called in the table). Nearly all use liners or shims between the rod and cap, but a few follow airplane-motor practice and bolt the cap and rod metal to metal.

Broaching

The finish of the rod bearing is usually secured by broaching but information on this subject was not always definite.

The method of fitting bearings is also indefinite in many cases, the usual practice, however, being to "run them in" by using an electric motor to run the engine during this wearing-in process. The hand-scraping of bearings has been practically abandoned by all builders.

TABLE III. CONNECTING-RODS FOR PASSENGER AND TRUCK MOTORS

Maker	Cylinder of Motor Bore	Cylinder of Motor Stroke	Center Length of Rod	Bearings: Piston Pins Diam.	Bearings: Piston Pins Length	Bearings: Crankpin Diam.	Bearings: Crankpin Length	Cast in Rod or Separate	Kind of Metal	How Finished	How Fitted
Autocar	$4\frac{3}{4}$	$4\frac{1}{2}$	9	1.121 / 1.122	$2\frac{3}{16}$	1.860 / 1.862	2.478 / 2.482	Sep.	B.B.B.*	......	......
Chalmers	$3\frac{1}{4}$	$4\frac{1}{2}$	10	$\frac{13}{16}$	$1\frac{3}{8}$	2.25	1.5	Cast	Babbitt	Reamed	Run in
Chevrolet	$3\frac{11}{16}$	4	$7\frac{3}{8}$	0.850	1.00	1.3755	1.875	Cast	Babbitt	....	......
Continental	$3\frac{1}{4}$	$4\frac{1}{2}$	$10\frac{1}{2}$	$\frac{7}{8}$	$1\frac{3}{8}$	$2\frac{1}{4}$	$1\frac{27}{64}$	Sep.	B.B.B.	Reamed	Run in
Continental	$3\frac{1}{2}$	$5\frac{1}{4}$	$10\frac{1}{4}$	$1\frac{5}{32}$	$1\frac{1}{2}$	$2\frac{3}{8}$	$1\frac{13}{16}$	Sep.	B.B.B.	Reamed	Run in
Continental	$3\frac{3}{4}$	5	$10\frac{1}{4}$	$1\frac{7}{64}$	$1\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{3}{16}$	Sep.	B.B.B.	Reamed	Run in
Continental	$4\frac{1}{8}$	$5\frac{1}{4}$	$10\frac{1}{2}$	$1\frac{7}{32}$	$1\frac{3}{4}$	2	$2\frac{1}{2}$	Sep.	B.B.B.	Reamed	Run in
Continental	$4\frac{1}{2}$	$5\frac{1}{2}$	11	$1\frac{3}{8}$	$2\frac{1}{4}$	$2\frac{1}{4}$	3	Sep.	B.B.B.	Reamed	Run in
Dodge	3.875	$4\frac{1}{2}$	11.39	0.812	1.750	1.625	2.125	Sep.	B.B.B.	....	......
Falls Motor	$3\frac{1}{8}$	$4\frac{1}{4}$	.....	0.740	0.75	$1\frac{7}{8}$	$1\frac{5}{8}$	Cast	....	Reamed	......
Franklin	$3\frac{1}{4}$	4	8	$\frac{7}{8}$	.....	$1\frac{5}{8}$	$1\frac{15}{16}$	Sep.	Die cast	Broached	......
Hudson	$3\frac{1}{2}$	5	$11\frac{7}{8}$	1.093	1.00	$2\frac{1}{4}$	1.989	Sep.	Alloy bronze	Reamed	Run in
Hupmobile	$3\frac{1}{4}$	$5\frac{1}{2}$	$11\frac{7}{8}$	0.865	0.875	$1\frac{3}{4}$	$1\frac{5}{8}$	Sep.	B.B.B.	Broached	......
Kelley-Springfield	$3\frac{3}{4}$	$5\frac{1}{4}$	11	$1\frac{1}{4}$	1.00	$1\frac{3}{4}$	$2\frac{1}{4}$	Sep.	Die cast	Reamed	......
Kelley-Springfield	$4\frac{1}{2}$	$6\frac{1}{2}$	14	$1\frac{3}{8}$	$1\frac{1}{4}$	$2\frac{1}{4}$	$3\frac{1}{4}$	Sep.	Die cast	Reamed	......
Light Mfg. Co.	$3\frac{1}{4}$	$4\frac{1}{2}$	9	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{3}{4}$	2	Sep.	Bronze	Broached	......
Locomobile	$4\frac{1}{2}$	6	12	$1\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{1}{4}$	2	Sep.	B.B.B.	Broached	......
Lycoming	$3\frac{1}{2}$	5	$9\frac{1}{2}$	$\frac{7}{8}$	$1\frac{3}{16}$	2	$2\frac{1}{8}$	Cast	Babbitt	Broached	......
Maxwell	$3\frac{5}{8}$	$4\frac{1}{2}$	$7\frac{7}{8}$	$\frac{3}{4}$	....	1.875	$3\frac{1}{4}$	Cast	Babbitt	Broached	......
Mitchell	$3\frac{1}{2}$	5	$10\frac{1}{2}$	0.984	$1\frac{1}{8}$	2	$1\frac{7}{8}$	Cast	Babbitt	Reamed	......
Moline-Knight	$3\frac{3}{4}$	5	$10\frac{3}{4}$	1.00	$1\frac{3}{4}$	2	$2\frac{1}{2}$	Sep.	B.B.B.	Broached	......
North America	4	$5\frac{1}{4}$	$11\frac{1}{2}$	1.00	$2\frac{3}{8}$	$1\frac{7}{8}$	$2\frac{1}{4}$	Sep.	Die cast	Reamed	......
Oakland	$2\frac{13}{16}$	$4\frac{3}{4}$	9	0.668	$1\frac{5}{16}$	1.618	$1\frac{5}{8}$	Cast	Babbitt	Reamed	......
Oldsmobile	$2\frac{7}{8}$	$4\frac{3}{4}$	$9\frac{1}{2}$	0.669	$1\frac{1}{4}$	2.124	2.126	Sep.	B.B.B.	Reamed	......
Packard	3	5	12	$\frac{3}{4}$	$1\frac{1}{4}$	$2\frac{1}{4}$	$1\frac{3}{8}$	Sep.	B.B.B.	Reamed	......
Pierce-Arrow	$4\frac{1}{2}$	$5\frac{1}{2}$	$11\frac{3}{4}$	$1\frac{1}{8}$	2	$2\frac{1}{4}$	$2\frac{3}{8}$	Sep.	B.B.B.	Reamed	......
Premier	$3\frac{5}{8}$	$5\frac{1}{2}$	11	1.065	$1\frac{1}{2}$	2.565	1.764	Sep.	B.B.B.	Reamed	......
Rutenber	$3\frac{1}{8}$	5	$9\frac{1}{2}$	$\frac{3}{4}$	$1\frac{1}{2}$	2	$1\frac{7}{8}$	Cast	....	Broached	......

*B.B.B. means bronze backed babbitt or bearing metal.

Milling and Boring Winton Cylinders

By I. B. Rich

The fixtures used by the Winton Motor Car Co. in milling and boring cylinders are particularly interesting on account of the way in which they handle work in comparatively small quantity and without undue initial expense. The same type of fixture will be seen in all three of the illustrations and this of itself reduces the cost of making these fixtures which, it will be noted, are of simple and inexpensive design.

Fig. 1 shows the double fixture used in milling the bottoms of the cylinder flanges. These cylinders are cast in pairs and are supported in the front in the fixture on the hard steel pins *A* and *B*, a suitable support being provided at the other end so as to allow them to be equalized at right angles to the cylinder bore. The clamp *C* has an equalized bearing on the upper side of the cylinder, pressure being applied by a substantial screw in the center. The other end of the cylinder is held by a similar clamp *D*. These clamps are loosely connected to the crossbars *E*, these having open ends which latch under the bolt head as at *F*, so that they can readily be swung in or out of contact as may be desired. This construction is shown very clearly at *D*, Fig. 2.

Fig. 2 shows the same type of a fixture arranged for holding the cylinders in a vertical position while the sides are being faced. It will be noted that the cylinders rest on tissue paper at *A* and *B*, the clamps holding the cylinder down as shown in Fig. 1. The blocks *C* position the cylinder sidewise so as to secure the proper distance of the milled surface from the bore. The first illustration shows two fixtures mounted on the table, while in the second, only one cylinder block is shown in position.

The cylinders are rough- and finish-bored at the same

AUTOMOTIVE CONSTRUCTION

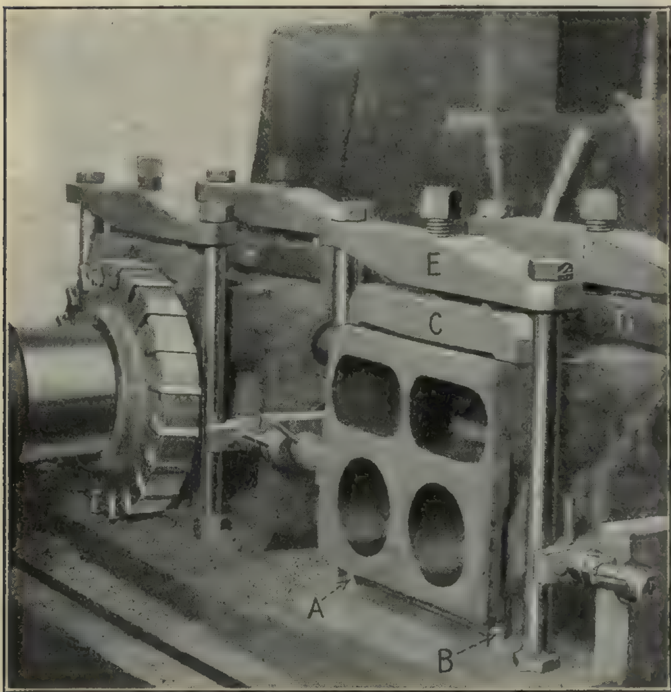


FIG. 1. FIXTURES FOR MILLING CYLINDER BASE

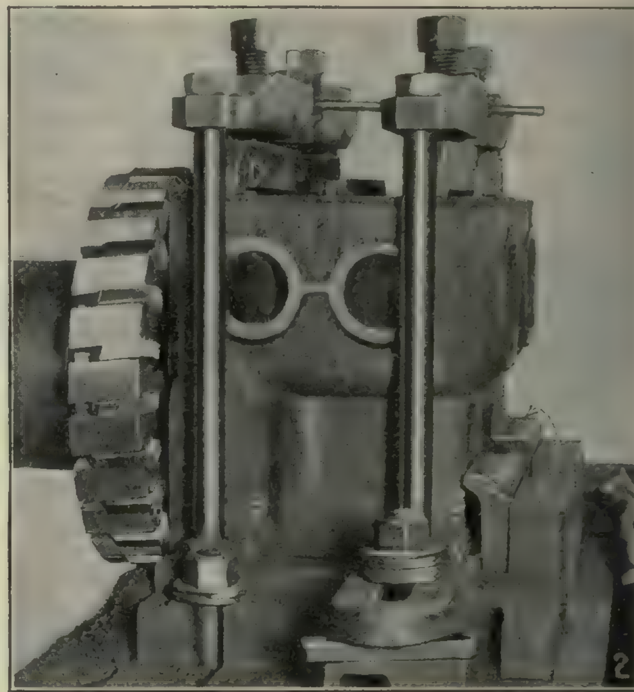


FIG. 2. MILLING THE SIDES OF THE CYLINDER

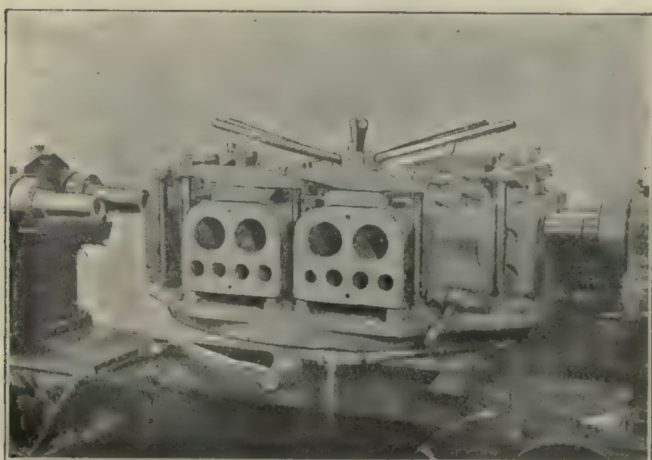


FIG. 3. THE METHOD OF BORING THE CYLINDERS

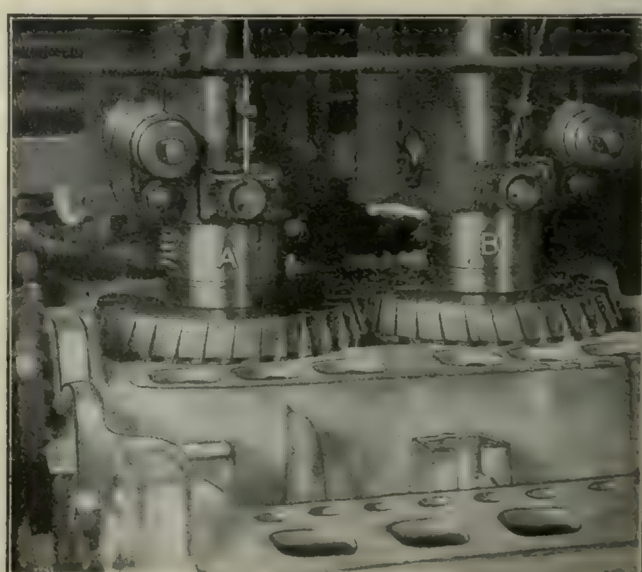
setting in a four-spindle Beaman & Smith machine having the work carried on a turntable as can be seen in Fig. 3. The same type of clamping fixture is used, each of the four sides of the table holding two cylinder blocks. This allows ample time for loading and unloading and makes the work very accessible to the operator. After the table has been indexed it is locked in position by the pilot wheel with angular spokes shown over the cylinders.

Intermeshing Milling Cutters

By Frank C. Hudson

The illustration shows a somewhat unusual arrangement of large milling cutters for surfacing crank cases in the Chandler motor plant. The main spindles, *A* and *B*, are adjusted together so that the teeth of one cutter come in the space between the teeth of the mating cutter. They practically mesh together in the same way as a pair of gears, except that the tooth space is so wide that there is no contact, as this would, of course, be fatal to the cutters.

These cutters finish the surface without a break and have the effect of a single cutter as large as the added diameter of the two. There are also two end cutters, and as the machine is double-headed and has a long table, it handles a large number of crank cases per day. This arrangement requires careful grinding and setting, but seems to be done without difficulty.



MILLING CUTTERS THAT MESH

A Factory Town

By W. Osborne

In this article the author draws a picture of the beginning of an industry and follows with a vivid description of its growth to prosperity, the coming of other industries, the birth and development of a town, the advent of the expert, the commencement and results of labor troubles, the dissatisfaction of stockholders, the change of management and all the evils attendant on these things; how the overload spelled disaster and what happened to the industries and the town. The picture is not overdrawn and it behooves us all, employers and employed, to stop—look—listen, "for these be parlous times.'

ONCE Zumbar was just a space on the surface of the earth. Having the usual sunlight, water and so forth, some people took it for a place to live in and it evolved into farms.

One of the farmers who had a "knack of tinkering" set up a little shop for his own use. His neighbors soon found that it was easier to take their machinery troubles to this shop than it was for each one to worry with his own. These neighbors furnished any assistance that might be needed.

The community grew and got to the dignity of having a name, and a store. and a church, and a graveyard, and the other appurtenances of a town; and, by and by, it was made a stop on the railroad, and had a post office; and the shop grew and finally got to be a "factory" that had shares of stock to represent the interests of the ones who had put money into it, for it had taken money to keep it growing.

Everybody in the community owned some of the stock.

When things were quiet on the farms the men found work in the factory, and so it was with the other activities of the neighborhood; and when extra help was needed on the farms or in other temporary lines of activity, some of the factory help supplied the need. Thus, the factory served as a sort of reservoir that took in and gave out energy to the benefit of all concerned.

In the beginning the material for use in the factory had been obtained from the surrounding neighborhood, which had also absorbed most of the output; but, as time passed and the factory prospered, there grew a demand for its output from farther away, and as that demand was met it became necessary to ship in material, and to get labor from farther away, and it was also necessary to get more money so as to enlarge the capacity to meet the demands.

The management of this factory had always remained in the hands of the man who had started it, and by this time he had disposed of his farm and other property and put the proceeds into it. He had also put in all of the money that he could borrow, and he was beginning to be spoken of as being a rich man, and the leading citizen of Zumbar.

Time passed. Not a very long time considered by itself, but time enough to bring a large increase in the population of the town, and to bring water works, and electric lights, and picture shows and a board of trade.

The prosperity of the factory and the activities of the board of trade had induced several other factories to locate in the town, and it could boast of two daily papers that seemed to know by instinct that each should oppose whatever the other favored. The instinct of the leaders in social, political and religious lines seemed to tend to the same view of things. Zumbar had all the ear-marks of getting to be a modern and up-to-date American city.

One of the prominent earmarks of the modern city is the expert. Experts began to blossom on all sides. Quietly but efficiently some of these experts began to show the working men that they were slaves who were working for a cruel taskmaster, whose only interest in them was in coining the life blood of themselves and families into dollars. The result was demands, followed by a strike in which, or so it seemed to the manager, the entire community took either active or passive sides against him. The interests, which had been teaching distrust, by the aid of subtle propaganda, etc., of the motives of all of those who did not belong to their own particular party of whatever kind it might be, had done their work well. The strike was finally compromised, not according to any principle of right and justice, but according to the force which could be applied. The merchants were being forced to give credit that filled them with uneasiness, and they called for a settlement—any kind of a settlement that would shift the load from them. The newspapers lived from the advertising of the merchants, and they voiced the demands of the merchants.

The labor-vote threat was held up to the politicians and they used their power to compel a settlement. The labor expert very adroitly worked on the sympathies and lack of practical experience of the clergy and they, failing to investigate the actual conditions in this (their home town), listened to the tales of the awful conditions which were said to exist in far away cities and which were blamed directly on the fact that some men had been energetic enough to furnish work for some other men, and pressed for a settlement. The directors of the bank saw trouble ahead with money being constantly spent and none being earned, and they urged a settlement.

A settlement was made—a settlement of force—and the labor expert was able to begin the same line of activities with the other employers in the town.

In the mean time other labor experts had been doing things among railway employees, and among the producers of the raw materials which the factory had to use; and both freights and the cost of raw materials

rapidly advanced The freight hit the factory both coming and going. Higher rates had to be paid both on the raw material and on the finished product.

At the annual meeting the manager's statement of the earnings was not very cheering to the assembled stockholders. A number of these who were not practical factory men but who were professional men, an financiers in a small way, had secured the services oı a business expert; that is to say, the business expert had sold his services to quite a number of such stockholders, and had convinced them that the business was not being properly managed.

Being fortified by information these stockholders, through one of their number, did not mince matters in showing how much more money might have been made under different management, and the other stockholders were horrified to learn of the amount of money which should have been earned in the past but was not, and moreover, to have the manager draw a gloomy picture of the future.

The manager admitted that he did not know all that there was to know about factory management. This was the only factory that he had ever managed, and all that he knew about factory management had been founded on his experience in managing it. Unfortunately for the other stockholders he now held a majority of the stock. He explained that this did not come from any fault of his but came because, when the factory had been obliged to sell stock to get money to enlarge the capacity, he had always bought any of it that others did not take, and, when any stockholder had wanted to sell his stock and could not find any other buyer, he had bought it.

He further explained that he did not desire to stand in the way of the future of either the other stockholders or of the town, and in view of the fact that he was likely too old to learn the more modern ways he would be willing to sell his stock to any combination of the others who would buy it. He named a price for it that was according to what the annual report had shown would be a fair value.

As a result of this offer a combination of some of the other stockholders bought the manager's stock, and as a concession they let some of the business men who had not before been stockholders have some of it, although at a considerable advance over what it had cost them. This they thought but right, in view of the increased earnings which would come from expert management.

While there was no active demand for this stock some others of the older stockholders sold their holdings to the active interests who were wanting to get in on a good thing.

A new and enlarged board of directors was elected by the stockholders. An up-to-the-minute manager was hired. Efficiency experts made an investigation of every phase of the business. Reports were made.

It surprised the board of directors to find what a poor factory that factory had always been. It surprised them to find out how much it would cost to make a modern factory out of it. It surprised them to find out that as the improvements were made the character of their employees was changing. It surprised them to find that the large returns were always in the future and that before they could be realized more money would have to be spent on more improvements. It surprised them to find out how many different ideas a large board of directors who were without practical experience can have, and how hard each one could insist that his idea be given a trial. It surprised them to receive demands of all kinds from their employees and to have numerous strikes.

Some were for increase in pay. Some were for shorter hours. Some were the result of one lot of workmen claiming the right of controlling another lot of workmen who would not admit that right. Some were because of sympathy for some other lot of workmen in some other factory who were on strike. Some were because of a new expert who had been taken on. Some were because of a popular but inefficient workman who had been discharged.

It surprised them to find out how much such demands cost whether settled with or without strikes.

These were not all of the surprises which they received as time passed.

From the outside things had many of the appearances of prosperity. New buildings had been erected. New machinery had been installed. New methods had been inaugurated. Along with these things a new feeling toward factories had sprung up. Factory laws seemed founded on the idea that factory owners were monsters. Taxes seemed based on the idea that they had an endless amount of money that could, with safety, be drawn for any purpose that might please a number of voters. Notwithstanding the fact that the price of food was going up, because men were leaving the farms where they were their own bosses and going into the factories where they put the

responsibility for results on others while they got a regular wage, the pulpit and the press dwelt on the iniquity of being able to make a success of running a factory. No, they did not word it exactly that way; but analyzed, that was the only meaning that could be arrived at.

Years passed and new managers came and went and it finally became evident to even the most hopeful that the business was not a paying one.

The newest manager was asked for a statement as to why it was not paying, and his report was discouraging but convincing. It was in substance: that, the investment was too large for the amount of business that could be done; that the situation was not right for the amount of business being done either in relation to the supply of raw material, or to the market for the finished product; that the supply of labor was neither of the desirable kind nor in sufficient quantity for the factory's needs; that the town was not the sort of place where labor such as they needed could be induced to come and to stay.

DOWN THE GRADE

You have been told before that Zumbar was just a space on the surface of the earth. The railroad that served its needs evidently also had some efficiency experts in its service for it straightened out the road in such a manner that Zumbar was no longer on the main line but was dependent on a loop that gave it one combination passenger and freight train each way a day. This was the finishing stroke. A committee of the stockholders was appointed to get as much out of the business as possible.

The amount that was realized was below the estimate of the most pessimistic. It is wonderful to behold the way values shrink when once a concern quits, and it is wonderful how fast a town can go down once it gets under way. The bank did not fail but it went out of business. Two of the smaller factories moved elsewhere and the sheriff closed up another one.

Anyone who has seen a mining town after the ore is exhausted or a lumber town after the timber is all cut or an oil town after water replaces the oil will

know how Zumbar now looks. There is not any natural reason for a town being there and the business reason is gone. The factory is dead.

Is it of any use to hold a post mortem?

A Small Shop's Experience with Cheap Labor

BY ELMER W. LEACH

I expect every one of my readers has said as many times as I have when remarking on some other fellow's wrong actions or bad judgment, "Well, it has been a costly experience, but he has learned something." However, it is not until one has made a few costly mistakes himself that he realizes the truth in his own casual remarks that "one learns by experience."

Now all of this means that the writer's firm has just completed a costly experiment; that is, the conclusions have been drawn, but we have by no means footed the bill, nor have we reaped the benefits of our deductions.

Ours was an experiment with labor—with cheap labor. To give a bit of personal history, we started our little factory less than a year ago, and not being blessed with an unlimited supply of capital we felt the necessity of exercising caution in our expenditures.

An unpleasant thing about a small shop is that its owners do not always dare go ahead with projects or ideas that really seem to be essential, because they must look ahead to Saturday's payroll, and they realize that it is already large enough to cause concern without making it larger by hiring the most expert machinists at the highest wages.

One of our first errors in judgment was our belief that we were exercising the greatest economy in hiring shop men at the lowest rate obtainable. We did that very thing when we opened our shop; we hired four such men, put them to work and turned out machines. All this was some months ago. None of those original men are with us now. Two of them left us, and two were asked to leave. The first of this year we made a resolution to hire good men at good wages, and I can already show very concretely how it has worked out in actual

practice. Our lowest paid man now is paid 7 cents an hour more than our highest paid man in the old crew.

One of the small machines which we manufacture requires two gears, 2½-in. diameter, ⅝-in. face, and ¾-in. bore. The lathe operations on the blanks were five in number, as listed later on. All of our jobs are figured on a "cost per piece" basis, and a "man hours per hundred" rate.

With the first crew we had been satisfied with the figures given in Table I.

TABLE I. COST OF WORK BY LOW-PRICED LABOR

Operation	Cost Each	Man Hours per 100
1. Face, drill, ream	0.0434	9.6
2. Face second side	0.0309	6.9
3. Straddle-facing	0.0273	6.1
4. Rough-turning	0.0481	10.7
5. Finish to diameter	0.0193	4.3
	0.1690	37.6

A short time ago one of our new men ran through 360 of these gear blanks as his first job. We could see by the way he attended to business that the work was coming right along; but we had not excepted any such shock as we received when the time cards came through on the finished job.

His costs and time rates are shown in Table II.

TABLE II. COST OF WORK BY HIGH-PRICED LABOR

Operation	Cost Each	Man Hours per 100
1. Face, drill, ream	0.0240	4.4
2. Face second side	0.0137	2.5
3. Straddle facing	0.0172	3.1
4. Eliminated	.....	.....
5. Turn to diameter	0.0184	3.3
	0.0733	13.3

To me there is a world of meaning in these two time studies, and they should be significant to your readers as well; for even though their manufacturing problems may be as far removed from mine as north is from south they surely cannot fail to recognize certain salient points which are applicable to all manufacturing plants.

First, let us see exactly what this new man did (and by the way, his performance was no "beginner's spurt," for he is keeping up the good work on subsequent jobs). Despite the fact that he was paid much more than the first man he reduced the cost per piece $0.0957, or 57 per cent of its original figure—the figure upon which we had based our selling price. Despite the fact that he used the same machines as the first man and worked under the same conditions all around, he increased the production 283 per cent. Also notice that he has eliminated one operation. We used to put ten blanks on a mandrel at a time when we turn them to diameter; and for some reason which we do not yet understand they would come eccentric.

By making a roughing cut and a finishing cut our first man was able to keep the average inaccuracy around 0.005 to 0.006 in. We did not say anything about this point to the new man—just let him go ahead with the job in his own way. The biggest inaccuracy we have found in his work is 0.003 in.; 90 per cent of the blanks do not run over 0.001 in. off.

We have been told at various times that "a little and good is better than a lot and bad," but it certainly seems with shop men that the good ones are the ones who also turn out the most work.

We have two big regrets: One is that we ever bothered with cheap machinists and the other is that this fellow hasn't got a dozen brothers just like himself.

Good machinists—men who can turn out accurate work rapidly—are scarce, but, thank Heaven, there are a few of them left and they not only command but are worth good wages. We have found a very few (as I said, we are only a small shop) men of the same caliber as the one whose time study I have quoted, and we have welcomed them to our shop with open arms. Our payroll is much larger, of course, but its increase in no way approaches the increase in production which has resulted. Machines which we had been content to produce at a rate of a hundred a month are now leaving our factory two hundred and fifty a month.

I am a new man as an executive, having first reached that point on the ladder of life in this present venture of engaging in business for myself, but from my own costly experience with men I have formulated one rule which with me will be ironclad. I would state it something like this: The only way to insure turning out the best work is to hire the best men, give them the best treatment and pay them the best wages.

I haven't the slightest idea what you would do with a man who could increase your production 283 per cent, but I want this man to show the rest of our crew how it is done, and so I told him only last week that just as soon (and I plan that will be within a few months) as we can use a foreman, I want him to hold that position. He is our highest paid man and yet he is our cheapest man—that is what I learned by experience.

What Is a High-Grade Machine?

E. B. Weston

On page 358 of the *American Machinist* Entropy says, in beginning his discussion of the above question: "A high-grade machine is a good one." I certainly agree with Entropy on this point.

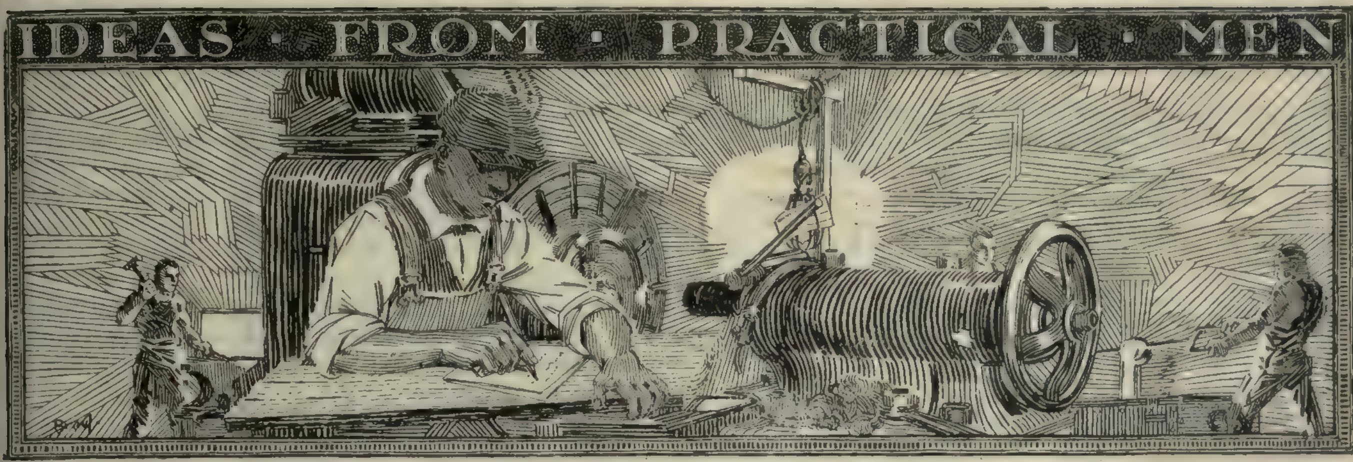
Now I wonder if the readers of *American Machinist* will agree with me when I say a good machine is not always a high-grade machine. Not long ago we received from the manufacturers a certain machine which, after a fair trial, I am ready to say is a good machine but not high grade.

It is a good machine because it is of good design; is not complicated; is accurate, strong and sturdy, and because with a fairly good operator on the business end of it, it will produce the goods. The product of this machine is well within the limits of inspection and the quantity is satisfactory.

The reason why it is not a high-grade machine is because it is not a "well finished" machine. In other words, high-grade workmanship was slighted or rushed through the shop in a hurry on some of the minor details (probably not thought necessary to the operation or accurate production of the machine). Sharp corners were left exposed on gear and wheel hubs, lever bosses, etc. Evidently filler and paint (or painter) was scarce, or perhaps H. C. L. or H. C. P. had something to do with it.

The workmanship was good where it really had to be, but some of the levers, handwheels, etc., were surely assembled in a hurry, having loose fits on shafts with loose feathers, keys, etc. There were not enough of these faults to prevent good operation of the machine with a good production, but there were enough to prevent one from calling it "a high-grade machine."

To be brief, it is my opinion a high-grade machine must be what this machine is and also what it is not.



Machining Monel-Metal Carbureter Float Points

By W. H. Addis

Monel metal which is 71 per cent copper, 28.8 per cent zinc, and 0.2 per cent lead, offers a very difficult machining problem when it is used for carbureter float points. The copper content causes the metal to tear when a box or forming tool is used. The metal is rolled to triangular shape ¼ in. across the sides. The points are cut about ⅜ in. long over all, and have a point formed at an angle of 60 deg. to the center line. This point must be gasoline-tight when lightly seated. It is not practical to grind these as the metal is so soft that it quickly becomes charged with the abrasive and forms a first-class lap.

The Van Briggle Carbureter Co., Indianapolis, has overcome the many difficulties which this job presents by using the set-up shown in Fig. 1 *A* being the turning tool and *B* the formed cut-off and point-roughing tool. The triangular-shaped monel-metal bars are chucked and turned to size by the turning tool. The turret is then indexed to bring the point-finishing tool into position as shown in Fig. 2. This tool is a very neatly constructed piece of work. It carries a bronze housing *A* set at 60 deg. to the center line, which serves to hold and guide the tool bar *B*. This bar carries a rack which meshes with a pinion on the under side of the wormwheel *C*. The tool bar is given a very fine feed by turning the handwheel *D*. The cutter used at *E* is of the conventional diamond-point shape, and when carefully fed, leaves the points with a fine finish which is gasoline tight when seated.

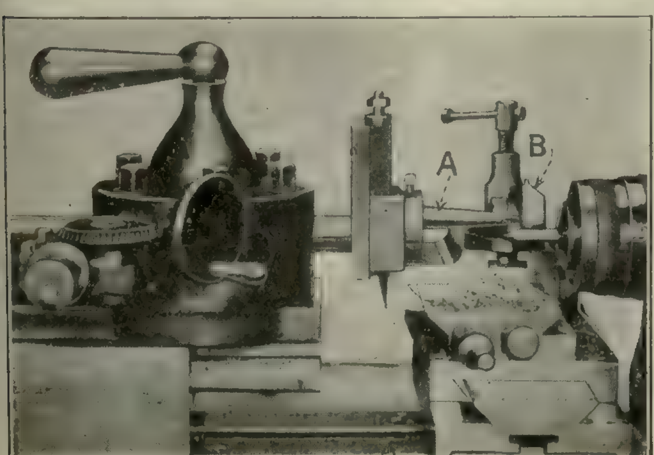


FIG. 1. SET-UP FOR MACHINING MONEL METAL POINTS

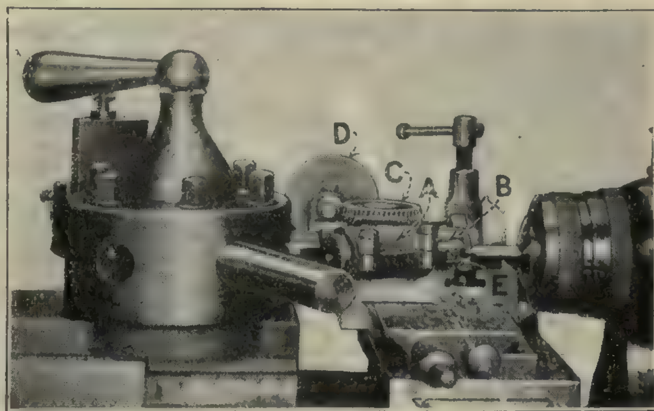


FIG. 2. THE POINT-FINISHING TOOL IN POSITION

Monel metal, being cold-rolled to shape, often comes to the user with a varying degree of density and hardness which causes considerable trouble in turning. This may be overcome by normalizing the bars before turning. A temperature of 1,000 deg. F. for 15 min. and air cooling is the normalizing prescription

An Interesting Spline Gage

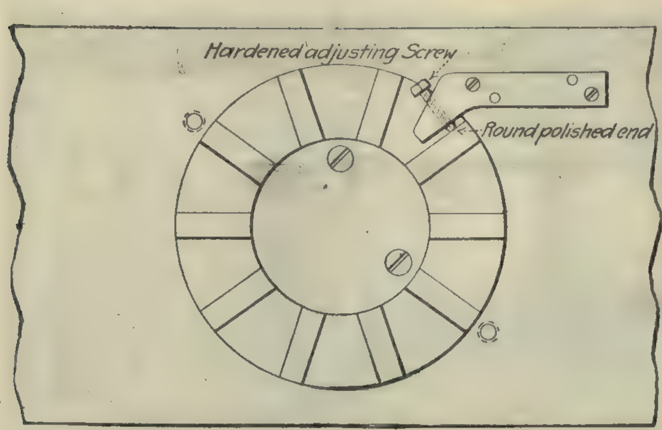
By Richard F. Moore

In reference to the article under the title, "An Interesting Spline Gage" on page 1109, Vol. 51 of the *American Machinist*: I have found such a method as Mr. Thayer used to be far from the best and will endeavor to prove why it is not good.

The principle that he used allows a small error to be cumulative. In other words, his first angle is, say, 0.0001 in. off, and on each set-up he gets that same "tenth" in the same direction (in all probability), so that by the time he has gone around the gage he will be off one thousandth, which would be anything but "exceptionally accurate."

I know of other methods to do this job, but I think the best is the one shown by the sketch herewith. The same fixture that Mr. Thayer used would be all right, but a stop should be used in connection with it instead of the sine bar. The stop does the trick—by setting the rounded and polished end of the adjusting screw against the milled surface in the groove next to the one you are grinding.

After a trial cut is taken all around in each space you will be within a couple of thousandths from the



THE GRINDING GAGE WITH A STOP

results of the milling job done before hardening. After going around once, all your angles will be alike except the last one, and that one will show your error magnified ten times.

The same principle is involved as when spacing around a circle with a pair of dividers. By two or three trial cuts you will be able to make the gage come around with the same angle at every stop and then, of course, you will have the right angle.

Device for Transferring Centers

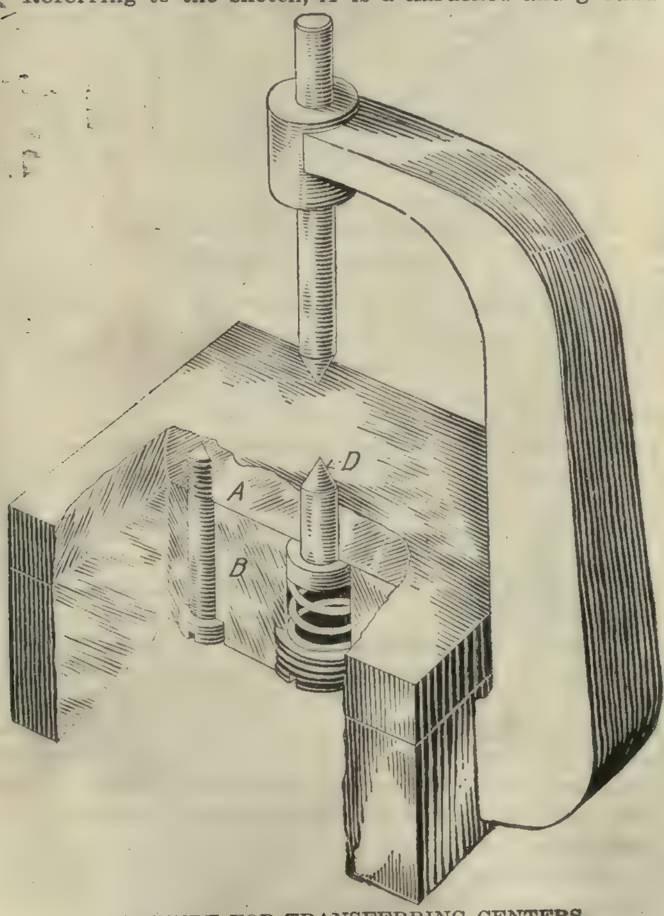
By Roy V. Terry

After seeing many toolmakers and diemakers using either a square or surface gage and plate for transferring a center to the opposite side of a die or flat plate, I wonder why more shops do not use a center-transfer of the kind illustrated.

Referring to the sketch, *A* is a hardened and ground plate screwed and doweled to the frame *B*. *C* and *D* are hardened and ground drill-rod or tool-steel points in line with each other and at right angles to the top of the plate *A*.

In operation, the die or plate upon which the center is to be transferred is laid upon the plate *A* with the point *D* in the prick-punch indentation and pressed down against the action of its spring until the work is flat on the plate. The tension of the spring serves to hold the work in position.

The point *C* is then let down on the work and tapped with a hammer. This device makes a much quicker and more accurate method of locating for relief drilling on small piercing dies, etc., than any other I have ever seen.

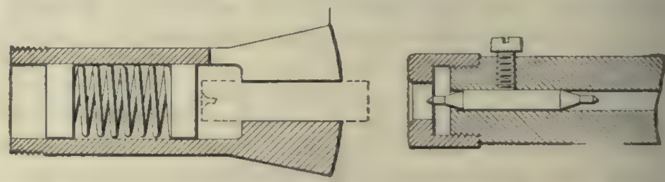


A FIXTURE FOR TRANSFERRING CENTERS

A Quick Centering Device for Screw Machine

By A. J. Abremsmeyer

The sketch shows a production method of centering on a hand screw machine. With this device I can center my work accurately and get the centers all of the same depth. Time is also cut in half as the work is done in one operation. The spring collet throws the piece out automatically.



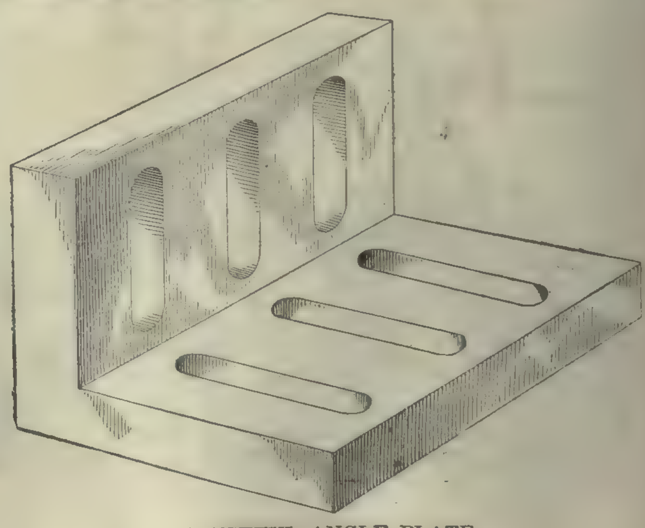
CENTERING DEVICE FOR THE SCREW MACHINE

A Handy Angle Plate

By Hugh Scott

The illustration shows a convenient size and shape of angle plate for general shop use. It is 8 x 10 x 12 in. in size and 1¾ in. thick; finished all over. The absence of ribs, and the slots instead of holes. make it adaptable for clamping or strapping work of any ordinary size and shape, and being finished on the inside as well as the outside makes these extra surfaces available for setting up.

The angle plates should be made in pairs with all dimensions exactly alike.



A USEFUL ANGLE PLATE

An Open Letter to the World Trade Club

BY courtesy of what you describe as "an organization of 500 leading merchant-manufacturers of San Francisco," I am in receipt of a packet of literature advocating the universal adoption of the metric system, and asking me to "lend the weight of my influence" toward securing the passage of legislative measures designed to make its use compulsory.

You claim that our present system of weights and measures is "archaic," "cumbersome," "difficult to understand," and that it was "inherited from Germany," being "foisted" upon England by the Hanseatic Trade League and that England in turn "landed" it upon America.

In declining to countenance an effort to secure legislation both arbitrary and pernicious, the effect of which would be only to render confusion worse confounded, I beg to call your attention to statements in your propaganda that are misleading and to certain facts which you have overlooked or carefully suppressed.

Admitting that our system of weights and measures is archaic, I fail to see where any benefit is to accrue to us as a nation, or as a unit in world society, by "foisting" upon a so necessary and vital function of our civilization as our manufacturing industries a system that is based *not* as you imply upon science, but upon the entirely erroneous calculations of a French pseudo-scientist and evolved by himself in collaboration with a party of fanatical associates, to whom the business of bringing their pretty theories within the hard-and-fast limitations of manufacturing conditions was as vague as is the aforesaid manufacturers' idea of the latest nebular hypothesis.

The system with which you have become infatuated and the advantages of which you so ardently commend, is *not* metric (though you are apparently unaware of the fact) but *decimal*, and the decimal system is but incidentally associated with the meter. It can be applied to any unit — the inch, the pound, the gallon — with equal facility, as witness our decimal system of currency; and it is already constantly applied to our manufacturing standard of linear measure, the inch.

Your quarrel is not with the English System, but with the *binary* system, and the latter was introduced *not* by "Teutons of the Hanseatic Trade League" but by nature herself when she made it possible to divide a thing in two equal parts, and each part into two further parts, four of which would equal the original. It was this natural phenomena that made pints out of gallons and ounces out of pounds, and until you can bring forward a system that transcends the laws of nature, these divisions will continue to be made.

You say that the British and United States standards are not identical. This is true only in part, and the differences are due to local causes quite as likely to operate against the metric as any other system. Again you say that there are as many different bushels in this country as there are states in the Union, and cite the fact that a bushel of fine salt weighs 80 lb. while a bushel of bran weighs only 20 lb. How strange! Just what would be the difference in weight between a gram of feathers and a gram of lead!

You say that our thirty allies in the war (I didn't know we had that many) all used the impeccable metric system of mensuration in their manufactures of war implements, and but two benighted countries—England and United States—dragged along under the old standard. About what proportion of the war material used was made in these two countries? You admit in a later paragraph that in reference to general manufacturing they furnish about 80 per cent.

You hold up to our shamed vision the alleged fact that Borneo and Timbuctoo, in their advanced civilization, rely upon the "meter-liter-gram" standard and leave us to wonder if their enlightenment is because of it. I believe they also eat strange missionaries there. We are indeed in the dark ages.

You state that Germany, having discarded the old system (after having accomplished her fell purpose by working it off on England) adopted the metric system in 1871 and call my attention to the miracles that Germany worked in the way of devastation and destruction during the war. I submit that the system of measurement had nothing to do with what Germany did. All German guns, munitions and appurtenances of war were made in Germany. They began making them, it is true, in 1871, but it made not the slightest difference whether the guns were made to centimeters, feet, "cubits," or to a special size, which they might call a dodo, if they wished, so long as parts that were designed to go together would do so.

German efficiency was due to German military methods, German training and German unity of purpose; not at all to the German system of mensuration. Austria, Hungary, Bulgaria and Turkey were efficient allies of Germany, not because their manufactures in the way of implements of war were in accord with Germany's, but because they were willing tools or dupes of Germany. Bulgaria and Turkey did not furnish implements of war, but men; Germany furnished the guns.

You state that the opposition to the metric system is exemplified chiefly by a "clique of professional objectors centered in New York."

I know these objectors—some of them personally. They are the men who build 90 per cent of the machinery that is produced in this country. Few of them live in New York. If you really want to find some of 'em, look in San Francisco. They object because of their intimate inside knowledge of the difficulty of changing from one system, not any too good, to one that has absolutely nothing to commend it but the "World Trade Club," and the enormous expense entailed to accomplish—nothing.

You say in the form letter which you would have me sign and send to my State Senator or Representative at Washington that "probably 99 per cent of the people of the United States and Britannia are in favor of this simplification," etc.: Why, then, in the name of common sense, are the 500 leading "merchant manufacturers of San Francisco" sitting around a banquet table in a hall that is "27 meters long, 15 meters wide and 8 meters high" (I'll bet a metric dollar it was laid out with a two-foot rule, by a builder that never heard of the metric system), making speeches, collecting money and printing a bunch of junk with which to persuade them, when 99 per cent of all the people want to do what you want them to do, and there is only a paltry 1 per cent to stop them, and that 1 per cent made up "chiefly of a clique of professional objecters in New York?"

In the envelope that brought your communication to me there were twelve pamphlets, no two of which were of the same size. There were five circular letters, three of which were folded to different sizes and shapes. There were ten standard post-cards, *all alike*, $3\frac{1}{4} \times 5\frac{1}{2}$ *inches*! Is this a silent argument for the efficiency of metric standardization?

Very truly,
HARRY SENIOR.

P. S.—Please: just what is a merchant-manufacturer?

Others Who Are Against a Compulsory Metric Law

Greenfield, Mass., Feb. 19, 1920.

Ethan Viall, Editor,
American Machinist.
Dear Sir:

You ask if we believe the metric system should be made compulsory. To this we answer "Positively, No."

You ask also, that if it were made compulsory, to what extent would our business be affected and what the change would cost. So far as we are concerned, as a manufacturing proposition it would not be so serious as it would be for the manufacturers who use the product which we would furnish. It would be serious with us were we forced to change from English to metric measurements. It would, however, be doubly serious to the manufacturer who was forced to adopt the metric system in place of the English, where the English is now in use. We, as manufacturers of tools, would naturally feel the change less than those in other lines, but we can see no good to come from a compulsory action of this kind.

Very truly yours,
Greenfield Tap and Die Corporation,
F. G. ECHOLS,
Vice President and General Manager.

East Moline, Ill., Feb. 17, 1920.

Ethan Viall, Editor,
American Machinist.
Dear Sir:

With reference to the movement now under way to force through a law compelling the use of the metric system, **I can think of nothing that would be more disastrous to American industry as a whole than a law of this character. When we take into consideration the enormous amount of manufacturing and engineering work that is carried on under the present system in this country, and the enormous amount of equipment, including jigs and fixtures, drawings and repairs which must be kept up for machinery that has been in service for years, we cannot but fully realize what it would mean to turn all our industries over to the metric system.** This question could perhaps have been advantageously taken up one hundred years ago, but to attempt to force it on the industries today would entail untold confusion and financial losses far beyond any possible hope of an offset return. It is my judgment that every effort possible should be put forth to defeat the passage of such a measure.

Yours very truly,
Root & VanDervoort Engineering Co.
and
R & V-Wagner Ordnance Co.,
W. H. VANDERVOORT.

Buffalo, N. Y., Feb. 24, 1920.

Ethan Viall, Editor,
American Machinist.
Dear Sir:

We wish to make ourselves clear in the subject of metric system and sincerely urge that everything possible be done to maintain the present standards of measurements, and not introduce the metric system which would require an entire change of engineering practice.

Very truly yours,
Buffalo Steam Pump Co. and
Buffalo Forge Co.,
EDGAR F. WENDT.

Newark, N. J., Feb. 26, 1920.

American Machinist.
New York.
Attention: E. Viall

We feel that the adoption of the metric system would prove one of the greatest sources of annoyance and needless expense to the manufacturers of machine tools, and therefore this movement should be defeated.

We are writing to our Congressmen and Senators and hope your efforts to defeat this movement will prove successful.

Gould & Eberhardt,
H. EZRA EBERHARDT.

World Recognized Associations That Are Against the Metric System

National Machine Tool Builders' Association

National Metal Trades Association

National Founders' Association

National Association of Manufacturers

Cleveland, Ohio, Feb. 24, 1920.

Ethan Viall, Editor,
American Machinist.
New York.
Dear Sir:

Relative to making the use of the metric system compulsory in the United States, we have given this matter serious attention during the past few years on account of the agitation in some quarters in view of this country adopting this metric system, and because of our increased interest in foreign business with countries using the system.

If this bill is intended to make the use of the metric system compulsory by the Government only, and on Government work, it would not be so serious a matter, and might ultimately be of benefit, and we presume this is what is intended.

We can hardly believe that it is contemplated to make it compulsory for all manufacturers, whether on Government work or not, as this would involve a tremendous expense to make the change in a short period of time.

It would cost us not less than $75,000 to $100,000 to make the change in our drawings and gages (and probably a great deal more), besides involving an additional cost and delay in educating our engineers in the metric system.

You may therefore set us down as decidedly opposed to such a procedure.

Yours truly,
The Wellman-Seaver-Morgan Co.,
S. H. PITKIN,
Vice President.

Another One On the World Trade Club

Cleveland, Ohio, March 6, 1920.

Ethan Viall, Editor,
American Machinist.
Dear Sir:

We notice in your issue of Feb. 26, 1920, on page 473, a copy of a letter written by the World Trade Club of San Francisco addressed to the Pratt & Whitney Co., the use of our name in connection with the adoption in this country of the metric system—the inference being that we were in favor of adopting it.

We desire to correct this impression and to say most emphatically, the name of our company was used without our authority and that we are emphatically opposed to the suggested change.

We will appreciate it if you will be kind enough to print this letter in your next issue.

Very truly yours,
The Standard Tool Co.,
H. A. Higgins,
General Manager.

Cincinnati, Ohio, Feb. 18, 1920.

Ethan Viall, Editor,
American Machinist.
Gentlemen:

Referring to proposed compulsory metric system law, kindly permit the Cisco Machine Tool Co. through the writer to join with its protest against the adoption of this system.

The machine-tool manufacturers in the United States are not only the largest machine-tool manufacturers in the world, but are producing the best and most accurate machines. Their machines are called for all over the world and are recognized as leaders.

American machinists are the best paid machinists in the world, and to bring into use the metric system which is entirely strange and foreign to the measurement standards to which they have been accustomed, would not only throw away millions of dollars worth of jigs and tools, but would also practically mean that every machinist in the country would have to start on a new system of education in order to learn the metric system thoroughly. It would mean chaos to American manufacturers; would result in an upheaval in every shop, and mean delays to all machine-tool manufacturers.

We sincerely trust that the bill may not go through.

Respectfully,
The Cisco Machine Tool Co.,
G. M. Horton,
General Manager.

Boston, Mass., March 3, 1920.

American Machinist,
New York.
Gentlemen: Attention Mr. Ethan Viall, Editor,

Before writing you, I have gone into the matter very carefully with our engineers and superintendents as I wished to be in a position to write you exactly what it would mean to this company if the metric system was made compulsory.

In the first place we have at least $200,000 worth of drawings that would have to be practically replaced by new ones, made up under the metric system.

We have also several hundred thousand dollars tied up in engineering publications and catalogs that would have to be thrown away, and it would take at least ten years to refigure our capacity, tables or curves and convert same into the metric system. Not only do we own thousands of dollars worth of small tools and gages but also our employees and workmen personally own many of these small tools, and these of course would be of little value under the metric system, and would have to in most cases be discarded.

We have hardly a machine in our plant that could be operated without serious changes if the metric system is made compulsory, as our lead screws and gages on the machines would all have to be changed, causing months or years of delay and costing at least $300,000.

I am very much afraid that if the metric system was made compulsory tremendous unrest and discontentment among all skilled mechanics would result, accustomed and experienced as they are to the use of tools under our present system.

After thinking for years in inches and fractions of an inch it would really work great hardship on these workmen in trying to do their thinking in centimetres and metres etc.

While I agree that the metric system would have been a beautiful thing if it had been established at the time our currency system was put into effect, I strongly feel that if it was made compulsory now, by any legislation, that the confusion, delay and discontentment resulting on all sides would tremendously outweigh whatever slight value might be derived from it.

I sincerely trust that Congress will not attempt to force the metric system upon the people and the manufacturers of the country as it will surely mean another heavy load, that will greatly increase discontentment and seriously hurt for years production that is so urgently needed especially at the present critical time.

In conclusion I will say that it would certainly cost this company over $1,000,000 if the metric system was made compulsory, to say nothing of the delays and demoralization that would be bound to result, the cost of which it is impossible to estimate but which would be tremendous.

Very truly yours,
B. F. Sturtevant Co.
By E. B. Freeman,
Vice President.

Lorain, Ohio, Feb. 24, 1920.

American Machinist.
Gentlemen:

Regarding movement now under way to make the metric system compulsory, we wish to advise that we are very strongly opposed to this proposition.

At present, we are unable to estimate the cost to us of such a change

Yours very truly,
The Thew Automatic Shovel Co.,
C. A. Weber,
Assistant General Manager.

Baltimore, U. S. A., March 4, 1920.

American Machinist.
Attention Ethan Viall.
Subject: The Metric System.
Dear Sir:

The proposed bill making the metric system compulsory would certainly work a hardship on the American industries at this time.

Responding to your letter of Feb. 18 we estimate that the changing over to the metric system would mean for us the changing of all drawings, gages, etc., and would probably delay our production about eighteen months.

This is probably the most inopportune time for such steps that could be found, as production is already way behind, and any such measure would certainly cripple American industry.

As it is the industries are besiged on all sides by problems, and their condition is worse than St. Paul's in his terrible predicament.

Every possible effort should be made to kill this bill.

Any steps that you might suggest where we could cooperate bringing pressure to bear we will certainly appreciate it and will do everything possible to lend our assistance and co-operation.

Yours very truly,
Standard Electric and Elevator Co., Inc.
By C. H. Mohr.

Cincinnati, Ohio, Feb. 23, 1920.

American Machinist.

Gentlemen:

In regard to the bill which is to be introduced in Congress, aiming to make the use of the metric system compulsory: We are quite sure that if it were generally understood just what the application of such a law would mean, it would have very few supporters, even among those who are now strongly for it.

The general impression seems to prevail that the industries could very easily and quickly change over to the metric system by merely re-figuring their drawings, substituting metric equivalents for inches. This impression would automatically disappear and the metric agitation would speedily subside if the general public could be made to understand that a change in the system of measurements carries with it a change in standards of manufacture.

If there is any merit at all in changing over to the metric system of measurements, the industries must carry it to its logical conclusion and adopt metric manufacturing standards; that is, standard metric commodity sizes. The adoption of metric commodity sizes is the only basis for the contention that a change over to the metric system will help foreign trade in some countries, but the metric advocates do not seem to be aware that metric commodity sizes are different from English or inch commodity sizes. We do not know of a better example to illustrate this than the one which we have often used before, which is the example of the milling-machine arbor. In all inch-using countries these arbors are made to the following standard diameters: 1 in., 1¼ in., 1½ in., 2 in.

Now the metric equivalent of the 1-in. arbor would be twenty-five and a fraction millimeters, but the actual manufacturing standard in metric countries is 27 millimeters, and the same is true of other sizes, as indicated by the table.

STANDARD MILLING MACHINE ARBORS

Catalog No.	Dia. in Inches	Exact Metric Equivalent	Dia. of Nearest Equivalent Metric Standard Arbor	Metric Size Variation from English Sizes in Millimeters	Metric Size Variation from English Sizes in Inches	Manufacturing Variation Allowed (Accuracy Limits)
16	1	25.3998+	27	+1.6002	+0.0629998	0.0002
81	1¼	31.7497+	32	+0.2503	+0.0098543	0.0002
86	1½	38.0997+	38	—0.0997	—0.0039252	0.0002
103	2	50.7996+	50	—0.7996	—0.0315002	0.0002

This is based on the length of the meter = 39,370432 in.

This same thing holds true of other parts of any machine and such things entering into machinery, as bolts, shafting, piping, etc. The application of this when translated into practice means the complete discarding of existing tools, jigs and fixtures, and their entire replacement with new ones made to metric standards. The direct expense involved, together with the expense of curtailed production, incident to changing over would be a good deal more than many manufacturers could bear. It must be remembered that the old fixtures and tools could not be changed over into the metric ones, even if their dimensions permitted this, because the old ones must be held for use when making repairs or replacements on existing machines.

If this question is again presented to Congress, for decision, we strongly advocate the appointment of a Congressional committee to make an investigation in the plants of various industries to ascertain its probable effect on manufacturing in the United States.

It may also be of interest to again point out that in such metric countries as France and Belgium, we are required **to supply cutter arbors made to the inch standards so that they can use their existing tools on those arbors.**

We have for a great many years been exporting our machines in large quantities to the so-called metric countries in competition with machines made in metric countries to metric standards, and we have yet to learn of a single instance in which the sale was in any way influenced by the system of measurement used in the manufacture of the machine.

We believe that a compulsory metric system law would lead to unnecessary confusion and prohibitive expense with no compensating advantages.

Yours very truly,
The Cincinnati Milling Machine Co.,
C. Wood Walter,
Vice President and Secretary.

A Few of the Automobile Companies That Are Against the Compulsory Metric Law

PACKARD MOTOR CAR CO.,
Detroit, Michigan.

WILLYS-OVERLAND CO.,
Toledo, Ohio.

REO MOTOR CAR CO.,
Lansing, Michigan.

AUTOCAR CO.,
Ardmore, Pennsylvania.

HAYNES AUTOMOBILE CO.,
Kokomo, Indiana.

INTERNATIONAL MOTOR CO.,
New York City.

MOLINE AUTOMOBILE CO.,
East Moline, Illinois.

MUSKEGON MOTOR SPECIALTIES CO.,
Muskegon, Michigan.

STANDARD MOTOR CONSTRUCTION CO.,
Jersey City, New Jersey.

FALLS MOTOR CORPORATION,
Sheboygan Falls,
Wisconsin.

SOUTHERN MOTOR MANUFACTURING ASSOCIATION,
Houston, Texas.

EDITORIALS

Unusual Information Concerning Milling, Boring and Tapping

THE article showing the methods used in the manufacture of recoil mechanisms for gun carriages, which begins in this issue, contains, perhaps, more suggestions for the progressive shop man than we are often privileged to present for his consideration. First, perhaps, is the detailed description of the methods used in removing very large amounts of metal by milling, and without distorting the finished product. The data in regard to the depth of milling cuts, as well as speeds and feeds, are well worth careful consideration.

One startling feature of these data is the fact that, under the conditions named, there is much less danger of the cutter breaking with an extremely heavy cut than where the cut is divided into two operations. Another suggestion along the same line is the construction of the milling-cutter arbor, where it was necessary to reduce its diameter below what was considered to be the safety point in order to clear the work. By confining this small diameter to as short a distance as possible and enlarging the arbor immediately above this point, breakage was effectually avoided.

The method of turning the trunnion by the building of a simple machine, the drilling and boring of the long holes, are all points which can be utilized by any good mechanic in a large variety of work. The method of lapping, especially the reasons for not supporting the lapping bars immediately at the end of the hole, can be easily applied to other work. Then, too, the experience in polishing which, of course, may seldom be necessary in actual manufacturing methods, is also one of the experiences to be tucked away in an engineer's private notebook.

This article is also an excellent illustration of the way in which information and experience can be applied to totally different work. The man who passes such an article by because he is not interested in recoil mechanisms, deprives himself of much valuable data on milling, boring, and lapping—data which are not available elsewhere. The ability to adapt ideas from one class of work to another is a great factor in making a man valuable. And one can usually find ideas in nearly every article, even in lines entirely different from his regular work.

Recruiting the Shop Force

THE question of industrial education has more sides than we usually consider. There is a crying need for a large number of skilled mechanics in many quarters and we are confronted with the very natural condition of not being able to reap where we have not sown. In other words, we have trained very few machinists during the past ten years, because some considered that it did not pay, or it wasn't worth bothering with boys, until we have worked the supply out—just as the farmers have worked out the soil in some sections.

Now we are trying to find a royal road by which to make a full-fledged machinist out of a boy or young man in a very short time, and there is disappointment in some quarters that the supply of boys anxious to learn the trade is not as large as might be desired. But there are several sides to the story.

We are apt to forget to what an extent conditions have changed during the last ten or twenty years, to overlook the passing of the demands for the old-time machinist in large numbers and the increased use of operators of special machines. The change has been recognized in some cases but we have not fully reckoned on its effect on the boy in all cases. We too often find only the question as to what we can get out of him, not what we can give or put into him. And the boy, alive with the spirit of the times, naturally wants to know where he "gets off," to use the slang of the day.

Leaving aside the boy whose leaning to the shop is so strong that you couldn't keep him out with a club, we have to deal with the average boy who has no special calling, and weighs the advantages of the different trades before deciding. If his sole aim is to make a fair living—and this probably obtains in most cases—is it any wonder that he looks with more favor on bricklaying than on learning to be a molder, or on some work where he can have shorter hours and wear better clothes than on either?

Have we gone about the matter of securing the right class of recruits with the same care and thoughtfulness that we use in other branches of the business? In too many cases the boy enters a shop because he must do something, rather than from any fitness for the work, and leaves it at the first opportunity to obtain better conditions than some of them provide.

We have been forced away from the old notion of "half a dollar a day" for an apprentice and are realizing that it pays to make the boy self-supporting and to pay some attention to him. But in too many cases the shops do not take into account the effect of cheerful surroundings on both young and old, or of an atmosphere with real live humanity in it, instead of only the grind of machinery. This does not mean that plush rockers should be part of every drill-press equipment or that vaudeville is necessary as a mental diversion. It does mean, however, that no live boy who is worth talking about, enjoys the prospect of becoming just a part of a machine, a mere gear in the feed train who is moved up or down a peg by the rate setter and his slide rule.

While some of these conditions have probably come to stay in modern manufacturing, it is expecting too much of an ambitious boy to choose voluntarily to become part of the plan without more advantages than are often held out.

In a recent conversation with an employer who was feeling something of the unrest that crops out here and there, he gave as his opinion that his men were perhaps less to blame for looking at things in a biased

manner than might be supposed. "They are running one machine day after day on one kind of work," he said, "until it becomes automatic and it leaves them practically free to think over the monotony of the work. They see it from one side only and their ideas become too firmly fixed to be easily dislodged."

Too few shop managers, busy every minute with multitudinous problems, realize as did this employer, the effect of the monotony of doing one thing day after day. He knew from experience.

It is with no spirit of pessimism that this is written. Every man who looks the conditions squarely in the face knows how they have changed and that they can never go back—in fact, it is probably not desirable that they should. Our problem is to meet the new conditions and solve the difficulties presented fairly and to the best interest of all concerned, for any other solution is but temporary and cannot be satisfactory to either party in the long run.

The question of properly training the boy is perhaps more important than that of getting him and keeping him contented, but this cannot be done until after he has been found and impressed with the advantages of becoming a mechanic. We believe a little more attention to the fact that he is a human being, not a part of the machinery, would greatly reduce the trouble caused by boys leaving after a short sojourn in the shop, and that it would be beneficial to all concerned.

An Experiment That Might Be Emulated with Profit

AN experiment leading to gratifying results in the way of stimulating the interest of machinists and toolmakers in their business has recently been put into practice by our contributor, Thomas Mateer, who is foreman of the machine shop at the plant of the Texas Steamship Co., at Bath, Maine.

There has been considerable discussion in the columns of the *American Machinist* as to what a machinist graduate of a trade school should know, and a list of questions by W. D. Forbes which such a man should be able to answer was published on page 169.

Mr. Mateer has taken most of these questions, added others as his judgment dictated and has compiled a catechism or questionnaire which he submitted to the men in his employ. The questions were arranged by points so that a possible score of 125 points was attainable.

One man made a perfect score, answering all questions correctly, and was awarded the prize—a new surface gage.

Revival of Immigration

One of the most encouraging developments in the industrial situation is the fact that the tide of immigration has begun to rise.

A Naples dispatch states that demands for passports to America far exceeds the transportation facilities.

Secretary of State Lansing says immigration is now at the rate of 540,000 a year, against 326,700 in 1915 and about 300,000 in 1916 and 1917.

The new tide of immigration is setting in more strongly from Italy than from Eastern Europe, possibly because potential immigrants from Eastern Europe have been unable as yet to get out of their own countries.—*The Supply Manufacturer.*

John Nazel

JOHN NAZEL, proprietor and general manager of the Nazel Engineering and Machine Works, Philadelphia, Pa., died on February 16, 1920. Mr. Nazel was born in Philadelphia on October 20, 1864, and has operated the engineering and machine works since 1900.

At an early age, being mechanically inclined, he commenced his apprenticeship as machinist, and in order to acquire a thorough knowledge of his trade, he secured employment for certain periods with the Keystone

Watch Case Co., Baldwin Locomotive Works, Thomas H. Dallett & Co., and Link-Belt Company.

After serving the last-named company for a number of years in a supervising position, he decided to engage in business on his own account and started in a small way in the basement at Ridge Ave. and 11th St. Due to his thorough knowledge of his trade, he soon built up a desirable patronage from leading manufacturers in the vicinity, and as a result was compelled to secure larger quarters, leasing the entire first floor of the 11th St. building.

Mr. Nazel designed and invented some valuable improvements to paper-making machinery, especially corrugated paper, and specialized on this class of machinery for quite a number of years, equipping some of the largest plants manufacturing corrugated paper in this country.

As his business was constantly growing and the facilities limited at Ridge Ave. and 11th St., he purchased the plant and equipment of the Corliss Engine Works, 4041 North 5th St., in 1907, where the business was located at the time of his death.

Mr. Nazel later became more deeply interested in metal-working machines than those for other purposes,

and seeing the market for forgings constantly increasing, in the year 1908 he started to specialize on forging hammers; as a result the Nazel pneumatic power hammer was placed on the market. Its decided merits and advantages were soon recognized by the trade and for the past few years the product of the plant has been nothing but hammers.

The business will be continued by his estate, under the management of his sons, Ralph W. and J. Milton Nazel, and C. H. Wackernagel, who has been connected with Mr. Nazel for the last 16 years.

Owing to Mr. Nazel's strong personality he acquired a large following of influential friends, not only in the machinery trade but in practically all walks of life, and due to his wide knowledge of current events and mastery of his business, his advice was sought freely and frequently, and generously given. It is needless to say that his loss will be felt keenly by his associates and all those who came in contact with him from time to time.

Spoiled Work and Its Prevention

Spoiled work, either from defective material or inaccurate workmanship, is a distinct loss, not only to the individuals but to the community. Any net reduction in the amount of spoiled work is a distinct gain to all concerned and is a real advance in the economy of manufacture.

The letters printed below from well-known firms show that the subject is being carefully considered in many cases. The causes and remedies suggested are of interest and should be carefully considered.

We believe that a frank discussion of this problem, not with a view of pointing out the faults of individuals concerned, but of suggesting remedies, will be of value to the machine-building industry as a whole. Preventing waste is about as important as making two blades of grass grow where only one grew before.

We believe that having the work inspected between each operation, issuing careful instructions to each workman as to the sequence of his particular operation, and as far as possible always giving the same job to the same man every time, are the most important factors.

The percentage of wastage is a very difficult thing to answer, but as nearly as we can determine from a careful survey of replaced parts, the spoiled work would not amount to more than 2½ or possibly 3 per cent.

We find that defective material is a most serious problem just at present. This is running as high as probably 4½ per cent. We have had on several occasions on certain castings as high as 100 per cent defective from the foundry; some defects of course do not show until after the machine work is done. This factor, when the delivery of castings is uncertain, is a very serious problem.

We feel that a very large percentage of the spoiled work in the average shop today is due to the present necessity of endeavoring to do good machine work with untrained men who are not particularly interested in the work they are doing.

THE BLANCHARD MACHINE COMPANY,
WINFIELD W. BLAKEMAN,
Superintendent.

All records of bad castings and spoiled work go immediately into the production and planning departments. Whenever the percentage of wastage is unusually high, an immediate investigation is made.

The object of the immediate investigation is twofold. First, it impresses on the man the fact that his work is carefully noticed, and so makes him more careful; secondly, it enables us to locate the cause of the trouble, and so possibly obviate same while the cause is still fresh in the workman's mind.

We do not keep a record of percentage of wastage, as we do not feel that such a flat percentage is of much value. What might be a high percentage for some kinds of castings (or some pieces) would be a low, or at least an allowable, percentage for others. We believe that the character and difficulty of the individual part must determine the allowable percentage of wastage for that part.

THE G. A. GRAY COMPANY,
AUGUST MARX,
Vice President.

In reply to your letter of Jan. 3, we submit the percentages of waste in our plant due to defective workmanship, defective material and engineering errors for the latter half of 1919:

Month, 1919	Defective Workmanship Per Cent	Defective Material Per Cent	Engineering Errors Per Cent
July	0.008	0.015	0.004
August	0.01	0.01	0.002
September	0.013	0.013	0.004
October	0.013	0.015	0.002
November	0.016	0.02	0.005
December	0.014	0.019	0.004

From our point of view, to decrease wastage, it is necessary that methods be standardized and to have someone in authority who will assume responsibility for results obtained, good or bad. This person should also have the ability to keep in close touch with the foremen and men, and by this means it is inevitable that an organization will obtain more production with less wastage.

THE KEMPSMITH MANUFACTURING CO.,
JOHN GOETZ,
Works Manager.

We have monthly departmental records showing the cost of factory supplies consumed. This is of valuable assistance in preventing the excessive use of miscellaneous supplies, such as waste, files, stationery, etc. The reports are sent to the various factory foremen each month to show the value of the supplies used in the respective departments. This gives the foreman a chance to make monthly comparisons and it gives the factory superintendent an opportunity to compare the supplies used by the different departments, in addition to the comparative department records.

One of the mistakes frequently made by factory managers and superintendents is depending, to a large extent, on inspectors to reject work spoiled in process. Most factories employ a large corps of inspectors. These are non-producers and the work they reject is partly, if not entirely, lost. We favor and work on the theory that it is too late to avoid waste by rejecting work spoiled in process. We employ more inspectors than should be necessary and are trying to reduce the number by placing greater responsibility on the actual producers, and increasing their compensation accordingly.

The responsibility for defective work should be placed on the foremen and the workers. The increased production of a careless worker is frequently more than offset by the work that he spoils. Every machine operator, or other producer, should be taught to realize that his value increases to his employer, provided he is a satisfactory producer, in proportion to the reduction in the amount of work spoiled in process. If this plan is generally understood by the employees, it increases production and is one of the best methods of avoiding waste.

We have no available figures of spoiled work which would be at all helpful in this inquiry.

LOCOMOBILE CO. OF AMERICA,
H. H. EDGE,
General Works Manager.

Patent Bill No. 11,984

THERE is no more important branch of the Government service than the Patent Office — nor one that has been more neglected in many respects. The employees have had but one general increase in salaries since 1848, and it is to the everlasting credit of those who are and have been employed there, that the records show but one in a position of responsibility who ever betrayed his trust.

As prices have mounted it has become increasingly difficult to hold trained employees or to obtain others. The bill given herewith offers some relief to the harassed Commissioner of Patents. It was passed unanimously by the House Committee and then went before Congress, and was passed March 5 by a vote of 272 to 6.

Regarding this bill, the Engineering Council passed the following resolution at a recent meeting.

Resolved: That the Chairman be authorized to arrange for sending notice by letter to the several societies represented on Engineering Council, urging them to use their influence in favor of the increase in salaries and staff proposed in the Nolan Bill, H.R. 11,984.

This resolution together with an appeal to engineers in general, was sent out March 3 over the signature of

EDWIN J. PRINGLE, *Secretary,*
Patents Committee, National Research Council.
CHARLES A. TERRY, *Chairman,*
Patents Committee, Engineering Council.
D. S. JACOBUS, *Representative,*
Am. Soc. M. E on Patents Committee of Engineering Council.

The bill is now before the Senate Committee composed of Senators Norris, Knox, Brandigee, Kellogg, Kirby, Smith and Gore. The chairman is Senator Norris.

It cannot be too strongly urged upon all engineers, manufacturers and others to whose interest the efficiency of the patent office is vital, that they help along the good work and use their influence toward the quick passage of the bill by the Senate.

Ethan Viall
Editor

An Act

To increase the force and salaries in the Patent Office, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 477 of the Revised Statutes be, and the same is hereby, amended to read as follows:

"Sec. 477. The salaries of the officers mentioned in the preceding section shall be as follows:

"The Commissioner of Patents, $6,000 a year.
"The First Assistant Commissioner of Patents, $5,500 a year.
"The Assistant Commissioner of Patents, $5,000 a year.
"Five examiners in chief, $5,000 a year each."

Sec. 2. That as much of section 440 of the Revised Statues as followed the words "in the Patent Office" and refers to said office only be, and the same is hereby, amended to read as follows:

"Chief clerk (who shall be qualified to act as principal examiner), $4,000; six law examiners, at $4,000 each; examiner of classification, $4,200; two examiners of interference, at $3,900 each; examiner of trade-marks and designs, $3,900; first assistant examiner of trade-marks and designs, $3,000; one second assistant examiner of trade-marks and designs, at $2,700, and one at $2,500; one third assistant examiner of trade-marks and designs at $2,200, and one at $2,050; six fourth assistant examiners of trade-marks and designs—two at $1,800 each, two at $1,650 each, and two at $1,500 each; examiners—forty-seven principals at $3,900 each; one hundred first assistants—forty at $3,300 each, thirty at $3,100 each, and thirty at $2,900 each; one hundred second assistants—forty at $2,800 each, thirty at $2,500 each, and thirty at $2,350 each; one hundred third assistants—forty at $2,200 each, thirty at $2,050 each, and thirty at $1,925 each; one hundred fourth assistants—forty at $1,800 each, thirty at $1,650 each, and thirty at $1,500 each; financial clerk, who shall give bond in such amount as the Commissioner of Patents may determine, $2,500; librarian, who shall be qualified to act as assistant examiner, $2,700; eight chiefs of nonexamining division at $2,500 each; eight assistant chiefs of nonexamining division at $2,100 each; private secretary, to be selected and appointed by the Commissioner, $2,000; translator of languages, $2,400' assistant translator of languages, $2,000; clerks—twenty-two of class four, at $1,800 each; thirty-three of class three, at $1,600 each; one hundred of class two, at $1,400 each; one hundred and twenty-five of class one, at $1,200 each; one hundred, at $1,100 each; skilled draftsmen, one at $1,800 and three at $1,600 each: three draftsmen, at $1,400 each; forty copyists, at $1,100 each: thirty-six messengers, at $1,080 each; thirteen laborers, at $1,080 each; forty-seven examiners' aids and thirty-nine copy pullers who shall be selected without regard to apportionment, $720 each;

"For special and temporary services of typewriters certified by the Civil Service Commission, who may be employed in such numbers, at $3 per diem, as may, in the judgment of the Commissioner of Patents, be necessary to keep current the work of furnishing manuscript copies of records, $7,500.

"For purchase of law, professional, and other reference books and publications and scientific books, and expense of transporting publications of patents issued by the Patent Office to foreign Governments, $10,000.

"For investigating the question of public use or sale of inventions for two years or more prior to filing applications for patents, and such other questions arising in connection with applications for patents as may be deemed necessary by the Commissioner of Patents, and expense attending defense of suits instituted against the Commissioner of Patents, $2,500.

"For the share of the United States in the expense of conducting the International Bureau at Berne, Switzerland, $750."

Sec. 3. That section 487 of the Revised Statutes be, and the same is hereby, amended to read as follows:

"Sec 487. The Commissioner of Patents, subject to the approval of the Secretary of the Interior, may prescribe rules and regulations governing the recognition of agents, attorneys, or other persons representing applicants or other parties before his office, and may require of such persons, agents, or attorneys, before being recognized as representatives of applicants or other persons, that they shall show that they are of good moral character and in good repute, are possessed of the necessary qualifi-

cations to enable them to render to applicants or other persons valuable service, and are likewise competent to advise and assist applicants or other persons in the presentation or prosecution of their applications or other business before the office. And, subject to like approval, the Commissioner of Patents may, after notice and opportunity for a hearing, suspend or exclude, either generally or in any particular case, from further practice before his office any person, agent, or attorney shown to be incompetent or disreputable or who refuses to comply with the said rules and regulations, or who shall, with intent to defraud in any manner, deceive, mislead, or threaten any applicant or prospective applicant, or other person having immediate or prospective business before the office, by word, circular, letter, or by advertising. The reasons for any such suspension or exclusion shall be duly recorded.

Sec. 4. That the third paragraph of the Act of January 12, 1895 (chapter 23, section 73, Twenty-eighth Statutes at Large, page 619), as amended, be, and the same is hereby, amended to read as follows:

"Third. The Official Gazette of the United States Patent Office in numbers sufficient to supply all who shall subscribe therefor at $5 per annum; also for exchange for other scientific publications desirable for the use of the Patent Office; also to supply one copy to each Senator, Representative, and Delegate in Congress; also to supply one copy to eight such public libraries having over one thousand volumes, exclusive of Government publications, as shall be designated by each Senator, Representative, and Delegate in Congress, with one hundred additional copies, together with weekly, monthly, and annual indexes for all the same; of the Official Gazette the 'usual number' shall not be printed."

Sec. 5. That section 4898 of the Revised Statutes be, and the same is hereby, amended to read as follows:

"Sec. 4898. Every patent or any interest therein shall be assignable in law by an instrument in writing, and the patentee or his assigns or legal representatives may in like manner grant and convey an exclusive right under his patent to the whole or any specified part of the United States. An assignment, grant, or conveyance shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the Patent Office within three months from the date thereof or prior to such subsequent purchase or mortgage.

"If any such assignment, grant, or conveyance of any patent shall be acknowledged before any notary public of the several States or Territories or the District of Columbia, or any commissioner of any court of the United States for any district or Territory, or before any secretary of legation or consular officer authorized to administer oaths or perform notarial acts under section 1750 of the Revised Statutes, the certificate of such acknowledgment, under the hand and official seal of such notary or other officer, shall be prima facie evidence of the execution of such assignment, grant, or conveyance."

Sec. 6. That section 4906 of the Revised Statutes be, and the same is hereby, amended to read as follows:

"Sec. 4906. The clerk of any court of the United States, for any District or Territory wherein testimony is to be taken for use in any contested case pending in the Patent Office, shall, upon the application of any party thereto, or of his agent or attorney, issue a subpoena for any witness residing or being within such District or Territory, commanding him to appear and testify before any officer in such District or Territory authorized to take depositions and affidavits at any time and place in the subpoena stated. But no witness shall be required to attend at any place more than forty miles from the place where the subpoena is served upon him; and the provisions of section 869 of the Revised Statutes relating to the issuance of subpoenas duces tecum shall apply to contested cases in the Patent Office."

Sec. 7. That section 4921 of the Revised Statutes be, and the same is hereby, amended to read as follows:

"Sec. 4921. The several courts vested with jurisdiction of cases arising under the patent laws shall have power to grant injunctions according to the course and principles of courts of equity, to prevent the violation of any right secured by patent, on such terms as the court may deem reasonable; and upon a decree being rendered in any such case for an infringement the complainant shall be entitled to recover, in addition to the profits to be accounted for by the defendant, the damages the complainant has sustained thereby, and the court shall assess the same or cause the same to be assessed under its direction. If on the proofs it shall appear that the complainant has suffered damage from the infringement or that the defendant has realized profits therefrom to which the complainant is justly entitled, but that such damages and profits are not susceptible of exact calculation and determination, the court may, on evidence tending to establish the same, in its discretion, receive opinion or expert testimony, which is hereby declared to be competent and admissible, subject to the general rules of evidence applicable to this character of testimony; and upon such evidence and all other evidence in the record the court may adjudge and decree the payment by the defendant to the complainant of a reasonable sum as a royalty or general damages for the infringement. And the court shall have the same power to increase such damages, in its discretion, as is given to increase the damages found by verdicts in actions in the nature of actions of trespass upon the case; but in any suit or action brought for the infringement of any patent there shall be no recovery of profits or damages for any infringement committed more than six years before the filing of the bill of complaint or the issuing of the writ in such suit or action, and this provision shall apply to existing causes of action. And it shall be the duty of the clerks of such courts within one month after the filing of any action, suit, or proceeding arising under the patent laws to give notice thereof in writing to the Commissioner of Patents, setting forth in order so far as known the names and addresses of the litigants, names of the inventors, and the designating number or numbers of the patent or patents upon which the action, suit, or proceeding has been brought, and it shall be the duty of the Commissioner of Patents on receipt of such notice forthwith to indorse the same upon the file wrapper of the said patent or patents and to incorporate the same as a part of the contents of said file or file wrapper; and for each notice required to be furnished to the Commissioner of Patents in compliance herewith a fee of 50 cents shall be taxed by the clerk as costs of suit."

Sec. 8. That section 4934 of the Revised Statutes be, and the same is hereby, amended to read as follows:

"Sec. 4934. The following shall be the rates for patent fees:

"On filing each original application for a patent, except in design cases, $20.

"On issuing each original patent, except in design cases, $20.

"In design cases: For three years and six months, $10; for seven years, $15; for fourteen years, $30.

"On every application for the reissue of a patent, $30.

"On filing each disclaimer, $10.

"On an appeal for the first time from the primary examiners to the examiners in chief, $10.

"On every appeal from the examiners in chief to the commissioner, $20.

"For copies of records made by the Patent Office, excluding printed copies, 10 cents per hundred words.

"For each certificate, 25 cents.

"For recording every assignment, agreement, power of attorney, or other paper of three hundred words or under, $1; of over three hundred and under one thousand words, $2; and for each additional thousand words or fraction thereof, $1; for each additional patent or application included in one writing, where more than one is so included, 25 cents additional.

"For copies of drawings, the reasonable cost of making them."

Sec. 9. That sections 4935 and 4936 of the Revised Statutes be amended to read as follows:

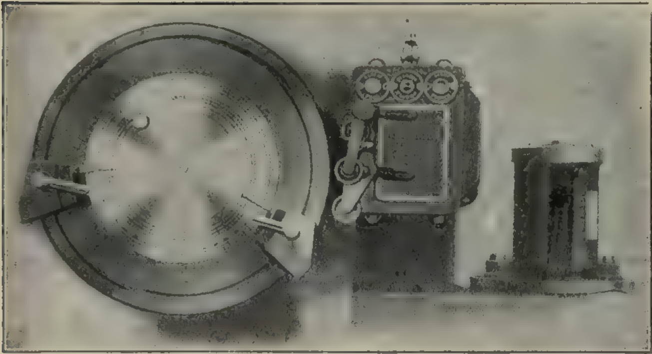
"Sec. 4935. All patent fees shall be paid to the Commissioner of Patents, who shall deposit the same, less any sum or sum refunded under section 4936 of the Revised Statutes, in the Treasury of the United States in such manner as the Secretary of the Treasury shall direct.

"Sec. 4936. The Commissioner of Patents is authorized to pay back any sum or sums of money paid to him by any person by mistake or in excess of the fee required by law."

Sec. 10. That the provisions of section 4934 as herein amended shall take effect July 1, 1920, with reference to the fee for issuing an original patent, and shall apply only to patents issued on applications filed after that date. The fees for issuing original patents on all other applications shall be as now provided by law.

Passed the House of Representatives March 5, 1920.

Attest: Wm. TYLER PAGE,
Clerk.



"Hiloplane" Electrically Controlled Planer

THE planing machine called the "hiloplane," illustrated in Fig. 1, contains a number of interesting features, including a reversing motor drive (current to which is supplied through a special generator set that is part of the equipment); magnetic feeds; the simplicity of setting the table stroke on a graduated dial, no table dogs being employed for this purpose, and the introduction of cross planing.

In its mechanical details the box-section bed, Fig. 2, is of an unusually substantial proportion. The driving pinions are forged solid with their shafts as the maker contends that at the speeds at which they run, solid pinions are safer in every way. One change of speed for slow-speed work is obtainable in the table gearing. The entire absence of belts, and the convenience of quick power traverses in all directions may be noted.

The most striking features, however, are the flexibility and ease of control obtained by the special system of driving and the magnetic feeds. The essential principle of the drive is the Ward-Leonard system of using a special motor-generator to supply current to an individual motor, the control of the latter being principally accomplished by manipulation of the fields of the former. The generator in common with the final reversing motor must be a direct-current machine, with independently excited fields. Variation in strength of the generator field provides a variable voltage with corresponding variation of speed in the final motor. This gives an infinite range of speed downward from a given normal by reducing the generator voltage to zero, although in practice the speeds are never reduced below 25 per cent of the normal on account of the reduced torque.

The overall range of the final reversing motor is usually increased to eight to one by the variation upward from the normal, by weakening the motor shunt field, the speed variation being accomplished by adjustment of resistance values in the generator and motor field. It is a simple matter to secure sudden alterations of speed at any part of the stroke, and an accelerating switch is fitted on all "hiloplanes," which enables the cutting speed to be increased after the tool has entered the metal, or the table speed increased to that of the return speed, in order that gaps between surfaces may be quickly bridged.

An exceptionally wide range of feeds is obtained by the special magnetic feed control which is operated by solenoid and small separate motor illustrated in Fig. 3. Light feeds are obtained by solenoid control only; broad feeds are actuated by the motor controlled by the solenoid working in synchronism with it, the feed obtained being according to the position of the handle in the horizontal slot shown. The motor is only energized for a few seconds at the beginning of the cut and is fitted with an adjustable slipping clutch. The feed motor mentioned is also used for quick power traverse to the heads which are obtainable in all directions; also for cross planing, a unique feature very valuable for short bosses on large pieces, for jig work and vertical planing or slotting.

The control of table stroke or cross stroke to head for cross planing is exceedingly simple; this is clearly illustrated in the headpiece. The length of stroke is obtained by setting the dogs to the necessary graduations which are direct reading in feet and inches. The reversal

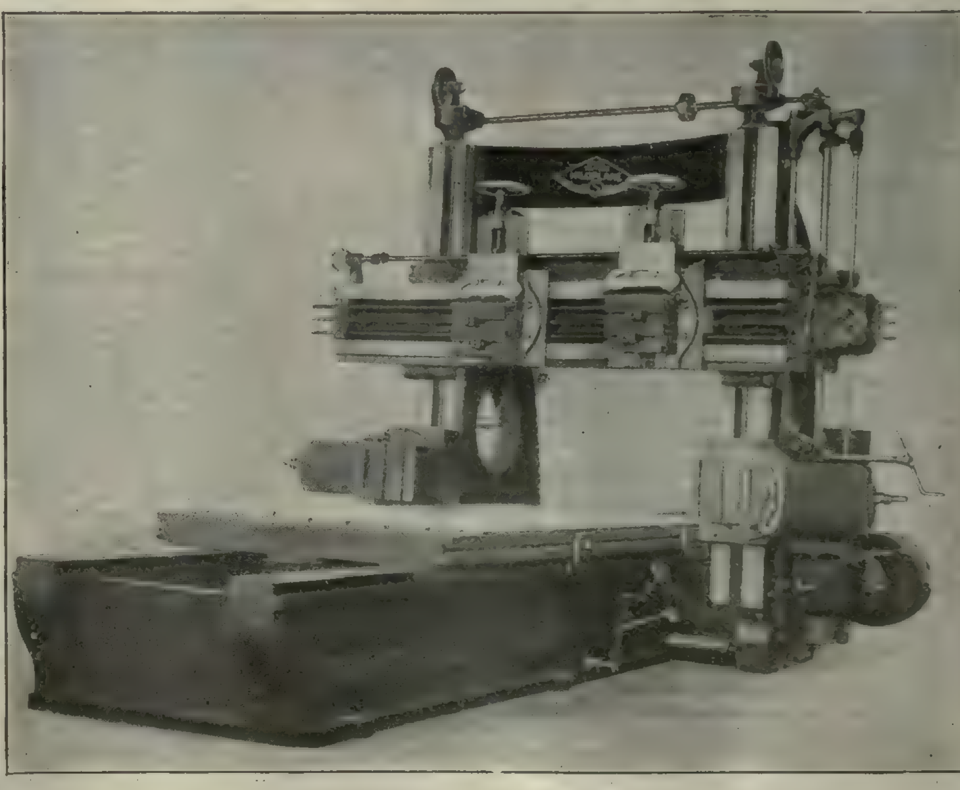


FIG. 1. THE ELECTRICALLY CONTROLLED PLANER

FIG. 2. THE BOX-SECTION BED

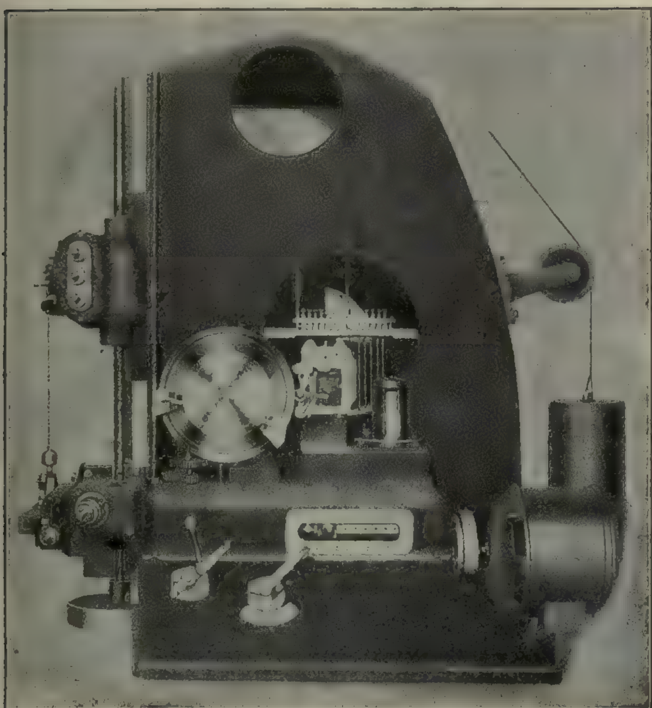


FIG. 3. MAGNETIC FEED CONTROL

of stroke is obtained by the action of the dogs on the master reversing switch shown in the same illustration. The combination enables a stroke of only 4 in. to be obtained on a 12-ton table. This stroke control entirely does away with table dogs and enables the operator to set both ends of the travel accurately from a given point. The table may be started or stopped at the master switch or from stations on either side of the bed; a hanging pear switch is also provided for convenience in setting up. It acts as an inching control. A safety switch is also provided to prevent the table running off the rack.

This planer is built by John Stirk & Sons, Ltd., Halifax, England, which firm is represented by Alfred Herbert, Ltd., New York.

The Clerical Man in the Machine Shop a Necessary Nuisance

By Henry G. Fenn

That's me! At least I am considered as such from the viewpoint of you foremen and working mechanics. In other words, I am an executive clerical man in a large modern machine shop. Ah! Now you all recognize me and I feel sure that you are ready to admit that the title of this short article expresses just what you all think I am. You, of course, never tell me so personally in so many words but I have met many different types of men in several large manufacturing plants in the last twenty years. Nearly all of them carry their unspoken thoughts on their countenances. So much for what you think I am.

Now the purpose of this little sketch is to get myself before you in a different light from that in which you now see me. I shall try the almost impossible task of convincing you that my title has just one word wrong; that I am a Necessary Associate to you all.

To illustrate my point I want to repeat what my son once said to his mother. When a young man or rather still quite a boy he worked one vacation in the stockroom of a plant where I held a responsible executive position in the office. His duties brought him into the office occasionally in the vicinity of my desk. After a few days he came home at night and told mother that he never saw father do any real work; he merely sat at a desk all day long looking over and sorting out papers which he gave over to others to handle.

Now honestly, men, isn't this pretty close to what you also think about me? Incidentally, this young man has since completed his school course, learned his trade as machinist and is a foreman. He has never changed his early opinion about dad's duties, but you and he are wrong. It takes clear conception, an open mind, general knowledge, education, tact, anticipation of wants, etc., to supervise this clerical work.

To you the problem of entering an order for, say, fifty machines is as easy as rolling off a log—but is it? The clerical man has several things to think of in this apparently simple matter. He must secure an inventory of all finished parts and also of all unfinished castings and materials in stock. He takes these into consideration when ordering enough for the lot.

Then some parts of almost every lot are also used on other lots. This makes it necessary for him to know if the parts for the other lot have been allotted from stock on hand. He must also allow a certain percentage over for breakage, spoiled work, etc. After taking all these conditions into consideration he must buy in quantities to get the best price.

The clerical man has every mix-up, every mistake, big or little, to rectify on his many records. He must go slow, investigate snap reports of discrepancies, and personally secure actual conditions which as a rule are at variance with the first hasty reports If he is stubborn and refuses to move until he knows the facts he is a "mule." If, on the other hand, he takes your version offhand and it proves wrong he is the "goat."

Now in spite of the abuse heaped upon him the clerical man is indeed human.

This little article is an appeal to you men to take a new attitude and co-operate with him, loosen up, and explain to him in plain language what you are sure he is ignorant of in a mechanical way. You may be surprised to find out how quickly he will grasp your meaning and how anxious he is to learn your end of the problem so far as his clerical education will permit. It is readily granted that the average experienced clerical man is not usually an expert mechanic but his general knowledge gives him a clear conception of any problem once it is put squarely before him in terms not too technical for an ordinary man to grasp.

Let us all get together and treat the clerical man as a human being.

What the Worker Really Wants

In order to discover the workings of the laborer's mind, Whiting Williams, welfare director of the Hydraulic Pressed Steel Co., of Cleveland, left his executive desk. For nearly seven months he worked as a day laborer in the steel mills, coal mines and ore dumps.

As a result of his long and intimate contact with those who furnish the muscular energy essential to the operation of basic industries, Williams said he had reached the conviction that among the things on the worker's mind as primary causes of the strikes and other industrial disturbances prevalent throughout the nation and the world are:

The unholy alliance between tiredness and temper, between fatigue of body and mind, between soreness of muscle and soul. "The tired man most quickly becomes a grouchy man, and, conversely, the grouchy man most quickly becomes tired. The tired man does not want to think; he wants to feel." Therein, Mr. Williams believes, lies a great danger, for it gives opportunity for agitators to work upon the feelings and sensibilities of the worker, his reason not being appealed to.

The almost complete ignorance of the average worker as to the plans, purposes, ideals and character of his employer. "The worker is told little or nothing of these things. As a result, he uses his head and makes deductions. He sees prodigal waste of materials about the shop, perhaps, and decides: 'This company cares for nothing but big money. What do my small wages matter? And he proceeds to soldier on the job. The longer I worked in the mills the less I did, because of the 'underground' instructions, a tap on the shoulder, with such behests as, 'Lots of time,' 'Take it easy,' 'Don't kill yourself,' 'Twelve hours,' etc. The ignorance of the worker regarding the company's principles and purposes, the result of lack of interest by the company in its workers, causes lack of interest on the part of the workers, which costs the company money in inefficient work."

Ignorance such as this breeds colossal distrust of employers, Mr. Williams pointed out, and makes for deep-set conviction on the part of the worker that "delivering the goods" gets him nowhere, that "pull" rather than merit is the thing that counts with the employer, and that marrying the boss' daughter is the acme of favorable influence.

Using the simile of the "industrial sector," Mr. Williams urged efforts on the part of employers to make their workers feel that they have an opportunity to "break through." He would strive to give the latter the thrill of accomplishment, to inspire a sense of their own value in getting the work of the world done. He contrasted what is often the hopelessness of the worker's position in life with the thrills and opportunities of those farther up in the scale of human accomplishment, and said that the worker must be helped to find himself, to realize that his work, too, helps meet the needs of the world of human beings.

Mr. Williams said it was a mistake to conclude that all workers were radicals. The latter are a small minority, he finds, but they have a lead on the employer group, chiefly because they have been industriously engaged in putting salt on the raw spots among the workers, thus taking advantage of idleness, fatigue and soreness.

The average worker, he said, was trying to lead a reasonable and logical life, in as normal and wholesome a manner as his occupation and living conditions would permit. He was not a Bolshevik, in the main. When he will become such, if ever, depends upon you and me. The average man doesn't want to upset things, to take over the management of industries. He wants a steady, good, decent, interesting job. We should try to get to him, to meet him where he lives, after we are sure we have set our own house in order. This is no time to harden our hearts and clench our fists. What everyone needs is a cool head and a warm heart. It is time we stopped fuming and raving about the "wops." We couldn't get along without them, for they are doing work we would not do at any price.—*N. Y. Ad. Club News.*

What Shall the School Shop Produce?

By George Heald

A very important problem of the school shop is that of providing suitable product to carry out the course of training. This problem has been discussed very little in articles pertaining to vocational training, and yet it seems to be a source of constant worry on the part of instructors of machine-shop work.

When a machine-shop class is first organized this condition is not so noticeable, due to the considerable number of tools and appliances which must be made to round out the equipment, but after a class has been established for a few years and grows to about one hundred boys, the situation becomes acute.

I don't believe anyone will argue today that the work should consist of exercises which eventually find their way to the scrap box, nor is the work of constructing equipment for various departments of the school, in my opinion, sufficient either in variety or quantity.

One hundred boys in the shop three hours per day will, if kept busy and if they have the opportunity, produce a considerable amount of finished work during a two-year course, and this must be so if they are to be taught proper concepts of machine-shop procedure.

Must we continue to scour the school system for projects, which in many cases are unsuitable, in an effort to supply work? Should we make a marketable product to be sold to private concerns? Or, should we gather in material from neighboring manufacturers to be turned back to them when completed?

To build a marketable product might be objected to, both by employer and employee, and since the capacity of the school and the capabilities of the students would only permit the building of one or two simple machines, it might tend to make the training rather narrow in its scope.

The best solution seems to be the selection of a series of articles from local manufacturers which would be adequate in variety to teach the necessary processes. These articles or machine parts could be sold to the school by the manufacturer. The school would complete the work and when such work had passed inspection it could be sold back to the manufacturer at what it would have cost him to produce it. Part of the money might be used to aid in making the school self-supporting and part of it might go to the student. It would be quite an incentive to a boy to know that if he completed a job accurately and in reasonable time he would receive some compensation for it other than the usual percentage grade.

I would like to see a frank discussion of this problem through the columns of the *American Machinist.*

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

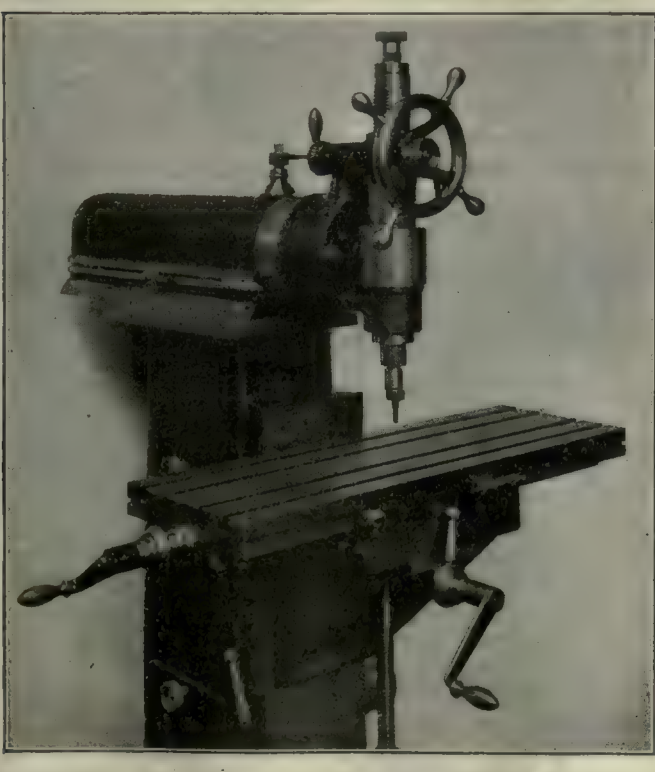
Pearson Precision Spacing and Boring Machine

The Modern Machinery Exchange, 25 Church St., New York, has placed on the market the spacing and boring machine illustrated herewith.

This machine is intended for use in spacing and boring jigs and in construction combines some of the features found in milling and shaping machines. The drilling head is mounted on the end of a ram and can be swiveled to any desired angle. The drive is from a cone pulley on the right-hand side through shafts and gearing to the spindle.

Both the ram and table carry adjustable micrometer heads opposed by stationary anvils on the frame and knee.

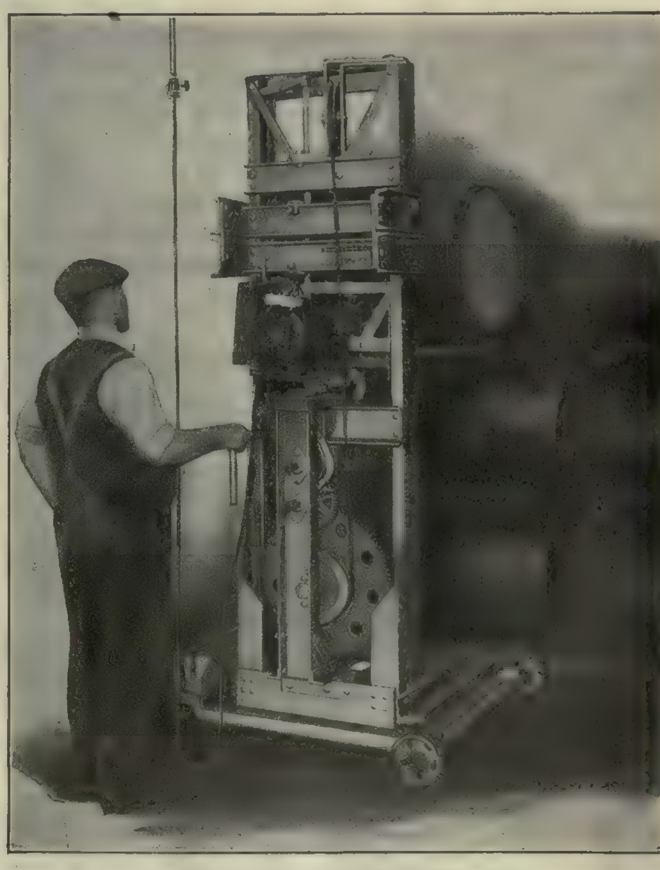
When the spindle is located for boring the first hole, end measures are placed between the micrometers. After boring this hole the location of the spindle for the next hole is found by removing the proper end measure and substituting another, differing in length by the distance between the holes, and adjusting the movable member until the end measure has the proper "feel" between the micrometer head and its anvil. It will thus be seen that the accuracy obtainable is only limited by that of the end measures and micrometers, and is not in any way affected by feed screws that may be of uncertain precision.



PEARSON PRECISION SPACING AND BORING MACHINE

Revolvator Tiering Machine

A tiering machine of improved design as shown is an addition to a line of similar machines manufactured by the Revolvator Co., Jersey City, N. J. Besides improved structural details, the new model is arranged for dual control, and may be hand or motor operated, the same crank being used in either case. When the motor is connected to an electric circuit, and the crank is attached to the switch, the car platform may be raised or lowered by shifting the position of the crank. The motor is of ½ hp. and can therefore be operated from any lamp circuit. Limit switches of a simple type are provided to prevent overrun. To change from power to hand operation the crank is simply moved to another position and used in the regular way. The advantage



REVOLVATOR TIERING MACHINE

of the combination control is obvious as the hand power arrangement is provided only for emergency use or where current is not available. The Revolvator is made in several standard types and in a number of different sizes that will raise loads from 800 to 1,800 lb. to various heights, the maximum rise being 18 ft. For greater capacities the machine will be built to order. The power equipment can be supplied for hand-operated machines now in use.

Moline Nos. 4 and 5 Horizontal Boring Machines

The Moline Machinery Co., Moline, Ill., has brought out the two horizontal boring machines shown in Figs. 1 and 2 and known as its Nos. 4 and 5. These machines are designed for the boring of crank and

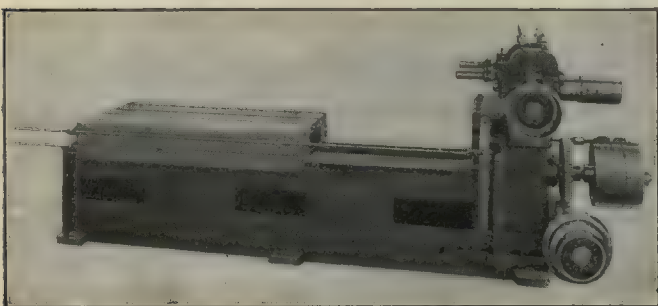


FIG. 1. MOLINE NO. 4 HORIZONTAL BORING MACHINE

transmission cases, but can be adapted to other work where a single-purpose machine is required. The table has a narrow guide on the bed, wide-surface bearing ways, and four T-slots on its top surface.

The table has three positive feeds toward the spindles and a rapid-traverse movement in both directions. The feeds and rapid traverse are interlocking, avoiding all danger of both being engaged at the same time. In building the machine the feeds and speeds are varied to suit the requirements of the customer. The two-pitch feed screw is $2\frac{1}{2}$ in. in diameter and runs in a hard bronze nut. A countershaft is furnished with the machine which gives two speeds to the spindles. All controls can be operated by levers

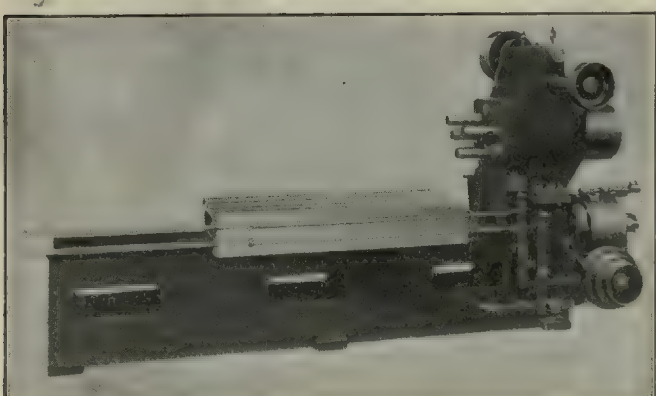


FIG. 2. MOLINE NO. 5 HORIZONTAL BORING MACHINE

Specifications: Working face of table, 24 x 48 in.; table travel, 48 in.; height of table from bed, 6 in.; height of table from floor. 26 in.; distance from table to top of rail on No. 4, $9\frac{5}{8}$ in.; distance from table to lowest spindles on No. 5, $8\frac{3}{4}$ in.; minimum center distance of spindles on No. 4, 2 in.; maximum center distance of spindles on No. 4, 26 in.; end adjustment of spindle on No. 4, 1 in.; spindles bored No. 4 or 5 Morse taper; weight of No. 4, 5,000 lb.; weight of No. 5, 5,400 lb.; floor space, 36 in. x 10 ft. 0 in.

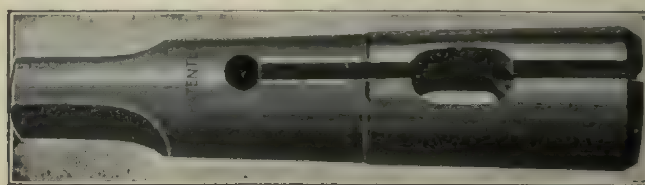
from either side of the machine. The control levers are also provided with adjustable automatic stop bars extending the full length of the table.

Both machines are built standard up to the head or rail. The No. 4 machine takes a rail and horizontal adjustable head. This machine is recommended where there is a series of holes to be drilled and the job can be conveniently set to bring all holes into a horizontal plane.

The No. 5 machine is recommended where two or more holes, not in a horizontal plane, are to be bored. In this case the machine is equipped with a group spindle head properly spaced and geared to meet the customer's requirements. For work of this kind the spindles are not adjustable. The entire head mechanism is driven through a helical gear and runs in an oil bath.

"Utility" Tool Sleeve

The J. C. Glenzer Co., Fort St. W. and 14th St., Detroit, Mich., has added to its line the "Utility" tool sleeve shown in the illustration. This sleeve is in-

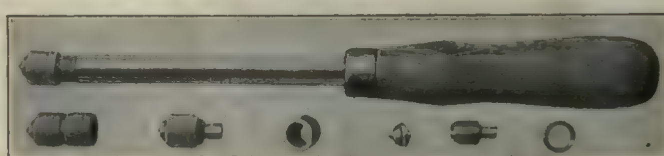


"UTILITY" TOOL SLEEVE

tended for use with straight-shank drills, reamers, taps, etc. It is made of $3\frac{1}{2}$ per cent nickel steel, heat treated and accurately machined, and can be furnished in all the standard sizes.

The "Froidset" Diamond Holder

The "Froidset" method of setting diamonds for industrial purposes has been introduced by the S. Rose Co., Inc., 133 Broadway, New York. The method employs a cold process to secure the diamond to the holder by imbedding it in a steel jacket. The diamond is first placed in the pocket of a small receptacle, with the cutting point projecting. A layer of special metal is



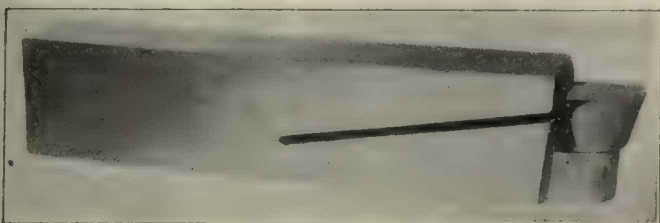
"FROIDSET" DIAMOND HOLDER

applied and the receptacle is then placed in the holder and screw pressure applied. This forces the metal to flow around the uneven surface of the diamond, thus forming a solid permanent matrix capable of resisting heat to the extent of 1,200 deg. F. The small holder may be screwed to a handle and used as a hand tool. It is also furnished suitable for attachment to the truing device of a grinding machine. Several types including a dismantled small holder are shown in the illustration. It is claimed for the method that the diamond when set is held immovable, that there is no carbonization or deterioration due to heat as in hot setting and that it is capable of many resettings. The small holder is

furnished to suit any style of grinding machine and when the diamond requires resetting it is necessary to return only the small holder. The line includes a number of different holders fitted with either black or bort diamonds ranging in size from one-fourth to three carats.

Martin Toolholder

The toolholder illustrated is a product of the Martin Tool Holder Co., Jackson, Tenn. In this holder short pieces of high-speed steel, broken ends of drills, etc., can be used. The toolpost screw secures both the holder and bit at the same time. It is claimed that this toolholder is particularly suitable for use in a four-way toolpost as the bit can be removed by loosening one setscrew and without disturbing the position of the holder which is held by the other setscrew. The holder is made of tool steel and is heat treated. It is made in all standard sizes, including the heavy-duty size ($2\frac{1}{4}$ x $3\frac{3}{8}$ in.) that carries a $1\frac{3}{8}$-in. bit.



MARTIN TOOLHOLDER

Ryerson-Glader Wire-Nail Machines

A line of wire-nail machines designated as the Ryerson-Glader machines, has been placed on the market by Joseph T. Ryerson & Son, Chicago, Ill. These are built in six sizes, similar to the one shown in Fig. 1, and range from the No. 00 to the No. 4 size. The production capacities of the six sizes range from 500 nails per minute for the No. 00 to 175 nails for the No. 4.

All important adjustments are within easy reach of the operator and can be made while the machine is running. All parts subject to strain or wear are of steel.

The wire is fed automatically from a bundle or coil between straightening rolls and then into the dies. While the wire is gripped in the dies the head is formed with one blow of the heading hammer, and as the latter recedes the straightener carriage moves forward the length of stock required for a nail. The wire is again gripped and the point-cutting dies both make the point and clip it off, leaving enough stock outside the dies to form the next nail head. In advancing, the heading hammer operates an ejector which removes the finished nail. The top view, Fig. 2, shows the operating parts of the machine.

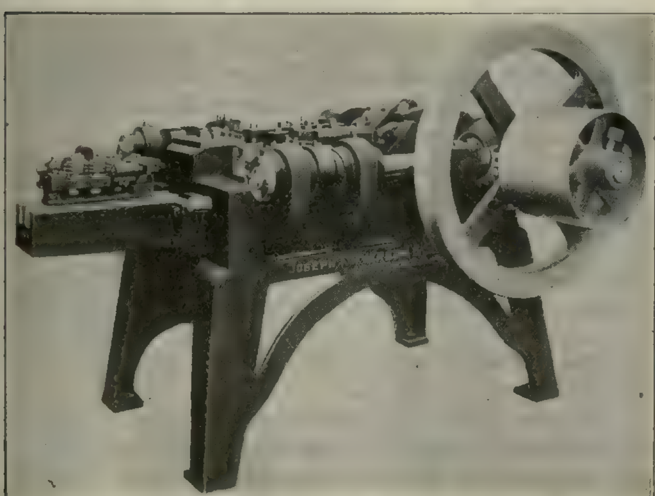


FIG. 1. RYERSON-GLADER WIRE-NAIL MACHINE

Specifications: Six sizes, from No. 00 to No. 4; capacities, No. 20 gage to 60d.; number of nails per minute, 500 to 175; horsepower required, $\frac{3}{4}$ to $7\frac{1}{2}$; net weights, 900 to 7,600 lb.

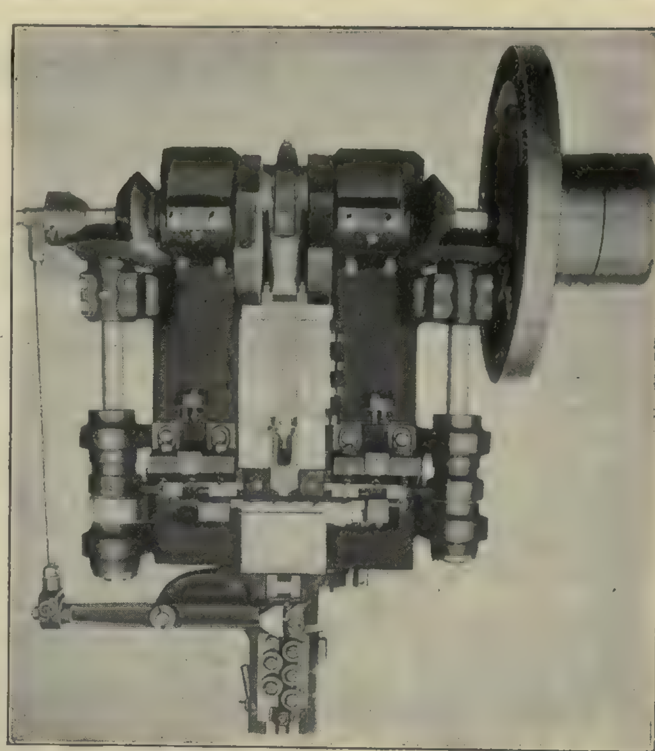


FIG. 2. TOP VIEW OF WIRE-NAIL MACHINE

The wire is straightened by the straightener rolls moving back over the wire while it is gripped in the dies. The crankshaft is counterbalanced to compensate for the thrust of the header cross-head. The equipment furnished consists of one set of gripping dies for the larger size of wire to be used in the machine, together with two pairs of point cutters.

Metric vs. English Decimal System

By Walter F. Belding

Mechanical Instructor, State Trade School, Putnam, Conn.

In the different articles in the controversy over the metric system I have not as yet seen the side of the working man brought forward. It is a foregone conclusion that it will cost the manufacturers millions of dollars to change over their jigs, fixtures, gages, etc., but that will not be the greatest loss. Every artisan will have to discard his present tools. One hundred dollars will not furnish much of a set of tools at the present prices, but a greater loss than that will be the disruption of the trades. It will take years to make the turnover. The younger class will have to learn it, the middle class will continually get the two systems mixed and the older class will not even attempt it. This has been my experience in attempting to teach it to a machinist of eighteen years' practice (and he was not a dull man); it was a slow process; he was continually getting the two systems mixed.

Motorizing Terminals*

By B. F. Fitch
President, Motor Terminals Co., New York and Cleveland

FOR years trucks have proved to be valuable transportation mediums, but their adoption and scientific operation have been ignored by railroads whose business was primarily transportation.

The ingredients to be considered in transportation-cost estimates are tons, miles and minutes. A team can successfully haul 75 ton-miles and a motor truck 500 ton-miles in a 10-hour working day. Compare this with railroad performance in which the average box-car movement is but 25 miles per day. If loaded with merchandise to but a 10-ton average, it discharges but 225 ton-miles in a 24-hour day. It is, therefore, obvious that box cars suffer a handicap.

Freight-house operating practice demands that box cars lie idle 10 hours a day. If utilized exclusively for transportation and kept continuously moving the remaining 14 hours, even at an average speed of but 20 miles per hour with 10-ton loads, the potential possibility of each freight car is 2,800 ton-miles daily.

There is practically no limit to what the rails will carry, if cars, when consolidated in trains, are at once started and kept continuously moving; therefore, it is logical to charge inadequate terminal facilities with the major portion of the box car's tonnage deficiencies.

The Prime Trouble

The prime trouble is that box cars have been assigned to a service for which they were never originally intended, and this make-shift usage has complicated switching interchanges at all terminal points to the detriment of high mileage efficiency of all cars.

Rail transportation cannot be greatly improved because locomotives are now practically up to the safety limits of rails and bridges and without increasing weight of locomotives, drawbar efficiency cannot be increased, and without an increase in drawbar efficiency transportation costs cannot be lowered. Thus, obviously the field for improvement is terminals.

Railroad transportation has outgrown railroad terminals. From outer classification yards to pier station delivery at New York the cost to carrier is not less than $3.50 per ton, and similarly at Philadelphia not less than $2.50 per ton, or a joint terminal cost of $6 per ton. Whereas, the main-line haul between these two terminals, if estimated at a maximum cost of 6 mills per ton-mile, suggests a transportation cost of 60 cents versus terminal costs of $6. Chicago is no better off than Philadelphia and the haul is about ten times as long; hence, joint terminal cost is as great as the transportation or rail haul cost from Chicago to New York.

Innumerable stations built over fifty years ago are still the intakes and outlets of our great transportation systems; no wonder the subject of terminals is a topic of nation-wide discussion.

Ideal joint terminals at a cost of $50,000,000 to $500,000,000 are possible in all of our principal centers, but present chaotic conditions considered who will assume the responsibility of such abnormal financing?

Every city in the country has its labyrinth of rails, team tracks, private sidings, obsolete main freight stations and substations, between all of which box cars are switched around. The innumerable switch cut movements and the cost of handling these cars over rails, to detriment of through traffic, is primarily responsible for excessive terminal expense.

Between all the widely distributed freight houses box cars are used in transfer service. When so used, they are termed "trap," "transfer" or "ferry" cars. For instance, in any city with seven non-competing railroads radiating to different sections, each line receives daily in its city cars with some freight for each of the six connections. Numerically this means forty-two cars in transit to and forty-two cars in transit from, a total of eighty-four cars. But due to yard interchange delays, these cars average a third day arrival instead of a second day arrival; hence, 252 cars are assigned daily to such service. Thus 75,600 car days are required annually.

This explains one of the reasons for car shortage and an operating abuse which has been obsoleted by the success of a *Motor Terminals* installation at Cincinnati Ohio.

The Installation

Briefly, this installation consists of overhead rails, electric cranes, electric hoists, motor trucks and a plurality of interchangeable motor-truck bodies. The system of operation requires an empty body for each station movement demand of railroad on its inbound main station platform. At the larger stations there are several locations for such body settings, thereby decreasing the trucking distance for freight. As the freight comes from the cars, it is trucked to the nearest location containing a body carded for any connection or any substation. When loaded, these bodies are sealed and under telephone order of a joint dispatcher, employed by the railroads, mechanically loaded onto trucks and thus routed over city's streets to connection.

On arrival at outbound platform of the connecting line, the body is mechanically removed and an empty body, previously unloaded, is similarly put onto motor-truck chassis for delivery to inbound platform of that house, where the operation is repeated and another loaded body forwarded in the same manner to some other freight house.

If the load happens to be to a sub-station, it remains on platform until dispatcher is advised by agent at sub-station that return load is available. Then the loaded body of inbound freight to that sub-station is forwarded and the motor truck exchanges same for the previously reported load of outbound freight to be delivered at main station, where it is consolidated with other city freight in line cars made up daily to innumerable other destination points.

From the above it is evident that all freight, except possibly the portion arriving during the last hour of station operating day, whether between main and sub-stations or between main stations of the various rail roads, is currently loaded and out of the terminal. Previously this freight by trap cars suffered an average three days delay and the shuttle movement of these

*Extract from a paper read at the convention of the Material Handling Machinery Manufacturers' Association, New York City, Feb. 26, 1920.

individual cars over terminal rails interferred with the group movement of complete cuts of station cars; hence the congestion which previously made Cincinnati notorious as a check-valve in rail routings.

In May, 1917, the Big Four Railroad permitted a test installation between its five main and sub-stations. A special committee was appointed to analyze the entire terminal and recommend what economies and benefits could be anticipated from completely motorizing Cincinnati's terminal.

The summary of this comparative report prophesied the following, and as a result contracts were negotiated:

Annual economy, $61,652.96.

Advance movement of freight, 52.4 hours.

Increase inbound platform floor area, 14.8 per cent.

Increase outbound platform floor arear, in ratio with station operation.

Increase main station trackage, 21.4 per cent.

Increase main station realty, 122,660 sq.ft.

Release 66,862.5 cars for line service, per annum.

Extension of present labor, 30.4 per cent.

Eliminating the rehandling of 86,976 tons of freight, lessens railroads liability of loss and damage.

In 1919 equipment orders were entered and railroads commenced station changes and superstructure construction. The terminal is not fully equipped. However, in recent analysis of accomplishments it is proved that, due to increased operating costs of railroads the prophesied 17.1 cents per ton economy is in practice actually a saving of 35.2 cents per ton and, therefore, the annual economies will be $126,507.75 instead of $61,652.46.

This service has proved that all widely distributed station facilities can be laced up as a unit without investment cost to the railroads, thereby giving to each and every terminal the benefits of a union freight station. The rates paid for the service are less than what interest charges alone would be on the cost of constructing a consolidated terminal. The operating program of railroads and the established perquisites of shippers are in no-wise disturbed, but the railroads at large through the influence of this current versus their past interrupted movements enjoy an increase of terminal rail, station rail and station platform facilities. This increase can be perpetually extended at minimum investment, in ratio with increasing tonnage demands, which naturally will accrue at any industrial city enjoying better shipping facilities.

What's in a Name?

By J. A. Raught

On page 278 of *American Machinist* E. M. Long wants to know the accepted dividing line between a worm and a helical or spiral gear. In answer to his query I would like to refer him to the "American Machinist Gearbook," page 163. Here he will find a model of spiral or worm gears with six different ratios.

In answer to Mr. Long's second question regarding the mandrels, I will say that in most cases I have found the large end to be the one where the size is stamped, although this has not always been the case. I think lathe mandrels should have the small ends marked "go" and the large ends marked "no go," although in a great many cases I have thought the only solution for this problem would be to have a shoulder on the large end of the mandrel.

What Business Men Can Do

On page 570 we called attention to the attempt of the House Appropriation Committee to strangle our foreign-trade service by cutting down the proposed appropriation from $1,658,000 to about $490,000. However, owing to the prompt action of individual business men of standing and of commercial organizations, the House has voted to appropriate approximately $910,000, which is practically the amount given for the current year. It took a two-day fight on the floor of the House to gain this, but it shows what real business men can do in an emergency against a committee with no business sense whatever.

While the appropriation is considerably less than should have been given, it is nearly double the amount the Appropriation Committee proposed to allow.

Of course this bill will have to be passed by the Senate before it is finally settled, but it isn't likely that the Senate will turn down anything so manifestly to the country's interest as this.

However—Isn't it about time to do something toward having responsible committees made up of men whose business experience will qualify them to decide right on such questions in the first place, and not have to be forced into it?

A Criticism of Device for Babbitting Bearings

By Milton Wright

There is an article on page 305 of the *American Machinist* in which John Vincent describes a device for babbitting bearings. This device consists of an arbor with four movable collars, the latter to be held against the ends of the bearing by means of U-shaped springs.

To use the device it would be necessary to bore the lips of the bearings to exact size in order to accommodate the narrow shoulders of the collars upon which he depends to center the arbor. It would also be necessary to face off both ends of the bearings, else the collars would not hold babbitt without gaskets, putty dams, or some one of the many expedients to which millwrights resort, and the use of which would render the collars a nuisance rather than a help.

If the device is to be used on repetition work, as in manufacturing, and the boxes are split as shown in the drawing, why not turn the arbor with permanent collars? The arbitrary dimensions of length of bearing, distance between bearings and diameter of bore are already imposed by the manufacturing requirements, so why not take advantage of them?

I have poured many hundreds of pounds of molten babbitt and it is my belief that a device of the kind shown would be more bother than it is worth.

What's All the Fuss About?

"Manufacturers seldom object to the use of the gram or the liter. Their objection is limited to calling an inch 25 millimeters."—*Arthur E. Kennelly, Electrical Expert, Massachusetts Institute of Technology and Harvard University.*

[The "fuss" is because manufacturers whose customers demand accurate machinery object to calling an inch 25 millimeters when it is 25.4001-millimeters. A little matter like 415-thousandths may not bother an electrical expert, but even a third-rate mechanic would lose his job if he couldn't work closer than this.]

Sparks from the World's

Aëronautical Session of Society of Automotive Engineers

Wednesday afternoon, March 10, of Aëro Week, was chosen by the Society of Aëronautical Engineers for its technical meeting in the Engineering Societies Building, on West 39th St. This meeting was followed by a dinner at the Hotel Astor at 7 o'clock.

The aëronautical vice president of the Society, Glenn L. Martin, presided over the meeting, which would have been better attended had the absentees known the value of the papers to be presented.

The first paper was by Lieutenant-Colonel V. E. Clark, of the Technical Section, Air Service, and dealt in a technical way with airplane performances at high altitudes, assuming that the engine power could be maintained constant. Colonel Clark brought with him some "movies" taken by the Army at McCook Field and Aberdeen Proving Ground.

The pictures showed the way in which the DeHaviland plane has been equipped with flotation gear for making forced landings on the water, and also showed in the air the actual drop of the wheels from the landing gear and the alighting of the plane on water.

The next views showed practical tests made on rubber-covered gasoline tanks with the machine gun firing, consecutively, armor-piercing, incendiary and ordinary bullets. This particular tank did not leak until the forty-seventh shot, after which, the metal in one corner of the tank had been entirely shot away and the rubber finally collapsed.

Ground tests were shown of a plane equipped with the Hart reversible pitch propeller. Methods of shifting the propeller blades were shown and also its remarkable braking effect on the taxying machine.

Following this came various views of parachute drops made by the students of the parachute jumpers school, at Dayton, Ohio. Each jumper was equipped with two parachutes in case of emergency. One was strapped to his chest and the other on his back. Free jumps as well as "pull-offs" were illustrated. The type of parachute used employed an auxiliary parachute of about six feet spread, making the opening of the main chute positive.

Most of the jumps were made by men standing on the lower wing and holding on to a strut; others were from the cockpit. The "pull-off" gets its name from the fact that the jumper maintains his position while pulling the check string of the parachute and is actually pulled off into space by the main parachute as it opens behind the wing.

The type of the jump to be employed from a burning machine consists of a jump from the cockpit and a drop from 300 to 400 feet before the check string of the parachute is pulled. This is done to prevent the parachute from being set afire from the burning airplane.

Colonel Clark also had pictures of Major Schroeder and his observer on the ground and in the air in the Liberty Lepere fighter equipped with supercharger.

The film ended with some views of aërial bombs taken from the plane which dropped them. It was interesting to note that the white-painted bomb, in almost every case, kept in the shadow of the airplane on the water until the splash indicated that it had reached its target.

Other papers were as follows: "Consideration of Landing Run and Get-away by Standard Types of Airplanes," by Alexander Klemin; "Effect of General Shape of Aviation Engines on Operation of Airplanes," by Grover C. Loening; "Some Factors in the Design of Airplane Radiators," by S. R. Parsons; "The Heat Treating of Brazed Fittings for Aircraft," by Archibald Black; "Flying an Aviation Engine on the Ground," by S. W. Sparrow.

In the evening the reception committee was on the job at six-thirty and got the diners off to a good start. The after-dinner speakers included Major-General C. T. Menoher, U. S. A., and Commander G. C. Westervelt, U. S. N., who spoke respectively on Military and Naval Aëronautics.

George H. Houston spoke on airplanes from the commercial viewpoint, and Major Maurice Connolly on some phases of civil aëronautics.

Colonel Thurman H. Bane, head of the Army Air Service, Technical Section, and Commodore Charleton, of the Royal Navy, were also called upon for a few remarks.

Factory Changes Hands

The Hardware City Manufacturing Co. of New Britain, new owners of the Elm City Brass Co. factory, will take possession of the property about May 1 and will manufacture trunk hardware. The new concern will make a number of alterations in the buildings and will install new machinery. The purchase of the factory was the result of a rush of new orders. The factory will employ about 100 hands.

Hudson Motor Car Co. Doubles Capacity

To meet steadily increasing demand for cars $5,750,000 has been expended by the Hudson Motor Car Co. during the past year for land, new buildings and equipment. Despite difficulties encountered in obtaining building material and new machinery, the capacity of the plant has been almost doubled, the actual manufacturing floor space being increased more than 50 per cent. Sixty-nine additional acres of land have been occupied near the main factory and more than 500,000 sq.ft. have been added to the floor space available at the beginning of 1919. A building devoted exclusively to the production of Essex cars, a complete axle plant and a thoroughly equipped heat-treatment unit have been built. A service building, said to be the largest in the world, is in course of construction. The plant used for the Essex is already in operation, while the axle and heat-treatment units are in partial operation, but will be running at full capacity in the next few weeks. In addition, the capacity of the power plant has been more than doubled and the machine equipment and production capacity of the main factory greatly increased.

Honors for Factories

Major-General Clarence R. Edwards, department commander of the army of the northeast, has notified the following New Britain factories to send representatives to headquarters at Boston, Thursday morning at 10 o'clock, to receive decorations for meritorious war work:

Stanley Works, F. S. Chamberlain, representative; Corbin Screw, N. B. Ford, representative; Landers, Frary & Clark, representative not yet named; Stanley Rule and Level Co., F. S. Chamberlain, representative; P. & F. Corbin, J. W. Ryan, representative; North & Judd, F. S. Chamberlain, representative.

During the war the New Britain factories were pressed to the limit of their capacity and the Government inspectors were so favorably impressed with the co-operation received that the matter was called to the attention of the War Department. The decoration is in the form of a certificate congratulating and thanking all connected with the factories in any way. The decoration is recorded at department headquarters and at the War Department at Washington, D. C.

Industrial Forge

Bonus and Profit Sharing in Ontario Shops

The Gary Dort Motors, Ltd., Chatham, has announced that a bonus system will go into effect from the first of the year. The bonus will amount to 5 per cent of wages paid and is based wholly on punctuality and regular attendance.

The Dominion Sheet Metal Co., Hamilton, has granted to its employees a bonus of 10 per cent on wages during the past year.

The International Metal Works of Brockville, Ont., employing about fifty hands, has announced a profit-sharing scheme according to the following plan: At the end of the year 10 per cent of the profits is set aside for depreciation; a maximum of 10 per cent is then paid on the capital invested, and twenty-five per cent is set aside as a rest account to provide for losses or unforseen expenses. The balance is divided on a fifty-fifty basis between capital and labor. This applies to those who have been in the employ of the company for one year or more. Payments to employees are made in twelve or twenty-four installments, according to the method of payment, and they are divided pro rata, according to the earnings of each employee. At the end of five years, if there have been no losses, a further distribution is to be made from the rest account, on a fifty-fifty basis, between capital and the employees who have been in the service of the company for three years or more.

Ford Trade School a Philanthropic Institute

The enrollment of the Ford Motor Co.'s Americanization and vocation training school in Detroit has passed the 3,000 mark. There are four courses available to Ford men: The English course, trade school, service course and toolmakers' school.

A four-story 30-room building is occupied almost entirely by the educational activities of the Ford Motor Co., which teaches English to its foreign-born employees; its service men the proper method of repairing the Ford car; makes toolmakers out of the workmen who show their desire to advance, and takes boys under sixteen whose parents can no longer send them to school and gives them a combination of general schooling and toolmaking or other trade for which the boy shows a liking. This latter part of the school is known as the Henry Ford trade school and is regularly incorporated under the Michigan laws as a private school.

On entering this school, the boys are granted an annual scholarship of $400, which is paid them in bimonthly installments and helps to support them while learning a trade. Provision is also made for increasing this scholarship as the boys progress and attain higher marks in classroom work and shop practice.

Besides the four general courses are a number of special courses for foremen, for men whose work requires their having a knowledge of metals and a teachers' training school. All of the teachers in the Ford school are Ford men—men who because of some especial fitness or because of their ability coupled with an understanding of the "help the other fellow" spirit have been called to the work of teaching other Ford men. In all, there are seventy-five teachers in the Ford school which is more than the ordinary high school employs.

It must not be inferred that those men who are learning trades do all their learning in the school. They do not. Periodically they attend the classes to learn the theory but the experience they gain from actual work is in the factory. Practice and theory proceed together and all of the time the students are working on actual parts for Ford machinery or the Ford car, and they are being paid the regular wage.

The Director of Sales announces that large quantities of hardware of various kinds are included in Surplus Property Division's List No. 6, to be sold through informal bids which will be received up to and including April 7th. Full information may be obtained by addressing any Zone Supply Office of the War Department, or the Surplus Property Division, Munitions Building, Washington, D. C.

Sessions of Pennsylvania Safety Congress

The Pennsylvania Safety Congress for 1920 will be held at Harrisburg, on March 21, 22, 23, 24 and 25. This congress is a continuation of the welfare and efficiency conferences which were held in the past. Due to the war, these have been discontinued since 1917. It is evident that too much emphasis cannot be placed upon the matter of industrial safety, with the purpose of reducing the great number of injuries and deaths. The arrangements for the congress are being conducted by the Department of Labor and Industry, which upon request will furnish programs and other information.

Trade Currents from New York, Cleveland and Cincinnati

New York Letter

The local machine-tool market is unusually quiet at this writing. Although inquiries are numerous, the proportion of orders received in relation to the number of quotations sent out is quite small.

Featuring the week was a $1,000,000 sale by the Worthington Pump and Machinery Corporation to large oil interests who are constructing 600 miles of pipe line in the Coastal Oil fields.

There is some slight increase noticeable in railroad buying. The New York, New Haven and Hartford completed a list the past week and is reported about to enter the market again.

Although the New York Central is said to be out of the machine-tool market at present, it is expected to replace much of the equipment that will be taken over with its acquisition of several New York street-railway systems.

The American Locomotive Co. received orders for twelve more Pacific type locomotives from the Canadian National Railways which brings the total requirements for this road to sixty-seven engines.

Several new industries are reported for the past week, and can be looked upon as potential buyers in the machine-tool market.

Machine-tool deliveries are unimproved. Several concerns have refused to guarantee 1920 deliveries in certain lines. These concerns have made a number of quotations for 1921 delivery which have been accepted.

Conditions in the used-tool market remain undisturbed. There is a good volume of business showing with sales favoring woodworking equipment and small drill presses.

Cleveland Letter

Further slackening off in machinery and machine-tool demand in the Cleveland market is noted during the last week or ten days. Even manufacturers and distributors who have not been affected by this slowing down now admit that orders are fewer and smaller. In only one or two instances is anything like a normal inquiry reported. Much of the inquiry now being received is for equipment that is difficult, if not impossible, to get at this time. This factor is having some effect upon demand also, leaders in the industry here believe, as the smaller consumer, with sufficient business on hand to make it worth while to add to his equipment, will not wait for his regu-

lar machinery house to deliver some months hence, but goes elsewhere in search of his equipment. Thus, it is considered largely a question of making delivery.

The larger outlet that was anticipated from the automobile industry, both in the Cleveland and Detroit sections, has not come to light so far, though it is admitted by both consumers and distributors of tools that added equipment is necessary if anything like the 1920 production anticipated some time back is to be delivered this year. However, the bulk of business still is coming from the motor-car interests.

Principal scarcity of equipment in this section is in milling machines, lathes and shapers, which appear to be wanted most.

The total volume of business created by these small orders is considered fair on the whole, though not up to expectations for this time.

That prospects for added equipment being needed in the immediate Cleveland territory are by no means dull, is seen in more plans for enlargement and the addition of more new industries in the Cleveland manufacturing trade. Among the latest developments of this character are the plans of the National Acme Co. to enlarge its plant, and the starting of construction by the Parish-Pool Co. of its plant on the South Side, where electrical furnaces will constitute much of new equipment required.

Cincinnati Letter

This machine-tool market continues to feel the strong buying demands. Delivery promises from some firms have been extended well into December of this year, while the earliest delivery in any line was one suggestion that there might be a few hand milling and grinding machines for sixty-day delivery. Those who have not made price advances in the past month or two are planning to do so immediately; one prominent maker of toolroom grinding machines has just wired his agents of a price increase, effective March 1.

A report recently given wide circulation to the effect that business was falling off and speculating whether this could not be charged up to price increases is said by responsible machine makers to be entirely unwarranted. A few large builders some time ago announced price increases which were dated far enough in advance to give most of their prospective customers a hurried chance to come in under the wire. This naturally drew in an unprecedented amount of orders for a brief period, and prospects who might otherwise not have closed for a month or two hurriedly placed their orders. The slight slack spell which followed was due to this business already being closed. A large builder states that had this extra rush of business been spread over the time it should naturally have occupied he would have termed it good.

The lack of material and men are the main features delaying production here as almost everywhere else. There is a shortage of cold-drawn shafting, and it is also found difficult to obtain an adequate supply of grey-iron castings.

Americanism Applied to Industrial Relations

(From *Industry*)

THE MOST vital question at the present time is the economic question as it is affected by both capital and labor. . . . A great deal of industrial strife can be avoided if employers take a human interest in their employees. It seems to me it would be wise for them to take as much interest in their workers as they do in their customers. They should pay their employees a living wage. This wage should be sufficient to enable the worker to build himself a home, to educate his family, to bring up his children in the proper way and to put something aside for his old age. The conditions under which he works should be as sanitary as it is possible to make them and he should be encouraged and given promotion if his work so deserves.

On the other hand, it seems to me that the working men should do their part in increasing production and in improving their efficiency. First of all, the working men should seek to do all that would increase their skill in turning out more work at the present time, so as to supply the needs of the world. They must realize that wages are paid from profits, and that profits cannot be made unless the material produced is of the very best and that it is produced in quantities sufficient to be able to compete with the production of other factories, mills and shops, which are working in the same field, and with the production of foreign countries. They must also realize that in order to get higher wages it is necessary to do their best and their utmost upon all occasions.—Leonard Wood.

New Officers of New Britain Machine Co.

Officers were elected and business of the annual meeting transacted recently by the New Britain Machine Co. The officers are: President, F. G. Platt; vice president, Mortimer C. Swift; treasurer, Herbert H. Pease; assistant treasurer, Abram Buol; secretary, Robert S. Brown; assistant secretary, Herbert E. Erwin; directors, the officers and S. P. Goss, Charles R. Hare, A. J. Sloper, Charles J. Parker and J. E. Cooper.

An "Increased Production Convention"

Seeing in increased production a means of restoring normal business and price conditions, the Chamber of Commerce of the United States, it was announced today, will make its eighth annual meeting, to be held at Atlantic City April 27 to 29, an "Increased Production Convention."

This subject is considered of such importance that in working out a program for the meeting every topic will be considered from this viewpoint. Lack of production, it is pointed out, is one of the chief causes of the high cost of living, which cannot be reduced until more goods are put on the market. The present is a seller's and not a buyer's market. Prices have been forced up by competitive bidding. This in turn has made necessary unusual wage increases, with a still further rise in manufacturing and production costs.

Even with the exchange situation as it is, with its threatened curtailment of exports to Europe, manufacturers generally believe it will be a long time before production in the United States catches up with the demand for goods. In the meantime producers are faced with the task not only of meeting current demands, but with making up in some directions production lost as a result of the diversion of manufactured goods for war purposes.

The general subject of increased production has been divided up in the program for the convention into subsubjects. The first to be taken up will be the Government in relation to production. Under this heading will be considered anti-trust legislation and taxation. Business of every kind is keenly interested at this time in the situation with respect to taxation, especially in the subject of excess profits taxes.

The second general subject to be taken up will be Transportation in relation to production. This will include both land and water transportation. One of the chief causes of lack of production just now, it has been pointed out, is the general shortage of railroad equipment. One authority estimates that the country is short at least 200,000 box cars and all lines of industry have felt the shortage.

(*Continued on Page 648d*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

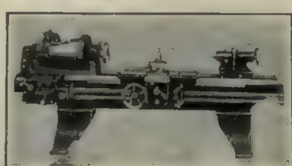
Pump, Fulflo Electrically Driven,
Fulflo Pump Co., Blanchester, Ohio.
"American Machinist," Feb. 26, 1920.

For permanent installation on machines provided with the company's drainage systems. It is possible to attach the unit at any convenient place, even where a belt-driven pump would be hard to operate on account of interference with the belt by overhanging or moving parts. Pump can be mounted above the level of the coolant, as it is claimed that it will hold its priming without the aid of check or foot valves. In operation attach the motor cord to a lamp socket.

Slotting Attachment, Bruno.
H. A. Moore Co., Rochester, N. Y.
"American Machinist," Feb. 26, 1920.

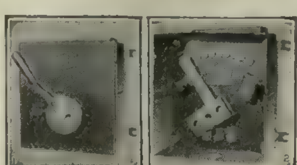
The Bruno slotting attachment for planers and shapers can be readily attached to the clapper of a shaper by removing the toolpost and using a clamping bolt furnished for the purpose. An adjustable friction arm provided with a spring buffer insures dropping into place of the clapper at end of the return stroke to prevent vibration of the tool. Cutting tools can be made of ordinary stock and may be turned to any position to cut on bottom, side or top. Three sizes are made taking tools with round shanks of the following sizes: No. 0, ⅜ to ½ in.; No. 1, ½ to ⅝ in.; No. 2, ⅝ to ¾ in. Each size furnished with two cutting tools. Weight, 5 pounds.

Lathe, Morris 22-In. Engine.
Morris Machine Tool Co., Cincinnati, Ohio.
"American Machinist," Feb. 26, 1920.



Specifications: Distance between centers (8-ft. bed), 3 ft. 6 in.; swing, over shears 23 in., over carriage 15 in.; front spindle bearing, 3⅜ x 6 in.; hole through spindle, 2 in.; taper hole in spindle, Morse No. 6; spindle speeds, eighteen, 10 to 300 r.p.m.; countershaft pulleys, 16 x 4½ in.; countershaft speeds, 165 and 200 r.p.m.; weight, crated 3,800 lb., boxed 4,750 lb.; size of case, 134 x 46 x 46 in.; cubic feet, 165.

Starter, Inclosed Faceplate Motor.
Cutler-Hammer Manufacturing Co., Milwaukee, Wis.
"American Machinist," March 4, 1920.

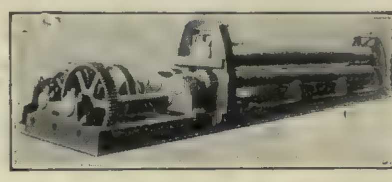


A pointer on the lever and legends stamped on cover indicate to the workman whether the starter is "off" or "on." The inclosed feature removes all danger from exposed parts, and protects button and segment contacts from damage due to fine collecting dust or spraying water. This starter, known as bulletin 2,111, is intended for small direct-current motors in exposed locations. It consists of the familiar type of direct-current hand starter inclosed in a sheet-metal case, having an external lever which engages the movable arm of the starter. The starter is made in capacities up to 50 hp., operating at 115, 230 and 500 volts.

Lathe, Boring.
Springfield Machine Tool Co., Springfield, Ohio.
"American Machinist," Feb. 26, 1920.

The lathe is intended only for boring and reaming operations at high speed. Has a geared head and the same system of clutch controls used on standard models of this make. Lead screw is omitted, as unnecessary. The air chuck is of the collapsible collet type. Carriage is the same style commonly used for boring spindles and axles. Steadyrest is of special design and consists of a counterbalanced quick-acting locking mechanism requiring a push of the hand to open it and a slight pull to close it.

Roll, Kling Bending.
Kling Brothers Engineering Works, Chicago, Ill.
"American Machinist," Feb. 26, 1920.



This machine measures 34 ft. 2 in. between housings, and has a capacity for bending ¾-in. mild-steel plates. Cut gears and bronze bushel bearings are used throughout. The top roll is 29 in. in diameter and weighs about 40 tons. The bottom rolls are 21 in. in diameter and each has two roller supports. The whole machine is built on a rigid cast-iron base. The drive is by two direct-current motors, one for the main roll drive, the other for power adjustment of the top roll.

Welding Machine, G. E. Automatic.
General Electric Co., Schenectady, N. Y.
"American Machinist," March 4, 1920.

The automatic arc welding machine is for use with the regular welding set, but designed to take the place of hand-controlled electrode. Consists of a pair of feed rolls driven by a small direct-current motor, which draws in and delivers to the arc a steady supply of wire and automatically maintains best working distance. The whole is controlled from a small panel. The panel carries ammeter and voltmeter for welding circuit, as well as rheostats, control relay, and contractors and switches for feed motor. Adjustment of the feed conditions made from the panel.

Truck, Haskell Shop.
Wm. H. Haskell Manufacturing Co., Pawtucket, R. I.
"American Machinist," Feb. 5, 1920.
(Note—This card supersedes previous card in which the manufacturer's name was incorrectly given.)

The body of the truck is made from ⅛-in. stock, reinforced at the inside corners with heavy angle irons. The axle is made from a steel bar 1⅞ x 1½ in., the wheel bearings being turned to 1 7/16-in. diameter. The truck is made in one size only. Dimensions: Height, 26 in.; length, 44 in.; width, 26 in.; body, 21 x 31 in., by 13 in. deep; side wheels, 20 in. in diameter with 2¼-in. face; front wheel, 7 in. in diameter with 2¼-in. face; cubical contents of body, 3¾ cu. ft.; net weight, 300 lb.

Clip, paste on 3 x 5-in. cards and file as desired

International finance and its relation to world production has a prominent place on the program. This subject will be discussed both from the financier's and the business man's point of view. The Chamber has just expressed its willingness to name delegates to an international financial conference under limitations outlined by the Treasury Department. Lack of means of financing European industries is a decided factor in retarding production in many of the countries of Europe.

One general session of the convention will be given over to agriculture in relation to production. Here will be presented for discussion the part of the government, the farmer and the business man in agriculture. Secretary of Agriculture Meredith will speak for the government.

Another important general subject will be the relation of labor to production. This will be approached from both sides, the employee's viewpoint being presented by a representative of the American Federation of Labor and the employer's by a business man.

Besides the general sessions there will be held group meetings, divided as along the great divisions of industry. In these meetings the subject of increased production, as in the general meetings, will be the main topic discussed.

Personals

B. L. WENNERSTROM, formerly with the E. L. Essley Machinery Co., Chicago, Ill., has been appointed vice president and sales manager of the Anderson Die Machine Co., Bridgeport, Conn.

F. C. HAESKE, formerly sales engineer for the U. S. Ball Bearing Manufacturing Co., is now with the production department of the Parish & Bingham Corporation, Cleveland, Ohio.

HORACE A. BROWN, JR., who has been identified with the Hyatt Roller Bearing Co. for the last nineteen years, has been promoted to the managership of the Motor Bearings Division with headquarters at Detroit.

EARLE M. PORTER has been appointed mechanical engineer for Giern & Anholtt Tool Works, Inc., Detroit, Mich. Mr. Porter was formerly connected with the Willys-Overland Co., Toledo, Ohio, as tool efficiency engineer.

N. CLAUSEN has resigned as equipment engineer of the Worthington Pump and Machinery Corporation, at the Epping-Carpenter plant, Pittsburgh, Pa., to take a position as plant superintendent of the John H. McGowan Co., Cincinnati, Ohio.

W. V. HOUCK, formerly factory manager of the Buffalo Metal Goods Co., located on Fillmore Ave., Buffalo, N. Y., a subsidiary plant of the General Motors Corporation, has severed his connections with that firm to become vice president and general manager of the O'Neil Iron Works, Inc., Buffalo, N. Y.

JOHN A. FITZGERALD, of Ogdensburg, N. Y., who recently returned from France after serving through the war as a K. of C. secretary, sailed for Havre on the "Lafayette," Feb. 26, 1920. In Paris Mr. Fitzgerald will assume his duties as managing director of La Societe de Machines Commerciales at France.

Business Items

The American Engineering Company has broken ground at Barnesdale, Ore., for one of its factories. This company has capital of $250,000.

The Dailey Automotive Products Corporation, Indianapolis, Ind., has been incorporated. The directors are Albert H. Dailey, Iva F. Carpenter and Carey L. Smith.

H. C. Durando announces that the H. C. D. Screw Machine Co., Hoboken, N. J., started its shop in operation on March 8. It is well equipped and able to handle screw-machine work of all kind.

The Phelps Foundry Co., Phelps, N. Y., has been incorporated recently to manufacture iron and steel products. The directors of this new company are: Walter R. Shover, Thomas Jones and C. P. Downs.

The Buffalo Forge Co., Buffalo, N. Y., held a meeting of its stockholders to appoint new officers as follows: Henry W. Wendt, president; Edgar F. Wendt, vice president and treasurer; Henry W. Wendt, Jr., vice president and secretary; C. A. Booth, vice president and sales manager. The new directors include the above named officers, and in addition H. S. Whiting.

The Foster-Johnson Reamer Co., Elkhart, Ind., has been incorporated under the laws of Indiana with a capital of $200,000. This new corporation will manufacture expansion reamers and the directors are: W. H. Foster, W. A. Kyte, W. T. Kough, Oscar Kylin and W. B. Johnson, with W. H. Foster as president, W. B. Johnson as vice president and Oscar Kylin as secretary.

Obituary

ARTHUR J. WILSON, sixty-one years old, of 789 Lexington Ave., formerly master mechanic of the Brooklyn Elevated Railroad Co.'s yards on upper Broadway and later with the South Brooklyn plant of the B. R. T. Co., died on Thursday, Feb. 12, 1920, from pneumonia.

SAGE W. SCHUYLER, vice president of the Dodge Manufacturing Co., Mishawaka, Ind., died Feb. 10 from pneumonia, aged sixty-five years. He was born in New York, graduated from Cornell University and was a member of the original Cornell crew. In 1893 he had charge of the Dodge exhibits at the World's Fair in Chicago.

Forthcoming Meetings

The National Federation of Construction Industries will hold its first annual meeting at the Hotel Sherman, Chicago, March 24-25. John C. Frazee, Drexel Building, Philadelphia, is executive secretary.

The Pennsylvania Safety Congress for 1920 will be held at Harrisburg, Pa., on March 21, 22, 23, 24 and 25.

The American Society Steel Treaters will hold a meeting at the Engineers' Club of Philadelphia, March 26, 1920.

The Association of Iron and Steel Electrical Engineers will hold a meeting at the Engineers' Club of Philadelphia, April 3.

The American Society of Civil Engineers will hold a meeting in Philadelphia on April 5, 1920.

The American Society Heating and Ventilating Engineers will hold a meeting at the Engineers' Club of Philadelphia, April 8.

The American Institute Electrical Engineers will hold a meeting at the Engineers' Club of Philadelphia, April 12.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

The National Metal Trades Association will hold a convention at the Hotel Astor, New York City, on April 19 to 22, 1920. H. D. Sayre is the secretary.

The National Chamber of Commerce will meet in Atlantic City, N. J., on April 26, 27 and 28.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21 at the Hotel Traymore, Atlantic City, N. J.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The spring meeting of the American Iron and Steel Institute will be held May 28 at the Hotel Commodore, New York.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of Eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Maufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Pa., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting, first Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

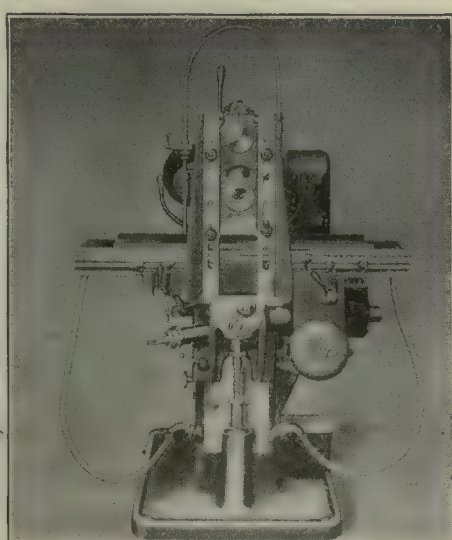
March 25, 1920 **American Machinist** Vol. 52, No. 13

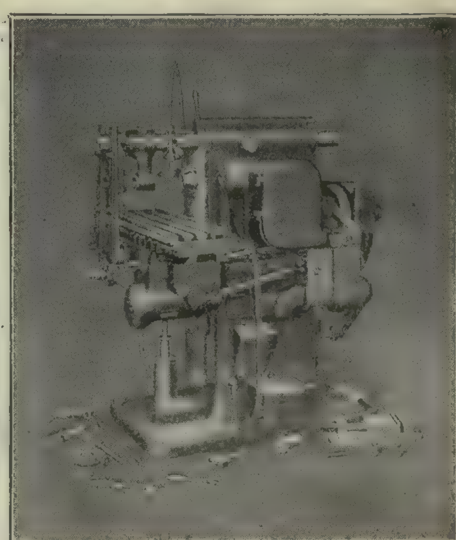
THE student of modern production methods will find a worthwhile study in machine design in the No. 21 automatic milling machine that has taken its place in the line of machine tools manufactured by the Brown & Sharpe Manufacturing Co., Providence, R. I.

The milling machine described in this article was designed for the production of duplicate parts on a quantity basis and is essentially a manufacturing machine. It is the latest development of a pioneer manufacturing company that had its beginning in 1833.

The sturdy appearance of this latest model shows that the company's established policy relative to design and construction has been closely followed as the machine has structural characteristics common to the other models of column and knee type machines of the same make. The distinction of the new design lies in the application of the automatic control of the spindle and table and in other important features and refinements that are mentioned in this article. The machine is double acting and continuous in operation as will appear from Fig. 1 where two fixtures holding the work are shown in offset position, one at each end of the table. Two sets of cutters with teeth opposed are employed, one set for each fixture and with the dogs set correctly, the machining operation is entirely automatic as the work of the operator is merely that of loading and unloading the fixtures.

The various automatic operations of the spindle and table are obtained through the medium of adjustable dogs located at the front side of the table. These cause slow, variable feed for cutting, and fast, constant travel for the reverse. They are also used, when necessary, to stop the spindle during the reverse movement of the table.





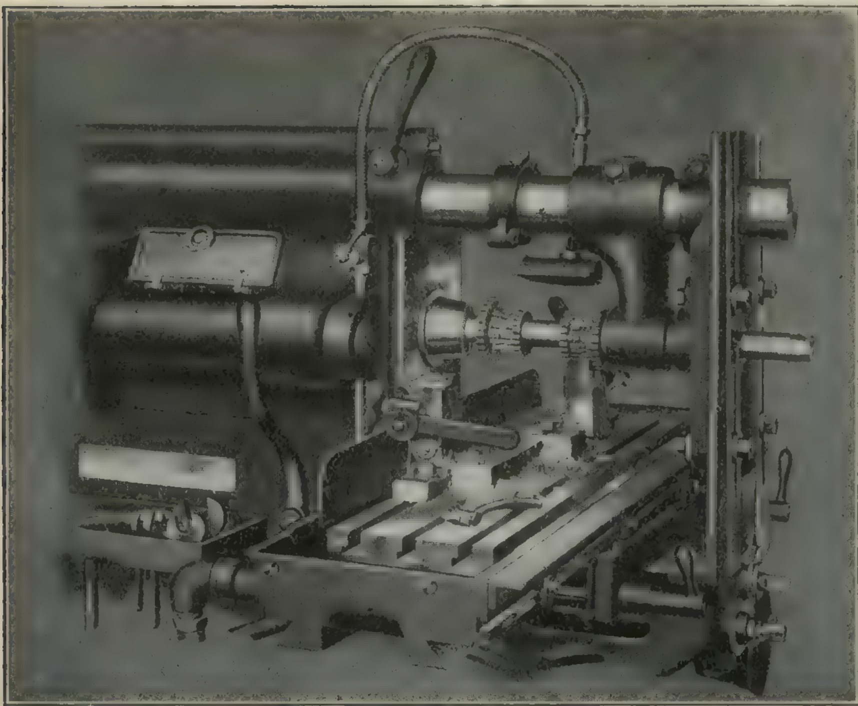


FIG. 1. TYPICAL ARRANGEMENT FOR AUTOMATIC OPERATION

From the illustration it may be seen that one set of cutters is used to mill the piece in one fixture and that the other set of cutters, with teeth facing in the opposite direction, is used to mill the piece in the opposite fixture. While the cutters engage the work in one fixture the operator changes the work in the other fixture. When moving to the reverse position, the table travels at a constant rate of 210 in. per minute. As the work approaches the cutters, the feed is automatically reduced to proper cutting speed and the spindle starts rotating in the reverse direction suitable for the reversed cutters. This cycle of operations is repeated automatically while the machine is working. However, owing to the flexibility of control many variations are possible. For instance, Fig. 2 illustrates how the machine operates with one set of cutters in connection with index heads. Obviously, in this case it would be unnecessary to stop the spindle during the reverse stroke of the table, but as a safety measure for the operator, the table is stopped upon the completion of the cut, protecting the operator when loading the fixture. Similar work, such as milling the tangs on twist drills, could be performed with one set of cutters by using ordinary fixtures. The adaptability of a vertical attachment to the machine is shown in Fig. 3 where a large-size, inserted-blade, face-milling cutter is rotated in the same direction for both cutting operations, although at the finish of each cut the spindle is automatically stopped to prevent marring the work when the table reverses and moves at fast speed to the opposite fixture.

The automatic movement of the table and spindle are controlled by the table dogs, which are quickly and easily adjusted to the various classes of work. The movements may or may not be intermittent in either or both directions and may take place one or more times according to arrangement of the dogs.

Four different style dogs are required to obtain all automatic movements, but for ordinary operations two or three styles are usually sufficient as the setting of the dogs is quickly and easily accomplished and by the applications of the various combinations a surprisingly large number of cycles may be obtained.

Although the automatic control of the spindle and table is by means of the table dogs, the same results may be attained by hand, employing the two controlling levers located on the front of the table saddle.

Occasionally the loading time of a piece exceeds the cutting time and the table is set to stop for the safety of the operator. Under these circumstances the machine is semi-automatic in operation, and the control levers are employed in place of the dogs, the left-hand lever starting the table which has been automatically stopped for the safety of the operator.

The manipulation of these controlling levers is extremely simple and the ease and rapidity with which they may be operated, is in some cases, faster than when it is fully automatically operated.

By means of the hand control levers the machine may be operated as a plain milling machine, accomplishing within its capacity the same results as the ordinary plain milling machine.

Variation of the spindle speed is obtained through change gears giving sixteen changes in geometrical progression from 28 to 695 r.p.m. in either direction. Although these gears, shown in Fig. 4, are totally in-

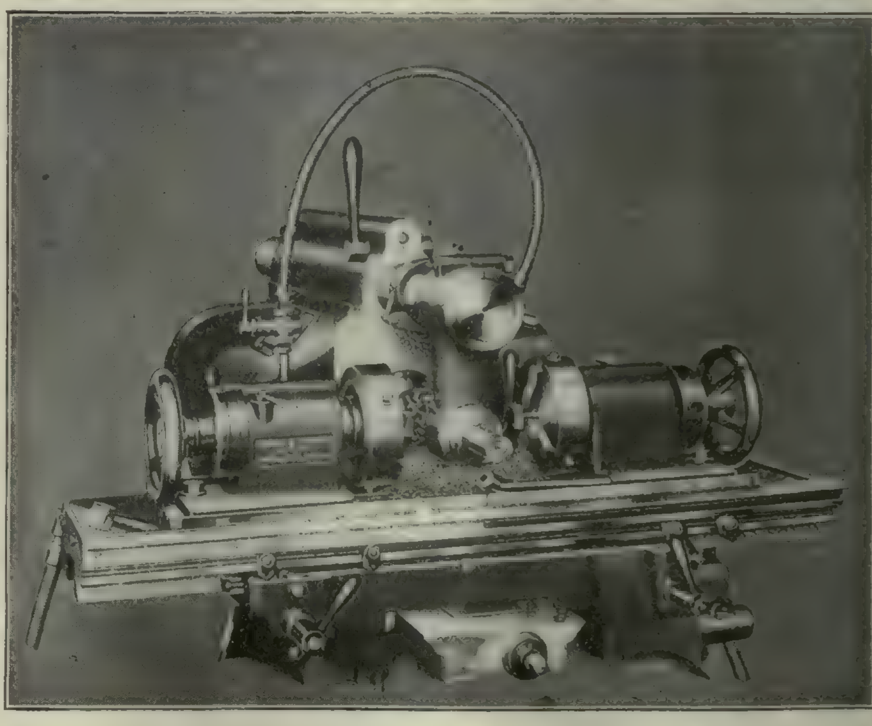


FIG. 2. USING INDEX HEADS WITH AUTOMATIC OPERATION

closed in a heavy cast-iron box, a full-size hinged cover provides ready accessibility. Upon the inside of this cover is cast a table of the spindle speeds with the proper change gears for each.

The table feeds are positive and are entirely independent of the spindle speeds. Twelve changes in geometrical progression are possible by means of change gears. The range is 1.37 to 18.38 in. per minute. This provides a range of 0.002 to 0.026 in. per revolution of the spindle for small mills and 0.026 to 0.656 in. per revolution of the spindle for large mills. The change gears for the feeds are inclosed in a case similar to that for the spindle speeds. A hole in the hinged cover permits a hand crank to be used on squared shaft thus providing means for a slow hand feed to use when setting up.

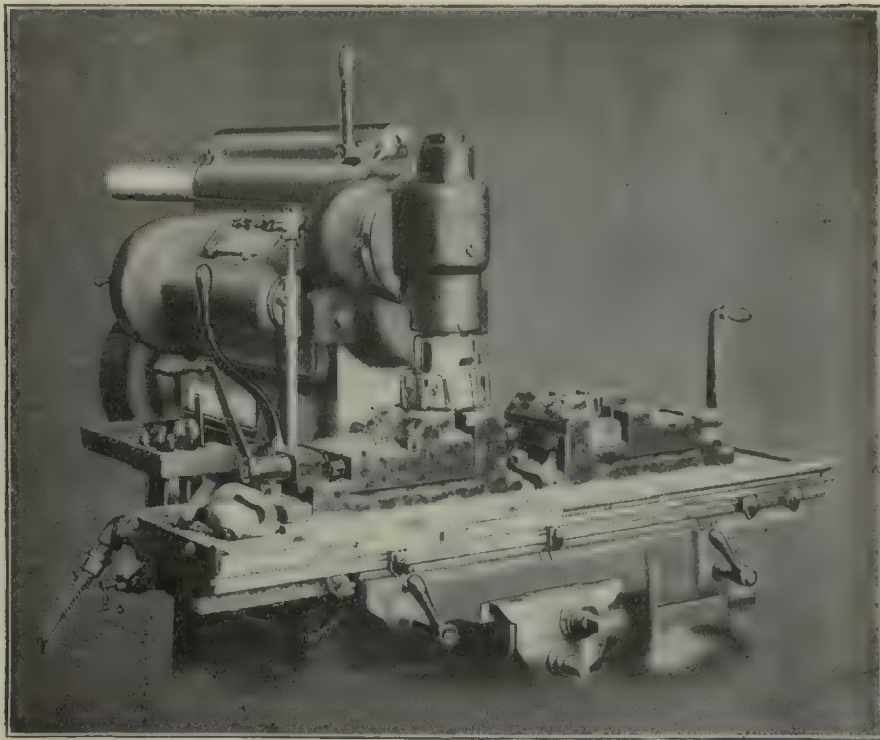


FIG. 3. CONTINUOUS MILLING WITH VERTICAL ATTACHMENT

The reverse gearing and cams that are actuated by the table dogs are assembled as a unit in an oil-tight case as shown in Fig. 5. This unit of mechanism operates the stop and reverse movements of the table and spindle. The gearing is automatically lubricated and is protected by a safety friction coupling set to slip at a predetermined load, thus guarding against possible damage.

A constant-speed drive makes the machine readily adaptable to the application of a motor and permits of the complete separation of all speeds and feeds of which there is a wide range. The driving pulley is amply guarded and is provided with a friction clutch for the stopping and starting of the machine. The power is controlled by a lever conveniently located at the front side of the machine. On the driving shaft is mounted the spindle reversing clutches, the spindle stop clutch and instantaneous braking arrangement. The spiral-type bevel gearing employed in the spindle reversing mechanism and the back gears are illustrated in Fig. 6.

Feed Gearing

Another unit of mechanism that responds to the action of the table dogs is shown in Fig., 7. This arrangement of gearing, etc., controls the fast travel and cutting feeds. The clutch and cams at the top of the case are used to cause the feed changes. The hardened spiral gears on the left constitute the drive for the fast feed and the large worm gear in the center acts in a similar capacity for the slow variable feed. The table rack driving pinion may be seen on the extreme left of the case. Ball bearings are provided throughout and all parts are provided with automatic lubrication and contained in an oil-tight case that is located directly below the table.

Taper Nose Spindle

The front end of the spindle is tapered, hardened and ground and has a recess to receive the cutter driver and clutch on arbors and collets. Arbors and collets are provided with clutches and have a threaded hole in the end of the shank, the clutch fitting into the recess in the end of the spindle and the arbor or collet being drawn into place and held securely by the drawing-in bolt which passes through the center of the spindle. The threaded end of the drawing-in bolt enters the end of the

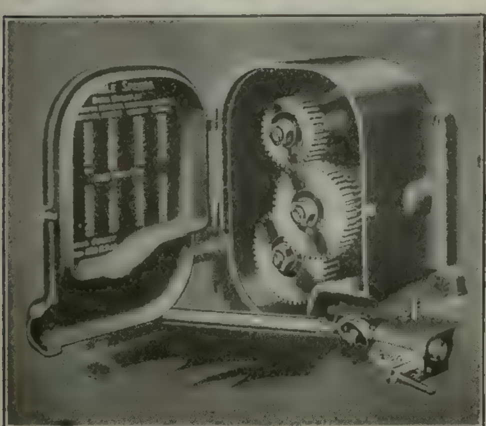


FIG. 4. SPINDLE-SPEED CHANGE GEARS INCLOSED IN HEAVY CAST-IRON BOX

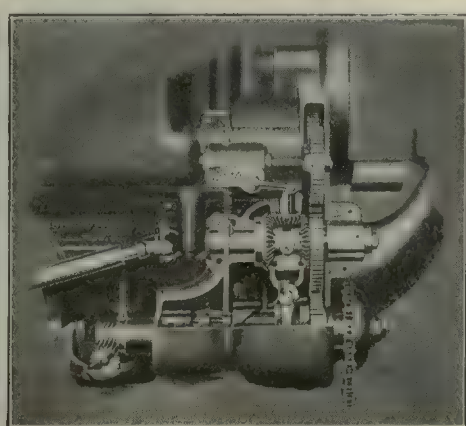


FIG. 5. REVERSE GEARING AND CAMS, CONTROLLING STOP AND REVERSE MOVEMENTS

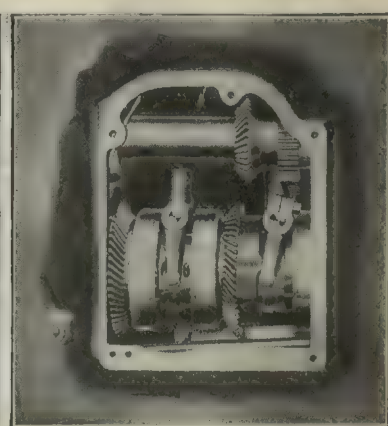


FIG. 6. ARRANGEMENT OF GEARING CONTROLLING FEED CHANGES

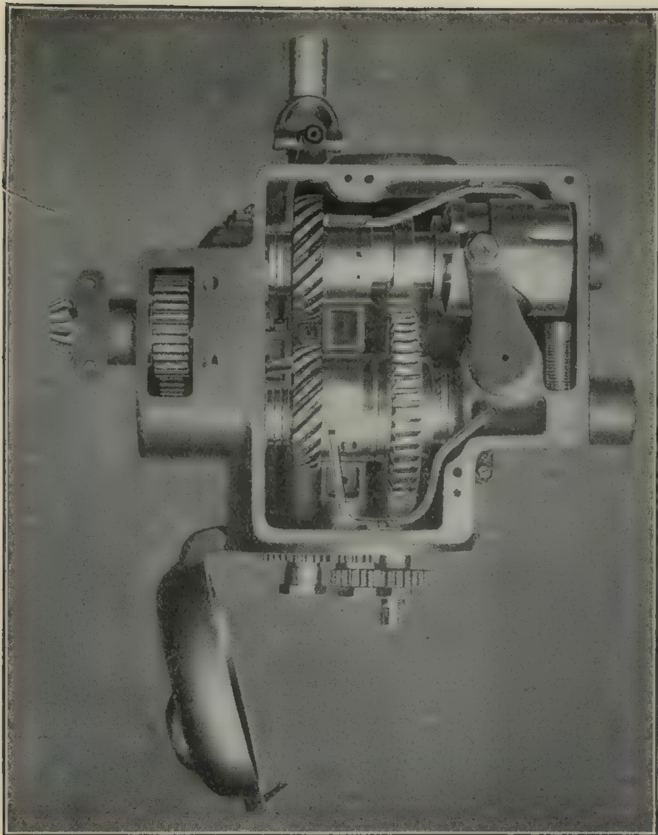


FIG. 7. SPINDLE DRIVE GEARING AND FRICTION CLUTCHES

shank of the arbor or collet and is tightened with a wrench from the back of machine.

Face-milling cutters are drawn directly onto the taper nose of the spindle by a cutter driver and the drawing-in bolt. The cutter driver fits into a slot in the face of the cutter and the recess in the spindle and the shank is threaded on the end to receive the end of the drawing-in bolt which draws the cutter onto the spindle with the aid of a wrench from back of the machine.

The simplicity and fewness of parts is particularly noteworthy. No plates, screws or loose parts are used and when the arbor, collet or cutter is in place it is essentially as firm as though a part of the spindle itself. Because no screws or plates are used the nose of the spindle is smooth and entirely free from projections.

The removal of arbors, collets and face-milling cutters is as readily accomplished as their replacement. This can be best appreciated in the case of face-milling cutters, no such troublesome, time-wasting condition as "freezing" of cutter to spindle, being possible.

A good feature of the machine is the automatic lubrication of all rotating parts within the frame. Filtered oil is pumped to a reservoir cast in the top of the frame and by means of pipes and a gravity system, oil is constantly distributed to the various bearings. For heavy manufacturing, an abundant supply of cutter lubricant is pumped from a tank of large capacity located within the base. The wearing surfaces of the table and all bearings are of generous proportions and means of compensation for wear is provided where necessary. The column, knee and table are provided with internal bracing and reinforcing ribs. The arbor is amply supported by means of an adjustable overhanging arm, and an arbor yoke furnishes added support for heavy duty-work.

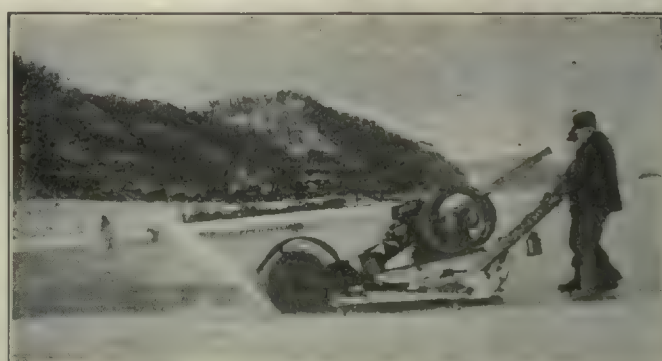
Capacity: Longitudinal feed, 22 in.; transverse adjustment, $6\frac{1}{2}$ in.; vertical adjustment, $14\frac{1}{2}$ in., longitudinal feed, automatic. Spindle: No. 10 taper hole; hole through spindle, $\frac{2}{3}\frac{1}{2}$-in. diameter. Drive: Diameter of pulley, 13 in.; width of belt, 3 in.; 5 hp. required; constant speed, 300 r.p.m.; sixteen changes of spindle speeds, 28 to 695 r.p.m. in either direction. Arbor support: Diameter of hole in bushing, $1\frac{3}{16}$ in.; center of spindle to under side of arm, $5\frac{1}{2}$ in.; greatest distance, end of spindle to center in arbor yoke, without arm braces, 16 in.; greatest distance, end of spindle to arbor bushing, in arm braces, $10\frac{1}{2}$ in.; greatest distance, face of column to arm braces, 16 in. Table: Working surface, 34 x 11 in.; overall dimensions of table, 44 x 11 in.; 3 T-slots, $\frac{5}{8}$ in. wide. Feeds: Positive, independent of spindle speeds. Twelve changes from 1.37 to 18.38 in. per minute; fast travel between cuts, 210 in. per minute. Cutter Lubrication: Tank cast in base; pump furnished inside of frame; capacity of tank, 7 gal. Vise (flanged) Capacity: $6\frac{1}{8}$ in. wide, $1\frac{9}{16}$ in. deep; opens $3\frac{5}{8}$ in. Floor Space: At right angles to spindle, 67 in.; parallel to spindle, $59\frac{1}{2}$ in. Weights: Net, about 3,350 lb.; ready for shipment, about 3,775 lb.; dimensions for shipment, 62 x 42 x 66 inches.

An Improvised Ice-Cutting Machine

By F. L. Clark

The illustration shows an ice-cutting machine which was rigged up for an Iowa small-town ice dealer and which performed the work much more economically than it could have been done with a team, the time-honored way of harvesting ice in towns and villages.

There are ice machines of several kinds on the market, but the small-town ice dealer and the farmers who put up ice in comparatively small quantities can not afford them. A machine like this one, however, can be put together at small cost at ice-harvesting time and taken apart at the end of operations, leaving the components available for other purposes during the rest of the year.



THE ICE-CUTTING MACHINE AT WORK

A five-horsepower gas engine was used and the saw from a wood-cutting machine. A sled about 4 ft. wide and 6 ft. long was made of boards and 2 x 4s, a marker attachment extended from one side and two beams fastened obliquely at the back. The engine was mounted on the sled and belted to the saw which was set in front to the right.

With the wood pieces at the back the two men who operated the machine could pull it along with little effort. The machine all assembled weighs but 1,000 lb. and can be used on ice too thin to stand the weight of a team.

Welding Boiler Tubes by the Electric Resistance Process

BY P. T. VAN BIBBER
Sales Engineer, Thomson Electric Welding Company

About 1912 the resistance, or Thomson, process of electric welding was first tried out in a locomotive shop for the purpose of replacing the oil-furnace welding equipment in safe-ending boiler tubes up to 2½ in. in diameter. At the present time, in shops in different parts of the country where electric welding machines have been installed, one will find many enthusiastic "boosters" for this process. It is to these users that we are indebted for the information contained in this article and for the benefit of those who are unfamiliar with this adaptation of resistance welding, an endeavor has been made to cover all the details possible.

IN USING the resistance type of machine for welding safe-ends onto locomotive-boiler flues, the old tube and the new safe-end are gripped securely in heavy copper jaws with the ends to be joined held in alignment. As these ends are pressed together a large volume of current from the secondary winding of the transformer is passed through them. Since the junction of the abutting ends is the point of greatest resistance to the electric current, the greatest heating effect is there and, usually, on a 2½-in. tube it requires only about 15 sec. to secure a perfect running or welding heat. A slight push-up by the pressure device on the welding machine sticks the two parts together solidly enough so that the tube can be removed to the mandrel of a rolling machine, exactly as is done when welding by the oil-furnace method, and the weld is then completed in a few seconds by rolling down the joint.

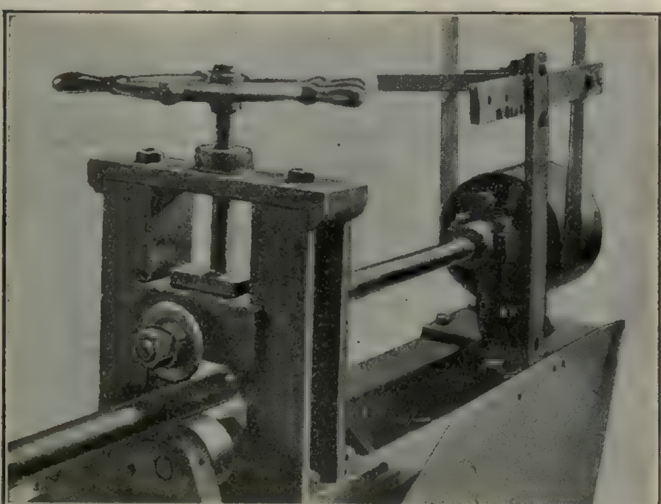


FIG. 1. MACHINE FOR CUTTING OFF FLUES

Since it is always necessary to scarf the ends of a tube and new safe-end before welding by the oil-furnace method, the first question that the practical boiler-shop man will ask is, How much preparation is needed for electric resistance welding? The first step in any method is to clear the tube from heavy scale, if in use under bad water conditions, by rolling in a large tumbling barrel. After this, the tubes are cut to the desired length to remove the old end that is to be replaced by the new section.

In some shops it is the practice to never allow more than one or two welds in a tube, which means that after removing the second time, the tube must be used in a shorter boiler than before. This procedure is carried out until the tube can only be used for small switching locomotives—if it lasts that long—after which it is scrapped. By this method, only one length of tube is bought new, which is that required for the longest boilers.

In other shops the writer found tubes with many welds, showing that the safe-ending was continued in order to maintain the same length each time until the tube was worn out, when it was replaced by a new one of the required length. This latter method necessitates buying several lengths new but in localities where the water is not very hard on tubes, it prevents a tube from going to the scrap pile as long as there is any good in it. After cutting off the old tubes, as shown in Fig. 1, which represents a common type of machine for this purpose, the tubes are next scarfed, or cut off square, according to which method of welding is to be employed.

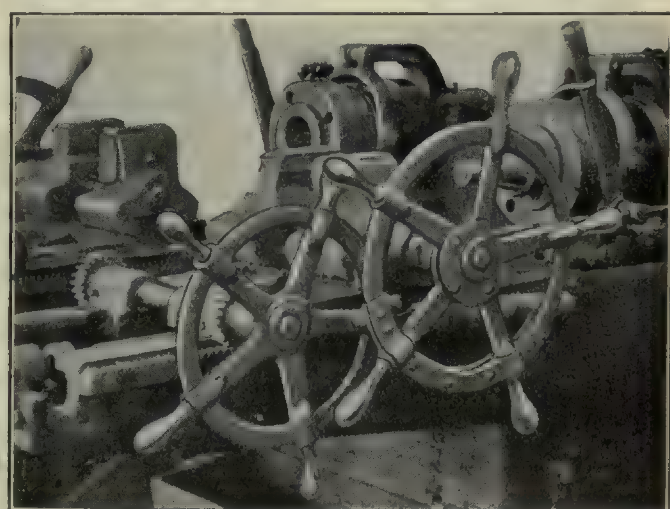


FIG. 3. BOLT THREADING MACHINE MADE INTO A SCARFING MACHINE

If a scarf weld is to be used, the old tube is generally beveled on the outside at an angle of from 45 to 60 deg., according to the length of scarf desired, about as shown in Fig. 2. The bevel is wholly a matter of personal opinion for just as good welds can be made with a 30-deg. scarf as when one of 60 deg. is used.

One type of machine used for scarfing is shown in Fig. 3. This has been rigged up from an old bolt-threading machine. The jaws shown at the left are for gripping the old tube which is then fed into a revolving chuck by means of the handwheel. This chuck

contains the necessary cutters for forming the desired bevel on the outside of the tube end. The jaws on the right-hand side of the same machine grip the new short ends as they are fed onto a revolving tapered reamer, which cuts a scarf from the inside. In some shops, the scarfing is done on an old lathe with special fixtures, but the remodeled bolt-threading machine seems to offer the most efficient proposition for, with this type of machine, it is possible for one man to scarf over 60 tubes and ends per hour.

FIG. 2. ENDS PREPARED FOR SCARF-WELD

If a straight butt-weld is to be made instead of scarfing the ends to be joined, they are cut off squarely, as shown in Fig. 4. This is done in an old pipe-threading machine, or a lathe, so that when placed in the welding machine, the abutting ends will be in contact practically all the way around their circumference. Although this last method of preparing work may sound shorter than scarfing, nevertheless, from actual observation of both methods in different shops, the former is faster by nearly two to one.

After preparing the ends for welding, if the tubes have not already been tumbled to remove all scale, which usually leaves the outside surface quite bright and clean, it is necessary to grind the surface of both old tube and new ends back to a distance of about 8 in. in order to secure a good electrical contact between the tube metal and the copper jaws of the welding machine.

There are three distinct methods of welding boiler tubes, which are called butt-, scarf- and flash-welding,

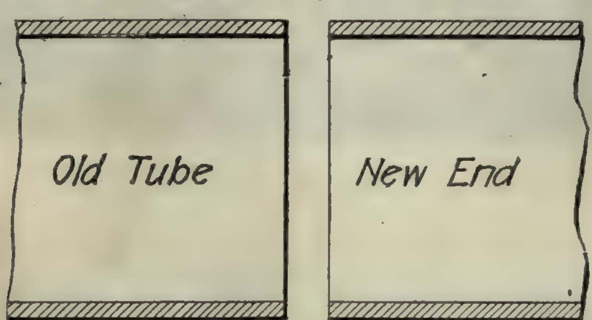


FIG. 4. ENDS PREPARED FOR A STRAIGHT BUTT-WELD

the latter producing the same effect as a scarfed joint when completed. In the straight butt-weld, the ends to be joined are first brought firmly together by means of the pressure device on the welding machine, and the current is then turned on. There is always some point around the circumference of the tube which starts to heat first, due to the impossibility of making the two ends to abut with the same pressure at all points of their contacting surfaces. However, the heat will gradually become uniform all around the circumference before the welding temperature is reached. The current is maintained through the tubes until the joint reaches a good running heat, as evidenced by a "greasy" appearance of the surface, when the pressure is applied sufficiently to push up the hot metal about $\frac{1}{8}$ in. which partly completes the weld. The jaws are then released and the tube is immediately thrust onto the mandrel of the rolling apparatus, which is described further on, and the bulge at the joint, caused by the pushing up of the hot metal, is rolled down until the joint is of the same diameter as the original tube.

This rolling-down operation, in addition to reducing this bulge of the tube, also forces a complete union of the plastic metal of the two pieces, thereby completing the weld. From this it may be seen that in welding boiler tubes, the welding machine is only used for a heating device to supplant the oil furnace, requiring only sufficient pressure to stick the ends together to hold it while removing work to the rolling machine where the welding is finished.

In the scarf weld, the beveled end of the old tube is pushed into the chamfered end of the new piece and the current then turned on the same as in making the butt-weld just described. Due to the "feather" edge of the short new piece, it is often necessary to apply the current intermittently until the joint is well heated

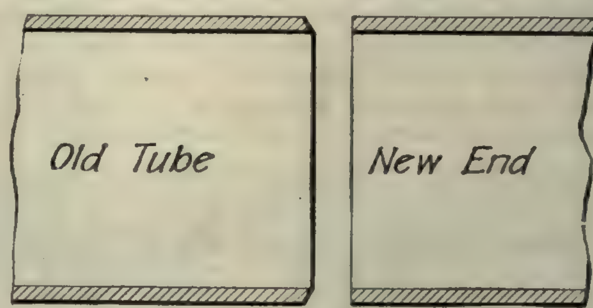


FIG. 5. ENDS PREPARED FOR A FLASH-WELD

all around the circumference; otherwise points of the sharp edge, which come in contact first with the opposite member, will be burned off before the heat is evenly distributed around the tube. Owing to the expanding effect of the scarfed ends, it is not necessary to apply so much pressure as with the butt-weld when the metal is plastic in order to stick the pieces together before rolling down.

With either of the above welds, it is necessary to give the old tube more projection beyond the copper clamping jaws than is given the new short piece. This is because the wall thickness of the old tube has been slightly reduced by wearing away in service and if the two parts were given the same projection, the end of old tube would heat much more rapidly than that of the new piece since its resistance to the electric current would be greater, owing to the reduced sectional area. It is always necessary for the heat to form uniformly in each of the abutting ends or one will burn away before the other reaches the plastic stage.

In making a flash-weld, not so much preparation is required as for the two other methods just described; hence it is a much cheaper job and yet, from all tests made so far, it is the only type of joint which is always 100 per cent perfect when considering the number of defective welds in any lot of tubes. The old tube is cut off the right length in a machine, which has a cutting wheel so beveled as to give an angle of 30 deg. from the vertical on the end of the tube, as shown in Fig. 5. The new ends are bought direct from the tube manufacturers with both ends cut square

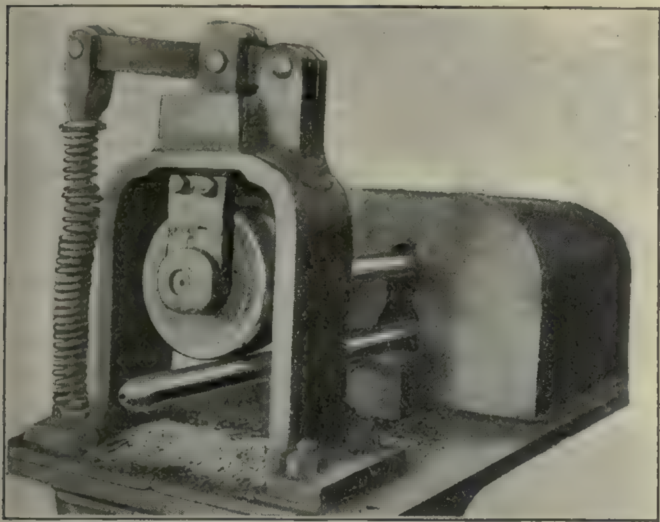


FIG. 6. SIMPLEST FORM OF ROLLING MACHINE

and the surface cleaned well so that there is no preparation needed on the new pieces. After cutting off the old tube it is only necessary to grind it on the outside about 8 in. back from the end to insure good electrical contact. The old tube is placed in the clamps with about 4 in. of projection and the new end with about 3 in. The current is turned on first and the pressure is then applied very slowly and steadily to bring the abutting ends into contact. As soon as they meet, a small arc or "flash" is formed which commences to burn away the points of metal coming into contact first. This flashing is continued until the abutting ends are arcing all the way around the circumference and by this time the sharp edge of the old tube, although somewhat burned away itself, has burned its way into the square-cut end of the new piece. A sudden application of more pressure stops the flashing and the joint then quickly attains the running or welding heat as in the butt- or scarf-welding method. The ends are now shoved together and as the current is turned off, the end of the old tube will have forced itself into the end of the new piece sufficiently to form a scarf-weld when rolled down in the rolling machine.

Using a Flux

From statements made by every operator interviewed, the use of flux does not help the welding in any way; yet it is used in each shop because it clears up the surface of the metal when the plastic stage is reached and enables the operator to judge the appearance of the heat more easily. The writer is confident that if a new operator were to be broken in on a welding machine, he would soon be able to correctly judge the right welding heat of the metal by its appearance without any flux, as there are many pipe shops using electric-welding machines for making joints in long coils, where flux was never heard of. Each railroad shop uses a slightly different kind of flux, but generally this material is nothing more than a common yellow clay, streaked with quartz formation, which has been pulverized and thoroughly dried out before using.

There are several methods and machines employed in the various shops for rolling down and completing the weld after heating the joint properly. One of the simplest machines in use is shown in Fig. 6. It consists of a power-driven mandrel slightly smaller than the internal tube diameter, above which is a power-driven roller. This roller is held a short distance above the mandrel by a spring. When the hot tube is thrust onto the mandrel, the upper roller is brought firmly down onto the outside surface of the joint by pressure on a foot treadle located under the table on which the device is mounted. The pressure is maintained until the joint has been rolled down to outer tube size. The main disadvantage of this style of apparatus is that the speeds of the roller and the mandrel must be in the correct ratio so as to not allow any slip on either inner or outer surface of the tube, otherwise the tube will roll unevenly and when finished will have a thicker wall on one side than on the other. However, this is the earliest form of rolling machine used with the electric-welding method and is still giving fairly satisfactory service in two well-known shops today.

Another type, which is more elaborate but more positive, is a three-roller machine, shown in Fig. 7. The mandrel here is stationary and the three idling rollers, being mounted on a power-driven head, continually revolve around it. After inserting the tube. which is also held stationary, pressure is applied by means of a hand lever which closes the three rollers in toward the center of the mandrel and the joint is rolled down by the surface pressure of the three rollers revolving around it. In order to still further insure uniform rolling, the tube is turned slightly on the mandrel three or four times during the rolling operation since the mandrel is slightly smaller than the tube and if the latter were to be held in only one position, a difference in wall thickness on one side might result.

Rolling machines of the types just described are sometimes located in direct alignment with the jaws of the welding machine, so that after obtaining the proper heat, it is only necessary to release the jaws and shove the hot tube directly onto the mandrel. If the three-roller type is being used, the tube is held stationary by locking one jaw of the welding machine. When a new position on the mandrel is desired the jaws are released and the tube allowed to turn slightly with the friction of the revolving rollers.

Another method is to have the rolling machine in back of the welding machine so that when the correct

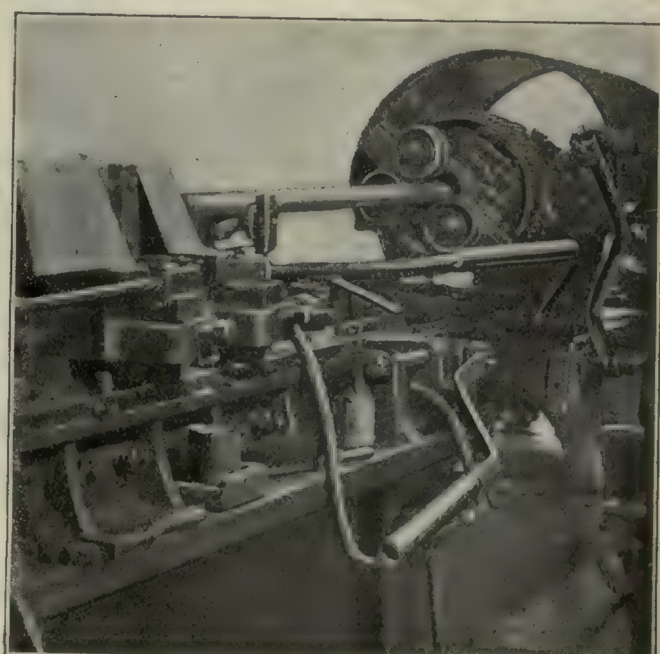


FIG. 7. THE THREE-ROLLER, OR HARTZ TYPE, MACHINE

heat is obtained, the tube is lifted out of the jaws by the operator's assistant who shoves it onto the rolling mandrel, leaving the operator free to get the next tube lined up in the machine for heating. In this last method, the assistant must act quickly so as not

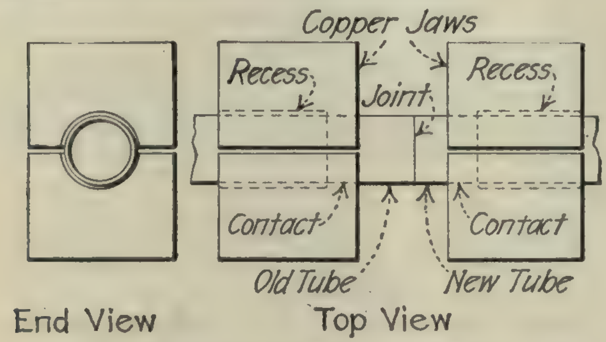


FIG. 9. RECESSED COPPER CLAMPING JAWS

to allow the joint to cool down before the rolling, as he cannot transfer the tube from the welding to the rolling machine as quickly as the operator could shove it forward onto the mandrel as first mentioned.

As to speed in welding, the writer observed that the same production could be obtained in different shops by either method of locating the rolling machine; hence it is purely a matter of space available around the welding machine, and local opinion.

A third way of handling the rolling down is to have the rolling machine built onto the welding machine, as shown in Fig. 8. In this particular apparatus, the mandrel is made long enough to permit welding in to a distance of 10 ft. from the joint, so as to reclaim old short tubes by making a new long one with a joint in the middle. This reclaiming of tubes has proved to be perfectly practical, having been forced in one locomotive shop during the war due to the inability to obtain new tube stock. The mandrel is power driven as well as the upper roller, while the two lower rollers are idlers. After obtaining the welding heat, it is only necessary to move the tube about one foot to bring the joint onto the rollers. A clutch at the rear end is then thrown in to revolve the mandrel and upper roller, and pressure is applied through the latter by means of an air cylinder mounted above it. While being rolled the tube is allowed to revolve freely in the open jaws of the welding machine. The rear end of the tube is supported on idling rollers.

After the rolling-down process, which is the same as has always been used with the oil-furnace method of welding, the tubes are subjected to the annealing and end-swaging processes. They are then usually tested hydrostatically for possible leaks and stacked away ready for assembling in the boiler. The percentage of leaks is less than 5 per cent in any shop, and in one shop they are so sure of their welding that the tubes are not tested until completely assembled in the boiler when the latter is subjected to a hydrostatic test as a complete unit. This particular shop uses the flash-weld method and has never had a defective joint since the welding machine was installed over four years ago.

Merits of Electric and Oil Heating

When asked to compare the electric welding with the oil-furnace method on boiler tubes of any size, one of the oldest users of the former replied that there was "no comparison." Using oil it was never possible to average over 30 or 40 welds per hour on tubes up to 3 in. with one furnace and one gang. This meant that the tube shop was always behind the rest of the repair departments and working overtime a great deal in order to catch up. Fuel oil will vary greatly in different lots as well as under different atmospheric conditions, so the oil furnace itself is a constant source of aggravation and calls for continual adjusting, which means an interruption in production while the fire is regulated.

As to production with an electric-welding machine, the average output on tubes up to 3 in. in diameter, taken from all shops using this process, will run 60 completed welds per hour, requiring one operator and a helper at the machine and a third man to prepare the work for welding. In the days of piecework, in some of the shops, records show that the maximum number of small tubes turned out in any shop, with the same number of men, was 125 per hour or a little better than one tube every 30 sec. and this could be kept up for two hours at a time without greatly tiring the men. This speed was obtained by three different shops, each using a different style and arrangement of rolling-down apparatus, which shows that all of the methods outlined previously in this article are equally fast.

On welding superheater tubes at the reduced section, where the diameter at the point of weld is about 4⅜ in., the production will run about 10 to 20 welds per hour, although better time has been made on piecework. By comparing these figures with the oil-furnace welding production, even under the best of working conditions, nothing further need be said as to the speed of the electric process.

As to cost, there are no figures available later than 1916, which of course would be much lower than at the present day, but by comparing costs of both methods at that time. taking into consideration upkeep, labor, cost of heat either way and cost of time lost by making adjustments or repairs to either apparatus, the electric costs per 1,000 tubes welded, is about one-third that of the oil-furnace method.

The only wear on the welding machine is the surface of the copper dies or jaws which grip the pieces and this is so slight as to only require smoothing off a few times a week. The machine does not cost anything for heating energy except when the weld is being made and it is always ready for action as soon as the operator has placed the work in the jaws. Hence there is no delay in starting up the fire in the morning or after lunch hour nor from the fire balking at any time during the welding. The replacements on welding machines in all the shops visited by the writer could be easily covered by $100 during the last six years.

In recapitulating the three methods of electric welding flues, it is safe to say that the flash-weld, which produces a scarfed joint when finished, takes the lead for simplicity of preparation, speed of actual welding and reliability as to percentage of failures in any lot of tubes.

Next to this comes the straight scarf-weld, which requires machining of the ends before welding but insures a good joint after welding although occasionally a small leak will show up on the first hydrostatic test. As stated before, the percentage of leaks is very low with this type of weld and practically negligible with the flash-weld.

The butt-weld, which was originally employed in all the shops, is now only used in one shop in the whole

country, probably due to the difficulty in making a perfect weld each time as compared to the ease of making a scarf weld. However, this one shop claims very high efficiency with a butt-weld, both as to tensile strength, which will average over 85 per cent of original tube section, and as to tightness of the joint under pressure.

The principal objection offered by most shops against butt-welding is that should the weld prove tight under pressure, but still be a weak joint mechanically, it might break apart in service. This has happened in a few cases, allowing the tube to drop down in the boiler and subjecting the engine crew to the danger of scalding. With a scarf-weld, which generally shows a tensile strength equal to that of the original tube, due to the area of the weld, should the tube not be welded strongly as just cited and a break should occur inside the boiler, the scarf would prevent the tube from pulling away from its end and only a slow leak could result. This sometimes actually happens with oil-furnace welded tubes.

The Kind of Machine to Use

As there are different styles and sizes of welding machines being used at the present time on flue-welding, the writer will endeavor to specify special characteristics that should be sought when selecting a machine for this class of work, which is different from any other pipe-welding job. The machine should be constructed to be as efficient electrically as possible; that is, the clamping jaw should be as close to the transformer as is practical in order not to have large inductive losses caused by the large gap due to the long secondary leads widely spaced. The fewer the joints between the secondary loop of the transformer and the copper jaws which grip the tube, the less chance will there be for resistance losses that cut down the heating effect gradually as oxides form in the joints or by dirt collecting from allowing them to become loose. Although the jaws should be long to permit thorough water cooling, it is only necessary to grip the pipe over a length of about 2 in. This length is bored out to exactly fit around the tube as shown in Fig. 9.

The pressure device does not need to be as heavy as would be used on the same welding machine for joining ordinary pipe or solid stock, since the squeezing together of the plastic metal is really done in the rolling machine. For fastest operation the clamping jaws should be operated by air cylinders so that only a slight movement of two valves is necessary to lock or unlock the tube in the jaws.

For welding up to 3-in. size tubes, a machine of 30-kw. rating ought to be large enough to stand constant use. Any form of toggle lever or screw-wheel pressure device, which permits the operator to stand close to the work will be suitable, as not over 1,000 lb. effective pressure is required on this size of work to stick the ends together sufficiently hard for placing in the rolling machine.

To handle up to 5⅜-in. superheater tubes, a machine of about 75-kw. rating should be employed. For its pressure device, an air cylinder or hydraulic apparatus may be used to best advantage so as to secure up to three or four tons' maximum effective pressure.

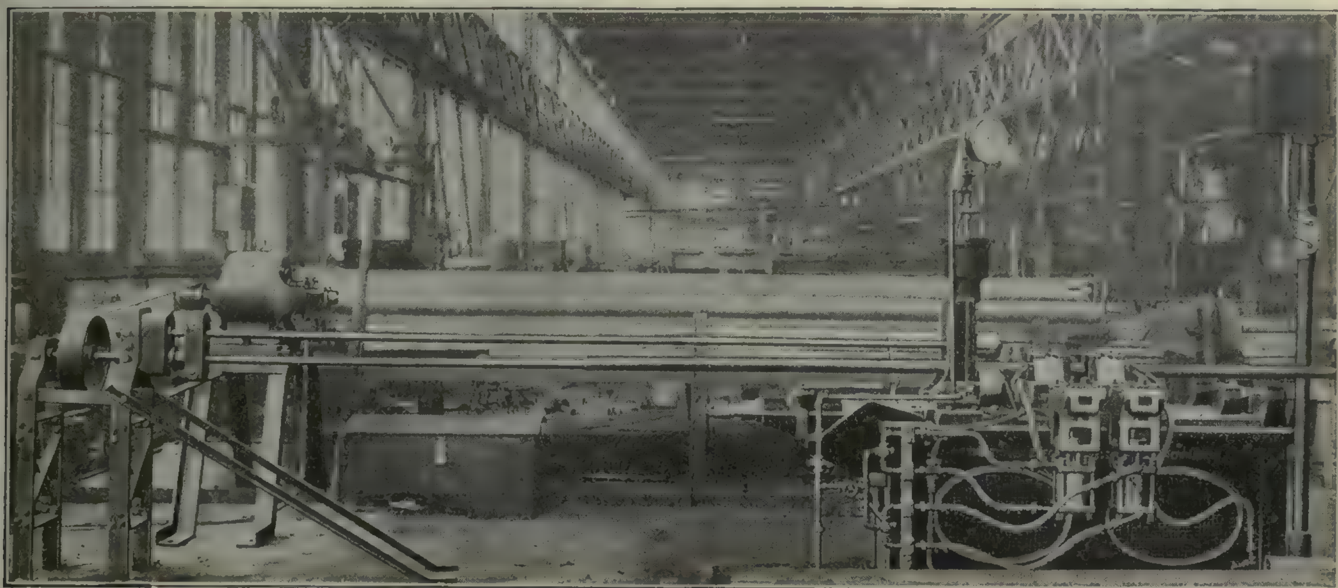


FIG. 8. ELECTRIC WELDING MACHINE WITH BUILT-ON ROLLING DEVICE

For ordinary butt- or scarf-welding, a hand-operated oil jack may be used, although trouble has been experienced in the past with this type of pressure device due to sticking of the valves at critical times, often spoiling a weld.

Flash-Welding

For flash-welding, a toggle lever or hand-screw wheel on small machines and an air cylinder or hydraulic pressure device on large machines *must* be used, to effect a slow steady forward movement of the movable jaw in order to maintain the arc of the flashing, yet to have available a quick reverse to break the parts away should they stick too soon from too rapid movement of the pressure device. In small shops, it is advisable to install a 75-kw. machine to handle all sizes of tubes up to the largest superheater. If the shop is large enough to keep a small machine busy all the time on tubes up to 3 in., it will no doubt pay to install in addition, a large machine just to handle the superheater tubes as well as any overflow lot of small tubes. While the large machine will handle any size, it is not so rapid in operation on small tubes as the smaller one, and the bulk of flue-welding is on small tubes, less than 10 per cent of the total being represented by the larger sizes for superheaters.

Hospital Work in a Large Machine-Tool Plant

By SANDFORD DE HART
Director of Hospital, the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio.

One of the large problems of the modern plant management is how best to protect employees from sickness and accidents, and keep them up to the highest possible state of physical efficiency. To do this successfully means that work of this kind must be in the hands of skillfully trained, foresighted and sympathetic people.

RECENTLY, an analysis was made to discover, if possible, whether any results were being obtained from our campaign of education on safety, accident and infection prevention.

This campaign extended over a period of five months, starting with May 1 and ending Sept. 30. The analysis disclosed that there was a total of 60 hours lost through injuries incurred in the plant, and since we have on our payroll about 1,000 men, this meant the loss of 3.6 minutes per man, for the period of five months. There was $6.90 compensation paid. The 60 hours lost are classified as follows: In May, 16.2 hours were lost; in June, no time was lost; in July, 10.1 hours were lost; in August, 13.4 hours were lost; in September, 20.3 hours were lost.

It might be well to state that the safety, sanitation and health work in our plant are under the supervision of the hospital department, the personnel of which is small, consisting of the writer, a surgeon, a dentist and a stenographer. It is the aim of this department to exercise close and careful supervision over the human element; just as the engineer exercises over the inanimate machinery technical parts of the plant.

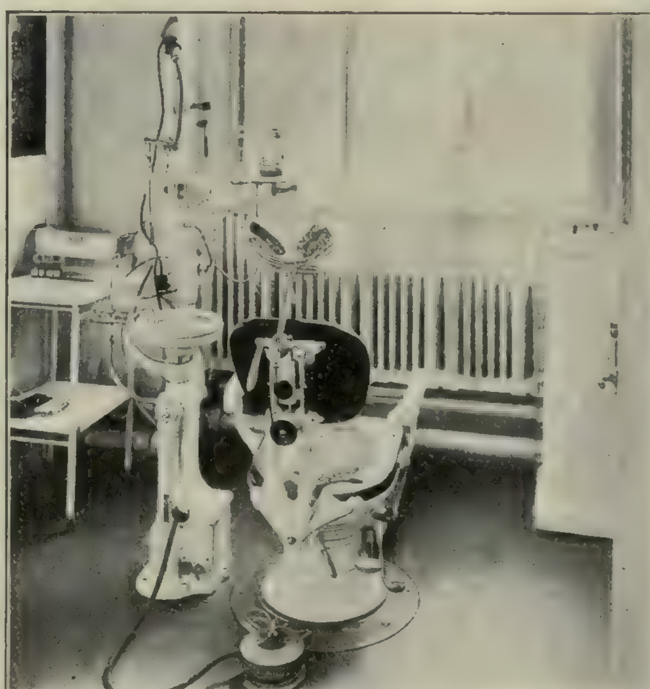


FIG. 2. THE DENTAL DEPARTMENT

Our records show that there were 3,106 cases treated, 1,914 of which were first-class surgical cases, and of this number there was not a single serious accident nor an eye condition serious enough to refer to an eye specialist. The foreign bodies extracted from the eye were for the most part floating particles. Persistent education and impressing upon the men the importance of having these foreign bodies removed before they became adherent to the eye, were largely responsible for our low eye-trouble rate.

The wearing of goggles was made compulsory and every objection on the part of the man using them overcome. We found that the goggles to be effective must fit closely and still allow air to circulate. The

FIG. 1. EYE-TREATMENT APPARATUS

screen covering on the outer border with small perforations and fitting snugly, brought better results than others which did not possess these advantages. However, as the experience gathered showed the goggle question to be more or less a psychological problem, we did not insist on minor details as to its construction. We were primarily interested in the man using protective goggles, regardless of type. Occasionally, we would have a man who would discard his goggles and go over to the grinding wheel to grind tools, only to find that the result of his foolishness was a piece of emery burnt into the cornea of his eye. This would necessitate removal with the aid of a local anaesthetic, dilatation of the pupil, and treatments every two hours until after the inflammatory process had subsided. A shield was placed over the injured eye and the employee kept at work. Our eye-treatment apparatus is shown in Fig. 1.

It was found that by far the greater number of injuries occurred between the hours of seven and nine in the morning, or during the period of adjustment. The accident rate was considerably higher on Monday than it was the balance of the week, with the possible exception of Saturday morning. In our campaign of accident prevention and accident reduction this period of the day received particular attention.

Classification of Injuries

In tne classification of the number of injuries, it was found that 204 men received one injury each and 96 men received three injuries each. Those receiving over 6 to 12 injuries numbered 80, and those receiving over 12 numbered three. The character of the work performed by the injured no doubt accounts to some extent for the percentage of injuries. There were less accidents with men operating machinery than those from falling bodies, lifting, etc. Individual characteristics of the employee had considerable to do with the injury; for instance, the injuries received by the three men with 12 injuries each were not due to the character of the work performed.

The nature of the injuries received for the most part were abrasions. Next in frequency were small lacerations, and after this were foreign particles in eyes. Of the injuries incurred, 86 per cent affected the upper extremities, involving fingers and hands, since these parts of the anatomy are the most exposed to injury. While it is seldom that a new employee does not incur injuries during the first two or three days of his entering our employment, the older employees are not immune to accidents. Occasionally, we found a man who had been working on the same type of machine for many years and practically had mastered every detail of the mechanism and operation, and yet there was that tendency on the part of the man to question the ability of the machine to do him personal injury. Hence his susceptibility to injury was increased. This susceptibility varied greatly with different men although they were engaged in the same class of work.

Causes of Accidents

Many factors enter into accident causes. One cause may be a sleepless night, due to financial or domestic troubles, or to a toothache.

We have established a fully equipped dental office to take care of defective teeth, with a dentist in charge. Our dentist is a picked man, being chosen not only for his professional ability, but also for the keen interest he has shown in industrial work. His business is to examine the mouths of all of our employees periodically, with the view of keeping the mouth in a hygienic condition; in other words, his duties are to anticipate and prevent toothaches, as it is the duty of the safety department to anticipate the occurrence of accidents. Our dental department is shown in Fig. 2.

Perhaps there is no one cause that is more productive of accidents than domestic trouble and difficulties. These difficulties may be due to misunderstandings between a man and a wife, sickness in the family, worry over the actions of children, or to numerous other causes of a similiar nature. To iron out these difficulties is the duty of our welfare director. The men are made to understand that they can come to the welfare director

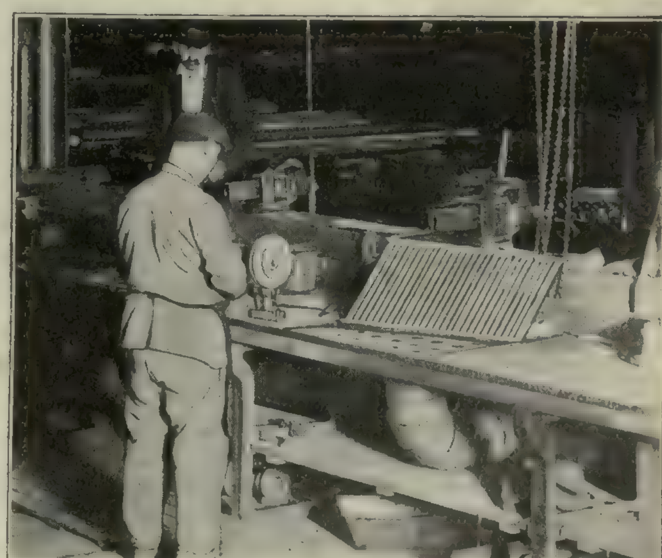


FIG. 3. BENCH GRILLS AND EXHAUST SYSTEM

with their troubles, and that they will receive sympathetic advice and aid. If the conditions surrounding a man's life outside of the plant lowers his working ability, it is just as rational to try to remedy this difficulty as it is to put a machine into working order that has been injured through some unknown cause outside of working hours.

Two departments which have responded very well to our activities along safety lines are the screw-machine department and the paint department. With the screw-machine department we experienced considerable trouble with our men, in their susceptibility to boils and minor infections. We have practically eliminated boils and have not had a single infection from this department in the last five months, or since we have been sterilizing the oil once a week.

With reference to the paint department, this department has always been productive of respiratory and eye troubles. To prevent these conditions an exhaust bench, shown in Fig. 3, has been installed for the painting and filling of machine parts. All of the dust and dirt, lead and other ingredients of the paint are sucked by an exhaust system, through grill work in the top of the bench and disposed of outside of the shop. The main parts of the benches are of the type adopted for work benches, being made up of standard and interchangeable parts, such as legs, drawers, runners and other material. These parts are carried in stock in interchangeable units and assembled as required.

The grills are spaced on about 3-ft. centers and are approximately 3 ft. wide, running the full depth of the bench. They are set in flush with the top of the bench, allowing castings to be readily slid along the bench from one operation to the next. Each of these grills is connected by an independent duct to the main exhaust line which parallels the length of the bench. All of the painting and filling of cast-iron parts, with the incidental rubbing down between the application of various coats, is done on this bench.

All the grinding of small parts with rough edges which the painter would otherwise have to chip off is also done on this bench.

Careful records have been kept and the employees of this department placed under special observation for respiratory and eye conditions. Before the installation of the exhaust system the conditions were more than ordinarily productive of traumatic eye conditions and also respiratory troubles. In the past five months there have been no cases from his department.

The Scope of an Industrial Hospital

An industrial hospital to be efficient must be more than a place to merely bandage fingers. The doctor should be sufficiently familiar with occupational hazards to anticipate accidents. He should be social minded, so that a man will not feel embarrassed to come to him with small wounds, as it is the small wounds that are the most likely to become infected. Insurance companies tell us that there is more time lost through infections than through serious accidents.

The study and elimination of occupational diseases, including those due to industrial poisons, is another duty of the hospital supervisor. He should know which occupational diseases induce or maintain the various accidents and how these conditions are apt to occur, and coöperate with the engineering department so that practical protective measures may be taken. His work is not to determine if a certain man measures up to his job, but whether he is physically able to perform the task assigned to him, or whether there are industrial conditions under which he is working that are harmful to him or his ability.

Efficiency is a synonym for output and there can be no efficiency where there is a likelihood of accidents, nor can there be maximum efficiency where the man is physically unfit to perform the task assigned him.

Designer's Slant on Metric System

By Malcolm S. Cate

In contemplating the metric system, it will be well to consider the chips that will be added to the fires of unrest that are now burning enthusiastically.

I am a humble machine designer whom fate and employers have treated kindly enough so that I do not contemplate taking a running jump into the adjacent Charles River or some equally wet body of water.

If Congress tells me to, I will obediently, if somewhat sullenly, discard such measuring instruments as I now possess, deny my wife her new spring hat, myself my semi-occasional cigar, and invest the amount derived therefrom in replacing my discarded tools with measuring instruments, the subdivisions of which more nearly suit George Q. Meddler (I strongly suspect his name is Von Meddler) and his associates. I will also readjust my life-trained mental process of thinking in feet and inches to thinking meters, centimeters and millimeters, regardless of the headaches engendered thereby, and reattack my work with a necessarily diligent if enwearied manner—and now let me reassert that I am a fairly content and unpugnacious member of the community.

I am acquainted with divers fellow craft who are just sore enough at their jobs that when being confronted with the conditions presented above, and an unheard of number of designs, drawings, sketches and computations which they have once completed and thankfully forgotten and which must be laboriously altered, will retire from their trades with an abandon which will border on frenzy and go into snow shoveling or some other equally exhilarating and remunerative enterprise. So much for designers and draftsmen who have never been considered of hefty importance in the general industrial scheme. Now let us come to the machinist and other workmen and we have something else again.

A friend of mine who is a machinist (a draftsman of proper diplomacy and servility may have a friend or two in this trade) has recently acquired a vernier caliper for which he paid in the vicinity of forty dollars in the best coin of the realm. To say that he is proud and jealous of this instrument would be hardly broaching the subject. When Congress tells him that this instrument is of no use and he must drop it into the nearest ash can, he will do it with a carefree cheerfulness; will he not. By altering the position of the first two words of the last phrase of the preceding sentence, you will get the right answer.

Likewise, when all of the machinists of this country are ordered to deposit their measuring instruments in the National junk pile, composed of jigs, fixtures, tools, patterns and templets, there will be a roar compared to which a full-grown artillery preparation would be a whisper. Yes,—and could you blame them?

In closing, let me arise to ask: Why add straws to the back of the camel whose knees are already wobbling?

The Printing Press as an Aid to the Drafting Room

BY F. H. PFEFFERLE

In most instances drawings must go through two or more stages before blueprints can be made from them. Pencil drawings may or may not be inked in for tracing and in some cases tracing may be omitted and the blueprint made from the pencil drawing direct. However, any part of the routine that can be saved is a distinct gain not only in dollars but in the time in which a drawing can be gotten ready for the shop. In this article the author describes and illustrates a method by which a printing process can be used to save much of the repetitive work required in tool designing.

NOW that machine-shop production has been standardized, attention should be turned toward the drafting room. If it is unprofitable for a man to do mechanical work that a machine can do for him, it is just as unprofitable for a draftsman to draw what a machine can draw for him.

When the war emergency required that drawings be completed in the shortest possible time, some firms resorted to making blueprints directly from pencil drawings, which were made on vellum paper. This method cut down the work considerably but there was still left the drudgery and loss of time that accompanied the making of a large number of drawings that were alike except for a few important details.

The problem of making a great many similar drawings confronted the National Cash Register Co., Dayton, Ohio, when it began to build its own tools. The designing of a large number of drill jigs was an important item. Most of these jigs were alike, except for the method of clamping the work to be drilled, so that whenever a new jig was designed the body of the jig had to be redrawn. While watching a man working on a half-dozen drawings of the same jig, the foreman conceived the idea of printing the jig bodies instead of drawing them over and over again. A jig body was immediately drawn up and sent to the printing department, where a photo-engraving was made on a zinc plate and a number of copies printed. Fig. 1 shows two views of the body of a single-hole drill jig as printed. After the "vitals" and the method of clamping a particular shaped object have been drawn in with pencil, the assembly appears as in Fig. 2. The numbers *1*, *2*, *3*, etc., indicate the various parts of which details are to be made, while all stock parts are listed in the space provided below. The piece to be worked on is designated by dot and dash lines. In this case it is a cylindrical stud which is clamped in a V-block by a screw and bell crank device as shown. A hole is to be drilled $\frac{1}{16}$ in. from the end of the stud. When the piece is drilled, the clamp is loosened and pushed aside as indicated by the dotted lines.

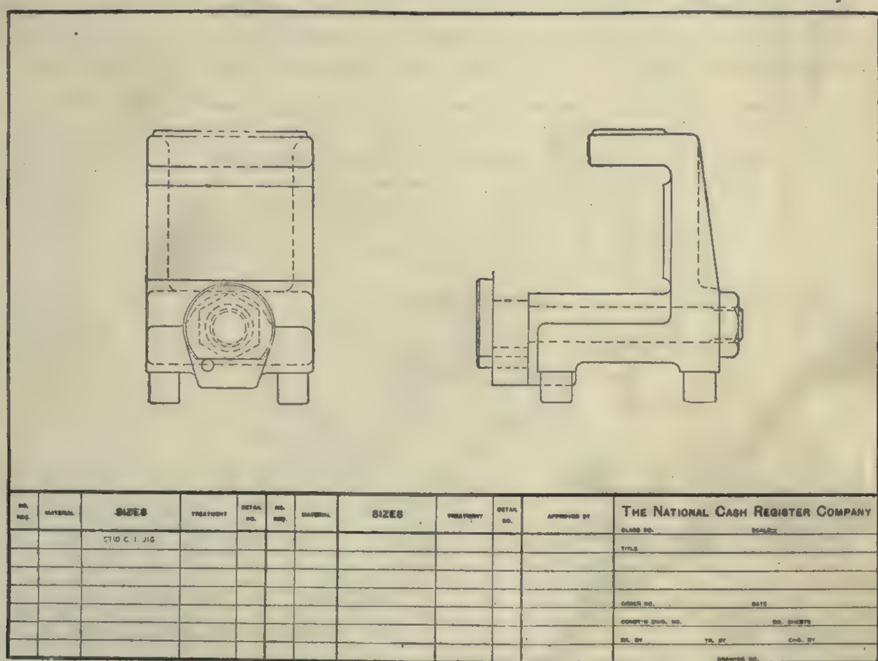


FIG. 1. PRINTED OUTLINES OF A JIG BODY

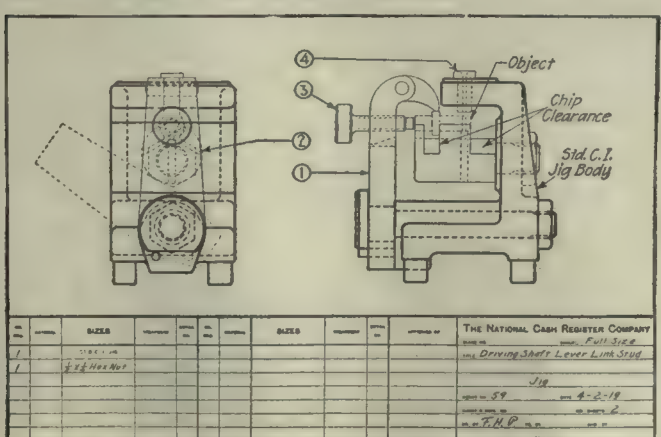


FIG. 2. JIG ASSEMBLY USING FIG. 1 AS A BASE

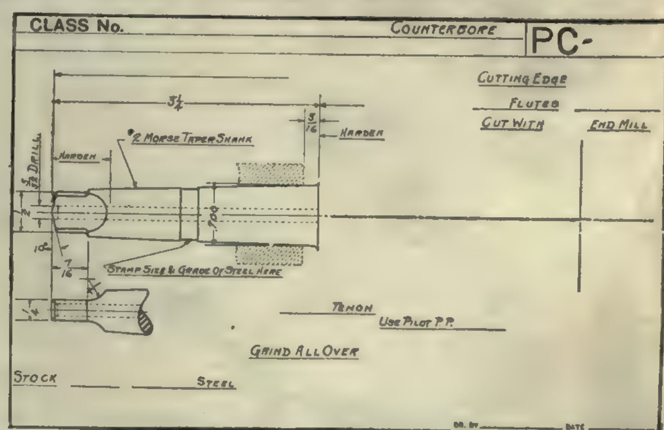


FIG. 3. OUTLINES AND DIMENSIONS OF PAPER SHANK

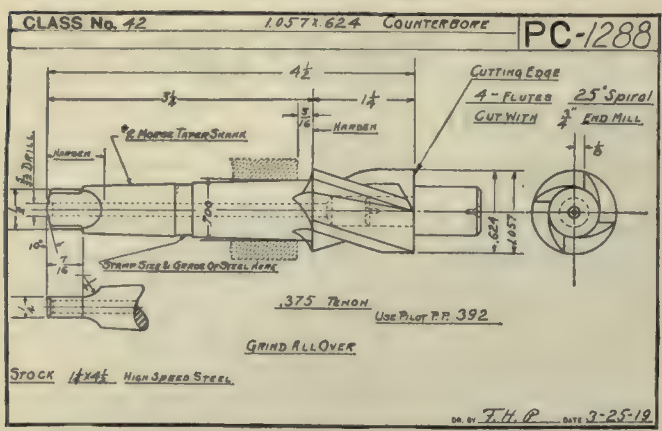


FIG. 4. DRAWING OF A COUNTERBORE USING FIG. 3 AS A BASE

This facilitates its removal, and the insertion of a new piece. Instead of being inked in, the completed pencil drawing is shellacked and sent to the shop. Thus the drawing has been completed in less than one-fourth the time formerly required. Thousands of parts can be drilled every day on a jig of this sort, so only one will be needed. To ink the drawing and to make a blueprint of it would be a mere waste of time.

This same method of making drawings has been even more successfully applied to small tools, such as reamers, end mills, counterbores, etc. Hundreds of such tools are designed every year. All of these have standard taper or straight shanks. The shank is not drawn every time a new cutter is required but instead a series of standard shanks of various sizes have been printed on vellum paper. Fig. 3 is an example of a shank for a counterbore. It will be noted that nearly all the dimensions and lettering are already on the plate, and it is only necessary for the designer to draw in the desired cutter and the few remaining dimensions. Fig. 4 shows the complete drawing, which having been made on vellum paper is ready to be blueprinted. With this method only two steps are necessary to make a print ready for use in the shop.

Another important use to which printed forms are put is in the designing of automatic screw-machine cams. Every single-spindle automatic screw machine has at least three cams. A front cam, which operates the front cutter, a back cam which moves the rear cutter, and a lead cam for revolving the turret. In laying out these cams it is necessary to keep in mind the exact position of one cam with relation to the others. To make clear this relationship at all times, the three cams are very often designed one on top of the other. To eliminate the complication which results from such a procedure, three forms, each of which is divided into 100 parts, are printed in red ink on a sheet of vellum paper. In this way each cam may be designed independently, but still the draftsman knows the exact relation of any point on one cam to any point on the other two. Fig. 5 shows the back and lead cams, for a single-spindle Brown & Sharpe screw machine, to be set up for making a small

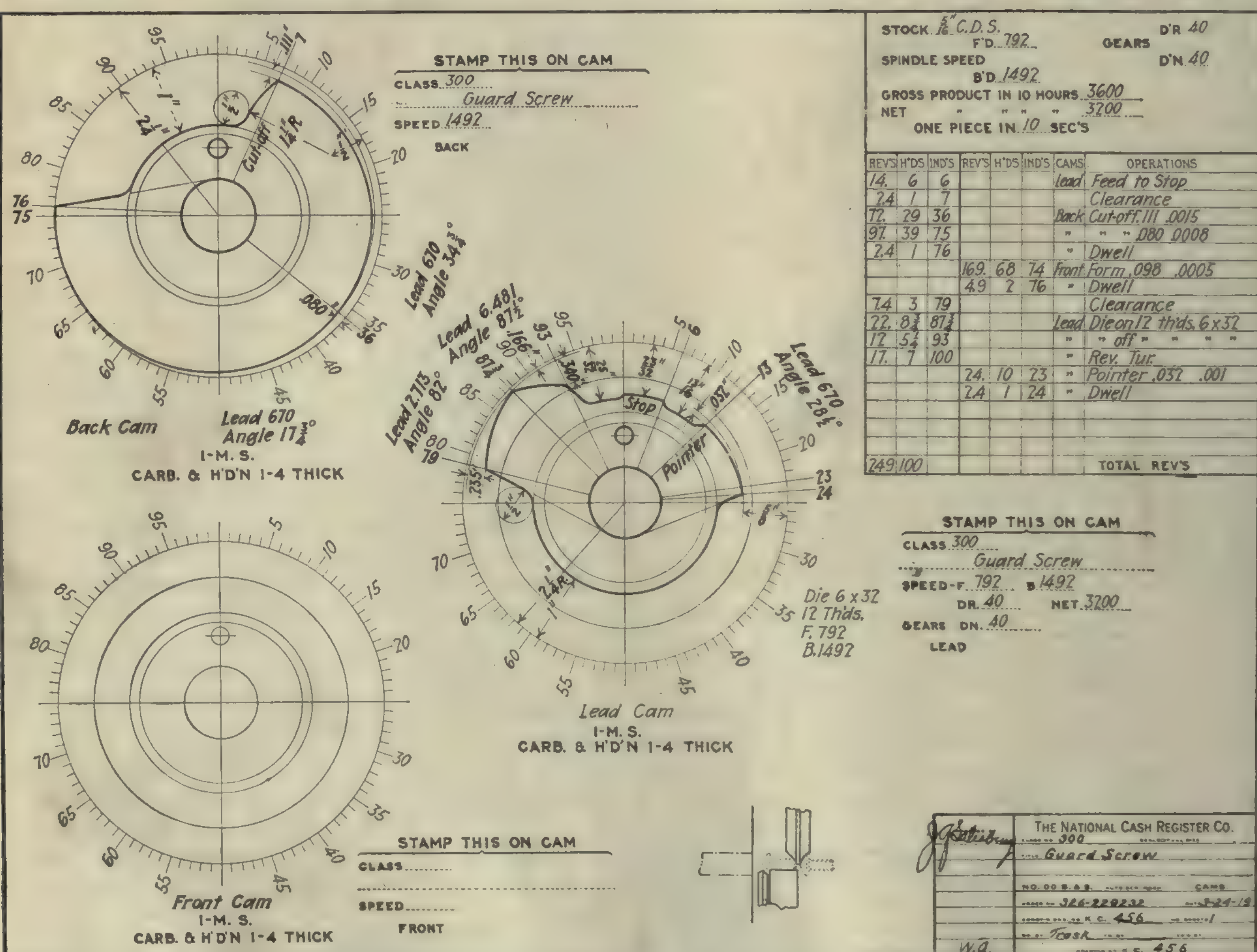


FIG. 5. PRINTED GRADUATED CIRCLES ON WHICH TO LAY OUT CAMS

guard screw. The front cam was omitted to illustrate the printed form on which the cams are drawn. Below the lead cam is shown the forming and cut-off tools at work. The leads and angles which are given at different points along the cams are the leads of the milling-machine table and the angles of the dividing head to be used in cutting the cam. In the block in the upper right-hand corner is noted the complete data of the action of the cams in turning the guard screw. The great simplification in the designing of cams which results from the above method is obvious and can be used to good advantage by every firm operating automatic screw machines.

This method of printing drawings is also used for standard die shoes and die holders, multiple-hole drill jigs, milling cutters and a number of other stock tools and parts. The saving of time resulting from making drawings in this way has paid for the cost of the photo-engravings many times over every year. Fewer men are needed to do the work while the elimination of the drudgery has greatly increased the efficiency of the tool-designing department.

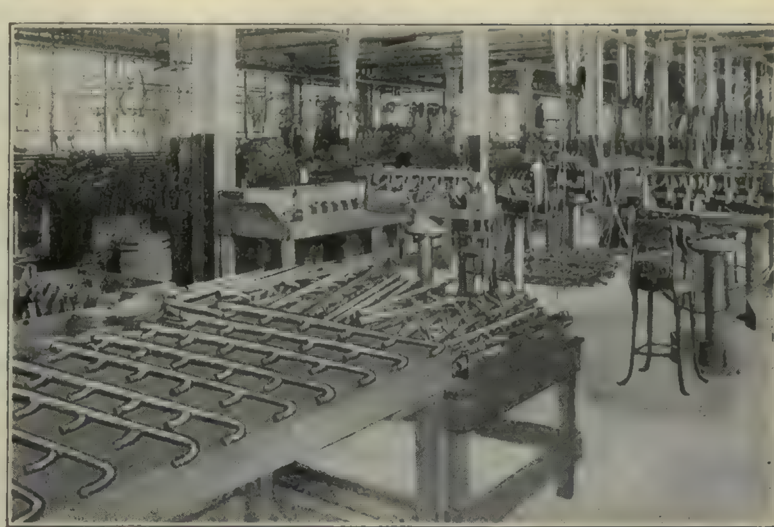


FIG. 4. COMPLETED MANIFOLDS FOR LIBERTY ENGINES

Oxy-Acetylene Welding Fixtures for Making Manifolds

By C. C. Phelps

Several ingenious fixtures are employed to great advantage in manufacturing manifolds for the Liberty engines by means of the oxy-acetylene process at the plant of the Ireland & Matthews Manufacturing Co., Detroit, Mich. The fixtures were designed in accordance with plans furnished by the engineering department of the Oxweld Acetylene Co., Newark, N. J.

FIG. 2. DETAILS OF FIXTURE PROPER. ASSEMBLED MANIFOLD INDICATED BY DOTTED LINES

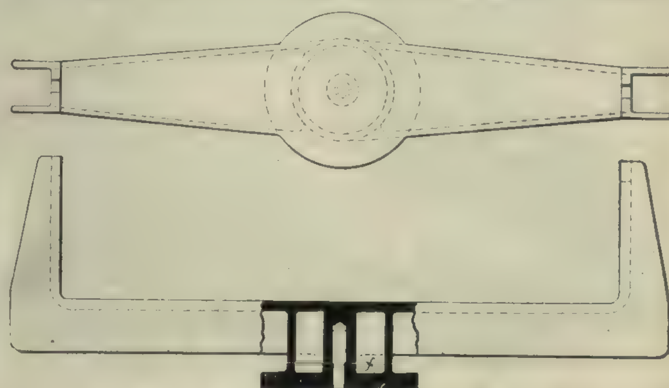


FIG. 3. DETAILS OF SWING SUPPORT FOR MANIFOLD WELDING FIXTURE

In assembling the manifold parts in the fixture, Fig. 1, the five branch inlets are first mounted on their respective pivots *A* in the bed of the fixture; the trunk of the manifold is then placed above and in contact with the branch lines, so that the openings in the trunk coincide with the ends of the branches, and, finally, the five hinged clips *B* are swung into position and clamped down on the assembled manifold by means of the hand clamps. The end of the trunk is bent to serve as one of the inlets and this end in turn is inserted over the end pivot. The fixture shown in Fig. 2, serves to hold the assembled parts in perfect alignment.

FIG. 1. FIXTURES USED IN WELDING LIBERTY ENGINE MANIFOLDS

The fixture proper is suspended at the ends to permit complete freedom of rotation, and the points of suspension are so located that the device will be in balance when containing the tubing. The support for the fixture, Fig. 3, is mounted on a pedestal in such manner as to allow rotation in a horizontal plane. Thus the operator is enabled to shift the work so that the blowpipe flame can be applied in the most advantageous manner at all times. Fig. 4 shows the completed manifold.

During the war this company manufactured various kinds of tubes and manifolds for Liberty and Le Rhone engines, bombs, gas shells, floats for the Navy and poison-gas tanks. When it is considered that the company had no welding equipment prior to May, 1918, great credit must be given to the inexperienced girl operators and the equipment that produced such results.

A High-Production Pneumatic Milling Fixture

By P. A. Udall
Chief Tool Designer, The Holt Manufacturing Co.

Fig. 1 shows a pneumatic milling fixture, designed for the Holt Manufacturing Co.'s first motion chain pins, straddle-milling both ends to a depth of 1⅛ in. and using 1⅛-in. diameter cold-rolled steel cut in 6-in. lengths. This fixture, Fig. 1, mills 16 pins at once, with a dividing bar *A* in the center to enable the operator to take out and replace the first eight pins while he is finishing the rest.

I am using a 4-in. piston with 100-lb. pressure. The piston plunger is 1 in. in diameter, tapered on the end to about 24 deg. This taper works between two toggles, with a reduction of two to one, as shown at *B*, top plan, developing a pressure of 2,400 lb. on each pin. An eccentric pin *C* is provided to take up wear.

A snap dog *D* with a square stud underneath locks the revolving fixture on either side, as shown at the left-hand side of the drawing, and on the right-hand side a similar dog is provided, but this one is locked and released by a thumb screw instead of a spring.

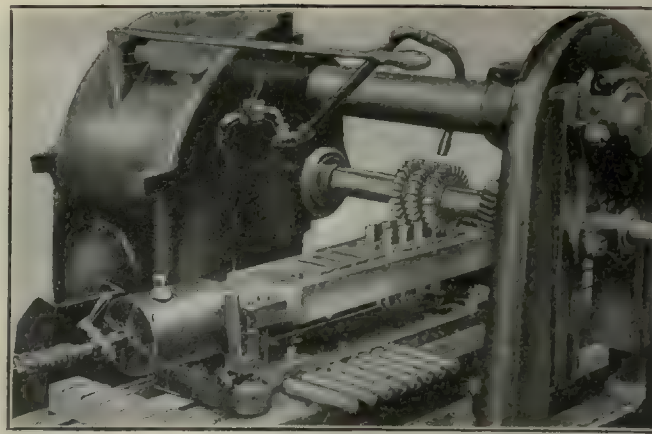


FIG. 3. FIRST EIGHT PINS FINISHED AND REMOVED

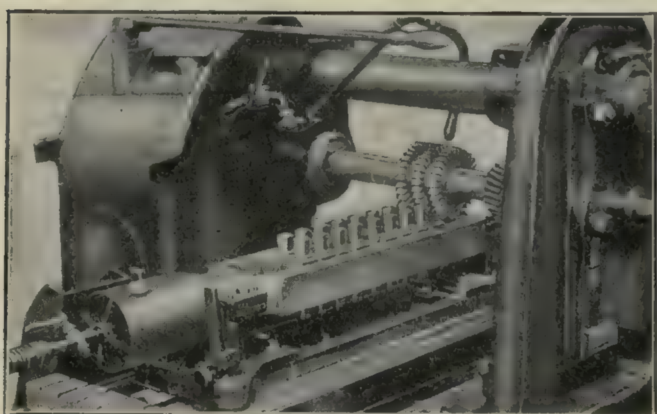


FIG. 2. FINISH OF FIRST CUT

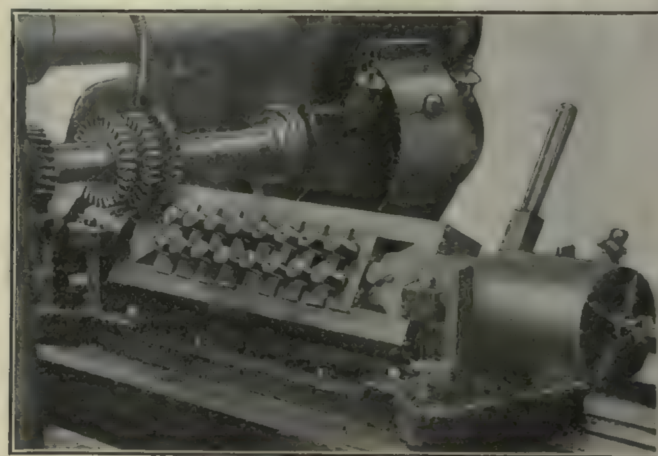


FIG. 4. REVOLVING THE FIXTURE

This gives the operator a chance to release or lock the thumb-screw dog *E*, so that he can release and revolve the fixture by handle *F* and spring dog *D*, locking thumb screw *E* when the feed is started.

The V-blocks are made for two rows of pins and spaced so that they take a standard width of cutter in the center, using any width of cutter on the outside.

The most important feature in this fixture is that any desired pressure can be applied on the V-blocks by changing the taper of the piston plunger *G*, and, with this arrangement, both rows of pins are held with an equal pressure, tightening its grip by the vibration of the cut. This fixture milled 1,200 pins on both ends in 8 hr., the fourth day after its completion and no doubt it will show still better results.

Figs. 2, 3 and 4 show the fixture when in operation. Fig. 2 shows the first cut just finished; Fig. 4 shows the fixture from the other end being revolved to mill the other side; Fig. 3 shows the first eight pins released and already taken out.

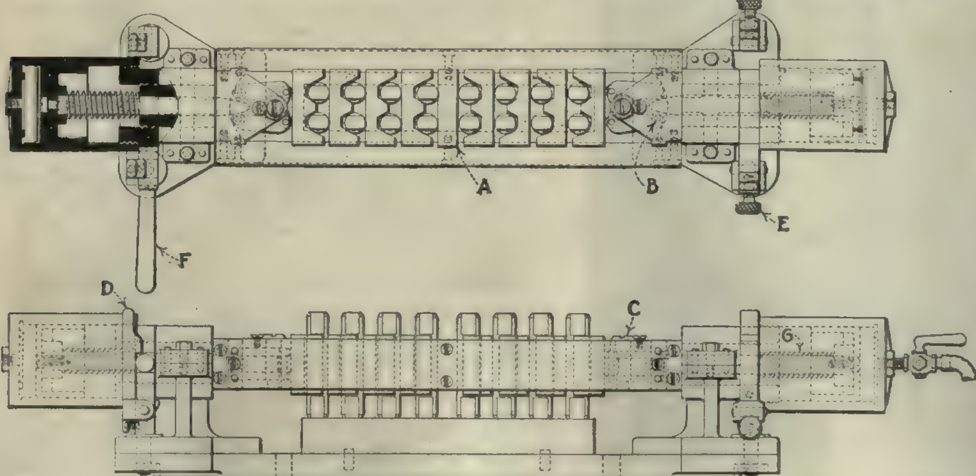


FIG. 1. PNEUMATIC MILLING FIXTURE ASSEMBLY

The Beacon Falls Rubber Shoe Co. in order to induce its force to be punctual and work steadily, adopted the scheme of paying a dollar a week bonus to any employee who had a perfect time record for a week. This resulted in reducing the absentee record by nearly 30 per cent. One executive has said that nearly 90 per cent of all lateness—a big factor in industry—is habit. There are probably other good ways to break the habit.—*Factory.*

XX. Welding Jigs and Fixtures*

The various devices shown in this article will be found suggestive of others that may be applied to almost every conceivable repetition job.
(Part XIX appeared on page 603, last issue.)

WHERE a welding shop does a general line of work which includes everything that comes, there should be an ample assortment of drilled straps, angle irons, bolts, V-blocks, clamps, plates and the like. Good supplies of fireclay and plaster of paris are also very desirable for supporting or holding irregular work that is apt to collapse or get out of line. Many times, a table such as shown in Fig. 234 will answer for certain jobs. The top of this table is made of a "grated" slab of cast iron supported on a welded angle- and strap-iron frame. The slots provide means for the insertion of clamping bolts. A table similar to this can easily be made in any welding shop.

Pipe welding is a very common and re-occurring job in most shops. Some rig up V-blocks, rollers or other devices, but the method shown in Fig. 235 is very good.

*For the author's forthcoming book on "Welding and Cutting."

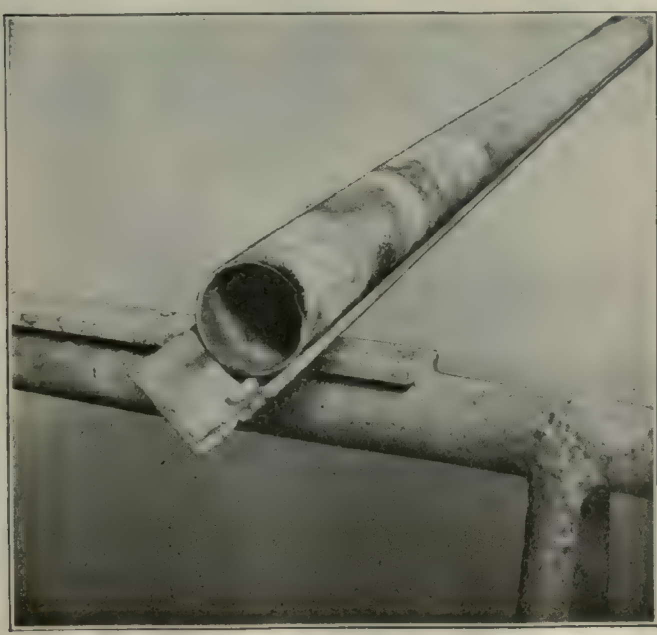


FIG. 235. HOLDING PIPE FOR WELDING

FIG. 234. TABLE FOR HOLDING WELDING WORK

FIG. 236. V-BLOCKS FOR HOLDING SHAFTS

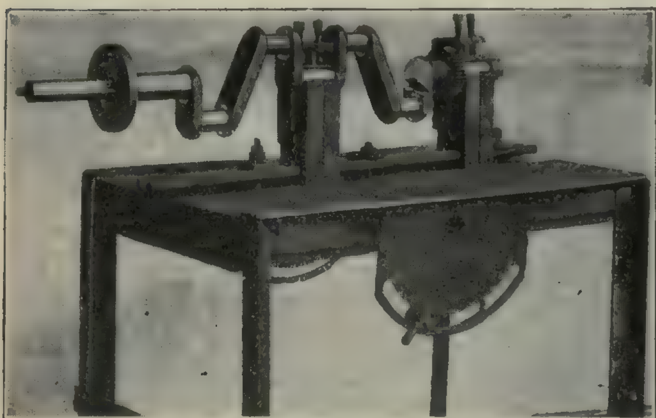


FIG. 238. AN ADJUSTABLE CRANKSHAFT JIG

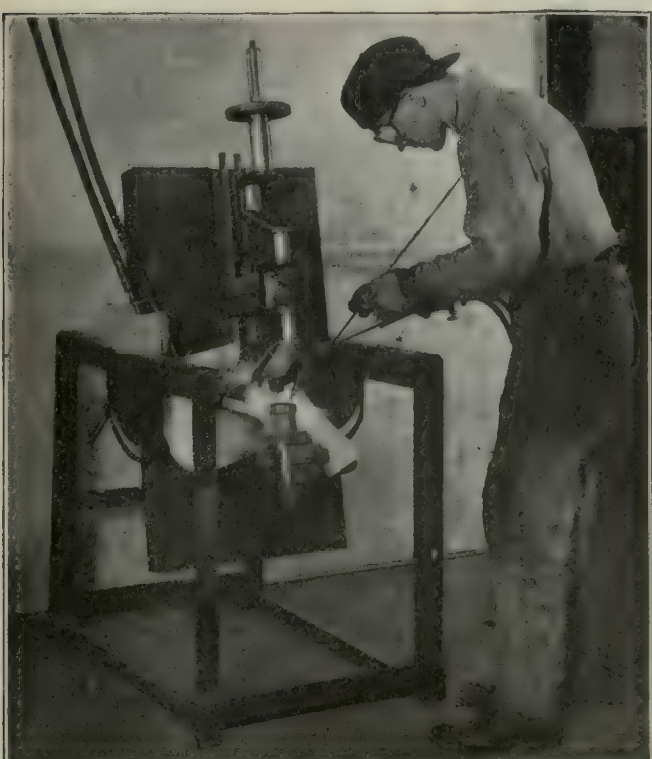


FIG. 239. WELDING A BROKEN WEB IN THE JIG

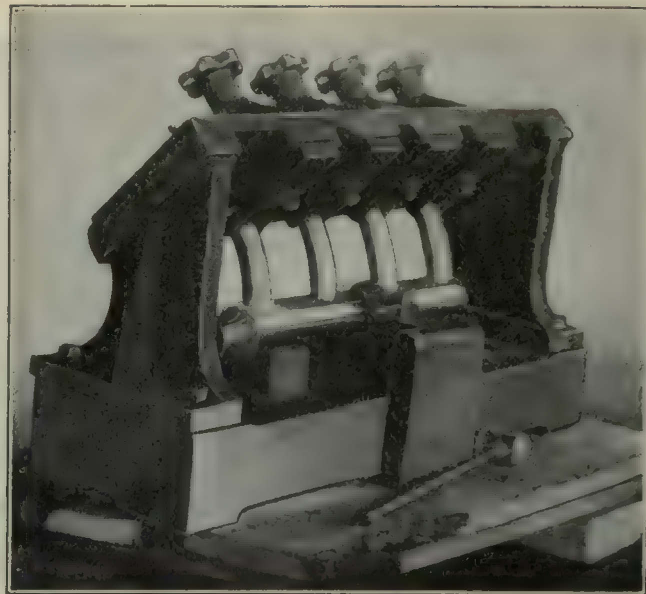


FIG. 243. MOTORCYCLE MANIFOLD WELDING JIG

FIG. 244. A WELDED MOTORCYCLE MANIFOLD

FIG. 245. A SHEET-METAL ROLLER WELDING JIG

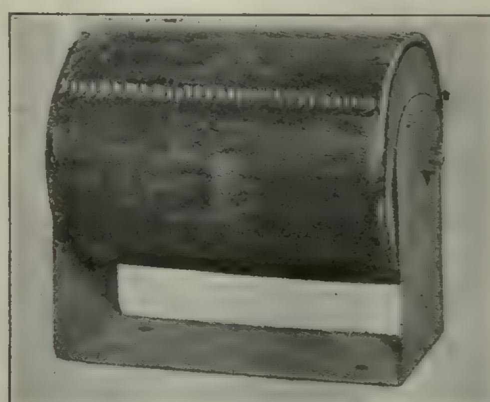


FIG. 246. A WELDED CONVEYOR ROLLER

It is simply a piece of angle iron placed on iron horses as illustrated. The ends of the pipe to be welded are cut square and the outside ground back for about two or three inches to remove rusty scale and dirt. On long pieces of pipe the grinding may be done with a portable electric grinding machine while the end of the pipe sticks out a foot or so from the end of the channel iron. The pipe in this case remains still and the grinding machine is moved around it as the operator stands

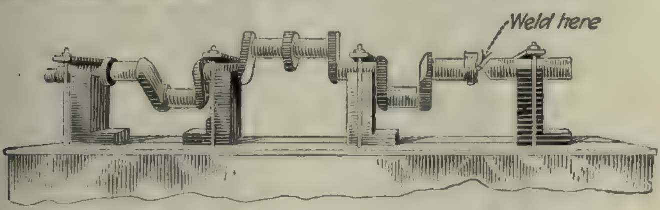


FIG. 237. JIG FOR HOLDING CRANKSHAFTS

in front of the pipe end. The short or easily handled pieces of pipe may be ground on a stationary grinding machine.

The best part about using an angle iron is that the pieces of pipe to be welded are held in line while being tacked together. On ordinary sizes the welder will have no difficulty in turning the pipe as he welds. On heavy pipe some form of rollers will be found very convenient.

A very simple way to weld straight shafts is shown in Fig. 236. Here the shaft simply rests on high V-blocks which keep it in line but do not interfere with expansion or contraction.

A jig for holding a motor crankshaft broken in the shaft, is shown in Fig. 237. The main part of the crankshaft is clamped to three V-blocks. The bases of these V-blocks are grooved to fit over a tongue in the baseplate, so that they may be slid along in order to adjust them to various sizes of crankshafts, and yet keep them in line. The V-block holding the short piece to be welded on is made in the same way, but the piece should *not* be clamped in solidly but should be so held that it can move lengthwise. This may be done by clamping loosely or else having the V-block free to move along the tongue. The rigid clamping of all parts would cause distortion and springing of the crankshaft.

The device shown in Fig. 238 is in use in the Oxweld shop. Four V-blocks are made to slide in a channel in the table and may be clamped wherever desired. Each V-block carries its own clamping screw for holding the

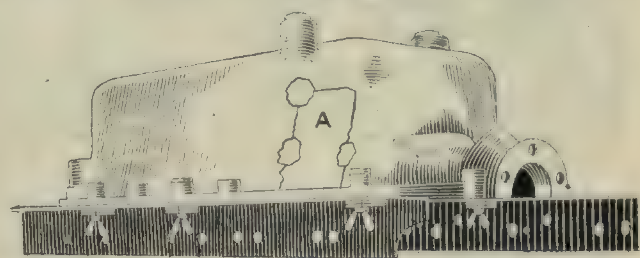


FIG. 240. ALUMINUM CRANKCASE STIFFENED BY ANGLE IRON

work. For ordinary shaft welding the table may be used in a horizontal position, as shown, but for welding breaks in webs the table may be tilted as shown in Fig. 239. This illustration also shows the use of a coal-gas and air torch to heat the work while the welder is using the welding torch.

Crank cases or other automobile parts may be held in order to prevent distortion as much as possible, as shown in Fig. 240. In this case angle irons and short bolts with wingnuts are all that are needed. The patch to be welded in is shown tacked in place at *A*. Another application is shown in Fig. 241. The patch *B* has been tacked in two places ready for welding.

In Fig. 242 both angle irons and mandrels are used in the bearings. These mandrels may be solid or of

FIG. 247. LARGE SHEET-METAL CYLINDER WELDING JIG

FIG. 248. APPARATUS FOR WELDING ENDS IN CYLINDER OR TANKS

pipe to fit the bearings. Sometimes, where it is necessary to keep the bearings cool, a pipe with elbows screwed on each end may be clamped in. With the ends of the elbows up, the pipe may be filled with water.

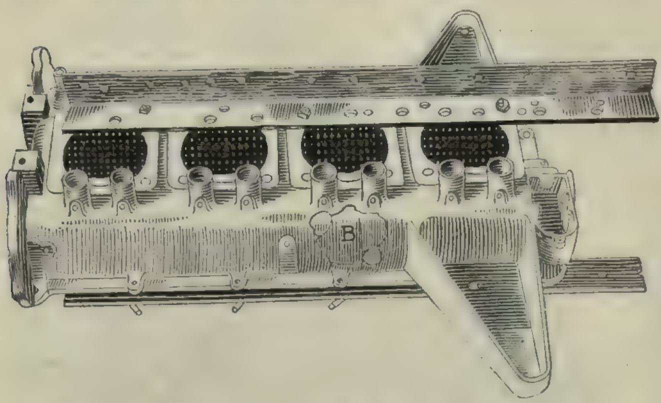


FIG. 241. ANGLE IRON APPLIED TO ANOTHER JOB

The Henderson Motorcycle Co. uses the jig shown in Fig. 243 to hold the parts of their exhaust manifolds while welding. The construction and operation are obvious. A welded manifold is shown in Fig. 244.

Holding Sheet-Metal Cylinders

A very simple welding jig is shown in Fig. 245. This consists of four castings: the base, two side pieces and the hollow mandrel. The cylinders welded are 6 in. in diameter and 8½ in. long, made of ⅛-in. plate. They are used to make the conveyor roller shown in Fig. 246. The seam is welded in three minutes.

Another cylinder welding jig is shown in Fig. 247. This is in use in the Thermalene shop. The edges of of the cylinder to be welded are held up to the V-channel from underneath by a bar locked in place by bolts and large wingnuts.

The speed for welding sheet metal will of course vary widely, but the following approximate results on sheet iron and steel are a fair average:

Thickness of metal	Feet per hour
20 gage	40
18 "	35
16 "	30
14 "	24
12 "	22
10 "	20
8 "	18

The welding of steel barrels of about 30 to 35 gal. capacity, used for oil or gasoline, can be done by an operator of average skill at the rate of 16 to 18 per day. These barrels are made of 12-, 14- or 18-gage

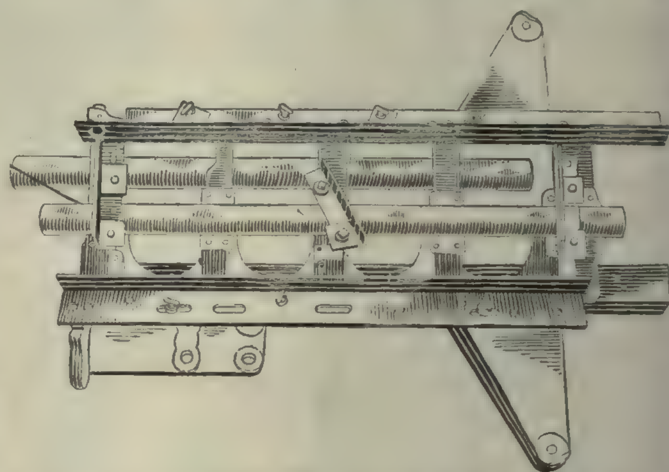


FIG. 242. CRANKCASE WITH ANGLE IRON AND BEARING MANDRELS IN PLACE

sheet steel, and require one seam weld, two complete end welds, two bungs welded in and a reinforcing ring welded on each end.

In welding the ends on cylinders or drums, the device shown in Fig. 248 is sometimes used. The work

FIG. 249. WELDING POISON-GAS CONTAINERS

rests on a turn table which is rotated by the welder's foot. A supporting arm and a suspension spring assist the welder in holding the gas torch.

The method of welding gas containers for war use with Oxweld apparatus is shown in Fig. 249. As shown at the right, the container bottoms are welded in while resting on rollers set on an inclined base in such a way as to present the work at the right angle.

FIG. 250. ANOTHER VIEW OF CONTAINER WELDING DEPARTMENT

Fig. 250 gives a better view of the bung welding apparatus, and also shows the excellent method of suspending the torches when not in use.

"Prices Are Coming Down"

"The same economic forces that have sent prices up will also operate to bring them down," said Calvert Townley, president of the American Institute of Electrical Engineers and an executive of the Westinghouse Electric and Manufacturing Co., in a recent address before a meeting of the Schenectady Section.

"Prices are up because wages are high; wages are high because, due to the war, the demand for labor is greater than the supply. Much has been said about the existence of a 'new order' of things that will permit working men to demand hereafter a greater reward for their labor, but there is no indication of a new order in the facts. The workingman is using today precisely the means to gain his ends that he has used for years, and that he is far more successful in gaining these ends than he has been before is simply due to the present abnormal economic conditions and not to any revolutionary changes in human society.

"As long as America is called upon to supply a large share of the world's commerce, our factories will be kept busy, wages will stay high, and so will prices. But as soon as the European industry begins to function properly and the demands of commerce shall have again become normal, it seems reasonably certain that there will be an excess of production over consumption and some nations will lack a market.

"Translated, this means that the supply will be greater than the demand and wages and prices will fall.

"It is then that the test will come. If the United States shall have used its period of prosperity to prepare for depression by reducing costs of production and by teaching its people economy and thrift, the readjustment may come perhaps without any serious disturbances and we may save a good share of what we have gained by our running start.

"But if we sail serenely on, ignoring the possibility of a coming storm, if we continue the policy of working less and less and paying more and more while Europe buckles to, the resulting depression with its period of unemployment, suffering and possible panics is appalling to contemplate. Then prices and wages will come down suddenly, and with a thump—such a thump as the country has never before known.

"Men who have been trained to think straight and speak clearly must do what they can to show up the idiocy of dwelling in a fool's paradise. Dispel the bogey of class control. Brains have always ruled the world and always will. Show that we are dealing with a perfectly normal problem which must be solved in conformity to well-known natural laws and not with any mysterious unknown or novel principles, or with newly discovered rules of life. No organized minority created for the avowed purpose of taking from the majority some of its property or just rights can long prevail. Witness Germany's effort to subjugate the world. The law of supply and demand will ultimately just as surely bring down the cost of living and wages as it put these items up. The only uncertain features are the time when the changes are to occur and whether these costs and wages shall be brought down in an orderly and gradual manner or whether they shall come down amid disaster and distress."

British Thomson-Houston Magneto Methods

BY I. W. CHUBB
European Editor, *American Machinist*

It was with some dismay that Great Britain found herself in the early days of the war almost entirely dependent on her chief enemy for magnetos for use with internal combustion engines. While it is true that one or two British firms had more or less successfully entered the field, progress was not very great, and the opportunity at the outbreak of war was seen and seized by several firms who had previously been experimenting with magnetos for automobile use.

A BRANCH works of the British Thomson-Houston Co., Ltd., in Coventry was devoted exclusively to magneto production, supplemented subsequently by an output from another works at Willesden, London, N. W. More than one type of machine was made including the ordinary Bosch type of pre-war days. Magnetos of the sleeve inductor type with fixed armature (the inductor rotating at engine speed in the case of an eight-cylinder magneto or at three-quarter speed for a six-cylinder magneto), were also produced. Some 18,000 magnetos of this type were produced before changing over to the polar inductor magneto, having a stationary armature and being suitable for 8- to 12-cylinder aircraft engines.

These magnetos have some special advantages for aircraft-engine purposes, the mechanical design giving ease for dismantling and, as four sparks are produced per revolution, the magneto runs at half the speed of the rotating-armature type. Further, the inductors are fixed on a straight-through shaft, thus resisting the effect of engine vibration better than is usually possible. Safety spark gap electrodes are carried and, being rotated constantly through the air, prevent undue ionization. A number of other features might be mentioned, and it may be stated that during the last 18 months of war there were made and supplied some 25,000 of these magnetos, mainly for eight-cylinder engines.

By the courtesy of the British Thomson-Houston Co. the writer was recently enabled to spend some time in its Coventry works and to witness the process of manufacturing these magnetos.

The machines are placed in the order of sequence of operations on components as far as possible and, up to the armistice, at least, the work in its progress through the shops did not deviate from a straight line. This, however, is not possible without some exception in a time of transition—when magnetos of more than one type are to be produced and the quantities of each type required in a given time cannot be accurately known. In certain instances—as for example, the grinding section—an exception is made because the work may need special attention. The same applies to bench lathes, where men are required in charge who are specially versed in bench-lathe methods. Bench machines are, in fact, largely employed in one section, as affording a better method of handling relatively small details such as the contact-breaker lever shown in Fig. 1, in which is shown the complete series of machining processes.

First the drop-forging has a central hole drilled in it in a bench lathe, in which the boss is turned and faced, as shown in the next two views. The piece is next milled on the side at the contact end and then on top, being in the sixth operation slotted for the fiber heel; in the seventh it is milled for the contact points, and then finally drilled and tapped at the same end.

The magneto parts are made as units or sub-units, and where two pieces have to be assembled together as a sub-assembly they are made in the same shop and proceed in parallel lines until they meet at a given point for assembly. Throughout the shops an endeavor

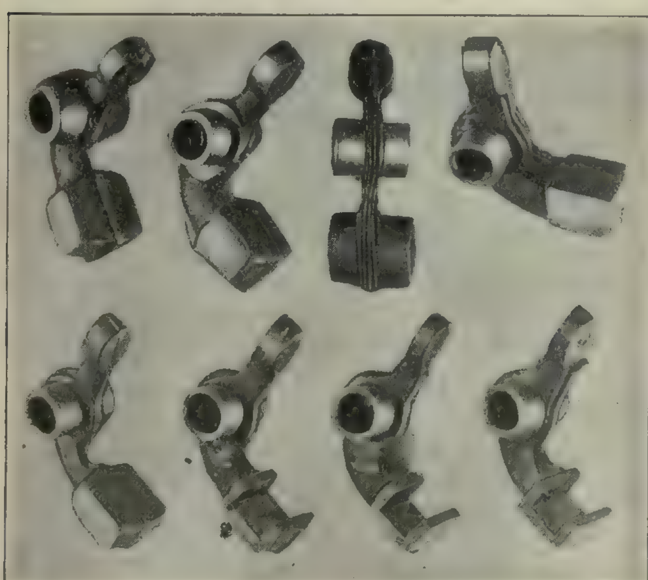


FIG. 1. STAGES OF WORK ON CONTACT-BREAKER LEVER

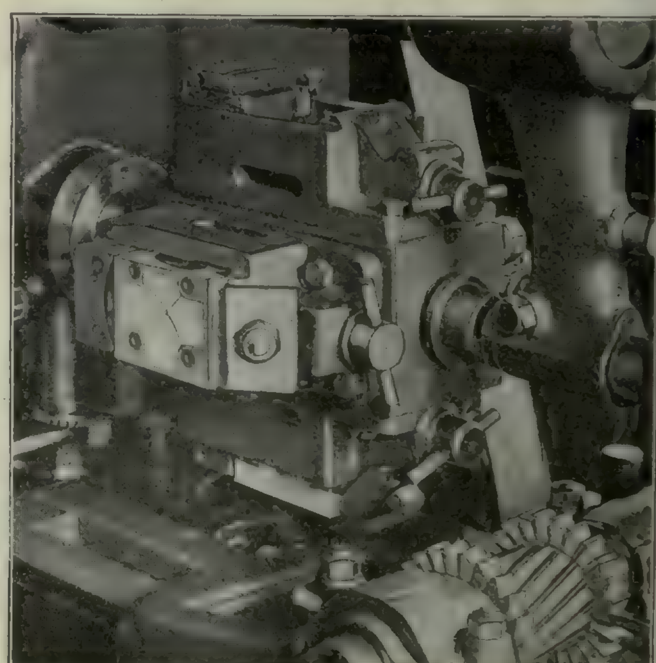


FIG. 2. MILLING ON A GEAR-CUTTING MACHINE

is made to keep everything orderly, and for gangways the not uncommon expedient is used of painting lines in order that clear ways may be kept.

The parts are moved from place to place in wooden boxes. Each box is specially divided to suit the detail it is to contain, but all boxes are of the same size so that they can be readily stored and the number contained readily counted. Stands at the machines are provided, an attempt being made to get the boxes containing the parts at convenient height for the operator. In the grinding section a suction system of grinding-dust removal is employed, this being put into operation every time a given grinding machine is working dry.

Reference has been made to the gearing. The cutting is an ordinary job on a Fellows machine with four to six blanks piled up. The test for the teeth is by measurement over four wires. This, however, is not found completely satisfactory and is supplemented by testing each wheel in mesh with a master wheel, the gears being run in pairs at correct center distances; this test shows whether the gears will run easily—a fact which cannot be determined simply by the wire test. It is usual to run four wheels, two large and two small gears together, and then the pairs in combination.

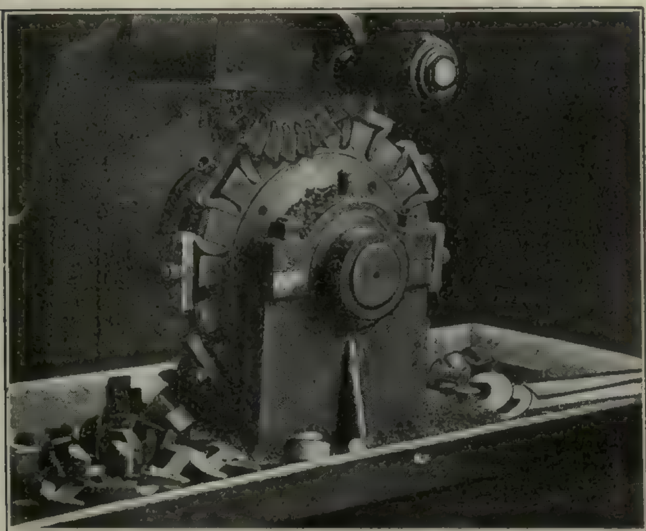


FIG. 3. MILLING ARMATURE END-PIECES

It is hardly advisable to describe the whole of the machining operations; in large part they follow closely, and in fact may be regarded as ordinary good practice. A rotating fixture, Fig. 2, used in milling the housings will be of interest; in this cut a gear cutting machine will be seen adapted for the purpose. The operator both loads and unloads the work from the front of the machine, and the fixture has four stations, one only of course being operative. The work is held in position by means of an inclined clamp as shown at the right of the fixture. When tightened up this clamp tends both to force the work toward the opposite end of the fixture and also to pull it down to its seat. A serrated jaw at the end opposite the clamp also tends to pull the work down on to the seat and, further, will swivel a certain amount to allow for small inequalities of the work. The job is simultaneously milled both on the base and on the sides, and it may be worth noting that the work is of an aluminium-copper alloy containing not more than 1 per cent. zinc.

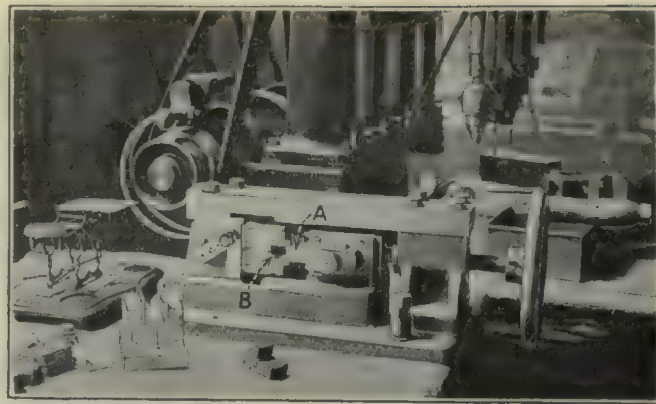


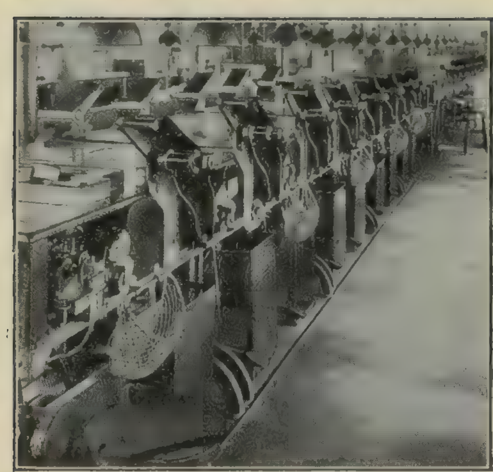
FIG. 4. ASSEMBLING POLE PIECES

A rotating fixture, Fig. 3, is employed in milling the two sides of the armature end pieces, this being the first operation. The clamping arrangement is obvious.

Fig. 4 illustrates the assembly of pole pieces. These are of high resistance iron laminations assembled together in about the required quantities by weighing. The laminations are first assembled at *A* in the fixture and then forced into the body by a screw and handwheel, the gap for them in the body at *B* having already been milled. When the laminations are in position a drill is run through both a hole previously drilled in the housing and the hole punched in the lamination so that the rivet will be a good fit. There are several sizes of holes to be catered for here and the work is done on a four-spindle drilling machine so that there need be no change of drills. It may be added that for brass or aluminium housings beeswax is employed as a lubricant when drilling.

An electric riveting or rather heating arm is used in connection with the core of the rotating type of armature. The core is clamping in a vise, the fixture forming part of the circuit and being controlled by a switch. The hanging cable, with a copper head added for weight, is then held over the pin to be riveted, which is almost

FIG. 5. FIXTURE FOR TESTING CAMS




FIGS. 6 AND 7. THE WINDING MACHINES

immediately raised to the heat required, the actual riveting processes however being done with a hammer. Steel rivets are used in the shuttle armatures, and up to ½-in. diameter are heated in this way. Low-tension electrical devices of this type are fairly common for local heating in electrical shops, though of course in mechanical shops it is not usual to heat rivets in this manner.

The disk, Fig. 5, is used when testing the cams. The cam is slipped on a spindle which carries an indicating arm, as illustrated. The disk bears marks which show where contact should be made or broken, and the limits. With a dummy contact breaker on the appliance the cam will break the circuit to the lamp *A* and thus shut off the light at the break position. Cams are ground from a former on an oscillating mandrel, the master cam being six times the size of the cam required.

The finest limit employed in the shops is 0.0003 in. The limits are however usually set down in millimeters, although this is not necesesarily known to the operator, who works to a fixed limit gage.

The permanent magnets are of hardened tungsten steel and as supplied by the Sheffield manufacturers have the pole faces and edges ground after hardening, the limits for the distance between the pole faces being plus and minus 0.2 mm., and for width of holes, plus and minus 0.15 mm. The highest magnetic quality in the materials is necessary because the electrical efficiency of a magneto is greatly dependent on the armature-core flux that is produced under working conditions, the spark energy being in fact proportional to the square of this flux. After no little research, elaborate methods for quickly testing the magnetic quality of each magnet have been developed. The instrument used for this purpose is of the moving-coil type from which the ordinary form of permanent magnet has been removed. Special soft-iron pole pieces are fitted, the instrument being designed so that the magnet being tested can be quickly fitted to these poles. A coil is placed above each pole and when the magnet is in position on the instrument each limb is surrounded by a winding through which current can be passed.

In testing, each magnet is first magnetized by coils on a block of soft iron so arranged that when it is placed on the block the coils embrace the limbs. The circuit through the coils is then closed by means of a switch two or three times, thus effectively magnetizing the magnet. A constant current is maintained through the moving coil of the instrument, with the result that when the magnet is fitted to its soft-iron poles, the instrument reading is directly proportional to the flux produced by the magnet in the air gaps in which the moving coil rotates.

This testing instrument has been devised to enable three determinations to be made on each magnet:

(1) The remanence, this being the flux density remaining in the magnet after magnetizing with a force of not less than 400 g.g.s. units. The term "remanence" really only applies to the condition where the ends of the magnets are closed on themselves, this condition being approximately filled by bridging the poles with a heavy soft-iron keeper.

(2) The coercive force; this is, the demagnetising force necessary to reduce the flux density in the body of the magnet to zero.

(3) An intermediate point on the B-H (flux density and magnetizing force) curve connecting remanence and coercive force so as to obtain some indication of the shape of the curve, it now being recognized that this factor is of vital importance in judging the quality of a magnet.

Generally speaking, if the coercive force is not less than 55, and the remanence not less than about 10,000, the magnet will yield satisfactory results on a magneto. But the view is that misleading results may be obtained if reliance is placed entirely on the coercive force and remanence figures, because it is possible for these figures to be attained in a magnet of poor quality, owing to the fact that the shape of the curve is bad. It is for this reason that the British Thomson-Houston Co. has for some time checked the shape of the B-H curve referred to under (3), by applying a partial demagnetising force, corresponding to an H (magnetizing force) of about 35, and determining the instrument reading under these conditions. When comparing magnets of similar design and make, the instrument reading so obtained is a criterion of magnetic quality.

All magnetos are tested by an endurance run and

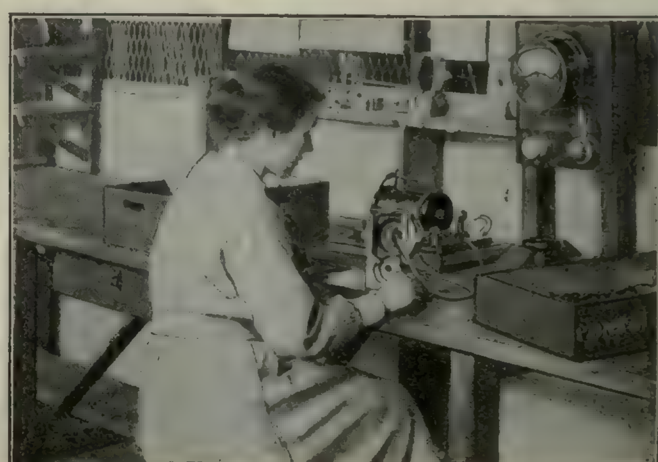


FIG. 8. TESTING INSULATION OF MOLDED PARTS

also checked for low-speed sparking separately. For the endurance run, the magneto is slipped into a set position on the bench, eight magnetos arranged in line being driven by means of one horizontal belt. Then each magneto is run for half a minute on its safety spark gap to test the insulation of all parts.

Standard tests of aircraft magnetos are 16 in all. First, the machine is magnetized and then run for half a minute with the secondary winding short-circuited in order to introduce a large demagnetizing force and thus artificially age the magnet. The minimum sparking speed is then determined across a standard spark gap of 5.5 mm. in length. A three-point sparking system is used with nickel points. With the gap named the peak voltage corresponding is about 8000. The limiting speed for low-speed test is 115 r.p.m. with the timing lever fully advanced and 230 r.p.m. for the fully retarded position. Next, the magneto goes to the benches for an endurance test of 12 hr., running at 2200 r.p.m. for an 8-cylinder magneto and 3300 r.p.m. for a 12-cylinder machine, with a spark gap as before of 5.5 mm. length. The magneto then goes back to the assembly shop, is taken to pieces, cleaned and examined, the parts being reassembled. Then the final run of 4 hr. is made at the previous speeds; gap and low-speed sparking tests are applied, after which it passes to the government inspection department. In view of the potential differences involved, considerable care has to be taken in the copper winding on the armature and in the insulation of the various layers forming it. The primary (0.7-mm. diameter) is wound first, in either three or four layers according to type. Between these, varnished Japanese silk 4 mils. thick (0.001 in.) is placed and between the secondary layers either varnished paper 3 mils. thick or silk is placed. Thus, over the second layer of wire may be placed varnished paper and over the third layer silk.

The paper is arranged just to fit between flanges, but the silk is cut wide by, say, 4 mm. so as to overlap about 2 mm. on each side. In this way the armature is divided into a number of separate sections, each with a silk casing all around. To prevent successive layers arcing to one another, it is usual to give a clearance of 3 to 4 mm. at the edge of every layer and also to add varnish by a brush on this spare area. An airplane magneto may have on the secondary 10,000 turns of 0.0044-in. wire, having a length of nearly 1 mile. For an automobile magneto it would have, say 8,000 turns of 0.0036-in. enamelled wire having a ¾-mile length.

The winding machines illustrated in Figs. 6 and 7 are employed, the wire being arranged on spools, with a tension device to give an even pull over the wheel to the spool being wound. The spindle carrying the spool is moved to and fro automatically to suit the layers. After the armature is wound the side pieces of silk are bound over each other and then covered with silk tape and Egyptian cotton. Before varnishing, the armature is placed in a vacuum oven for 4 hr. at 200 deg. F. A coat of varnish being given by a brush, it is then placed in a baking oven for 5 hr. at 200 deg. F. Second, third and fourth coats are then applied and baked giving a total of four bakings.

In testing for insulation of the armatures the primaries are placed in series of three at a time with a battery and contact breaker and operated by an induction motor. The armature is used as an induction coil, the secondary being connected to a standard sparking gap of 7.5 mm. length, this being maintained for about

FIG. 9. THE RESEARCH LABORATORY

15 min. The voltage rises to 11,000. To determine the proportion of turns, the voltage is measured at primary and secondary in an alternating magnetic field.

The condenser is built up of the best ruby mica and tinfoil, a dab of varnish being placed between the two which are then clipped together and baked at 200 deg. F. The varnish squeezes out, spreading so as to make a solid compact mass. The capacity of the condenser for the airplane magneto is 0.16 microfarad and for an automobile magneto, 0.12 microfarad. To test the insulation an alternating current voltage is applied by a step-up transformer, the voltage having a root-mean-square value of about 600. To test for capacity the condenser is charged from Leclanché cells and discharged through a ballistic galvanometer, the throw of the galvanometer being a measure of the capacity.

The test employed to determine the insulation soundness of molded insulation is, to put it briefly, that of a dead short which cuts out a spark on an induction coil. For this purpose, Fig. 8, a standard induction coil is employed, the needle-point electrodes being set to give a ½-in. gap corresponding to, say, 14,000 volts. The detail to be tested is then placed in a frame, which stands on a brass plate connected to one side of the coil. The other side is connected by flexible wire to an insulated needle held by the operator. A dead short, that is an insulation breakdown, is shown by the cutting out of the spark. The frame for the part tested corresponds to the part on the actual machine.

In connection with the work a special investigation department has been equipped for dealing with defects. This department is purposely kept away from the ordi-

nary production side of the organization so as not to disturb the run of the shops. There is an experimental department where new models are built up, special mixings for insulation materials are made, etc.; a research laboratory has been equipped, a section of which is shown in Fig. 9. Here, for example, the resistance of insulating materials to the softening effect of increase of temperature is determined. The material is placed in an oil bath where a weighted plunger, the end tapered to ⅛-in. diameter, bears on it. Contacts are set to a gap of 0.002 in. and the temperature of the oil bath is raised until, as a result of the pressure of the weighted plunger, the contacts meet and ring a bell. This is regarded as the softening temperature. The comparison is of course quite arbitrary but is useful.

The German material Stabalite was largely used in Great Britain as a molding insulation material before the war, but during the period of the conflict was obviously not available. Several English compositions have been prepared, and the one adopted has the same softening temperature—namely, 85 deg. C.—that of ebonite, for comparison, being 45 deg. to 50 deg. C. Other work carried out here is determining the hysteresis curves of magnetic materials. A rotary spark gap will be seen, the characteristic of the sparks given off by the magneto being discovered, and the lag between the opening of the contacts and the beginning of spark ascertained. This amounts to only about half a degree, at 3,000 r.p.m. In this laboratory, too, the energy of spark is measured by the temperature rise in a calorimeter, and further, a complete equipment is provided for measuring the peak voltages met with in magneto work. This comprises a kenetron valve and electrostatic voltmeter. A number of spark plugs have been tested, the results suggesting that, in the past at any rate, these articles have not been of anything like standardized quality, as regards the voltage required to produce a spark.

The Trials of Old Baldy—I

By A. R. Durant

The Ajax Machine Co. during its long and troubled existence has had many queer characters upon its payroll, because of its custom of hiring tramp machinists and other floaters whenever opportunity afforded or business necessitated. Some of these would last a week while some would make their stay more brief, but while they lasted each was pretty certain to cause more or less trouble for "Old Baldy," the foreman.

Old Baldy was some peculiar himself. As "Deek" Williams used to say, he was "intensely independent and considerable sarcastic," and when, in the persons of Old Baldy and some of the above characters, Greek met Greek, there was something started besides a restaurant. Thus after awhile the old standby's began to dub the new-comers as "Old Baldy's Trials."

One morning a man blew in with a little imitation-leather tool case in his hand and a long black dust coat over his arm. He was an "expert" lathe hand, who had "worked in all of the big shops in the country."

Old Baldy put him on, and when he had got ready for business "Slim" Benson was overheard to remark that he "thought the new guy was a horse doctor when he came in, but now he looked more like a sick priest."

Baldy gave the man a light cast gear about 10 in. in diameter, and explained that the hub was to be faced off and the bore threaded to fit a shaft which was already lying on the bench waiting for the gear to be fitted to it, "and it wants to run pretty blame true," he appended.

The reverend-looking gentleman managed after much endeavor to get the gear in the chuck and trued up fairly well, and, after a great deal of tool grinding and setting, to face off the hub and rim. Then putting a dog on twist drill and supporting the latter by the tail center he proceeded to stab a hole through the hub of the gear. Though the drill wabbled a good deal he got the hole through without its snagging and jumping of the tail center, which was disappointing to the furtive watchers. He next got the tap of the right diameter and pitch and wrung it through the hole with a monkey wrench without any preliminary boring or threading.

Releasing the gear from the chuck he screwed it onto the threaded shaft and put the assembled piece on centers to test its truth. Old Baldy had a habit of happening around at the psychological moment, so when the parson started up the gear Baldy was just behind him. At the first movement Baldy yelled to one of the old hands: "Fer Gawd's sake Bill, shet that winder. Ef this here job ever gits out of the shop we never'll catch it again."

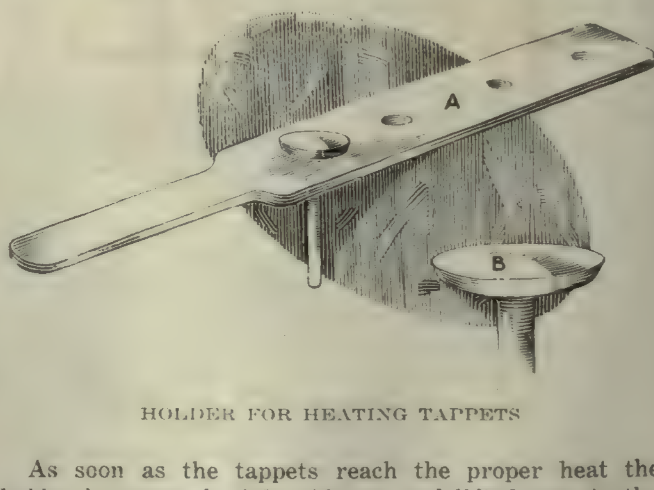
After the excitment had abated, Old Baldy carefully explained to the new man that he was altogether too heavy for the light work demanded by the Ajax Co. and so the parson faded sorrowfully away.

A Handy Tappet Valve Holder

By Hugh Scott

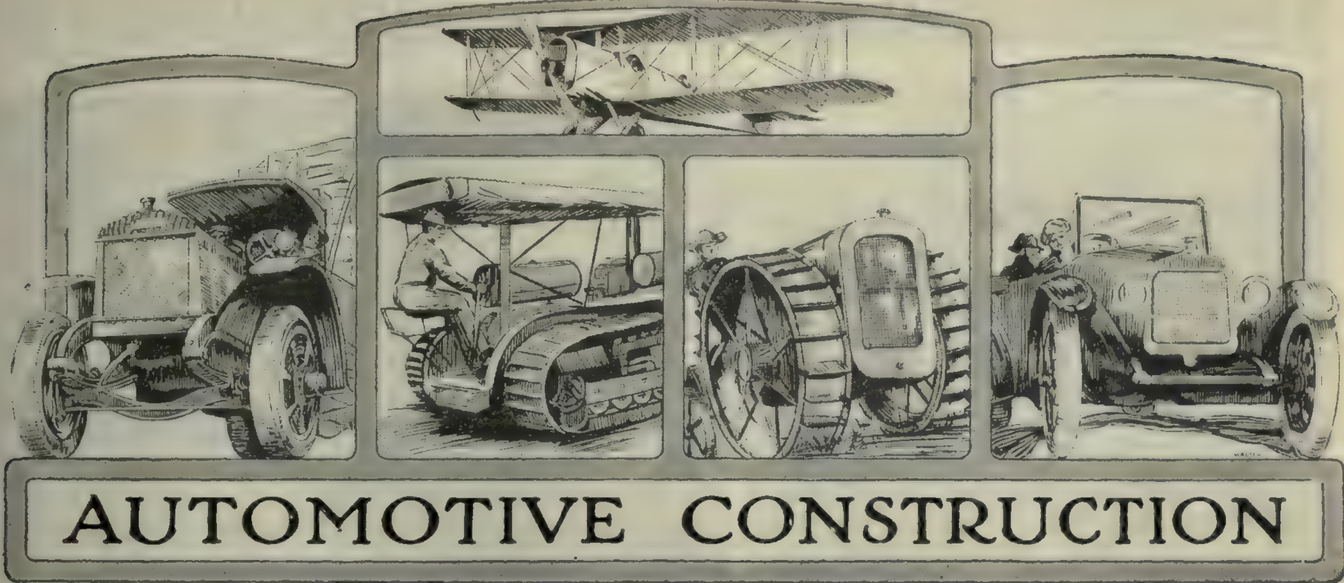
At the plant of the Willys-Overland Company, West Toronto, they use a handy holder for heat-treating their tappets which is well worth explaining.

Referring to sketch we see at *A* what the holder looks like, while *B* shows the tappet itself. These tappets are hardened in a lead bath and several holders are used.



HOLDER FOR HEATING TAPPETS

As soon as the tappets reach the proper heat the holder is removed, right side up, and lifted over to the oil bath, where by merely turning the holder over, the four pieces fall out into the oil. It is but a matter of a moment to drop four fresh pieces into the holder, and continue the procedure.



Pistons for the Fordson Tractor

By FRED H. COLVIN
Editor, *American Machinist*

Those who have the idea that the building of motors for use in tractors does not require the same care as motors in faster-moving vehicles, must revise their opinion. For while the vehicle itself moves at slow speed, the motor is running at its normal, if not its maximum load, almost continuously. This article shows how the pistons are made for such a motor.

THE transformation sheet in Fig. 1 gives a good general idea of the way in which the main operations on the Fordson piston are performed. It also shows the general design of the piston and the way in which it is held during the different operations. The first operation is to mount the piston casting on an expanding mandrel, as in Fig. 2, to face both ends and at the same time bore the inside of the skirt to be used as a locating point in future operations. This is done on a turret machine with a cross-slide, the boring being accomplished by a short, rigid tool in the slot *A* at the end of the tool block, which is readily adjusted by means of the screw *B* to maintain the correct size. Next comes the rough-drilling of the piston-pin hole in a New Britain double-deck chucking machine, Fig. 3. The piston is located by the bore of the skirt and also by the piston-pin bosses to insure the holes coming in the right position. The pad *A* fits inside the piston and forces it against a suitable seat at *B*. The illustration shows a loading station, the holes being drilled in the usual manner. This machine handles

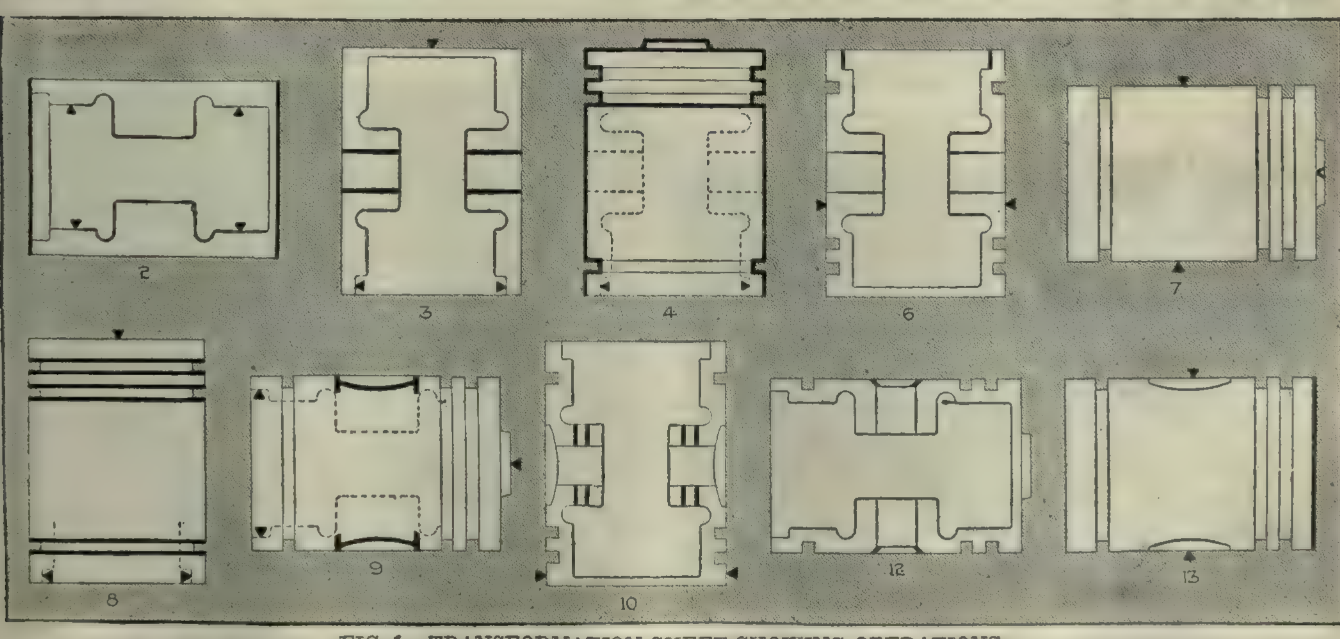


FIG. 1. TRANSFORMATION SHEET SHOWING OPERATIONS

AUTOMOTIVE CONSTRUCTION

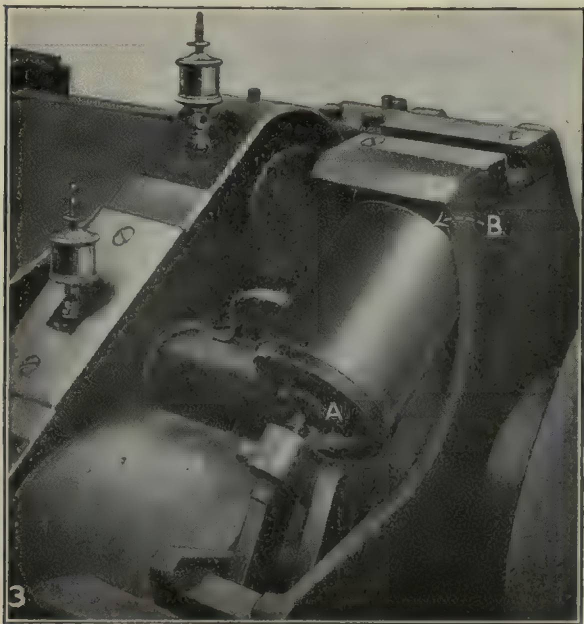


FIG. 3. DRILLING PISTON-PIN HOLES

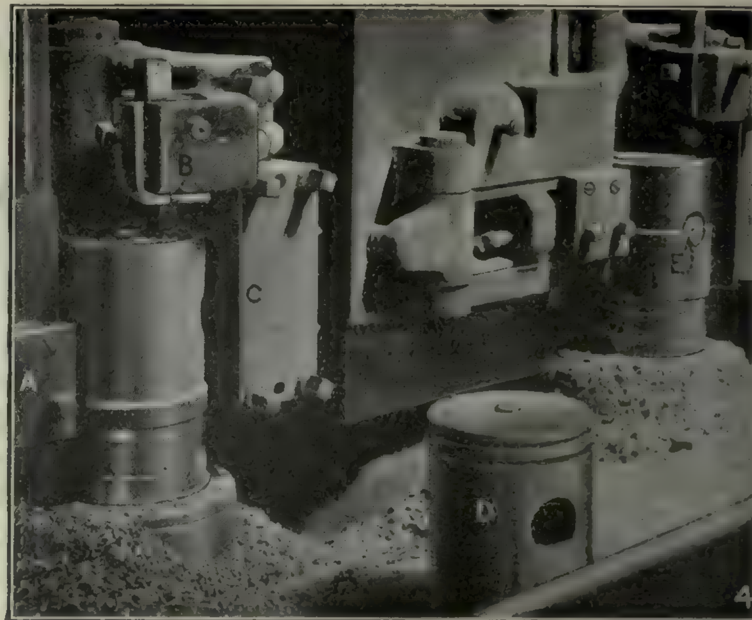


FIG. 4. ROUGH TURNING AND GROOVING

a little over 300 pistons in eight hours. Using the open end of the skirt for location and the piston-pin hole as a means of clamping the piston rigidly in position, the rough-turning and grooving is done on a special Foote-Burt machine, as shown in Fig. 4. The turning tool is held in the block *A*, the facing tool for the top is at *B*, and the grooving tools are held in the tool block *C*. Stellite is used for this operation and has been found very satisfactory. The rough-turned piston is shown at *D*, and the pin which holds it in position for turning can be seen at *E*.

Annealing to Relieve Stress

To relieve internal and other stresses which may have been imposed by the previous machining operation, the pistons are annealed in the continuous furnace shown in Fig. 5. They are delivered to the end of the furnace nearest the reader by the inclined runway shown, and after passing through are placed on a similar runway at the other end, by which they pass easily and automatically to the following operation.

To insure all future operations being accurate and within the prescribed limits, the open end of the skirt is next reamed, as shown in Fig. 6, particular attention being paid to keep this diameter within a total variation of 0.002 in. Here the piston is held without distortion between the blocks *A* and *B*, the cam *C* forming a clamp which operates quickly. The gage is shown at *D*.

Centering and Relieving

Holding the piston in the split or contracting chuck shown in Fig. 7, the end is carefully centered as an aid in securing accuracy in all future operations. One of the first uses of this center is shown in Fig. 8, where the grooves are being finished to size by the tools in the special tool block shown. This operation also finish-turns the pistons to size, after which the sides are relieved over the piston-pin bosses as shown in Fig. 9. This is for the purpose of retaining oil at this point

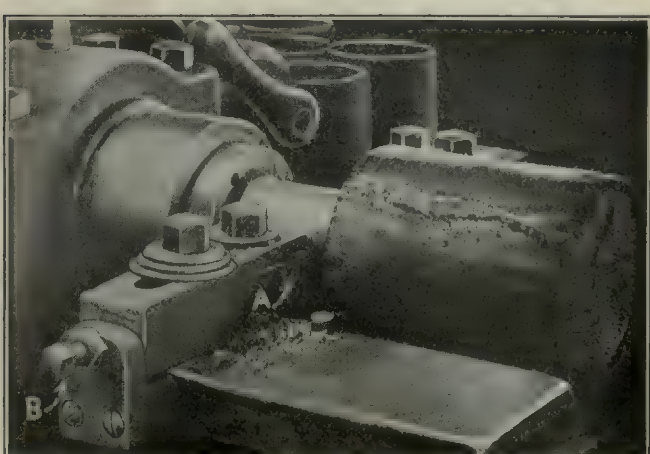


FIG. 2. FACING AND BORING OPEN END OF PISTON

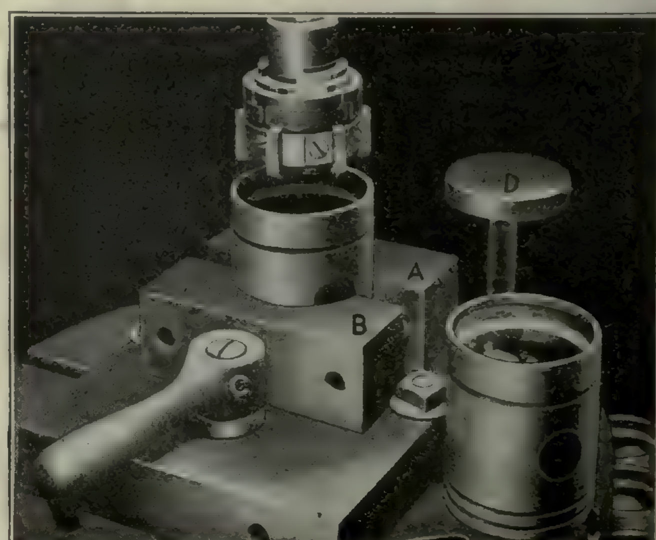


FIG. 6. FINISH-REAMING PISTON SKIRT

AUTOMOTIVE CONSTRUCTION

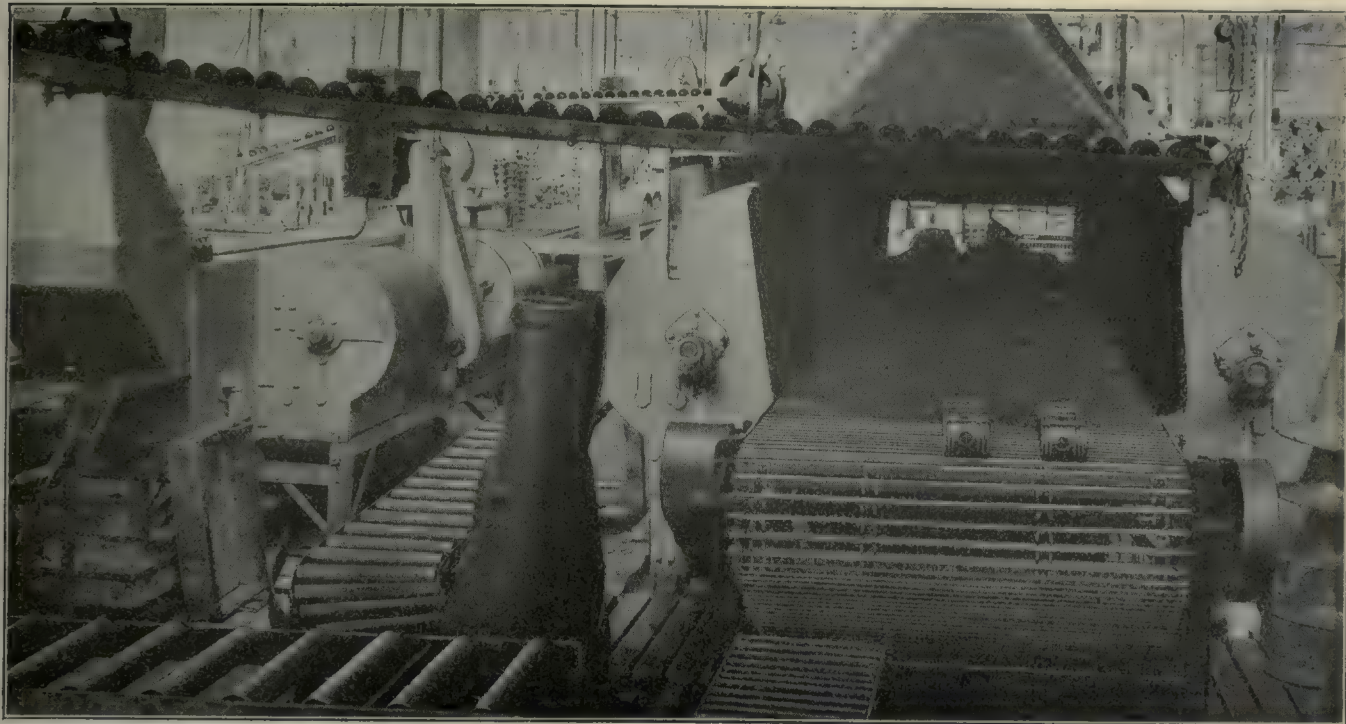


FIG. 5. ANNEALING PISTONS IN CONTINUOUS FURNACE

for aiding in the lubrication of the piston pin and it also allows for extra expansion of the piston at this point.

The clearance or relief is cut in a somewhat similar manner as the relieving or backing off of cutters in the toolroom. The tool *A* held in the block *B* cuts the full width of the relief. Its action is controlled by the roller *C*, acting on the cam *D*, this cam allowing a heavy spring to feed the cutter into its work at the proper point and forcing it out as soon as the piston has turned past the piston-pin hole. The piston is held on a mandrel, the outer end being supported by the substantial collar *E* and driven by the pin *F*. The pistons are handled very rapidly in these machines.

The oil holes through the piston-pin bosses are drilled in the simple fixture shown in Fig. 10. The lugs *A*, *B*, and *C* locate the head end of the piston, while the bushing plate *D*, which is located from the piston-pin hole, carries two bushings and allows both holes to be easily drilled by simply turning the piston in the fixture. This enables the pistons to be handled very rapidly, the production being astonishingly high on this operation.

Finishing the Piston-Pin Hole

Next comes the finish-reaming and chamfering of the piston-pin hole, these operations being shown in Figs. 11 and 12. The piston is held in a very simple fixture for the reaming operation, expanding reamers being used for this purpose. The plug gage is shown at *A*, Fig. 11. The chamfering is done by simply laying the piston in a semi-circular block and using a shell taper reamer as shown in Fig. 12. The burrs are then taken off by hand with an 8-in. mill file, after which the end of the piston is finished in what might be called a shaving operation. This is shown in Fig. 13, the tool at *A*

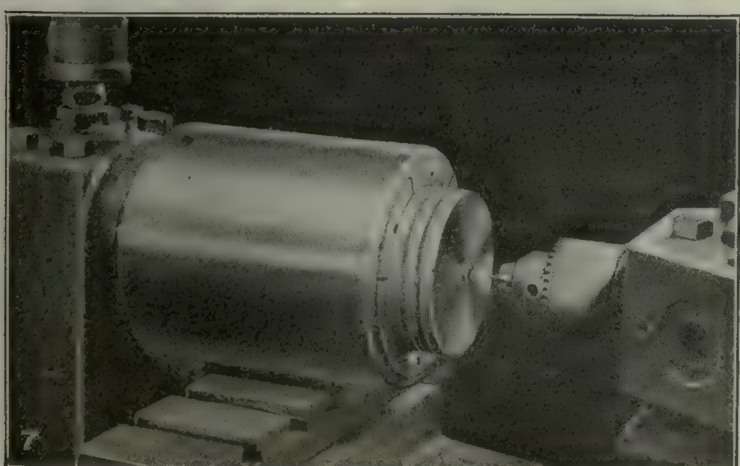


FIG. 7. CENTERING HEAD OF PISTON

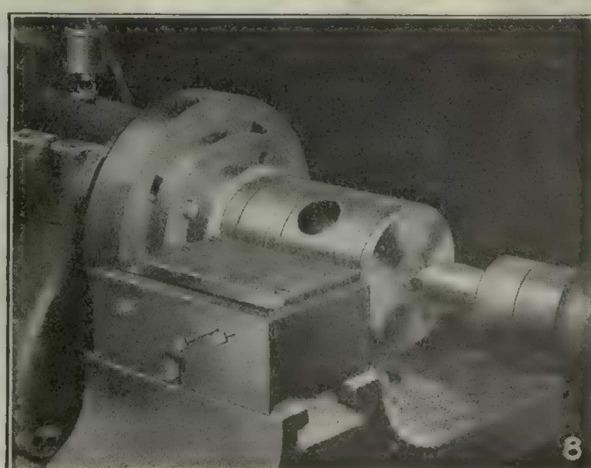


FIG. 8. FINISH-TURNING AND GROOVING

AUTOMOTIVE CONSTRUCTION

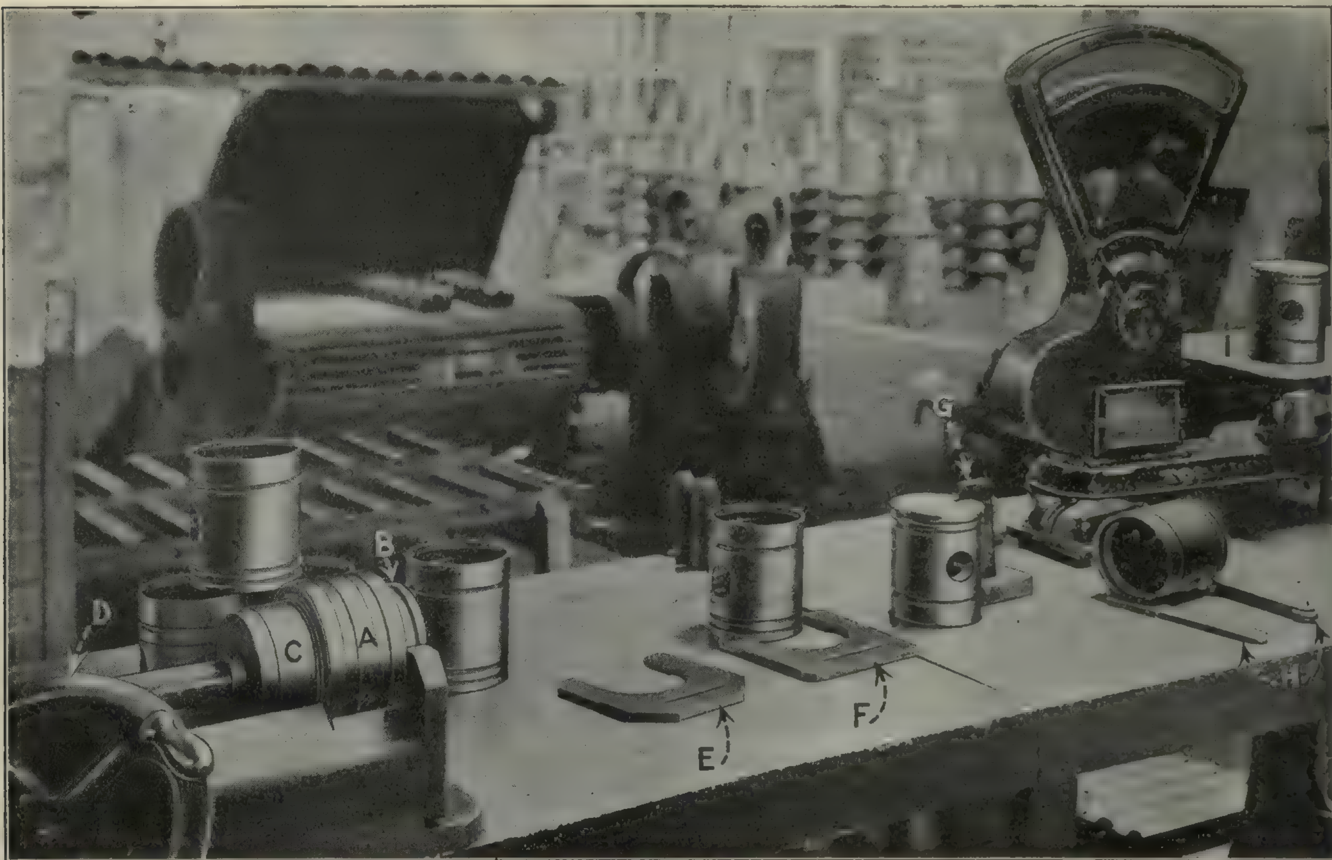
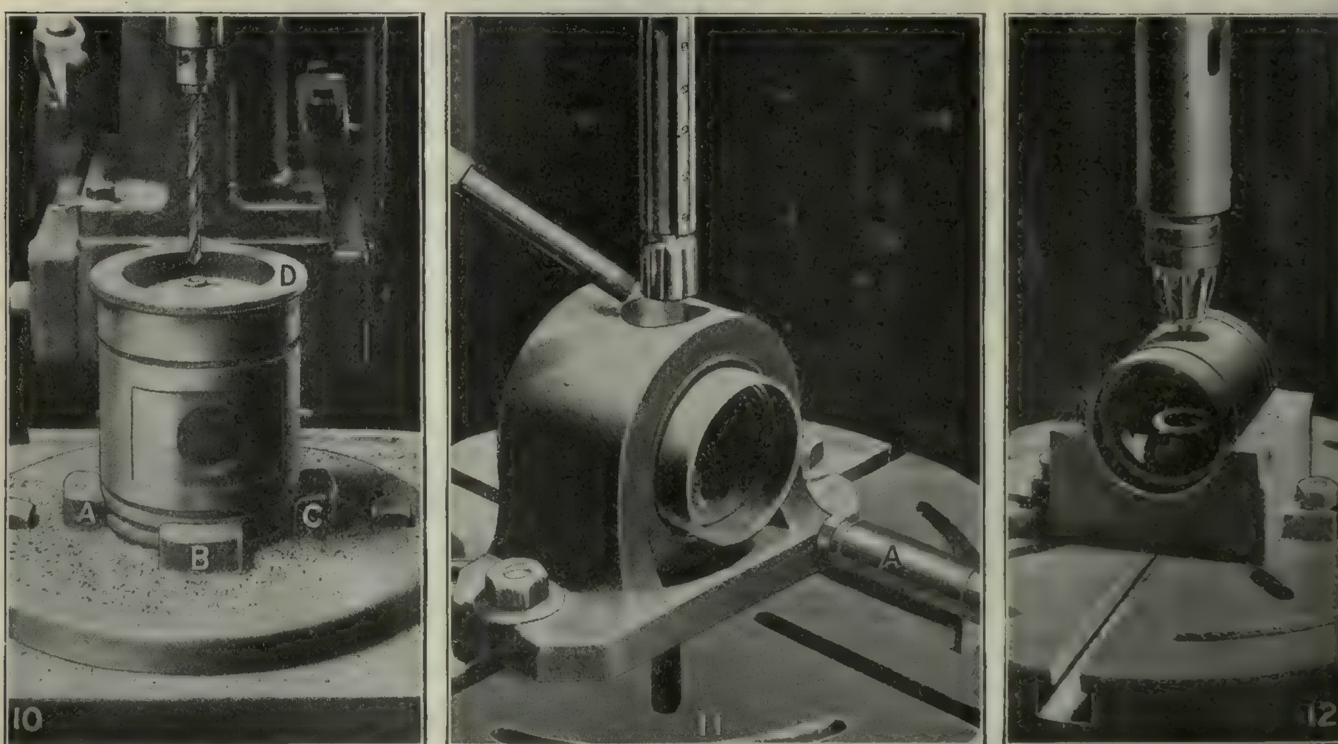


FIG. 14. BENCH AND GAGES FOR FINAL INSPECTION



FIGS. 10 TO 12. DRILLING AND REAMING OPERATIONS
Fig. 10—Drilling Oil Holes in Piston-Pin Bosses. Fig. 11—Finish Reaming Piston-Pin Hole. Fig. 12—Chamfering Piston-Pin Hole

being rigidly supported. Over 30 pistons per hour are done on each machine.

The pistons are then thoroughly washed to remove all chips, after which they are ready for the inspector's bench shown in Fig. 14. Coming in from the left they are first tested for diameter in the gage *A*, which is

AUTOMOTIVE CONSTRUCTION

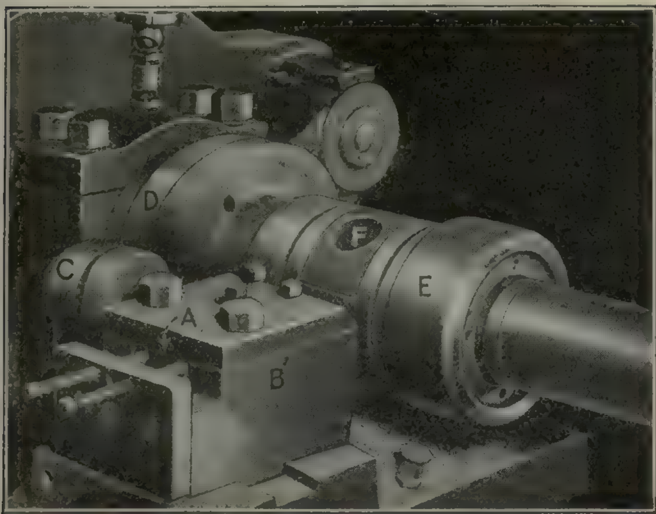


FIG. 9. CUTTING RELIEF ON SIDE OF PISTON

mounted in the hand machine shown. The piston *B* is being pushed through the gage by the plunger *C*, this being operated by the handwheel *D*. The way in which it passes this gage determines its size, the total variation being from 3.995 to 3.997 in., this giving the proper clearance in a 4-in. cylinder. Should a piston be so large as not to go through the gage easily, the ring *A*, with the piston inside, is lifted out and reversed, the plunger *C* pushing the piston back out of the gage without difficulty.

The gages *E* and *F* determine the depth of the piston grooves, gage *G* the proper length of the piston, and gages *H* the width of the grooves at each end. These are held between 0.25 and 0.251 in. in each case.

Head End of Piston Reduced

The head end of the piston, as far back as the land between the two head rings, is reduced to 3.984 to 3.987

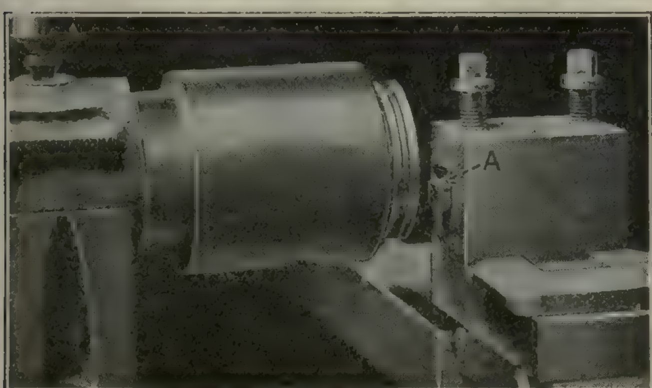


FIG. 13. FINISHING HEAD OF PISTON

in. to allow for expansion due to the extra metal and to this part of the piston receiving the greatest amount of heat. The pistons are then carefully weighed at *I* and asserted into sets of equal weight, the variation in each set being limited to within ½ oz. As with the other Ford practice, no grinding is allowed in finishing the pistons, the contention being that the surface of the metal as it comes from the tools is most suitable for the work.

Some Interesting Piston Operations

By Frank C. Hudson

The following operations from the shop of the Peerless Motor Car Co. have been selected on account of their peculiar interest and not with a view of showing the entire process of manufacture. Most of the remaining operations are standard practice in well-known

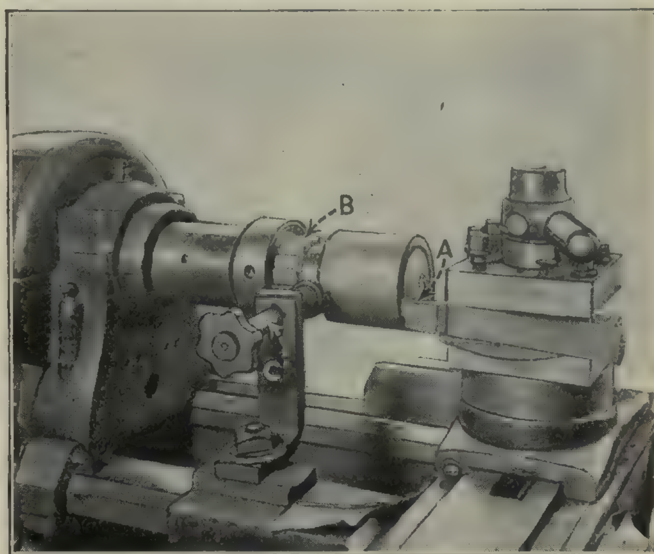


FIG. 1. FACING, BORING AND REAMING OPEN END OF PISTON

shops where the output is not, and cannot be, extremely large on account of the character of the car built.

In selecting these operations the main object is to show the ingenious and practical manner in which the problem of producing a limited number of pistons at an economical cost has been solved. The piston department is arranged in a very compact form so as to avoid

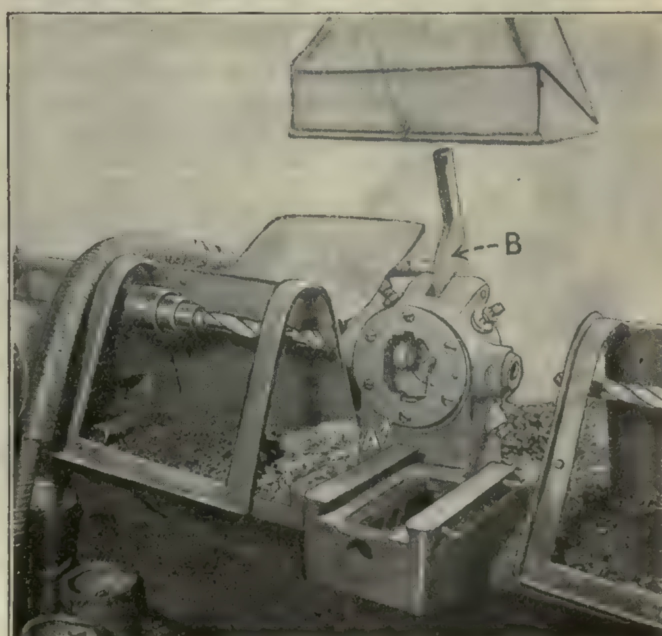


FIG. 2. DRILLING PISTON-PIN HOLES

AUTOMOTIVE CONSTRUCTION

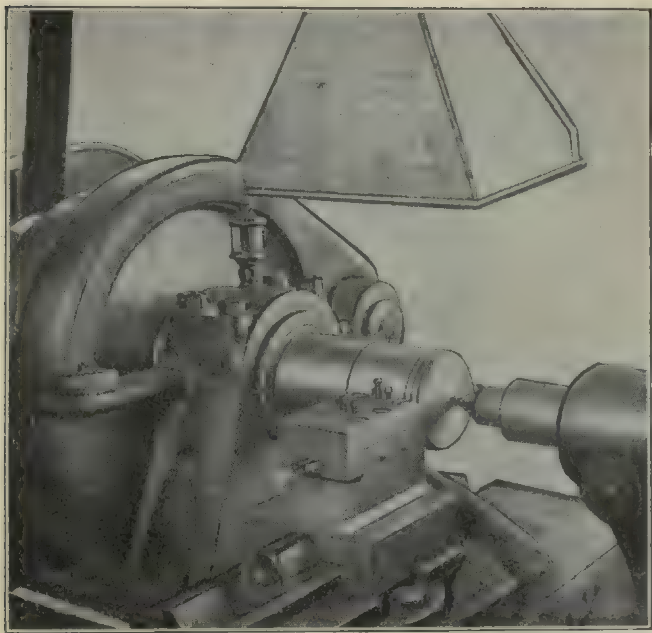


FIG. 3. FINISH-TURNING PISTON-RING GROOVES

all lost motion in handling and to insure a continuous flow of the product from one end of the department to the other. As a starting point, the open end of the piston skirt is faced, bored and reamed by means of the ingenious method shown in Fig. 1.

Piston Held on Expanding Mandrel

The piston is held on a special expanding mandrel which centers it and holds it firmly in spite of the overhang shown. The tool *A*, shown in the front of the tool block, bores and faces the open end of the pistons, being swung 90 deg. by the turret toolpost for that purpose. It is turned in the position shown in order to obtain a clear view. Then the ingenious reaming device shown at *B* is brought into play. This consists of a sleeve carrying the reamer shown, and also a substantial collar with a pilot hole.

After the end has been bored, the turret is turned to swing the cutting tool out of the way; the carriage runs to the left until the end of the pin *C* can engage the hole in the large collar. This prevents the reamer from turning and also allows it to be fed into the work, effectively sizing the open end of the piston without removing it from the mandrel and insuring the bore being concentric with the inside and at right angles to the end which has been faced.

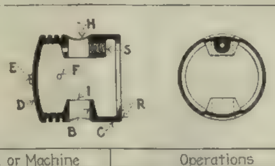
The piston-pin holes are next drilled in the double-headed machine shown in Fig. 2. The piston is pushed in from the back, centering on a raised concentric projection inside the end plate *A*, and held in position by the cam *B*. It is also located with reference to the pin bosses by suitably inclined surfaces inside the fixture. The inner ends of the bosses are also faced by suitable cutters in this operation.

The pistons are then rough-turned in the regular way on a semi-automatic machine, after which they are finish-turned in the engine lathe shown in Fig. 3. This also finishes the grooves by means of the special tool block shown. Figs. 2 and 3 both show the hood of the exhaust system which removes the loose particles of cast-iron dust that were formerly so annoying to the machinist.

Some Miscellaneous Operations

Following these operations are: the drilling of oil-drainage holes through the piston, drilling the setscrew hole which fastens the piston pin firmly in place, and grinding the outside and also the relief over the piston-pin boss. Then comes the finish-reaming of the wrist-pin hole, after which it is again reamed by hand and the piston carefully inspected. The last operation is to grind off the center projection and polish the piston at this point.

Fig. 4 shows the operation sheet used by the Peerless Motor Car Co. and is given as an excellent example of a simple and compact form of sheet for this purpose. The illustration of the piece itself together with the reference letters showing exactly what is referred to in each operation, makes it easy to follow the work from point to point and is very helpful to the department head as well as to the men who are really interested in the work.



Operation Sheet
Peerless Motor Car Co.
Cleveland Ohio
Model 5FF Sheet No. V-3947
Name Piston
Remarks
For oversize Pistons use Drill Jigs S.T. 8518 & S.T. 7522, marked oversize 0.015" & 0.025"

No. of Operation	Checked by	Dept. or Machine	Operations	Jigs, Fixtures and Tools Req'd.
1		Prentice Lathe No. 675 " " " 717	Face, Bore & Ream at E	Pin Chuck S.T. 8435, Fay Scott Turrett & Driving Attach. S.T. 8528
2		Garvin Duplex No. 1685	Drill 2-$\frac{13}{16}$" Holes & Fase inside of bosses at B. & I.	Drill Jig & Cutter S.T. 7226
3		2 P. Potter & Johnson No. 1537	Rough turn at C Rough Groove & Crown at D.	
4		Gridley Automatic No. 849; 765	Finish turn at C, finish Groove & center at E	
5		Leland Gifford No. 1530	Drill 6-No. 30 Holes at F	Drill Jig S.T. 8518
6		Avey Drill No. 1771	Drill $\frac{5}{16}$" Set Screw Hole at G	" " S.T. 7522
7		Aurora Drill No. 1314	Countersink Wrist Pin Hole at H	" " S.T. 8439
8		Rickert-Shafer No. 1239	Tap $\frac{5}{16}$" Hole at G	
9		American Lathe No. 1204	Finish Groove	Tool Block and Adapter S.T. 8443
10		6x18 Landis No. 1567; 1568	Grind outside at C	
11		Norton Grinder No. 571	Grind relief	
12		Dreses H.S. Mach. No. 201	Finish Ream Wrist Pin Hole at B	Fixture S.T. 7122; Reamer S.T. 7123
13		Bench	Hand Ream Wrist Pin Hole at B	Standard Equipment
14		"	Inspection	
15		Polishing Jack No. 471	Grind off & Polish Center at E	Standard Equipment

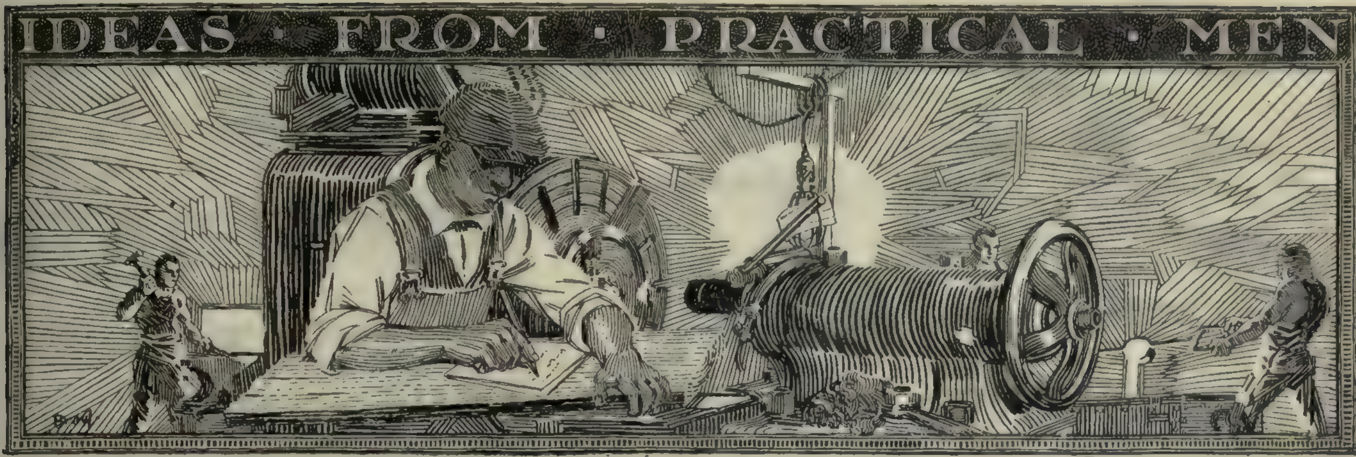
FIG. 4. OPERATION SHEET OF PEERLESS PISTON

Tapping Aluminum Castings

By T. Greening

Tapping holes in aluminum castings sometimes becomes a troublesome job owing to the ease with which the holes are reamed or the threads are stripped before the tap gets to work properly. We had trouble when using a jig for drilling and facing crankcase side-hole covers.

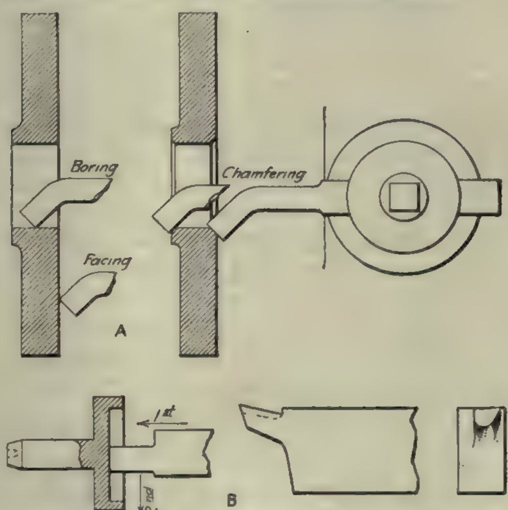
After the tapping hole had been drilled, the drill bush was removed to allow of countersinking and facing, after which the piece was tapped. In this operation a good many pieces were spoiled by the tap either reaming or stripping the first two or three threads. To obviate this trouble a screwed guide bush was made and used with perfect success. It insures the tap leading into the work properly and the employment of such screwed bushes in jigs for crankcases, gear boxes, etc., has entirely eliminated the scrap previously due to badly tapped holes.



Saving Time Between Cuts

By Charles Canec

There are times when it is an economy to use two tools at once, and there are other times when a saving can be effected by using the same tool for two or more operations. Even when the form of tool used necessitates a reduction in cutting speed, the time saved between cuts may more than compensate for this loss, as the machinist does not need to waste time changing tools, etc. The sketch shows at *A* the boring and facing of a flange, all the work being done with one tool. At *B* is shown the recessing of a "piercing nose" for a cartridge die. In the latter case the carriage is locked and the compound rest turned at right angles to the crossfeed so that the depth of recess, 0.125 in., can be gaged by the micrometer collar on the compound screw.



USING THE SAME TOOL FOR MORE THAN ONE OPERATION

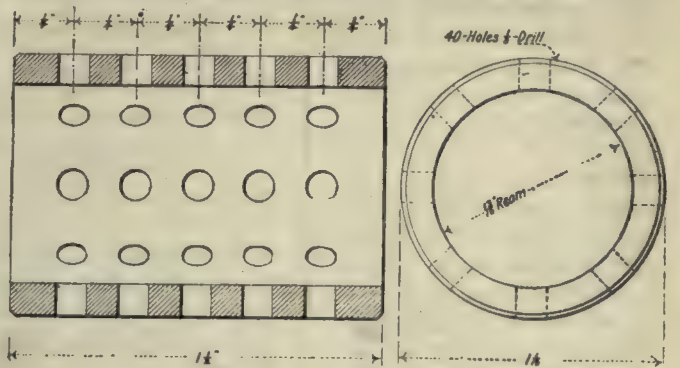
These are two simple illustrations of what can be done to save time when doing repetition work on the engine lathe, and in the small shop where chucking machines and turret lathes are scarce, little wrinkles of this sort help to increase production.

Rotary Bushings

By Robert Mawson

Regarding the various articles which have lately appeared in the *American Machinist* on rotary bushings and their use and methods of manufacture, I herewith send you a sketch of a type that has been found very satisfactory on high-grade textile machinery.

Bushings of this type are used on medium-speed work, say up to about 350 r.p.m. The bushings are made of cast iron with the inside reamed to be a good fit on the shaft and the outside diameter turned to a running fit in the bearing housing. Forty ⅛-in. holes are drilled



A ROTARY BUSHING

as shown. The holes are filled with graphite and heavy oil, and we have had some bearings in service for about five years without showing appreciable wear.

Improving a Bench Planing Machine

By M. E. Duggan

In my bench planing machine I have made a few changes that might interest the makers of these machines: The first is a 12-in. extension to the front table. With his extension I can dress light but much longer stock than could be dressed on the short table. Next, I have discarded the regular nut for clamping the gage and substituted wing nuts. Where frequent adjustments are necessary a wrench becomes a nuisance.

The front edge of the guard being very thin, the stock to be planed has a tendency to ride over instead of pushing the guard open especially if the corner of the stock is slightly rounding. To correct this trouble I have turned the front edge up to form a vertical face for the stock to press against.

IMPROVEMENTS ON BENCH PLANING MACHINE

War on the Decimal System

by
Frederick Franz, M.E.

The Octimal System of Numerals

LET us look into some of the elements in the measurement of magnitudes. When dividing any magnitude, as *AB*, Fig. 1, into smaller units for the purpose of measurement, the first national division that suggests itself is to halve it as at *C* so that any other magnitude *XY* could be measured by the number of units *AC* contained in it. If these subdivisions proved too coarse, commonsense and human instinct always moved us to again divide them into two as at *D* and so on as at *E* until we obtained the degree of minuteness and precision sought.

We are presenting here two independent efforts to provide a substitute for our present decimal system as applied to measurements in the shop. They were apparently conceived about the same time, although neither was written up until some time later. It is hoped that constructive criticism will be provoked and the comments will be based on careful study of both articles. Perhaps this idea may lead to the discarding of the awkward common fractions and decimal equivalents—Who knows?

This spontaneous division into halves is due to the ease of physically or mentally dividing the magnitude into two parts and to the ease of comparing the accuracy of the division. A division into more than two equal parts, although just as possible as division into two parts, makes the process physically more difficult, taxes the mind to a greater degree, and makes a comparison of the accuracy of the division more difficult. A notable example of the spontaneous tendency is afforded in the report of Frederick A. Halsey on "The Weights and Measures of Latin-America," Journal A. S. M. E., November, 1918, page 947. We find by examining this report that in Brazil, although the metric system is in use, ¼ and ½ kilograms are used in place of grams or decigrams.

Referring again to Fig. 1, after dividing at *C* into two, only one sensible factor could possibly influence a further division into fifths in preference to halves, thirds, quarters, sevenths, or any other division. This factor is our concept, that, if we applied the consecutive numbers of our present number system (0-9) to the consecutive divisions we would effect the desirable condition of having our magnitude jump to the next higher (or lower) order simultaneously with our numerals, thus making easy the numerical conversion of units from higher to lower orders or vice versa. This is the justified basis of the creation of the ten-unit division of magnitudes under the metric system.

But the binary subdivision has been carried out whenever no regard was given to our present system of pure numbers. Thus, we see that in the manufacture of most products of such size that the inch alone may be used without resorting to larger units, binary division (halves, eighths, sixty-fourths, etc., of an inch) has survived as the fittest division, excluding those cases where free adoption has been hampered by compulsory legislation. Institute decimal division; yet binary thought will continue just the same. Ten cents equal one dime; ten dimes equal one dollar (a decimal system), but a fifty-cent piece equals one-half dollar, and a twenty-five-cent piece equals one-quarter dollar, and in some sections of the country "two shillings," by common though corrupt usage, has grown to mean twenty-five cents; that is, one "shilling" equals one-eighth dollar. Also, a nickel equals one-half dime.

Where is the fault? Someone once suggested that if man had only eight fingers instead of ten, our number system would have been started correctly. Just so. During the writer's strife in handling a vast number of dimensions in figures of thirty-seconds and sixty-fourths

FIG. 1

FIG. 2

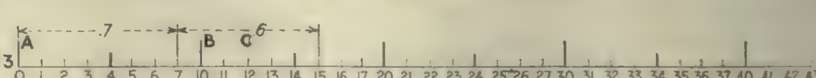

FIG. 3


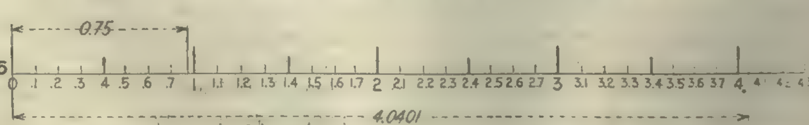
FIG. 5


FIG. 1. DIVISIONS OF MAGNITUDE
FIGS. 2, 3 AND 5. COMPARISON OF BINARY AND OCTIMAL DIVISIONS

of an inch in the redesign of a machine several years ago, he evolved the following octimal system of numerals. Let us construct this system and see how easy the representation, addition, substraction, division, etc., of

20000	Units of the first Magnitude
4000	" " " " "
700	" " " " "
50	" " " " "
6	" " " " "
24756	" " " " "

Units of the 5th Magnitude

1st 2nd 3rd 4th 5th

2 4 7 5 6

FIG. 4. COMPOSITION OF AN OCTIMAL NUMBER

such figures as $\frac{1}{8}$, $\frac{1}{64}$, $\frac{25}{32}$, etc., become.

In Fig. 2 let us call the spaces 0-1, 1-2, etc., units of the first magnitude; spaces 0-10, 10-20, etc., units of the second magnitude, or briefly first magnitude, second magnitude, etc., respectively. Now, under our present decimal system, ten first magnitudes equal one second magnitude, the 0 in the number 10 meaning no first magnitude, and the 1 meaning one second magnitude. Thus 28 indicates eight first magnitudes and two second magnitudes. See also Fig. 4. Now let us refer to Fig. 3: 0-1, 1-2, etc., are still equivalent units of the first magnitude, but instead of changing to the second magnitude at *C* (Figs. 2 and 3) we will change at *B*, calling the space (*A-B*) one second magnitude and assign to it the proper character, 10, Fig. 3, which means one second magnitude and no first magnitude. Now, in the octimal system we must forget entirely that such characters as 8 and 9 ever existed. Also, for convenience in understanding what follows, whenever a number in the decimal system is used it will be underlined, thus: 2, 4, 8; and numbers in the new (octimal) system will be written plain, thus: 2, 4, 10. By comparing the two scales we see that 2 = 2, 7 = 7, 10 = 12, 17 = 21, etc.

Fig. 5 represents an enlarged scale of Fig. v; 0-1, 1-2, eet., are equal on both scales. In Fig. 5, 0-1 is divided into 10 (not 10) divisions as shown, numbered .1, .2 . . . .6, .7, 1.0. Each of these equals one-tenth (not one-tenth) of a first magnitude, and is indicated as such by a figure and octimal point as shown. Each one of these may again be subdivided into tenths, but then a cipher must be prefixed, thus: .01, 02, ...06, .07, .1. (In other words, the octimal point must be moved one space to the left.)

With the foregoing principles firmly borne in mind, we are able to perform elementary arithmetical operations. First, we will construct our addition table (see Fig. 6). Should we choose actually to make use of this system we must memorize this table of addition or keep it constantly before us. Each figure inside of the heavy lines at the intersection of a column and a row is the sum of the numbers at the head of its column, and at the right-hand end of its row appearing immediately outside of the heavy lines. Thus: 4 + 3 = 7, 6 + 5 = 13, etc. Just as in our old system it was necessary to memorize that 7 + 8 = 15, so in our new system we must memorize additions and multiplications. Often during our day's work, as we rapidly add, multiply, etc., we fail to realize that we once had to commit to memory the fact that 8 + 9 = 17 and 7 × 9 = 63, etc. The table shows that 7 + 6 = 15. This figure was obtained by counting 7 units from 0 to 7, see Fig. 3, and then counting 6 more, proceeding from 7 in the same direction and ending on 15. Every other sum given in the table was obtained in a similar manner. The reader is now able to prove the following examples in addition.

23	23	23	43	54
33	34	35	35	66
56	57	60	100	142

By adding in exactly the same fashion as in the decimal system except using the table in Fig. 6 for the sums, we can easily prove these figures. Thus, in the last example, adding the 4 and 6 (by table), we get 12; write 2 and carry 1; 6 and 1 are 7 (by table) and 5 equal 14. A

1	2	3	4	5	6	7	10	0
2	3	4	5	6	7	10	11	1
	4	5	6	7	10	11	12	2
		6	7	10	11	12	13	3
			10	11	12	13	14	4
				12	13	14	15	5
					14	15	16	6
						16	17	7
							20	10

FIG. 6. TABLE OF ADDITION

few examples of the expression of some equivalent fractions in both systems follow:

$\frac{1}{2}$ = .5 = .4 $\frac{1}{16}$ = .0625 = .04

$\frac{1}{4}$ = .25 = .2 $\frac{1}{64}$ = .015625 = .01

Note the simplicity of representing these fractions.

For example in addition of fractions let us take the following:

Decimal addition of: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$ and $\frac{1}{64}$	Octimal addition of: $\frac{4}{10}$, $\frac{2}{10}$, $\frac{1}{10}$, $\frac{4}{100}$, $\frac{1}{100}$ (Same values as given in decimal comparison)
.5	.4
.25	.2
.125	.1
.0625	.04
.015625	.01
.953125 = $\frac{61}{64}$ Ans.	.75 Ans.

(The heavy line placed under a figure identifies it as belonging to the decimal system.)

For comparison of the work of addition the two methods are shown together. But the actual work of adding is not the only factor that saves time.

This example, for instance, does not show how in the decimal addition we must first reduce the common fraction to a decimal, then after adding the decimals finally reduce the decimal to a common fraction again before we are able to lay off this value from a scale, if it is in inches. In the octimal system our figures are already in the octimal form. (We can write them as a vulgar fraction, as shown, if we choose). All we need to do is to add them octimally to obtain the answer. We find in this case that the value is .75. This value is in the sub-unit .7 to 1. This sub-unit of .1 of a unit is again divided into 10 (or 8 if you please), 5 of which must be added to the .7. Note that .75 is not midway between .7 and 1. (The median point is .74.) See Fig. 5.

1	2	3	4	5	6	7	10	1
2	4	6	10	12	14	16	20	2
		11	14	17	22	25	30	3
			20	24	30	34	40	4
				31	36	43	50	5
					44	52	60	6
						61	70	7
							100	10

FIG. 7. TABLE OF MULTIPLICATION

The part of this system which produces the most astonishing results for rapid calculation is the multiplication and division of fractions. In Fig. 7 is shown the octimal table of multiplication. This differs from Fig. 6 only in that the figures at the intersection of the column and rows are the octimal products of the numbers at the head of the columns and right end of the rows. Thus, $3 \times 2 = 6$, $4 \times 3 = 14$, $6 = 5 = 36$, $10 \times 10 = 100$.

These products were obtained by taking a number of steps from zero along the scale, Fig. 3, the length of each step being made equal to the multiplicand and the number of steps being made equal to the multiplier, always starting a following step where the previous one ended. Thus, taking 5 as a multiplicand and 1 as a multiplier, we start at zero, add 5 and end at 5, our product. With 2 as a multiplier, we start at 5, add 5 and end at 12, our product. With 3 as a multiplier, we start at 12, add 3 and end at 17, our product, etc.

We will compare the multiplication of $2\frac{1}{64}$ by $2\frac{1}{64}$ under the old and new systems.

Decimal multiplication:	Octimal multiplication:
2.015625	2.01 ($= 2\frac{1}{64}$)
2.015625	2.01
10078125	201
4031250	4020
12093750	
10078125	4.0401 Ans.
2015625	
40312500	
4.062744140625 Ans.	

The heavy line indicates the decimal numbers as before.

The reader ought now to be able to locate the value 4.0401 on the scale. (See Fig. 5.) He can test himself by proving the following: $2\frac{43}{64} \times 4\frac{3}{32} = 2.77 \times 4.06 = 14.1572$.

Conversion of fractions from the one system to the other is simplified by the use of Fig. 8. The writer used a conversion chart similar to this in his original calculations, as it was always necessary to convert the octimal calculations into the decimal system before the figure was fit to be used; but often, when it was only necessary to lay off the figure found as a lineal dimension, without recording its decimal value, the regular draftsman's scale, graduated in eighths of an inch, was

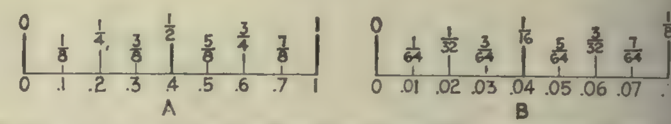


FIG. 8 (A). COMPARISON OF BINARY DIVISIONS WITH OCTIMAL NOTATIONS OF SECOND MAGNITUDE; (B) COMPARISON OF BINARY DIVISIONS WITH OCTIMAL NOTATIONS OF FIRST MAGNITUDE

used. As a matter of fact the writer calibrated his scale so it looked similar to the lower half of *A*, Fig. 8. In division, we must obtain each trial figure for the quotient by reference to the multiplication table, then use Fig. 7 for all multiplying and Fig. 6 for all addition. By following through each step for trial quotient, multiplication and subtraction, in the following example the application of the method to division will become obvious.

```
          .564 +
5.52)4.071
     3422
     ----
      4470
      4174
      ----
       2740
       2650
       ----
         70
```

From the foregoing we conclude that:

1. Ten is a rationally wrong basis of measuring.
2. Eight or any binary system is just as effectual as ten in computing, but far more effective in measuring.
3. There is available a system of computing and measuring as described in the foregoing which will greatly simplify the work of many engineers, draftsmen, clerks, inspectors, etc., in the mechanical industries or any other industry employing binary measurements, and can be used together with our present system.

A system based on units of twelve could be devised along the lines of the octimal system. If this is the "duodecimal system" which has often been referred to but never intelligently explained, we see that it would be almost as difficult to express and handle those commonly used binary fractions in this duodecimal system as it now is to express and handle them in the decimal system. Another disadvanage would be the larger addition and multiplication tables required to be memorized, but this disadvantage would be offset somewhat by the smaller number of figures required to express large numbers.

Octaval Notation and the Measurement of Binary Inch Fractions*

By Alfred Watkins
Hereford, England

A RECENT investigation into the usage of coinage, weights and measures of all kinds, summed up in the author's pamphlet, "Must We Trade in Tenths," showed two distinct and clashing tendencies. The first, which is prevalent in all branches of commerce and craft, is to divide a unit into halves, quarters, eighths, etc., down to sixty-fourths. The stock broker, farmer, corn dealer, or auctioneer does this with his sovereign; the liquor dealer with his pound; the draper with his yard; the mechanic and engineer with his inch. And in many cases this is persisted in in the face of an awkward customary notation, as when shares are sold in 32nds of a sovereign, and the mechanic has to measure his $\frac{1}{32}$ in. with a micrometer which, though it uses four places of decimals, does not measure correctly. This last example is the reason for the present paper.

The second tendency is on the part of the man who has more to do with computation than actual exchange or craft. He, finding a decimal notation all cut and dried and usable with easy facility, is thoroughly impatient with any other method, and wants it to be universal and compulsory. To this class belong the counting-house man, the schoolmaster, and the scientist, who have never entered into the unexplored science of commerce and handicraft.

And as we all, with a slight exception in dozens, count upward from unity in a ten grouping, many of us are apt to decide that the ten grouping is also an inevitable division of the unit downward. But this ignores the general fact that no market man or craftsman does divide a unit into tenths until forced by the counting house into doing so. The figure ten only halves once into a whole number, and after that each halving adds an additional decimal place. The ten grouping is not the only scale of notation and such textbooks as Hall & King's Elementary Algebra point out those with a basis or radix of 6, 8, 12, 16, or any other numbers and give rules for the conversion of one notation to another. It is exceedingly unlikely that we shall disturb the ten grouping for our counting from unity upward. But there is not the slightest difficulty in expressing parts of a unit in modern fractions of some other radix than 10.

Unfortunately there is no notation which fits perfectly with all fractions used in commerce or craft. The three groups of fractions most used are 3rds, 6ths, and 12ths; 5ths and 10ths; and the binary group, 4ths, 8ths, down to 64ths. The last group is undoubtedly used more than all the others put together, especially in the mechanical division of a unit of length, and a numeration with a binary radix is best. As a radix of 16 would necessitate the selection of six new numbers, 8 is the scale of notation to select, and it fits the engineer's binary inch fractions to perfection.

Table I explains the perfection of the octaval notation and the faults of the decimal notation for binary division. An octaval fraction is distinguished from a decimal fraction by a special mark, the small circle or "pip," originated by the author, and placed in the same position as the decimal point.

*From a paper presented at the Annual Meeting of the A. S. M. E., December, 1919, in New York City.

TABLE I. OCTAVAL NOTATION CONTRASTED WITH DECIMAL NOTATION

Units		Fractions				
Decimal	Octaval	Vulgar		Decimal		Octaval
100	64	1	=	1	=	1
50	32	$\frac{1}{2}$	=	0.5	=	${}_{\circ}4$
25	16	$\frac{1}{4}$	=	0.25	=	${}_{\circ}2$
12.5	8	$\frac{1}{8}$	=	0.125	=	${}_{\circ}1$
6.25	4	$\frac{1}{16}$	=	0.0625	=	${}_{\circ}04$
3.125	2	$\frac{1}{32}$	=	0.03125	=	${}_{\circ}02$
1.5625	1	$\frac{1}{64}$	=	0.015625	=	${}_{\circ}01$
		$\frac{1}{128}$	=	0.0078125	=	${}_{\circ}004$
		etc.		etc.		etc.

Octaval fractions can be added, multiplied, etc., with much the same facility as decimals and far easier than vulgar fractions as for example:

Vulgar	Octaval
$\frac{1}{2} + \frac{33}{64} = \frac{32}{64} + \frac{33}{64} = \frac{65}{64} = 1\frac{1}{64}$	${}_{\circ}4$ ${}_{\circ}41$ $1{}_{\circ}01$

Note that as 8 is the radix, it becomes 10 in all octaval arithmetic.

In the structure of octavals, just as 0.2345 in decimals

$$= \frac{2}{10} + \frac{3}{10^2} + \frac{4}{10^3} + \frac{5}{10^4}$$

$$= \frac{2}{10} + \frac{3}{100} + \frac{4}{1000} + \frac{5}{10000}$$

$$\text{so } {}_{\circ}2345 \text{ in octavals} = \frac{2}{8} + \frac{3}{8^2} + \frac{4}{8^3} + \frac{5}{8^4}$$

$$= \frac{2}{8} + \frac{3}{64} + \frac{4}{512} + \frac{5}{4096}$$

Application to Inch Fractions

The foregoing explanation leads up to the subject of this paper, which is the practical application of octaval notation to the construction of micrometers, calipers, and measuring rules, and the great ease and facility it imparts to the measurement of the allowances and limits so much used in precision work.

In most British and American works the binary inch fraction is still the favorite standard, and as has been pointed out, this instinct is a sound one, although the crude way in which these are expressed in vulgar fractions leads to great inefficiency. How can such adjacent figures as $\frac{1}{2}$, $\frac{33}{64}$, $\frac{17}{64}$, $\frac{35}{64}$, and $\frac{9}{16}$ be marked on a scale or rule, or conveniently used in calculation? The consequence is that they are never marked, and we are so accustomed to the inefficiency caused by the omission that we do not notice it.

A beginner recently asked for an explanation of the reading of a vernier calipers. The particular instrument in question reads down to $\frac{1}{128}$ and is a pattern sold under different names. No instructions are sold with it; not a figure is marked except for full inches; the inch is divided into 16 parts, the vernier into 8 parts. There are no index lines given; therefore, the unhappy beginner has to guess which is the index line and to find out which of the divisions it indicates by counting them; then to do the same with the vernier divisions. But results have to be kept in mind, and such a result as five-sixteenths in the main divisions, and five one hundred and twenty-eighths added together and reduced in the head to the conventional vulgar fractions.

This crudity in the notation of our binary fractions, and the inexplicable neglect of the logical fractions with a binary radix, compelled the makers of micrometers, when precision work became necessary, to

translate the binary fractions into decimals and construct their instruments on that basis, with the imperfect and illogical consequences already pointed out.

The honest mechanic, who deals in sixteenths of an inch, and knows them mentally as quarters of a quarter of his unit, is complacently told that he must now measure them as six hundredths, plus two thousandths, plus half a thousandth of an inch. And when it comes to the necessary sixty-fourths, which ought to take six decimal places down to thousandths of thousandths, the instrument maker gives it up in despair and makes four places do. This omission makes a micrometer measurement (on the usual instrument) of 32nds and 64ths short of the true value, 0.00005 in all 32nds and either 0.000025 or 0.000075 alternately in all 64ths. This may seem unimportant but it may amount to one-third the "limit" in certain items in the Newhall tables and

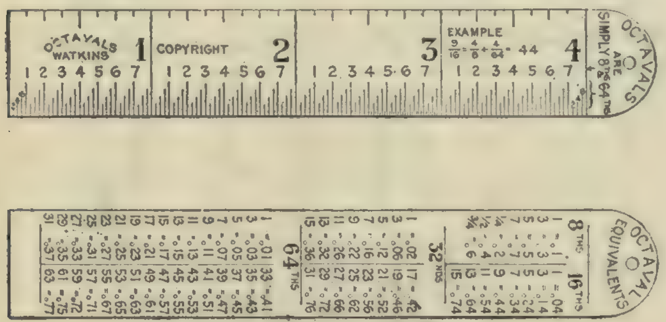


FIG. 1. OCTAVAL RULE

to one-half the "limit" in certain items in the table in the Johansson catalog.

Our present crude blend of decimal allowances with standard binary fractions is complex and illogical, and it would seem that as a "limit" table is based on the square root of the diameter of the part, it can be more accurately and simply compiled in octavals than in decimals. The structure of an octaval fraction is much on the lines of a mechanic's mental conception of the fraction. Thus $_0$42 (that is, $\frac{4}{8} + \frac{2}{64}$) for the fraction usually called $\frac{17}{32}$ is obviously half an inch plus a thirty-second.

It should be also noted that the octaval figures are continuous, so that adjacent fractions as $\frac{1}{2}$ and $\frac{33}{64}$, so inconveniently expressed now, are in octavals $_0$4 and $_0$41, obviously adjacent. With an octaval radix the counting omits 8 and 9, and goes directly from $_0$07 to $_0$1, from $_0$17 to $_0$2 and so on until $_0$77 is reached, when the next value upward is 1$_0$0 or unity. The octaves of the eighties and nineties are omitted, as well as the single figures 8 and 9.

Measuring Instruments With Octaval Notation

It will be noticed that in the instruments illustrated (Figs. 1–5) all or almost all the divisions can be marked with figures indicating their value, and that, except in the case of the rule, there are no very fine divisions to try the eyes. It should also be noted that in each case there is a separate scale for each place in the fraction, each figure of it being read separately, so that no addition is necessary to get the results.

Octaval Rule—The octaval rule, Fig. 1, shows that all the eighths are figured, and the figures form the first place in the octaval fraction. The writer has devised an original way of indicating the subdivisions of the eighths (the sixty-fourths) in staircase fashion which enables the alternate even number to be marked, and these numbers constitute the second place in the octaval fraction. This method of a different length of line for 2, 4, and 6 allows the value of the indicated division to be known, even if it is not uncovered by the thimble or sliding bar of a measuring instrument. It is applicable to decimal divisions and to ordinary and slide rules.

Simple Calipers—The simple calipers shown in Fig. 2 measures the standard fractions down to 64ths, employing the staircase subdivisions described. In place of making the edge of the sliding jaw uncover the division, an indicating line, as illustrated, is used, as it is more exact for observation. The jaw is cut away

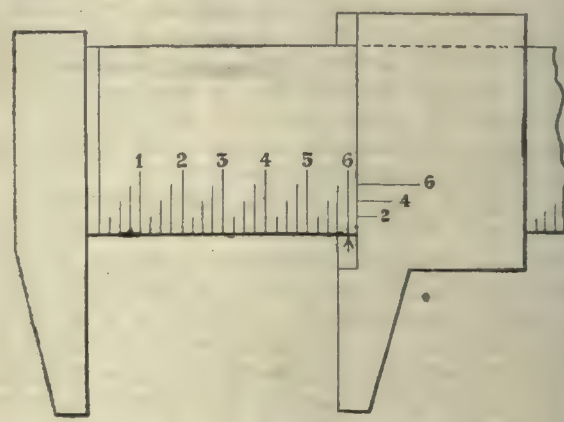


FIG. 2. SIMPLE CALIPERS

a little to allow of this arrangement. The values of the different division, of different lengths, are marked by horizontal lines, also of corresponding different lengths, on the jaw itself. This enables each division to be figured with its value. The author considers that 32nd divisions are quite fine enough for convenient observation on a scale, and therefore he has not inserted the odd 64ths, these being indicated by setting the index line midway between the two divisions.

Simple Vernier Calipers—The simple vernier calipers shown in Fig. 3 measures down to 64ths, and yet the divisions are scarcely finer than eighths. The vernier method is used, and every division is figured. The index line points to the first figure of the fraction, or beyond it, short of the next division, and the vernier line which coincides with any upper division is marked with the second figure of the fraction. A partial dislike to the vernier method is probably due to their usual association with fine, eye-straining divisions. Here it is applied with coarse divisions. The scales representing the first and second octaval places have been marked with the distinguishing letters *A* and *B*. This marking will also be on the other instruments, with *C* and *D* added for the 3rd and 4th octaval places.

Double Vernier Calipers—A flat model of the double vernier calipers is illustrated in Fig. 4 in order to show its action more plainly, although it is quite probable that a model with a circular stock will be the commercially useful one. The standard fraction is set, in two places of octavals, exactly as in the instrument already described. A fine movement for the 3rd and 4th octaval places is frictioned on the coarser movement. It is a double wedge with a taper of 1 in 32, and a movement of $\frac{1}{16}$ in. on this cross-slide moves the calipers $\frac{1}{512}$ or $_0$001 in the third place of octavals. The fourth octaval place is indicated by a vernier scale.

In this, as in the next instrument, the 1st, 2nd, 3rd and 4th scales are lettered *A*, *B*, *C* and *D*. The advantage, to which reference has been made, of devoting two scales to the main fraction and the two others to the allowance, shows up very strongly in this instrument, for there is a separate plus and minus scale for the allowance. The mechanic has therefore only to set one part of the calipers for his main fraction and the other part for his allowance, either plus or minus, and has no pencil or mental calculation to make. No decimal instrument can do this unless the standard main fractions adopted are tenths or hundredths. It will be noticed that the construction remedies a fault in previous beam calipers which had the pull of the fine adjustment on one side of the main axis of the instrument. When used to caliper the exact size of an unknown dimension, the jaws are adjusted to the size, and a front clamping screw, not shown, is tightened on the beam, the rear screw being left loose. The fine adjustment is then worked so that a vernier line on the scale *B* coincides with an upper division. The *C* and *D* scales then indicate the variation from the standard fraction. It should be noted that this construction makes the reading of the second place of the fraction different from previous instruments. With this one it is always set exactly for the precise standard fraction, and the fine adjustment does not alter this setting, but indicates how much more, or less, than the standard the dimension is, or is intended to be.

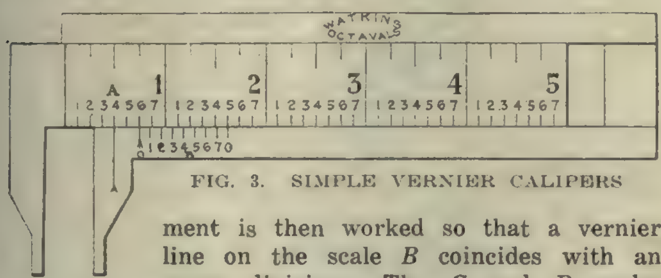


FIG. 3. SIMPLE VERNIER CALIPERS

Single-Screw Micrometer—A screw micrometer, bow type, is probably much more used than a sliding calipers. The octaval one first designed by the author is on the same lines as the usual one, but the screw is of 32 pitch and the scales are so arranged that each place in octavals is read separately, the one screw motion reading to four places. The usual micrometer reading in 0.025's mixes up two places. This pattern is not described more fully because, although completely efficient, it does not bring out the strong points of the separation of the standard fraction from the allowances so completely as in the next instrument.

Two-Screw Micrometer—The two-screw micrometer shown in Fig. 5 is the result of the author's conviction that the separation of the scale for the main fraction from that of the allowance, rendered possible by their being expressed by different places in octavals, is a great practical convenience. In this instrument the standard fraction is measured by the usual screw on the right hand. It is of 8 pitch, probably 4 threads. It indicates the first octaval place, eighths, on the index line, which also points to the 8 divisions on the thimble for the second octaval place. For measurement of the main fractions this is all that is required. The end usually occupied by a fixed anvil is fitted with a measuring screw for the allowances, 3rd and 4th octaval places, which is kept at zero until required. This is a 32-pitch screw, it has a range of one revolution only, and its thimble has a double scale starting each way from 0 for plus or minus allowances. The 4th octaval place is read by a vernier scale. The workman therefore sets his standard fraction on the coarse screw, turns the micrometer round, and sets his plus or minus allowance on the fine adjustment, there being no calculation either for him or for the draftsman. As illustrated, the fine adjustment was used left handed, but it would probably be figured to use it on the right hand, and the position and the use of the vernier would then be exactly those that workmen are familiar with in the present instruments.

To measure an unknown dimension in four places of octavals the coarse adjustment is first set to the article, which is then withdrawn and the screw turned in to register the nearest (smaller) standard fraction. The final measurement is then made with the fine screw, which would probably be fitted with a ratchet, and the instrument would then read for the four places of octavals expressing the dimension. The fine-adjustment end can be used alone for measuring fine dimensions less than $\frac{1}{64}$ or the coarse-adjustment screw alone for the main fractions.

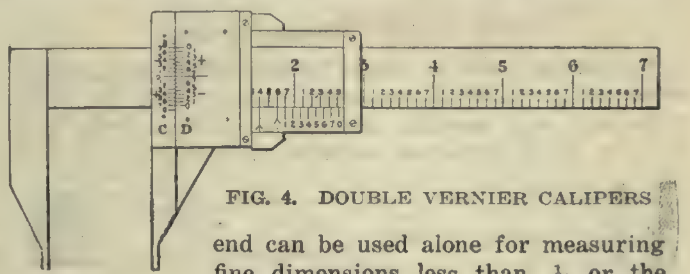


FIG. 4. DOUBLE VERNIER CALIPERS

An alternative arrangement in the construction of the instrument is to use a sliding rod, or anvil, in place of the coarse-pitch screw, and to adjust this for the main fraction by a set of standard blocks as described in the third from last paragraph, the fine-adjustment screw measuring for the plus or minus allowance. It might be commercially desirable to issue both of the above types of instrument with the fine-adjustment screw of 50 pitch and the scale decimal. This would work with the present limit tables.

Simplifications in Measuring "Limits"

The fact that all the standard binary fractions are expressed in the first two places of octavals and that all the limit allowances and tolerances come in the next (third and fourth) octaval places, gives a new and unexpected value to octaval notation. The workman sets his standard size on two scales of the calipers or micrometer, and the plus or minus allowance on two different scales. No pencil or mental calculation of adding or deducting is required. Another happy fact which makes the provision of limit tables for octavals very easy, is that the third place in octavals ($_{o}001$) is $\frac{1}{512}$, and half this ($_{o}0004$) is $\frac{1}{1024}$, which is so near the much used "thou" of the mechanic (within $2\frac{1}{2}$ per cent of it) that it can safely be substituted for it in all the limit tables. Accepting this substitute we obtain the following equivalents:

Decimal	Octaval
0.00025	$_{o}0001$
0.001	$_{o}0004$
0.002	$_{o}001$
0.003	$_{o}0014$
0.004	$_{o}002$
0.005	$_{o}0024$
0.006	$_{o}003$
0.007	$_{o}0034$
0.008	$_{o}004$
0.009	$_{o}0044$
0.01	$_{o}005$

Another fortunate coincidence is that the well-known Newhall table of limits takes a quarter of a "thou"

(0.00025) as its smallest unit and all the figures in the table are multiples of this. As this unit is $_{\circ}0001$ in octavals (the lowest figure read on the octaval micrometer described) the Newhall table can be given and used as an octaval table with perfect ease. A dot is placed between the 1, 5, 2 divisions on the calipers and micrometer, so that the mechanic has available his familiar thousandths division.

The economy in building reference blocks up in binary series instead of a numerical series (as in the Johansson series) has not been recognized. To illustrate the point, the usual commercial pile of weights from 4 lb. to ¼ oz. is cited, each half the weight of the next larger. The total weight of the series is ¼ oz. less than 8 lb., and its perfection as a series is such that it, without any duplicate weights, will weigh anything within its limits to ¼ oz. Any binary series either of weight or thickness has a similar perfection. No weights or measures selected from a decimal series can approach it.

Finer "Limit" Measurements

Supposing 9 similar blocks be taken from 4 in. thick down to $\frac{1}{64}$ in. thick, standing exactly 7$_{\circ}$77 in. high (7$\frac{63}{64}$ in.), any possible dimension in 64ths from $_{\circ}$01 ($\frac{1}{64}$) to the limit named could be calipered from it for

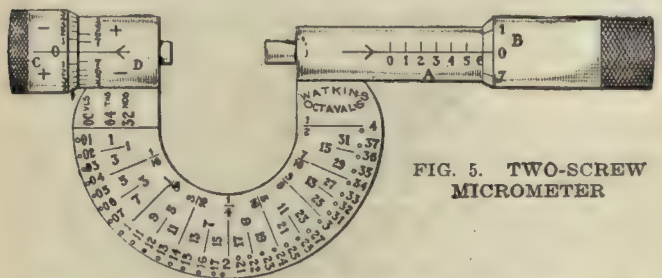


FIG. 5. TWO-SCREW MICROMETER

precision work. For finer "limit" measurements some modification would have to be made, but the total number would come far below those in the Johansson series of 81. Considering the great expense of such standard blocks, this is important.

In conclusion, it should be stated that this paper is not a proposal for the substitution of octavals for decimals in all branches of engineering. It advocates their use to denote the British binary inch fractions in the workshop and on workshop precision instruments. Any use beyond this, and there are many, is for future experience. A maker adopting these in workshop practice need not bring them into his catalog until their simple logical structure is better known.

Machine Tools for the Belgian Commission

Our Washington correspondent has just sent us the following list of unfilled requirements of the Belgian Commission which came over here to select machine tools for its country from the surplus stock of the War Department.

The tools enumerated on the list have so far not been found among the War Department's assortment and must be supplied from the stocks of the builders and dealers of this country.

Further information may be obtained from the office of the Director of Sales, War Department, Munitions Building, Washington, D. C.

Here is the list:

Lathes	Stud	2	
	Engine	136	
	Toolroom	4	
	Automatics	21	
	Chuck and turn	1	
	Turret	10	
			Total 174
Screw machines		15	
	Automatic	19	
	Turret	9	
			Total 43
Millers	Hand	2	
	Universal	7	
	Plain	1	
	Briggs	2	
	Vertical	9	
			Total 21
Slotters			9
Gear cutters			59
Cranes			4
Air compressors			2
Boring mills	Vertical	73	
	Horizontal	23	
			Total 96
Bolt and Nut Machinery			46
Drills	Radial	16	
	Upright	44	
	Multiple Spindle	25	
	Sensitive	10	
			Total 95
Grinders	Universal	4	
	Universal tool and cutter	3	
	Plain	6	
	Tool	3	
	Emery	23	
	Wet Tool	5	
	Internal	5	
	Twist Drill	3	
	Cylinder	4	
	Miscellaneous	10	
			Total 66
Hammers	Drop	1	
	Air	14	
			Total 15
Planers			6
Shapers	Crank	39	
	Traverse	19	
			Total 58
Saws	Circular	1	
	Cold	3	
	Friction	1	
			Total 5
Cutting-off machines			16
Punches and Shears			53
Key seaters			8
Presses			27
Furnaces			1
Centering machines			3
Sheet-metal working			8
Motors			7
Woodworking			28
Miscellaneous			39
Grand Total			889

Nickel Babbitt Minus Nickel

The name nickel babbitt does not always indicate that the alloy so designated contains nickel, as the effect of nickel on babbitts is similar to that of copper. As a matter of fact many such alloys contain no nickel. A nickel babbitt can be made as follows: Copper, 4 per cent; nickel, 0.5 per cent; antimony, 10 per cent; and tin, 85.50 per cent.—*Foundry.*

A Letter on Spoiled Work

Cleveland, Ohio, Jan. 31, 1920.

There is nothing unusual in our method of handling scrap with perhaps one exception—that we insist upon the foreman of the department signing his name to a detailed report of all the scrap made in his department. He also knows that a copy of this report goes to the superintendent, and also to the accounting department.

All scrap from each department is kept separate and is accumulated for thirty days, and at this time a post-mortem is held by the assistant superintendent and foreman on all this material.

The reason for keeping this material for thirty days is to impress the men responsible with the volume of scrap.

There is a very noticeable difference between a foreman passing two or three pieces of scrap daily and passing a large quantity of scrap at the end of thirty days.

The Peerless Motor Car Co.,
W. S. Staring, Factory Manager.

What Other Editors Think

Congress and the Merchant Marine

FROM *New York Times*

IN GIVING his views about the American merchant marine General Leonard Wood avoids details, as does almost every public man who ventures to say something about this irrepressible and difficult problem. All agree that we should have cargo carriers under the American flag in sufficient numbers to transport American products to all parts of the world. It is like the question of continuing to pay rent when a man should own the house he lives in. Why pay the British, Norwegians and Japanese for cargo space when we can build and operate our own ships? The war gave us our opportunity. Ships were built by the gross to carry troops, munitions and supplies to Europe, and the war over the building program was continued in order to found an American merchant marine and put the Stars and Stripes in ports where for forty years it was rarely, if ever, seen. "Let us see to it," says General Wood, "that, to as large an extent as possible, they (the ships) remain in the hands of Americans." He adds that "the Government will have to sell its ships at considerable loss," and there the General stops. He does not trust himself to details. He steps wairly.

Some questions of prime importance remain unanswered. Can the ships be sold cheap enough to tempt firms and companies to buy? What Government control shall there be over private operation, if any? Would it be expedient for the Government to lease some of its ships, retaining title? Is Government ownership to have any consideration? Can officers be provided for as large a merchant marine as would be able to compete with the British before they got the cream of the ocean-carrying trade? Can crews be obtained and kept at living wages, American standards? Is it practicable to operate American ships profitably without amending the navigation laws? Would passenger ships pay in competition with foreign liners not handicapped by prohibition laws?

The American merchant marine is in an inchoate state, waiting for Congress to do something, with Congress reluctant, backing away, fearful. The problem must soon be dealt with courageously and with resolution. One thing is certain—if those questions relating to operation cannot be answered satisfactorily, the sun rising on the American merchant marine will be obscured by clouds.

How To Increase Production

FROM *Manufacturers' Record*, BALTIMORE

INCREASED production on the farm and in the factory by intensive work, without any decrease in wages, should be unceasingly urged by every employer; but let us dismiss any thought of lower wages, for low wages are unfair to the laborers, and they breed suffering and unrest and Bolshevism. We must accept high wages and rejoice that the laboring man can through this change enjoy more of the comforts of life.

Low wages are in the end the costliest wages; low wages always have been unprofitable. The South was for years tremendously handicapped by low wages.

The laboring man has a right to receive more pay than in the past, and the public is the better off for the higher wages now paid.

If the people of this country will universally accept these truisms, they can then effectively give their attention to urging increased efficiency.

The man who was underpaid and who knew it was never in the frame of mind to produce the best results. Unhappiness and even hatred were gnawing at his heart in protest against the injustice which doomed him to want amid the luxury of the increasing wealth of the country. Laboring men as a whole are not different from other men—all are very much alike. Many of them are misled at times, but how many millions of others more blindly follow politicians than labor men blindly follow their false leaders?

"Come, let us reason together" should be the spirit of employers and employees. Let them come together and study each others' problems, and while employers should stand unalterably upon the right of the open shop for every man who wants to work, they can go a long ways to create a spirit of efficiency and production by a spirit of co-operation and sympathy.

Costing

FROM *Mechanical World*, ENGLAND

ALTHOUGH a great deal is heard from time to time of costing systems in relation to scientific management, there is plenty of evidence that insufficient attention is given to this important matter.

There is too great a disposition to place works costing systems in the hands of any superior clerk, whereas, of course, works costing is really an intricate affair and demands some knowledge, at any rate, on the part of a works assistant, of the particular business. Too much reliance is placed on the advice of the chartered accountant when he comes in for his periodical audit, whereas, in fact, the functions of a works accountant and the chartered accountant are widely separated in the sense that the former's duty should be to provide the works manager or the managing director, or both, with weekly figures, or, at any rate, continuous figures which will assist the management to come to decisions on matters affecting the policy of the business. It will therefore be seen what an important post that of the works and costs accountant should be.

It is with the object of improving the status of works and costs accountants and of providing them with some emblem indicative of proficiency that the Institute of Works and Costs Accountants has been formed, and it is quite clear that in the engineering industries there is great scope for the activities of such a body. The difficulties which arose between controlled firms and the Ministry of Munitions were eloquent of the manner in which even chartered accountants often fail to appreciate some of the finer points in works accountancy; and, perhaps, nothing was more striking in this connection than the question of overhead charges.


AMERICAN
INDUSTRIAL
MILL
WATCH WHEN I PUT THIS IN !
MACHINE TOOL MOTOR THE SOURCE of all POWER
WORLD TRADE CLUB
WOOLEN
COMPULSORY METRIC GEAR
AMERICAN MACHINIST

IT WONT MESH !

The Compulsory Metric Law

Read This—and Then Get Busy

THE World Trade Club is sending out to all parts of the country, thousands of post cards, addressed to the Bureau of Standards, Washington, D. C., urging legislation in favor of the *exclusive* use of the meter-liter-gram in the United States.

These cards are being signed by doctors, lawyers, school teachers and all sorts of people who know absolutely nothing of real manufacturing or export conditions.

Probably a hundred thousand of these cards have been mailed to Washington favoring one side of the question only, and many Congressmen have been led to believe, in looking over the reports on this flood of cards, that the whole country wants a compulsory metric system, when in fact nothing is farther from the truth. This dangerous propaganda *must be counteracted* by the same means the "millionaire's club" has employed.

Now—Mr. Manufacturer—Mr. Exporter—Mr. Man—**You** whose **very existence** depends on the smooth running of our industrial machinery which would be hopelessly crippled by a compulsory metric law—**all of you turn in and help in this campaign by taking up our proposition.** Also get the help of every association you belong to.

Chairman of Committee on Coinage, Weights and Measures,
House of Representatives,

Washington, D. C.

I am against all legislation tending to make the use of the metric system compulsory in the United States.

*Name*______________________________

*Address*______________________________

____

*Vocation*______________________________

Here is our proposition! We will furnish you, **free of charge,** all of the post cards you can use, similar to the one shown. Distribute these cards to your employees and have them sign and mail them. The cards are all properly addressed and need only to be signed and a one-cent stamp affixed and then they are ready for mailing.

Ask us for enough cards for every employee you have and all their friends who are against the proposed compulsory metric law.

Ethan Viall

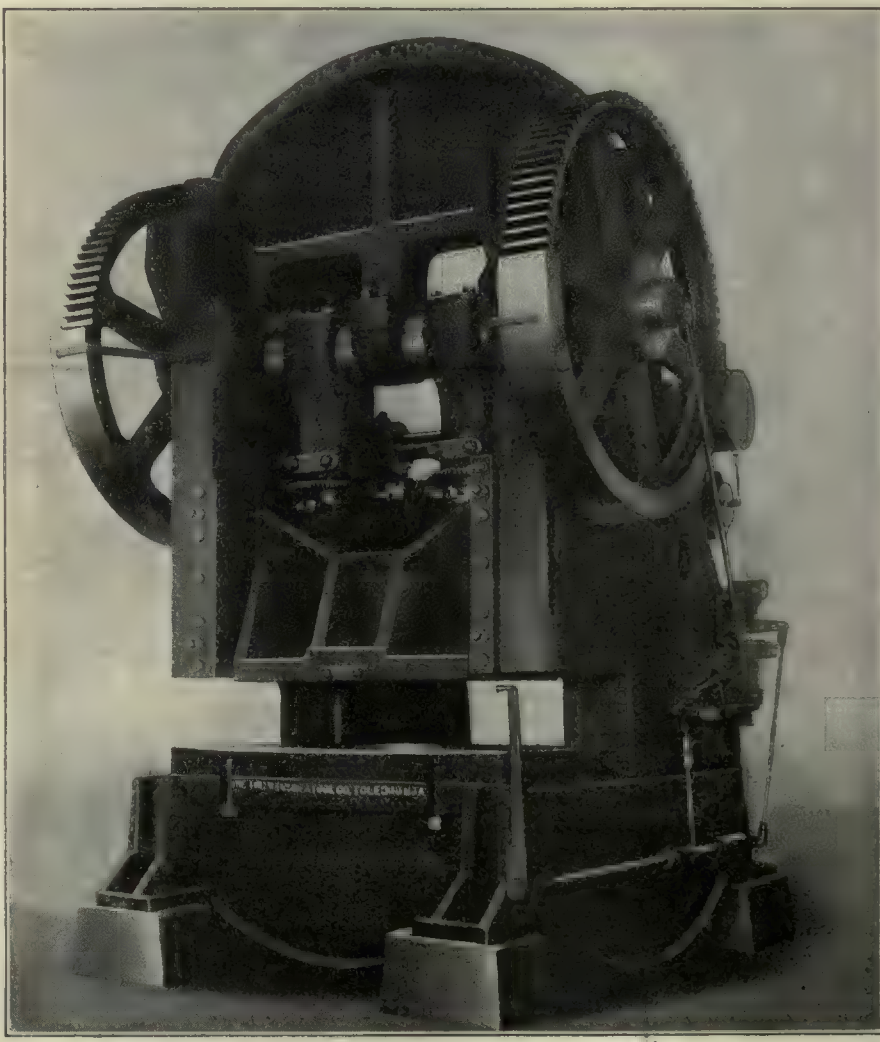
Editor

A Giant "Toledo" Power Press

The work of large power presses is now seen in many branches of industry, the stream-line body of the automobile being a good example of such work. The development of these useful machines has progressed steadily to meet the demands of designers of large commercial shapes.

WHAT is believed to be one of the largest deep-gap, double-crank presses that has ever been built, was recently completed in the shops of the Toledo Machine and Tool Co., Toledo, Ohio. The illustration gives a good idea of the design, but not of the size, as it stands eighteen feet seven inches above the floor line and weighs 175,000 pounds.

The frame is unusually massive and is of the four-piece steel tie-rod type of construction, the main stress being taken by two large steel tie rods 9½ in. in diameter running from the bottom of the bed to the top of the arch directly in back of the main gears. There are also two tie rods located in front of the bearings which hold the press together in a most substantial manner. The uprights are extra heavy to take care of the re-action and any lateral stresses. The feet of the uprights are made especially long and there is a pair of tie rods at the extreme back of the press, which, in addition to the main tie rods, bind the uprights securely to the base.



A GIANT TOLEDO POWER PRESS

The power is supplied by a 30-hp. motor running at a speed of 1200 r.p.m. allowing the press to make twelve strokes per minute. The twin-gear drive has a ratio of 29 to 1 and is well protected with guards. The large gears are each 86 in. in diameter with a 9-in. face; they are made from steel castings and the teeth are cut from the solid.

The crankshaft is 12 in. in diameter and is supported in 11-in. bearings.

The gearing is all self-contained so as to leave a space around the machine available for stock and other purposes. The two pitmans are adjusted simultaneously by means of screws operated by bevel gears, which may be noted from the illustration.

The press being specially designed for blanking it does not have a very long stroke and of necessity would not require a great amount of adjustment.

An item of particular interest is the clutch-operating mechanism. This is so arranged that the press may be started or stopped at any point of the stroke by means of the hand lever shown in the illustration, or by throwing backward a small weight shown in connection with the mechanism, the press will automatically stop at the top center. An idea of the magnitude of the machine may be had from the following dimensions: Distance from bottom of frame to top of arch, 223 in.; floor space over all, 150 x 159 in.; distance between uprights, 60 in.; distance from center of slide to housings, 20 in.; area of slide, 40 x 60 in.; area of bed, 56 x 85 in.; opening in bed, 24 x 56 in.

The press is known as No. 210-A and is particularly adapted for large blanking of the heaviest kind of stampings which are frequently used in automobile and other work of a similar character.

Some Effects of "Compulsory" Use of the Metric System

BY C. C. STUTZ

IRRESPECTIVE of any merits the metric system may have, the country in case the system is made compulsory will have to face:

1. A long *transition period.* As a matter of fact, old units never disappear. After eighty-three years of compulsion in France some of its industries, as, for instance, the textiles, still use the old units. Besides, 80 per cent of all screw products of the world are today manufactured on the "inch" basis, as found by the National Screw Thread Commission which met in Paris, France, in the fall of 1919.

2. The introduction of a *dual* system, because the habits of people cannot be legislated away.

3. A *confusion* between the two systems, becoming a most prolific source of error and expense.

4. A *cost* appalling in its magnitude, represented by the change involved in deciding on new standards, making new drawings, tools, fixtures, etc., which would seriously threaten during the transition period at least our system of "interchangeable" parts, this bulwark of our industry.

5. The *re-calculation* and establishing of new prices for every commodity raised and manufactured to conform with the new standards of length, weight and volume. In practically all such calculations the results will come out in fractions. If the higher value be taken the customer pays an increased price; if the lower be taken the seller loses.

6. The re-calculation of compound units and their use, such as pounds per square inch to kilograms per square centimeter; foot-pounds to meter-kilograms; English horsepower to metric horsepower, etc. Example:

1 lb. per sq.in. = 0.07030954 kg. per sq. cm.

1 kg. per sq.cm. = 14.222820971 lb. per sq.in.

7. The twofold application of the metric system, that is, one man may keep in the article he makes, say the dimension of 3 in. and call it 76.2 mm., another may change it to 75 mm. in order to avoid the fraction; thus standardization is no longer possible.

8. Even should Congress, as a preliminary measure, make the metric system compulsory only for the departments of the Government, the country would feel the effects of such legislation. This becomes apparent when we consider such a Government agency as for instance the Post Office or the Interstate Commerce Commission.

9. Thus we shall have: Complexity instead of simplicity; confusion instead of order; diversity instead of uniformity, and extra expense all around.

This article is especially valuable in view of the fact that Mr. Stutz is a mechanical and electrical engineer with thirty-four years' professional experience. He was educated in Switzerland and brought up to the use of the metric system. He came to the United States and became a naturalized citizen in 1890. After he came to the United States he familiarized himself with the English system of measurement and used it for about twelve years. He then spent several years in Europe as sales engineer for an American firm and then as chief engineer and shop manager of a large and well-known European concern building machine tools, engines, printing presses and special precision machinery. While with this firm he again used the metric system. On his return to the United States he once more took up the use of the English measuring system. From this, it will be easily seen that he has had exceptional chances to become familiar with the workings of both the metric and English systems in actual shop practice and in general engineering work. He considers that while neither system can be called perfect, his experience has taught him that the English system presents such decided advantages over the metric—especially when it is considered from the standpoint of the workman who after all represents the great mass of its users—that he is unalterably opposed to the making of the use of the metric system compulsory. He considers the inch with its divisibility to which the workman takes so readily, to be the foundation for the superiority of American machine design. In measurements of precision, our method of "interchangeable parts" has as its foundation the thousandth part of an inch, which is a dimension as readily used by the workman as the inch itself.

As far as the relations of the governmental departments to each other are concerned the general public would not be affected, except that Government reports would not be intelligible to the average man.

All departments come in touch with the daily and industrial life of the nation to a greater or lesser extent, and being obliged by law to use only the metric system would thereby create an intolerable situation.

The Post Office Department probably comes into closer touch with the public than any other. Postage rates go by weights, sizes of packages are restricted to certain dimensions. It can readily be seen what the effect would be should the department be obliged to insist on metric units.

Not in as close a touch with the general public, but affecting large interests, are many departmental sub-divisions or bureaus, as for instance the Interstate Commerce Commission. Being an integral part of the machinery of the Government and therefore bound by such a metric law, the Commission would ask that all reports, petitions and statistics it requires and receives from the railroads be given in metric units. Its decisions, rates and rulings would likewise be thus expressed. The railroads, using the present system of measurements, would thus be twice compelled to translate all figures submitted and received. The enormous amount of energy thus uselessly expended can only be realized by those familiar with this subject.

All governmental departments are large purchasers, and some are also producers. If specifications for goods to be bought call for these articles to be made to the metric system, it stands to reason that if they are obtainable at all, they will cost more and this added cost will have to be raised by increased taxation.

Only a brief outline can be attempted as to what will be required of the various railroad departments.

Tariff Department—Every item of the numerous tariff lists will have to be re-calculated to conform to the new dimensions, weights, volumes, distances and car dimensions.

Claim Department—Many shippers will not understand the new units, from which will arise errors, misunderstandings, claims and general dissatisfaction.

Freight Agents—The education of this force, scattered as it is along the line, will be a task of no mean proportion.

Purchasing Department—All existing specifications will have to be re-written. All commodities bought will have to be called for in metric units, with prices as per the new unit.

Real Estate Department—All deeds, plans, surveys, drawings and descriptions of properties, rights of way, etc., will have to conform to the new system and valuations figured as per new units.

Maintenance of Way Department—All earth, stone, gravel and brick work, fills, excavations, etc., will have to be ordered and executed in cubic meters. Mile-stones to be replaced by kilometer signs, etc.

Car Department—All capacities and weights marked on cars are to be changed to metric units; spare parts and repairs will have to be called for in the new language.

Engineering Department—Locomotives and all mechanical and electrical equipment of freight and passenger cars will have to conform to the new units as well as all apparatus for block and signal systems. Thousands of drawings will have to be changed in every office. The great difficulty the engineers will experience, however, will be from the fact that all engineering tables will have to be re-calculated, and this cannot be done until new standards have been agreed upon.

Accounting Department—The difficulties of this department, especially during the transition period will be very considerable. All printed forms will have to be revised.

Plan To Effect Co-operation between Industry and Schools

Realizing that technical schools are not serving to a maximum degree the industrial market to which they owe their existence, the Technology Clubs Associated, through their president, have called a meeting to be held at the Drexel Institute, in Philadelphia, on March 25, 26 and 27.

Dr. Hollis Godfrey is now president of the combined Technology Clubs Associated. As chairman of the engineering-education section of the Council of National Defense, during the period of the war, he foresaw the alarming shortage of trained men. He saw that there was much waste in present technical education and that to eliminate this waste, industry must be called upon to specify exactly what they require of the graduating engineer. The following plan was therefore formulated. Since that time every detail of the plan has been worked out and will be presented at the comming meeting in Philadelphia.

A number of industries seeing the need for betterment, each contributed $2,500 to carry on the study, and besides gave much of the time of their executives. Educators who were also engineers were sent out into the industry. They made a study of manufacturing processes to determine what knowledge was essential if men were to be successful in the various fields. They called conferences of executives and obtained facts regarding training from them. They sat in foremen's shop meetings, and talked with the operators at their machines. They made every effort possible to determine industrial demand upon the educational institution.

Their findings, together with the suggestion of the representative plants visited, were submitted to a board of educational experts who outlined courses and formulated plans to meet the industrial demand with the possible educational supply.

At the winter meeting of the Technology Clubs Associated there will be gathered representatives of educational institutions and of industry. At that time a composite plan for future education will be worked out. The results of preliminary studies and of the meeting will be put into a permanent record, in book form and in terms common to all concerned.

It is believed that a greater and better industrial America will evolve from this effort to bring about co-operation; that it will improve the quantity and quality of technical men with a reduction of cost in time and money; that it will increase production and increase industrial co-operation because all industrial history shows that these increase in proportion as technical knowledge and training increase; that it will accomplish these ends swiftly and with minimum friction because it is adapted to the human needs and desires of all those concerned with it.

The March meeting of the Technology Clubs Associated is undoubtedly the most authoritative meeting of the year, a meeting which will mark the beginning of the new era in educational-industrial co-operation.

One plant has eliminated the danger caused by falling over trucks left in dark corners by careless truckers by painting the trucks white.

SHOP EQUIPMENT NEWS

- Edited By -
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs and equipment

Prestometer Attachments

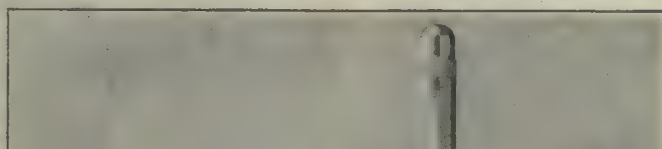
The Coats Machine Tool Co., Inc., 110-112 West 40th St., New York, has brought out three attachments for the prestometer which are illustrated herewth.

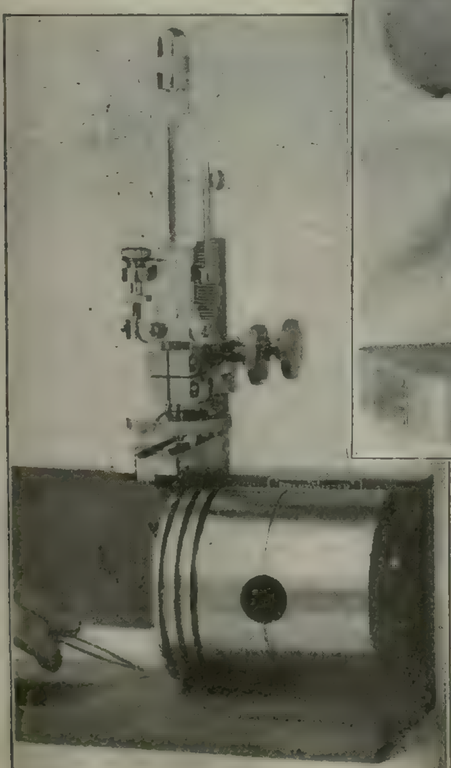
Fig. 1 is an attachment for gaging the bores of Hoffman ball races. The nose of the anvil block will accommodate races of one diameter only, interchangeable blocks being used for races of different diameters.

The gaging point, the location of which is indicated by the pencil, is connected to the instrument contact-point by a floating lever having a two-to-one reduction. It is evident that by changing the position of the race on the anvil by sliding and revolving, the gage readings will show if the hole is bell-mouthed, taper, oval or out of parallel, as well as indicating if the diameter is correct.

As the limits on this particular work are very close (+ 0.0002) (—0.0001), a glass having a very small bore is used for the indicating fluid, giving a magnification of 3,000 diameters. The graduated scale is 3 in. long, and the graduations are 0.30 apart, each graduation representing a 0.0001-in. variation in the diameter of the piece being gaged.

An attachment for gaging a 4½-in. diameter piston is shown in Fig. 2. In this case, as the limits are not so close as in the case of the ball races, the tube is made with a larger bore, the magnification being 250 diameters. As the gaging point and the instrument contact-point are connected by a two-to-one reduction lever, each ⅛ in. on the scale represents 0.001 in. in the work. The anvil indicated by the pencil is a ⅜-in. ball supported by a setscrew from below and a cup from above, and can thus be set to project beyond the surface of the base. In this case it is set to project about 0.011 in. so as to contact with the





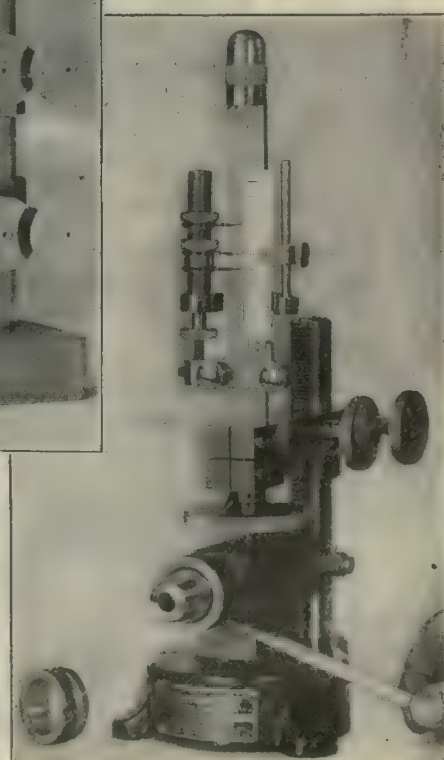


FIG. 1 (RIGHT). ATTACHMENT FOR GAGING BALL RACES

FIG. 2 (LEFT). ATTACHMENT FOR GAGING PISTONS

FIG. 3 (CENTER). ATTACHMENT FOR GAGING PINION-SHAFT HOUSINGS

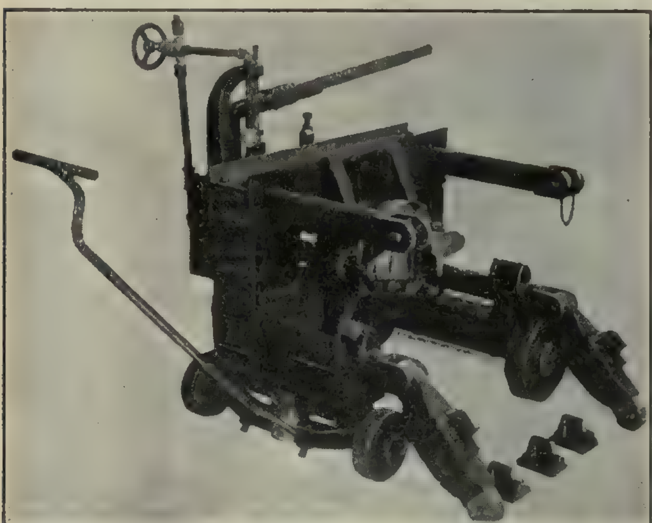
lands of the piston which are smaller in diameter than the body. In gaging, the piston should be located with the pin holes horizontal and the piston should be pushed longitudinally between the gaging contact and the anvil. The special scale will then show the correctness or variation from standard of the parts indicated thereon, the single pointer showing the normal height of the liquid. It is claimed that all parts of the piston, as indicated on the scale, can be gaged in one-quarter of a minute.

The attachment shown in Fig. 3 is intended for gaging pinion-shaft housings. This attachment is provided with two contact points, each of which is connected by a floating lever to the contact point of the instrument. The advantage of this arrangement is that it enables internal gaging to be done in a manner that has probably not been before attempted, in that internal stepped diameters can be accurately gaged even though they are not concentric either with each other or with the outside of the work.

In some cases it might be easier to support the work in V-blocks, but in this instance the outside diameter of the work was not the same throughout its length.

Hydraulic Rail-Bending Press

The accompanying illustration shows a hydraulic rail-bending press recently designed and built by the Hydraulic Press Manufacturing Co., of Mount Gilead, Ohio. The press is of 35-ton pressure capacity. It is of



HYDRAULIC RAIL-BENDING PRESS

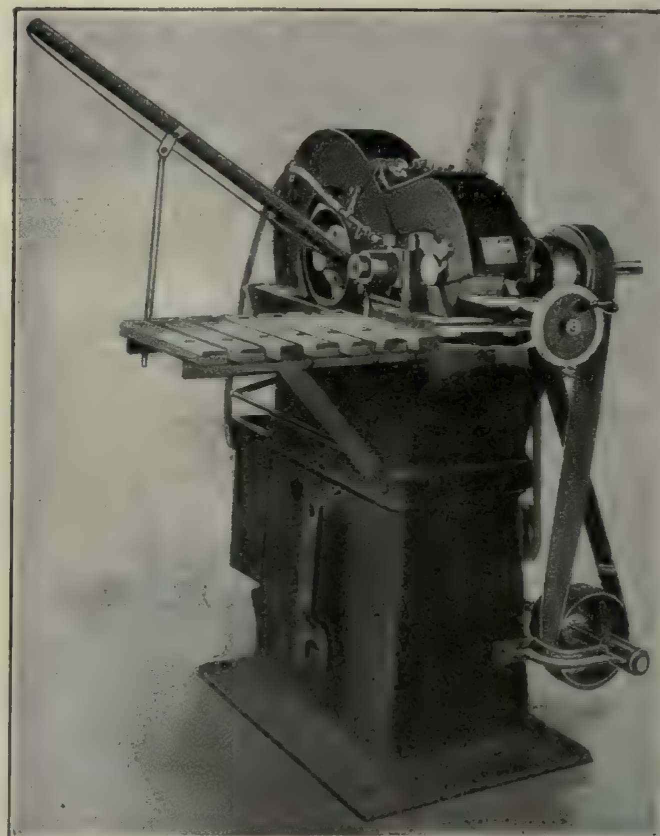
the horizontal type and mounted on wheels so that it can readily be moved and adjusted to the work. It is claimed that while the construction is comparatively light the machine is exceedingly rigid and ample in strength for the severest service that is likely to be required of it. Four cast-steel strain rods are rigidly attached to the double I-beams and are formed like clevises at their outer ends. Steel hinge pins at the bottom and steel locking pins at the top provide for connecting the two steel resistance heads when bending a rail. Each of the bottom strain rods has a steel roller mounted in such a way that when a rail is in the press it may be easily moved to apply the pressure at different points.

This press is fitted with a hand pump, spring relief valve, and a by-pass valve. The pump may be used for either high or low pressure. The low pressure may be used until the bending block meets the rail and the operator cannot operate the pump; then the high pressure is used.

The bypass valve is closed when the pressure is applied, and opened when the pressure is to be released. The spring pull-back device inclosed in the two small side cylinders returns the ram to its initial position.

Sanford Precision Centerless Grinding Machine

Russell, Holbrook & Henderson, Inc., 30 Church St., New York, has put on the market the centerless grinding machine shown in the illustration. This machine is intended for the precision grinding of rolls and other work having one diameter. In general, it consists of a grinding wheel to which is opposed a feed wheel of smaller diameter and inclined at an angle that may be



SANFORD PRECISION CENTERLESS GRINDING MACHINE
Capacity, 6 in. in diameter. Weight, net, 950 lb.; crated, 1,075 lb.; boxed for export, 1,500 lb. Floor space, 50 x 28 in. Height, 50 in. Grinding wheel, 20 x 3 in. Feed wheel, 10 x 3 in.

varied to suit the determined amount the work is to be fed past the grinding wheel. Ways for guiding the work are located between the grinding and feed wheels.

The carriage on which the feed wheel is mounted has provisions for adjustment due to wear. Its movement is by a screw having a micrometer head. Between the screw and the carriage there is a heavy spiral spring to provide a cushion which makes possible heavy cuts and fine finish. The rest which supports the work while being ground is a hardened round rod of a less diameter than the work and set below the centers of the wheels. The work being held between three almost equidistant points can not "whip" or jump and can only move endwise as directed by the feed wheel. The rod is supported at both ends of the carriage by special clamping nuts which also carry the guide for positioning

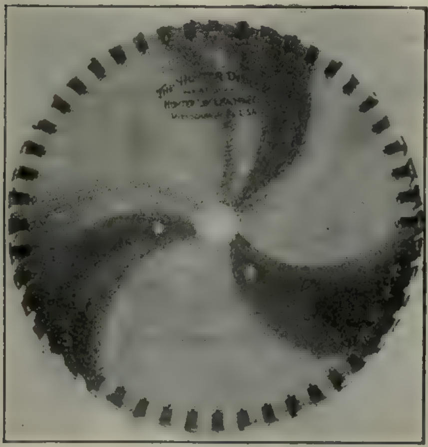
the work and carrying it directly to the grinding wheel.

The two diamonds are so mounted and the diamond holder is so arranged that the faces of both wheels can be turned at once. The drive is from a countershaft having a cone pulley so that the speed of the grinding wheel can be increased when worn. An arrangement of belts and worm gearing provides a reduction of speed for the feed wheel and a quick shift to high speed when this wheel is to be tried.

A feed chute is provided in which the work is placed and from which it is fed by gravity. The regular equipment includes two grinding wheels, one feed wheel, pump, tank, piping, countershaft, feed chute and all necessary wrenches. This machine is built by F. C. Sanford Manufacturing Co., Bridgeport, Conn.

Hunter Inserted-Tooth Saw

The inserted-tooth metal-cutting saw illustrated is a recent development of the Hunter Saw and Machine Co., Pittsburgh, Pa. The method used to fix the tooth in place employs a nut, screw and wedge arrangement. The half-round nut is fitted into a circular pocket at the bottom of the slot with a tongued and grooved joint to prevent side movement. The screw passes through the nut into a clearance hole drilled into the body of the saw. The tooth rests upon the hexagon head of the



HUNTER INSERTED-TOOTH SAW

screw and when adjusted is locked in position by the wedge. The wedge and tooth are also tongued and grooved on both sides to prevent side slip. Independent screw adjustment is provided for each tooth. The saw teeth are alternately round and square nose. The round-nose teeth, being slightly higher than the square, act as leaders. The body of the saw blade is made of a tough, hard, oil-treated steel. The teeth are made from high-speed steel and the screws are heat treated.

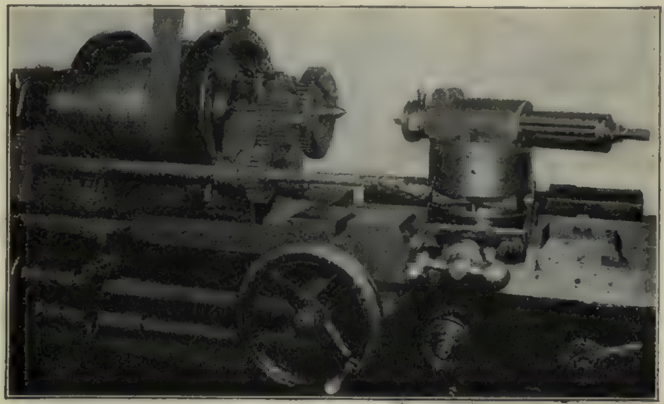
Peerless Duplex Saw Blade

The hacksaw blade illustrated is a product of the Peerless Machine Co., Racine, Wis. The fine teeth at the toe of the blade are provided to start the cut, preparing the way for the faster-cutting teeth which follow. In hand sawing it is sometimes customary to start the cut with a file or by drawing the blade backward across the work, a practice which dulls the blade very quickly. Coarse teeth will sometimes hog into the work when starting a cut or jump sideways, particularly when working across corners. The Duplex blade is said to start the cut smoothly. It is made in 16—32-in. pitch, in 10- and 12-in. lengths only. Blades are made either of tungsten steel hard all over or of carbon steel with flexible backs.

PEERLESS DUPLEX SAW BLADE

"Fullswing" Relieving Attachment

The relieving attachment illustrated herewith is manufactured by W. D. Jones, 1010 Wilder Building, Rochester, N. Y. This attachment is said to be capable of relievmg work internally, externally, or on the face

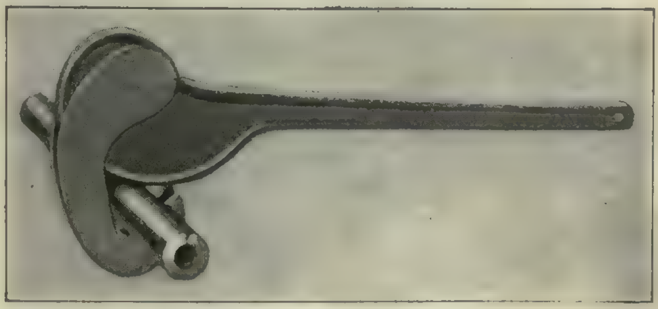


"FULLSWING" RELIEVING ATTACHMENT

either straight or at an angle. Cams with one, two, three or four steps, giving a standard relief of $\frac{1}{16}$ in., are furnished. These four cams will, in connection with the proper change gears, relieve work having from 2 to 28 flutes with the exception of 11, 13, 17 and 23. A vertical adjustment of $\frac{3}{8}$ in. is provided for the tool. This device will work in connection with the lathe taper-attachment and is regularly made to fit 13,- 16- and 18-in. lathes having compound rests. It can be furnished on order for 24- and 30-in. lathes.

Efficiency Pipe Wrench

The pipe wrench shown is manufactured by the Efficiency Device Corporation, 199 Eighth St., Long Island City, N. Y. The jaws are automatically closed by a spring inside the body of the wrench. The wrench is made in two sizes and styles, with teeth and without teeth, the latter being used for finished pipe. The grip is said to be positive for all working conditions of pipe fitting. The No. 10 wrench is used for pipe sizes ranging from $\frac{1}{8}$ to $\frac{3}{4}$ in. For the larger sizes ranging from 1 to $1\frac{1}{2}$ in. the No. 11 is used.



EFFICIENCY PIPE WRENCH

"Kavle" Correct Involute Contour Indicator

The contour indicator illustrated in Figs. 1 and 2 is being marketed by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. It is used to test the accuracy of the form of gear teeth. Its operation employs the same principle as used in laying out a true involute tooth form.

The indicator consists of a base plate, a plug of the same diameter of the base circle of the gear to be indicated, a plug or bushing to locate the gear and a straight-edge which is held in contact with the base

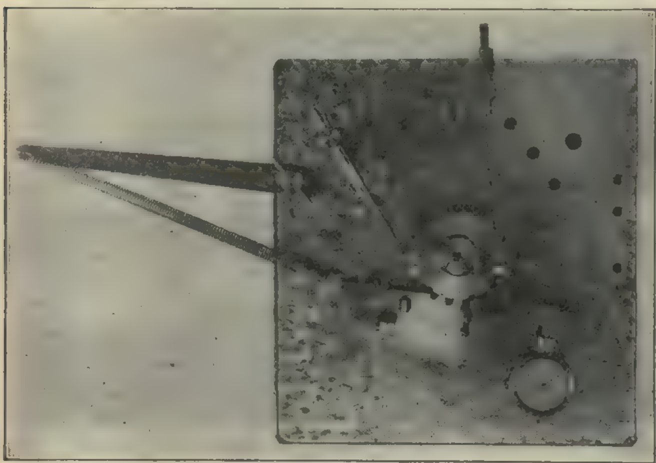


FIG. 1. "KAVLE" CORRECT INVOLUTE INDICATOR

circle plug by means of a steel ribbon, 0.002 in. in thickness, and a spring.

On the straight-edge is mounted a five-to-one lever, the short arm of which is in contact with the tooth form to be indicated, while the long arm is in contact with the plunger of an Ames indicator. The five-to-one lever multiplies the reading so that one mark on the indicator gives a reading of 0.0002 inch.

As the straight-edge is rolled about the base circle plug, the short arm follows the tooth form while the long arm remains in contact with the indicator plunger. If the tooth is of true form the pointer will not move. If the tooth is not of true form the indicator will show any deviation from within 0.0002 of an inch.

The indexing of the teeth may be indicated to the same degree of accuracy by means of the spring stop together with the indicator reading.

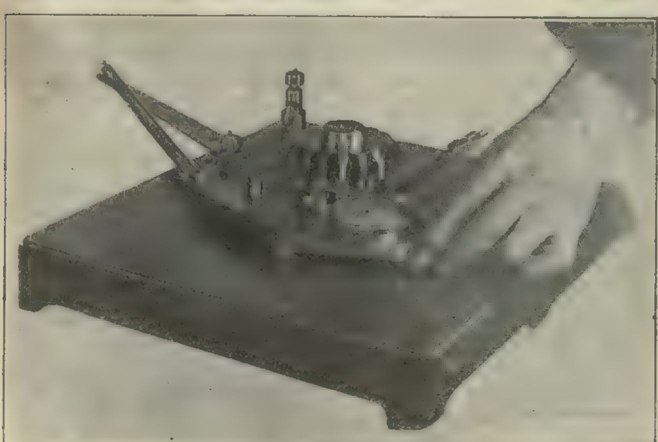


FIG. 2. TESTING A GEAR WITH THE "KAVLE" CORRECT INVOLUTE INDICATOR

Bush Safety Cartridge Fuse Remover

The tool shown is manufactured by the Bush Electric Co., Cleveland, Ohio, and is used for removing and replacing cartridge fuses from ½ to 1½-in. in diameter. It is made entirely of a special insulating compound, the parts being held together with small rivets. The small

BUSH FUSE REMOVER

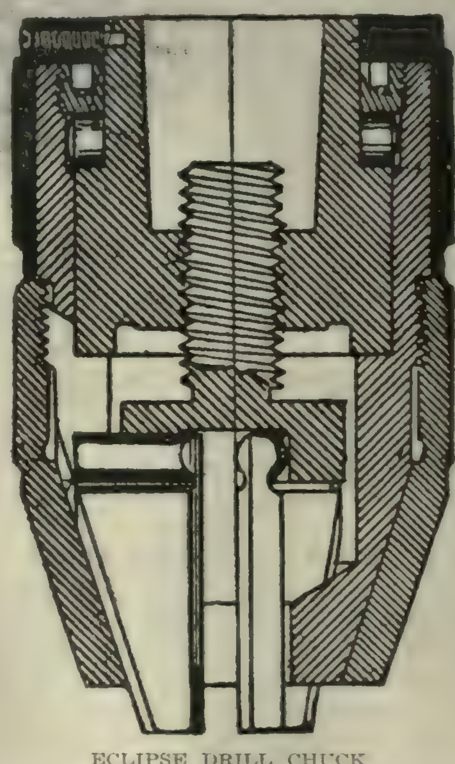
movement of the handles as compared with the large movement of the gripping jaws makes the tool very simple to operate, and useful when working around live circuits.

Eclipse Drill Chuck

The improved drill chuck shown in the illustration is made by the Nielson-Barton Chuck Co., 106 South Jefferson St., Chicago, Ill.

It is designed for hand operation only and is especially suitable for machines that have free running spindles, such as high-speed sensitive drilling machines and portable electric drills.

Two knurled collars are provided as grips for operating the chuck, one for each hand. As the gripping

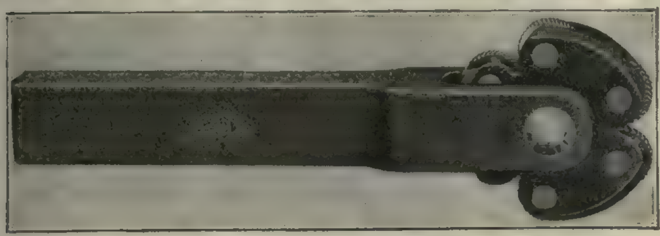


ECLIPSE DRILL CHUCK

power is augmented by the use of differential screws and the thrust is taken by a roller bearing it is not necessary to use a key or wrench in tightening the drill.

"New Britain" Knurling Tool

The New Britain Tool and Manufacturing Co., New Britain, Conn., has added to its line the multiple knurling tool shown in the cut. Each tool carries three pair



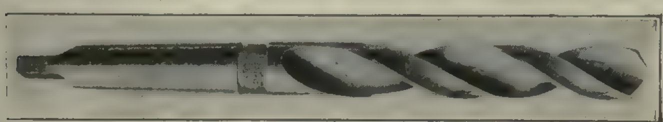
NEW BRITAIN KNURLING TOOL

of knurls for fine, medium or coarse knurling, and does away with the necessity for changing knurls.

The holder is drop-forged and case-hardened, the knurls are mill-cut. The tool is made in two sizes: $\frac{7}{8}$ x $\frac{1}{2}$ x $6\frac{1}{2}$ and 1 x $\frac{1}{2}$ x $6\frac{1}{2}$ in., the knurls being $\frac{5}{8}$ in. in diameter in each case and with a face width of $\frac{3}{16}$ and $\frac{3}{4}$ in. respectively.

Detroit Double "D" Drill

The drill shown is made from steel high in tungsten and chromium by the hot-rolled process, and is a product of the Detroit Twist Drill Co., Detroit, Mich. The flutes are formed straight by successive passes through special rolls at a temperature of 1,850 deg. F. The rolling



DETROIT DOUBLE "D" DRILL

process is said to refine the grain and produce a compression at the outer edges. The fluted blank is then reheated and twisted in a specially designed automatic machine.

The design of the drill with its wide flutes and 32-deg. helix angle is said to specially adapt it for deep drilling in tough or hard heat-treated material.

March Meeting of the American Steel Treaters' Society

An interesting address was delivered by Major A. E. Bellis, of the Springfield Armory, in the Auditorium of the Bush Terminal Sales Building on West 42nd St., before a comfortable audience composed of members and friends of the New York Chapter of the American Steel Treaters' Society, on the evening of Wednesday, March 17.

The subject of Major Bellis' address was Tool Hardening, with especial reference to the treating of high-speed steel to be used for cutting tools, and comparison of this material with carbon steels used for the same purpose.

The keynote of the speaker's talk was uniformity of conditions in heat treating. "There are," the Major said, "two hundred variables; two hundred excuses that the heat treater can put forward to explain a failure, and the only hope of getting a line on any one kind of high-speed steel is to handle it under absolutely uniform conditions so far as these latter are under the control of the treater, changing but one condition at a time, when conducting experiments and noting carefully the effect of one change before proceeding to another."

Major Bellis described the equipment in use at the Springfield Armory during the war, and told as one result of the laboratory experiments in treating high-speed steel how the record of five rifle barrels drilled to one grinding of the drill was raised to 36 barrels per grind with the same drill.

The speaker recommended the use of carbon steels for finishing reamers and similar tools which have comparatively light duty and depend upon their keen cutting edges for maintenance of size, and concluded with the sound advice "Don't use high-speed tools unless you have a high-speed job."

More About That Section Lining Kink

BY HENRY R. BOWMAN

I notice on page 204 of *American Machinist* an article by Geo. W. Childs in which he criticizes the use of a section liner. I would like to say that where any considerable amount of hatching is to be done such a device will cut down the time by fifty per cent.

There is one on the market that sells for about two dollars and it is all that can be desired. I have used it on Patent Office drawings requiring twenty lines to the inch; in book illustrating; and in Government work.

In hatching for steel, where there are two lines close together and then a wider space, I use a railroad

pen for the double line and set the section liner fc the wide space.

I think I can qualify as a practical draftsman according to Mr. Child's standard. I have had over ten years' drafting practice; I smoke, drink (used to before last July), cuss when occasion requires, and have some designs to my credit that are actually running.

Sparks from the World's

The Second Annual New York Aëro Show

The Second Annual New York Aëronautical Show under the auspices of the Manufacturers' Aircraft Association, Inc., was held at the 71st Regiment Armory, New York City from March 6 to 13. While not so large as its predecessor it was totally different in many respects and was quite successful from the standpoint of the exhibitors.

Unlike all former aëro shows, this one had no military planes or equipment on exhibition. The past year has been one of transition in the industry and the change from military to civil airplanes has been most complete. The only reminder of war in the whole show was a motor in the Wright-Hispano exhibit which was constructed with a 37-mm. cannon mounted to shoot through its propeller hub.

The most noticeable feature of the show was the tendency toward personal comfort for the passengers and simplicity and ease of operation for the pilot. Structural refinement developed by the war was evident on all machines, but the fundamental design of most of the planes did not resemble the standard military types. Much thought has been devoted to making flying enjoyable as well as safe, and because of this many departures from old practice were shown. The upholstery of many of the planes resembled that of high-grade motor cars and all four of the inclosed fuselages exhibited were finished in soft and luxurious tapestries.

A number of new motors were on view and showed many interesting developments. A tendency toward smaller motors of low power was in evidence and the radial motor monopolized this field quite thoroughly. The Cato motor, with two opposed cylinders, developing 72 horsepower, and the Lawrence three-cylinder radial motor rated at 60 horsepower, were good examples from a standpoint of development and construction in this class. An airplane engine exhibited by E. L. Beecher attracted considerable notice. It was an eight-cylinder motor with opposed cylinders.

The Hall-Scott Motor Co. had an exhibit of six-cylinder motors, which followed the general design of the Liberty motor and used many of its parts, including the cylinders, valve mechanism and pistons. The Curtiss, Aëromarine and Packard motors were shown and each made an interesting exhibit. For the first time, Liberty motors were actually placed on sale in competition with other motors.

More attention was paid to instruments than in previous years, and most of the planes were well equipped with them. Practically every airplane in the show had a compass in its equipment, and running lights on the wing tips and tails were also prevalent. The Pioneer Instrument Co. had its products in working order and attracted much attention. A realization of the need of good instruments on the part of fliers was apparent.

Three of the largest types of mail planes were exhibited: the Martin (in model form), the L. W. F. and the Thomas-Morse. The L. W. F. machine was by far the biggest machine in the show. It had a wing spread of 105 ft. and was equipped with three Liberty motors. The Thomas-Morse plane with a wing spread of 45 ft. was equipped with two 300-hp. Wright-Hispano motors mounted in tandem and had a useful load of 2,610 pounds.

A "Pony Blimp" exhibited by Goodyear was the first lighter-than-air machine to be offered to the public for sport purposes. It was 95 ft. long with a maximum diameter of 28 ft., and was propelled by a 40-hp. water-cooled motor.

Interesting exhibits of instruments and unusual airplane equipment were shown in exhibits of the Army, Navy and Bureau of Standards. The latter exhibit consisted mostly of instruments taken from captured German airplanes.

The increase in public interest in the airplane industry was shown in numerous ways and, as a result, many new aircraft publications have come into the field. Many demobilized Army and Navy fliers attended the show and their general attitude was that they wanted to get back into the flying game as soon as they could find an opening. The recent war caused many people to become interested in aviation in at least a general way and this interest was reflected during the show by the knowledge of the general public of things aëronautical.

The following is a list of the exhibitors as given in the official program: Aircraft—Aëromarine Plane and Motor Co.; Curtiss Aëroplane and Motor Corporation; Gallaudet Aircraft Corporation; General Motors Corporation, Dayton-Wright Division; Goodyear Tire and Rubber Co.; L. W. F. Engineering Corporation; Glenn L. Martin Co.; Ordnance Engineering Co.; Stinson Aëroplane Co.; Thomas-Morse Aircraft Corporation; West Virginia Aircraft Co. Engines—Aëromarine Plane and Motor Co.; Curtiss Aëroplane and Motor Corporation; Hall-Scott Motor Co.; Lawrence Aëro Engine Corporation; L. W. F. Engineering Corporation; Packard Motor Car Co.; Wright Aëronautical Corporation.

Government Exhibits—U. S. Army Aviation, U. S. Navy Aviation, Army and Navy Radio, Bureau of Standards.

Instruments—Pioneer Instrument Co., S. Smith and Sons Co.

War Department Not Connected With French Negotiations

In connection with the orders for machine tools being placed in this country by the French and Belgian commissions, it is pointed out at the office of the Director of Sales that the War Department is in no way connected with the negotiations which are taking place between these commissions and private manufacturers. Some manufacturers are under the impression that because the French have been extended credit to make their purchases of machine tools, private credits can be arranged through the War Department. This is not the case. The War Department simply agreed to allow the French to have such surplus tools as they might desire, on credit. While the Director of Sales is anxious to be of service to American manufacturers and to the French Commission in assisting the French to round out their needs, the private purchases of the Commission are in no way being financed by the Government.

Since the French Commission has been in the United States machine tools have been accepted to the extent of one million dollars. Much heavier purchases are expected to follow promptly. The Commission was somewhat disappointed by the results of its trip in the West as few tools suited to its needs were found. The trip to Bridgeport and to the Watervliet arsenal, on the other hand, were very successful. Practically all the machine tools available at those points were accepted by the Commission. The next trip will be to inspect stores of tools at Rochester, N. Y., Springfield, Mass., and Boston. St. Louis interests are extending an urgent invitation to the Commission to visit that city where considerable quantities of tools are available.

All of the War Department's sales to the Commission have been at domestic prices. The French are paying for crating, loading and transportation to the seaboard.

Barber-Colman Co.'s Clubs

The Barber-Colman Co., of Rockford, is taking delight in providing for the welfare and recreation of its employees. A mutual benefit department, bowling leagues, a gun club, a crack band and a girls' club are among the more prominent bodies within the B-C group. Easy banking facilities are also provided through a special arrangement by the Barber-Colman Association office.

Industrial Forge

Carl F. Deitz Reports on the European Situation

Carl F. Deitz, vice president and general sales manager of the Norton Co., had unusual opportunity to study industrial conditions abroad during his recent European trip, for he came into intimate contact with manufacturers of Great Britain, France, Germany, Holland and Belgium and, to some extent, with those of the Skandinavian countries. He returns to America convinced that in a relatively short time the American market will be seriously influenced by the flood of manufactured goods produced in European mills, basing his opinion on what the manufacturers across the water are doing in the way of preparations.

The Europeans have learned a lesson from the war, said Mr. Deitz. They found that they could not depend upon their own resources, that when they came face to face with the emergency they must turn to America. They realized at last in spite of the discrepancy of wages existing in their favor American mass production methods must always get the upper hand. Now the European manufacturers are saying that "if America could do these things with her tremendously high wages, think what we can do with the same methods and cheap labor!"

Consequently, continued Mr. Deitz, Europe is abandoning its hit or miss methods and will specialize. With specialized labor-saving tools and the methods employed in this country—and some of the best American brains are going with the foreign manufacturers to develop this idea—production per hour per man will get higher and higher.

However, the threat of European invasion is not for the immediate present. The handicap of raw materials is too great, and prices abroad, especially in Great Britain, are tremendously high. But later, perhaps, by two years from now, when industry over there has adjusted itself and the producers both of raw materials and of finished products are on their feet again, the invasion of America will begin.

Mr. Deitz expects that European machine-tool builders will become important factors in the American trade. One well-known British distributor said to him: "You have come into our market and competed. Why should we not go into your market?" They are making very good machines abroad, said Mr. Deitz, some of them perhaps not so good as the American tools, but good machines none the less, and with quantity production the Europeans should be formidable competitors here. The higher the grade of American machine the less the competition will be. The better the methods and better the designs of machines made abroad, the greater the hold that the foreign builder will have on his home market. This is also true of German and French machinery. Thus, American export trade will be affected.

The British are tremendously aggressive at this time in developing their foreign markets. They have agents all over the world preparing to undertake a vast business. They are getting in touch with prospective customers, putting them on their feet when necessary, and closest co-operation is being developed between the mother country and her colonies, that business which one cannot handle may be diverted to other British dominions. An important influence in developing this foreign trade lies in the associations organized for the purpose, each for its own industry as, for example, the Association of British Machine Tool Builders.

The Stanley Works Merger

The latest step in the merger of the Stanley Rule and Level Co. and the Stanley Works, both of New Haven, Conn., was a meeting held recently by the respective directorates who went over the outlines of the plan for the culmination of the deal. The directors of the Stanley Works compiled a statement for the stockholders which set forth the proposition to make the purchase and explained how it will work out.

The directors of the Stanley Rule and Level Co. received the outline and prepared a statement for the stockholders setting forth the terms of the purchase and the plan for the sale. The meetings of the stockholders will follow shortly. In view of the proposed merger there is considerable interest in the out-of-town concerns of the Stanley Rule and Level Co. which are as follows: The Roxton Pond plant where the Canadian plant of the Stanley Rule and Level Co. is located; the Roxton Tool and Mill Co. which now employs sixty people; the Plantsville shop which manufactures small tools; the Atha Tool Co., of Newark, N. J., the largest branch of the company, where 400 people are employed; the John S. Fray Co. which manufactures bits, etc.; and the Eagle Square Manufacturing Co., of South Shaftsbury, Vermont.

An Amendment Adopted To Keep the Arsenals Going

During the consideration of the Army Reorganization Bill, the House adopted an amendment directing the Secretary of War to cause to be manufactured or produced at the Government arsenals, and at Government-owned factories, all such supplies needed by the War Department as such plants are capable of producing. A proviso makes it mandatory that the cost of these supplies shall not exceed the cost if purchased in the open market. It is also provided that materials produced at these Government plants must meet the same tests and requirements as materials purchased from private manufacturers.

In urging the acceptance of the amendment, Representative Sanford of New York made the following statement:

"The Government has invested at Watervliet over $20,000,000; there is employed there at this time a force of highly trained mechanics gathered together from all parts of the country to meet the emergency created by the war. The arsenal is now equipped to do work of the finest grade involving that most intricate of all machine work necessary to produce modern cannon. There are about 2,500 men employed there at this time, a large part of whom the Government plans to discharge in the near future.

"I assure you that this plant can do as high-grade machine-shop work as the Bethlehem Steel Co. or any other private concern.

"The purpose of this amendment is to compel the executive officers of the Government to have Government work done at such arsenals as this and to cease handing out appropriations to private manufacturers. It is perfect nonsense to allow such an investment as this to go to waste and at the same time turn over work to be done by contract by private manufacturers.

"Unfortunately under the provisions of the general law appropriations of money for work to be done in a Government plant lapses at the end of the fiscal year for which the appropriation is made. This amendment removes this restriction and continues the appropriation for an additional year. This limitation of law has often compelled the Ordnance Department to turn work over to private manufacturers."

"When a man tells you that you can live without working, ask him where he gets his."—*Industry.*

Trade Letter from Our London Correspondent

London, March 5th, 1920.

The three British Industries Fairs held in London, Glasgow and Birmingham close today. It is too early to give an exact idea as to the volume of business transacted, but according to official statements heavy orders have been received from the United States and from Holland, Switzerland and Spain; also from Scandinavia. In fact, outside of late enemies, all the countries of Europe, new and old, have one way or another been mentioned in connection with business transacted, while buyers have given orders from Japan, Burma and Iceland; this apart from the British dominions and colonies, in connection with which Canada has been specially noted.

In Birmingham, toolmakers seem to be rather disappointed. However, in the engineering trades, inquiry for special tools has been satisfactory, while business is expected to follow from the many inquiries relating to foundry plants. The inquiries seem to be mainly British, though a few of the European countries are known to be seeking new equipment.

At the last meeting of the London Iron and Steel Exchange the most noteworthy feature seemed to be the absence of sellers. Apparently, an advance in rates has been decided on but not the extent. Meanwhile, a report from Yorkshire shows that the price of steel billets is now more than £20 a ton, or between three or four times the pre-war price. Despite this, orders pour into Sheffield, where a steel famine is regarded by some authorities as not far distant. The sales to America of high-speed steels have improved, and tool-steel price advances have been effected as follows: From March 1, 3s. 2d. for 14 per cent tungsten qualities, to 3s. 9d. for better qualities. The reasons stated are both increased cost of production and the great demand. Special steels have been in request, but according to a local report the makers can cope with the call. In the Birmingham district 5s. a ton has been added to the price of coke and the probability is that pig iron will be raised by 10s., this being based on 1½ ton of coke to 1 ton of pig iron, with allowance for the extra amount of moisture in coke as now supplied.

Complaints are prevalent as to the lower rates of production now obtained from all classes of workers. Some evidence on this point was given recently at the Law Courts, London, W. C., during the course of the inquiry on the minimum wage demand by dock workers. One witness from Glasgow stated that the rate of discharge on ore is now 21 tons an hour, as compared with 29.6 tons in 1913 and 64 tons in the middle of 1918. The explanation of the latter figure is that at the request of the Ministry of Munitions piece-work was introduced as a war measure, while last year there was a reversion to time work. Not only had the output decreased by 66 per cent, but the number of men employed had been increased in the ratio of 15 to 19.

Among firms that, as a result of the demand during and following the war, are extending their facilities for the production of smaller articles in the equipment of the machine shops is B. S. A. Tools, Ltd., really a section of the well-known Birmingham organization, with which the Daimler and a number of other companies are associated. The firm of Burton, Griffiths & Co., Ltd., a subsidiary company, is the distributor. Recently, the engineering press of Great Britain was invited to inspect the shops of the small-tool side and were entertained at luncheon.

The B. S. A. have four factories, three in the Birmingham area; namely, at Small Heath, Sparkbrook and one on a Coventry Road site, with another factory at Redditch.

This firm manufactures standard twist drills in high-speed steel up to 3-in. diameter, milling cutters, reamers, slitting saws, gages of all types, taps and dies, jigs, fixtures and special machines. The firm proposes, in fact, to act as consultants in the engineering workshop equipment, advising, if necessary, on the layout of a plant for a given product in quantities; supplying machines and small tools needed, and planning operations.

During the war girls formed about one-third of the personnel employed in the company's shops. To judge by inspection their numbers have been considerably reduced. The weekly output then averaged about 15,000 cutters of all kinds, about 1,000 jigs and fixtures, some 800 gages and 40,000 drills of various sizes, the last without reference to drills supplied for the firm's own works. As to the production of machine tools, special spline milling machines for finishing the fins on the Bentley rotary airplane-engine cylinder head are mentioned. For this purpose, as soon as the demand was evident, designs were made, patterns of castings obtained and the first four machines were built in eight weeks, the total of fifty-eight eventually being produced, so that at the time of the armistice the weekly output was some 2,000 heads, each of which, it may be mentioned incidentally, passed through 75 operations. The plant at Sparkbrook includes about 2,000 machine tools, chiefly American, including Hendy, Brown & Sharpe, Gisholt, Cincinnati, Cleveland, Greenfield and Herbert & Churchill productions.

William L. Kaiser Promoted

William L. Kaiser, for the past four years sales manager for the Sumter Division, Splitdorf Electrical Co., Chicago, has been promoted to the position of general sales manager. His many friends will receive the announcement as good news. Mr. Kaiser holds the respect and love of every member of the Splitdorf organization and is generally known as "Bill."

Previous to his connection with the Splitdorf company, he spent a number of years on the road as sales engineer for other manufacturers of magnetos and ignition specialties, and through

these years of constant work has become very widely acquainted in the tractor, truck and farm-engine fields.

This change does not mean that Mr. Kaiser will be off the road, but necessity will confine him to fewer calls. He expects to multiply his own ideas and methods through the salesmen working under his direction.

Maryland Company Takes Over Black & Decker Plant

The Dieffenbach-Westendorf Manufacturing Co. has been incorporated under the laws of Maryland with $80,000 capital stock divided into 800 shares, and has taken over the special machinery department formerly used by the Black & Decker Manufacturing Co., 105-115 South Calvert St., Baltimore, Md. The last-named company recently moved into larger quarters at Towson, Md. The equipment which was used was left at the old building and this, too, has been taken over by the new corporation.

The company will continue using the plant for the manufacture of special machinery of all kinds. The incorporators are Otto W. Dieffenbach, who was secretary of the Black & Decker Co.; John W. Westendorf, who was shop superintendent for the company, and George M. Kimberly, who will continue as treasurer of the Black & Decker Co. and fill the same office with the new company.

Small-Arms Plant for Chile

Ambassador Joseph H. Shea has cabled from Santiago that the Chilean Government has contracted with the Niles-Bement-Pond Co., an Ameriacn corporation, for the construction of a small-arms factory.

Rockford Machine-Tool Companies in Good Condition

The situation in the Rockford, Ill., machine-tool factories never presented a rosier aspect than it does today, at least with respect to volume of business in hand and in sight.

Some difficulty is being experienced in securing sufficient material, and just the right kind of help, but the factories are taking these small hurdles in as cheerful a manner as possible and are going ahead with the object of turning out just as large a volume of goods with the forces in hand as is possible.

A recent epidemic of influenza seriously handicapped the Rockford concerns while it lasted, and the effects of the renewal of the "flu" have not been fully dissipated. In a number of the factories the working forces were cut down 20 per cent while the epidemic was at its height.

Many of the factories are greatly pressed for room in which to take care of the expanding business, both domestic and foreign. Buildings now under way will increase the capacity of a number of the concerns this spring and by summer the Rockford factories will be in a position to give improved service in delivery almost in every line.

Among the concerns which will profit by additional floor space this spring will be the Ingersoll Milling Machine Co., Anderson Brothers Manufacturing Co., Mechanics Machine Co., Barber-Colman Co. and Eclipse Fuel Engineering Co.

General Electric Leases Remington War Plant

The great munition plant that the Remington Arms U. M. C. Co. constructed at Brideport during the war has been taken over under lease by the General Electric Co., with the option to purchase, Joseph P. Day, who engineered the transaction, announced recently. More than $7,000,000 was involved in the deal.

The factory is probably the largest of its kind in the country. It was built purely for the filling of war orders, and the normal work of the Remington Co. will still be carried on in its long-established Bridgeport plant.

Covering a tract of about forty acres, the General Electric Co.'s new structure affords actual floor area of 1,555,257 sq.ft. When in full operation it will employ several thousand workers.

C. L. Reierson, president of the Remington Arms Co., said: "The plant that has just been taken over by the General Electric Co. was one of our surplus properties. The leasing of this property has no effect whatsoever on our U. M. C. plant at Bridgeport."

Two Large Saws for Western Forests

Henry Disston & Sons, Inc., of Philadelphia, have recently finished two of the largest circular saws ever made. They are of the spiral inserted-tooth type, and are to be used by a well-known concern in the West for cutting shingle blocks from the large trees of that section.

Each of the new saws measures 108 in. in diameter, and 190 teeth are inserted in the rim. One may gain some idea of the size of the new saw by comparing it with a 54-in. saw, which is large as we ordinarily think of the term. The 54-in. saw requires for its making an ingot of steel weighing approximately 180 lb. and its weight when finished is about 125 lb. The 108-in. saw started out as an ingot weighing 1,140 lb.; and, after reheating, rolling and trimming, the remaining weight was about 795 lb. In size, a 54-in. saw is apparently just half that of the 108-in. one, but actually the 108-in. is four times the size of the former.

In the making of large circular saws, Henry Disston & Sons have had long experience. As long ago as 1876 they made one 100 in. in diameter for exhibition purposes. Some years after they made another 100-in. saw for cutting stone, each tooth of which was studded with a black diamond to give the necessary cutting edge.

The turning out of a huge saw is a difficult process when one realizes that the ingot must be not only fashioned into a plate exactly straight and true, but also that the steel must be uniform in quality throughout the entire surface. Such are the facilities and improvements at the Disston Works that the standard machinery was used throughout. All that was needed in addition was extra man power as "holders-up" during the smithing process.

To fully appreciate one of these immense saws, one must see it in action. At full speed, the teeth are traveling about 130 miles an hour. It is then that the forcefulness of this flying mass of toothed steel becomes strikingly impressive, and the sight of this huge saw, resistlessly and quickly cutting an immense log, is long remembered.

Trade Currents from New York, Cleveland and Chicago

New York Letter

The machine-tool business for the past week showed a decided improvement over the week preceding, with all lines active. Deliveries show some indication of easing up, and one firm is quoting certain types of millers at 40 to 60 days, but, generally, delivery dates remain about the same as at last writing.

Grinding machines were in good demand on last week's inquiry lists. New England industries entered the New York market for all types, and prompted a statement by a leading firm that its New England grinding-machine business was much heavier today than on October 15 of last year when a high level of sales was reached.

Inquiries of late have been somewhat indefinite, being accompanied in many instances by statements that the inquirer "expects to be in the market within the next few months." There is, however, a substantial volume of inquiries that are being turned into orders. A fair volume of inquiries for estimating purposes is going through also.

Among the railroad buyers in the New York market last week were the Boston & Albany, Boston & Maine, Lehigh Valley, and the C. R.R. of N. J. It is reported that the lists have been completed, and that the roads mentioned are temporarily out of the market.

The Otis Elevator Co. issued a list during the past week of about fifteen items, and the Westinghouse Electric and Machine Co. has been inquiring for equipment to be used in its Springfield plant. The Port Wentworth Lumber Co., of Savannah, Ga., and the Stockham Pipe and Fitting Co., of Birmingham, Ala., were among the Southern interests represented in last week's business.

The Commercial Union of America reports a demand from its Levant houses for lathes, millers, automatic screw machines, and general machine-shop equipment.

Cleveland Letter

The northern Ohio machine-tool market closed the week steady with shapers leading the demand. A good volume of business was represented by drill presses, planers, and twist lathes.

Orders continued small, single-piece orders prevailing. Much of last week's business was placed by garages and repair shops, with general manufacturing buying lightly.

There is considerable inquiry from points outside of the Cleveland district proper, chiefly for used equipment.

Shop material most in demand is scarce, while lines in light demand are reported plentiful with spot delivery offered.

Some export business has been placed with Cleveland dealers during the past week, France, England, and several South American countries buying. Drill presses form the bulk of the business.

Chicago Letter

The last fortnight has witnessed a perceptible falling off in business. Dealers are a unit in stating that store trade, that is, buying by callers, has materially declined, and with one exception are agreed that inquiries and orders received through the mail are in lesser volume than has been the average for the past three or four months. This reduction is not so great as to cause any uneasiness, but is rather welcomed by all concerned. The volume of business remaining may be appreciated from the fact that all houses report all their salesmen busy on specific prospects.

The cause of this slackness is problematical. Many dealers believe it to be occasioned by difficulty in machinery users securing raw material. In some cases, when machines on back order have been ready for delivery, dealers have been requested to take them off the buyer's hands, as the purchaser was unable to secure materials with which to operate the equipment. In each case, a resale of the machine in question was easily made, as deliveries in all lines are still far behind. Other dealers believe high prices to be the cause. In view of the fact that prices in many other lines are showing a tendency to seek lower levels it may be that prospective purchasers feel like awaiting developments. With raw material conditions as they are, with labor still scarce and high priced, and with manufacturers booked solid for months to come, any anticipation of lower prices at present seems unfounded.

The future of railroad purchasing is a matter of much conjecture. It is fairly well understood that at least two of the great Western systems are preparing comprehensive lists of requirements. No requests for bids on specific items have as yet been received by the trade.

Government sale of equipment at the old Symington plant continues. There remains but little unsold. The St. Louis District Salvage Board is forwarding weekly bulletins of miscellaneous equipment offered for sale. The current list includes eight drill presses, nine screw machines, thirteen presses of various types and a number of lathes ranging in size from 24. in x 12 ft. to 27 in. x 14 ft. Tools will be sold to the "first bidder submitting price, considered, by the Government, to be a fair value."

Sales in Chicago district continue to be widely diversified in character and to come from all classes of industry. Buying by automobile manufacturers has been reduced to a very small item, but no other industry is conspicuous either as a heavy or light buyer. Deliveries are even worse than they have been. Three large dealers report that the volume of their deferred deliveries is increasing about $30,000 a month.

Short News Notes

The Alloy Electric Steel Casting Co. will erect a plant at Warren, Ohio, on a site secured by the Warren Chamber of Commerce.

It will manufacture a general line of auto parts, with a small casting foundry in connection.

N. L. Coxey is president; A. T. Ranck, vice president, and J. S. Coxey, Jr., secretary and treasurer.

* * *

The Cleveland Duplex Machinery Co. celebrated its second anniversay with a dinner and theater party.

President G. Jack Hamkey presided at the dinner, and headed the list of speakers, which included other officials of the company.

* * *

The Peck Spring Co., Plainville, Conn., has elected D. C. Peck, president and secretary, and D. K. Peck, treasurer and general manager of the concern, which was recently incorporated.

Soft Coal Output Gains

The weekly report on the production of coal, compiled by the Geological Survey Department of the Interior, shows an increase in the output of bituminous coal during the week ended March 6. The total output (including lignite and coal coked) is estimated at 10,352,000 tons, an increase over the preceding week of 207,000 tons, or 2 per cent.

Telegraphic reports received from two out of the nine anthracite carriers indicate a slight decline in production during the week ended March 6. No estimate of the total production can yet be made.

Obituary

Doctor A. L. Garver, member of the Industrial Board, was stricken with a cerebral hemorrhage on Tuesday, March 2, while on a business trip to Altoona and died almost immediately. Doctor Garver had been a member of the Industrial Board since Dec. 1, 1916, representing the employers of labor of the State of Pennsylvania.

Domestic Exports of Metal-Working Machinery from the United States by Countries During December, 1919

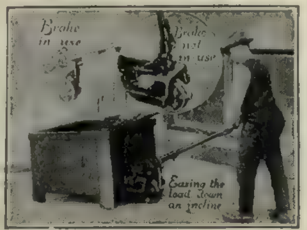
Countries	491 Lathes	492 Other Machine Tools	493 Sharpening and Grinding Machines	495 All Other
Austria-Hungary	$4,875	......	......	......
Belgium	12,720	$14,449	$540	$49,012
Denmark	1,019	......	4,489	2,330
France	136,419	191,095	63,908	572,351
Greece	......	......	17	......
Italy	2,032	29,703	13,385	53,445
Netherlands	4,340	7,472	286	4,121
Norway	2,672	5,433	2,068	8,577
Portugal	......	65	674	......
Russia in Europe	6,765	5,148	......	2,164
Spain	30,389	22,322	7,176	50,576
Sweden	15	137	233	......
Switzerland	2,933	16,124	6,462	15,451
England	171,708	212,996	62,277	375,269
Scotland	......	2,136	197	2,587
Canada	68,317	196,883	39,456	235,762
Costa Rica	......	71	......	......
Guatemala	......	......	......	199
Honduras	31	......	200	......
Nicaragua	......	352	......	1,260
Panama	939	660	......	99
Salvador	795	......	......	270
Mexico	88,994	2,157	2,783	4,690
Newfoundland and Labrador	......	1,023	......	250
Jamaica	61	......	......	......
Trinidad and Tobago	......	76	......	142
Other British West Indies	......	......	......	2
Cuba	14,594	16,099	897	20,871
French West Indies	......	60	......	......
Haiti	......	17	......	......
Dominican Republic	90	45	......	3,933
Argentina	12,245	3,208	378	23,174
Bolivia	......	......	14	......
Brazil	5,844	1,569	1,021	5,719
Chile	4,408	17,716	3,423	45,925
Colombia	85	99	21	1,575
Ecuador	584	......	......	......
British Guiana	......	289	20	1,283
Peru	572	8,798	......	12,342
Uruguay	27	1,063	......	......
Venezuela	......	3,748	......	1,230
China	......	1,187	45	989
British India	5,891	12,623	12,476	133,203
Straits Settlements	......	325	......	......
Dutch East Indies	130	4,315	1,106	4,750
Hongkong	......	220	62	1,722
Japan	8,098	14,054	7,523	31,884
Siam	......	87	......	......
Australia	9,524	31,557	9,848	33,054
New Zealand	3,787	1,197	2,752	490
Philippine Islands	1,201	1,709	300	1,139
British South Africa	3,815	8,637	705	13,930
French Africa	......	246	......	......
Morocco	......	27	121	98
Egypt	1,813	......	......	......
Total	$607,732	$837,217	$244,863	$1,715,868

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Attachment, Transveyor Brake
Cowan Truck Co., Holyoke, Mass.
"American Machinist," March 4, 1920

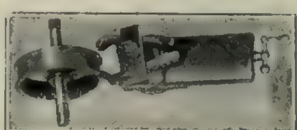
The brake shoe is normally held from contact with the wheel by a flat spring. A pendant hooked up to the tongue may be released and dropped into a notch in the lower part of the brake shoe. When in this position, pressing down on the tongue will apply the brake. The brake shoe is lined with raybestos.



Milling Machine, Crankshaft Cheek
Newton Machine Tool Works, Inc., Philadelphia, Pa.
"American Machinist," March 4, 1920

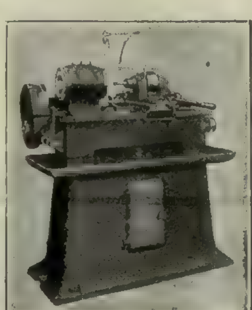
The centers for carrying the crankshaft are movable on the table to accommodate work of varying length. Suitable arch clamps furnished for holding work. The cutter bodies are steel castings having tool slots machined from the solid. Internal driving gears are integral parts of the cutter bodies. Cutters are driven by individual motors. Specifications: Maximum distance between centers, 15 ft.; swing, 22 in.; diameter of cutters, 40 in.; distance between cutters, minimum 4 in.; maximum 30 in.; number of feeds, six.

Toolpost, T. M. B. Double
Connery Machine and Tool Co., 56 Harrison Ave., Springfield, Mass.
"American Machinist," March 4, 1920



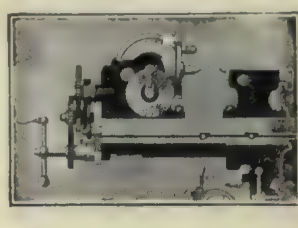
The broad, flat base and top clamp furnish a substantial means for holding two tools securely and at the same time absorbing much of the vibration. The combination of a convex washer and spring under the nut allows the equalizing clamp to adjust itself to tools of various sizes. A curved plate below the base permits the tool points to be raised or lowered in the usual manner. The bolt head is of irregular shape so as to be adaptable to different widths of slots.

Milling Machine, Automatic Thread
Automatic Machine Co., Bridgeport, Conn.
"American Machinist," March 4, 1920



Machine is of the hob type in which the cutter has the form of the thread to be cut but is without lead. Thread can be cut in one revolution of the work plus a slight overtravel. Both internal and external threads can be milled. Cutter and work spindles are driven by separate belts from same countershaft. Headstock can be swiveled on the bed so that taper threads can be milled. Specifications: Swing over bed, $14\frac{1}{2}$ in.; diameter of spindle face, $7\frac{3}{4}$ in.; hole in spindle, $4\frac{5}{8}$ in.; maximum distance between work and cutter spindles, 14 in.; hole in cutter spindle, No. 9 B. & S. taper; capacity, 6 in. in diameter; floor space, 50 x 24 in.; weight, net 2,000 lb., crated 2,200 lb., boxed for export, 2,525 lb.; dimensions of box, 72 x 56 x 30 in.

Dividing Head, Universal
Conradson Machine Tool Co., Chicago, Ill.
"American Machinist," March 4, 1920

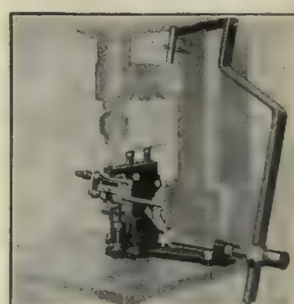


The faceplate has twenty-four holes for direct indexing and a $\frac{3}{8}$ x $\frac{7}{32}$-in. slot for the driving dog. The head is graduated and can be clamped in any position from 10 deg. below horizontal to 10 deg. beyond perpendicular. Regular equipment consists of three index plates that will divide all numbers up to fifty and many beyond, wrenches, bolts, driving dogs, and an index table giving all divisions up to 360. Swing, $14\frac{1}{4}$ in.; maximum distance between centers on Ryerson-Conradson No. 3 milling machine, 41 in.; combined length of headstock and tailstock, $24\frac{11}{16}$ in.; hole through spindle, $2\frac{1}{16}$ in.; taper hole in spindle, No. 14 B. & S.; faceplate, 8 in. in diameter; weight, 335 lb.

Lathe, Geared-Head Engine
Cincinnati Lathe and Tool Co., Cincinnati, Ohio
"American Machinist," March 4, 1920

Lathe is built in seven sizes, from 16 to 28 in., and is furnished with either single-pulley drive, or motor drive through silent chain; also furnished as a manufacturing lathe, as shown, a power feed is supplied for the turret. Constant-speed motor is used, as all speed variation is obtainable through gears, which provide twelve speed changes in geometrical progression. Gears are positioned by three levers on the front of headstock and safety devices are not required. Any lever may be shifted without interfering with the others, and without any danger of locking the gears. A control is provided at the apron by which the spindle may be started, stopped or reversed while the power is on.

Jig, Adjusto Drilling
Automatic Drill Tool Co., 549 West Washington Blvd., Chicago
"American Machinist," March 4, 1920



Designed to speed production by automatically clamping and ejecting small pieces of work from the jig. The device can be set for various sizes of work and for different locations of holes, thus avoiding the building of special jigs for certain classes of work. The device can be easily attached to a high-speed sensitive drilling machine and can be adjusted to take parts up to 1 in. in diameter. It drills up to $\frac{7}{32}$ in., and can be fitted with special holding blocks for odd-shaped pieces.

Testing Machine, 60-Ton Horizontal
W. & T. Avery Ltd., Soho, Birmingham, England
"American Machinist," (English Edition) Feb. 4, 1920

Machine, capable of testing hemp or wire ropes and also chain cables. Bar specimens of iron or steel may be tested to destruction and owing to the long length of tensile specimen which may be used, namely 6 ft., very useful data of material under test may be obtained. Machine has a hydraulic cylinder and a weighing system. Between these is the steel compression frame for receiving the strain. Hydraulic cylinder and ram are designed to give both slow straining speeds for testing stroke and a quick-return action. Pressure supply is derived from a Hele-Shaw pump driven direct by electric motor. Pump delivers oil under pressure to either end of cylinder, direction of the movement of ram, also the testing speed, entirely controlled by pump handwheel.

Clip, paste on 3 x 5-in. cards and file as desired

Business Items

The Van Norman Machine Tool Co., Springfield, Mass., has moved its New York office from 320 Fifth Ave. to Room 1856, 50 Church St., with J. D. Apgar in charge.

Charles A. Cook & Co., Inc., Brooklyn, N. Y., has had its name changed to the Reliance Spring and Manufacturing Co., Inc. It will continue to manufacture springs as heretofore.

Stockholders of the Four Wheel Drive Auto Co., Clintonville, Wis., have organized a $500,000 corporation to take over the Menominee Motor Truck Co., of Michigan. A new plant will be erected in this city.

At a recent special meeting of the stockholders of the Rome Wire Co., held at the company's offices, Railroad St., Rome, N. Y., a proposition to increase the capital stock of the company was unanimously adopted.

The Morris Machine Tool Co., Cincinnati, Ohio, has bought the business of the American Metal Products Co., manufacturer of screw-machine products, automobile starting cranks and drag links, Cincinnati, Ohio.

The Aetna Machinery Corporation recently organized and incorporated in New Jersey has its principal offices and warehouse at 15 Mechanic St., Newark N. J. This company has no other branches or offices and all communications should be sent to the Newark address.

The Joseph T. Ryerson & Son Co., Chicago, Ill., is distributing its new bulletin No. 5015, describing the new Ryerson-Conradson No. 3 high-power milling machine which it is now marketing. The bulletin also contains a description of the vertical milling attachment and universal dividing head for use on these machines.

Personals

G. DANNEHOWER, vice president of the C. E. Johansson, Inc., New York City, has resigned his position.

C. A. MARSH, of the Associated Manufacturing Co., Waterloo, Ia., returned recently from a six weeks' business trip to England.

A. M. PESKINE, formerly manager of Iznosskoff & Co. and more recently with Youreveta & Co., both of New York City, has joined R. S. Stokvis Zonen, Inc.

E. E. YAKE, of 21 Kenwood terrace, has resigned his position with the Gilbert & Barker Manufacturing Co., Springfield, Mass., and has accepted a position with the Walworth Manufacturing Company.

E. W. HIATT, who, for the past five years, has been factory manager and engineer of the Saginaw Sheet Metal Works, Saginaw, Mich., manufacturers of automotive sheet metal parts, has resigned his position.

ALEXANDER HARPER, of Bristol, Conn., was recently elected president of the American Silver Co. Only a comparatively short time ago, Mr. Harper was a bank clerk, which illustrates anew the possibilties awaiting young men of sincerity and ability.

B. C. SAUNDERS, formerly sales manager of the Wilmarth & Morman Co., has become identified with the Grand Rapids Grinding Machine Co., of Grand Rapids, Mich., as secretary and sales manager.

New Publications

Hendricks' commercial register of the United States for buyers and sellers. Twenty-eighth annual edition, 1919-1920. S. E. Hendricks Co., Inc., New York.

The twenty-eighth annual edition of "Hendricks' commercial register of the United States for buyers and sellers for 1920" has just been published, after being delayed for two months by the strike of the printers in New York. The new edition contains several improvements. The most noticeable being the new method of exterior indexing by coloring the front edge red, white and blue to indicate the different main sections of the book.

The first section is blue, on which is stamped the words "Trade Index." This contains 162 pages in which every product listed in the book is indexed and cross-indexed for ready reference. The red section is the main classified trades list. It contains 1,813 pages listing over 18,000 different products. In the present edition we find over 1,200 new headings, including many completely covering the chemical industry. The third section of the book, as indicated by the white edges, contains 216 pages listing the trade names under which products are manufactured, with the names and addresses of the manufacturers. The second blue section is the Alphabetical Section of 487 pages containing all the names in the book in one alphabetical list, with addresses and their line of business. This is followed by the index to advertisers of 20 pages, containing a full list of branch and foreign offices following each name. The whole book makes a volume of 2,703 pages.

The list of trade headings covers from the raw material to the finished article all products connected with the electrical, engineering, hardware, iron, mechanical, mill, mining, quarrying, chemical, railroad, steel, architectural, contracting and kindred industries, and the firms listed cover producers, manufacturers, dealers and consumers.

Rectangular Areas. By A. W. M. Elliot. Scott, Greenwood & Son, London, and D Van Nostrand Co., New York. 5 x 7½ in., 93 pages. Price $3.

This little book is intended for use by tin-plate manufacturers and others using superficial areas in their business. It consists of tables giving areas from 8¼ x 8¼ in., advancing by quarter inches to 54 x 28 in., and other useful sizes up to 40 x 40 in. Areas are given in whole square inches and decimals. A simple method of finding areas is given when one decimal is expressed in eighths or sixteenths of an inch and the other in quarters of an inch. The book should prove very useful within its limits to all whose calculations are in terms of area.

The Military Engineer (formerly "Professional Memoirs"), the Journal of the Society of American Military Engineers. Published at Washington Barracks, D. C. 112 pp., 9 x 12 in. illustrated.

We have just received the first issue of "The Military Engineer," the new title of "Professional Memoirs," the old organ of the Corps of Engineers, United States Army.

The new paper is very attractive in appearance and contains a well-balanced ration of editorials, news, professional papers and comment. It seems to us that it should fulfill admirably its mission as the mouthpiece of a new organization, the Society of American Military Engineers.

This society shows promise of supplying a long-felt want in a means of linking military and civilian engineers to their mutual advantage and we are heartily in favor of it.

We extend our congratulations and best wishes to the modest "amateur" board of editors. If they have as much success with subsequent issues as they have had with this one they sould be well satisfied with their achievements.

Forthcoming Meetings

The American Society Steel Treaters wi'l hold a meeting at the Engineers' Club of Philadelphia, March 26, 1920.

The Association of Iron and Steel Electrical Engineers will hold a meeting at the Engineers' Club of Philadelphia, April 3.

The American Society Heating and Ventilating Engineers will hold a meeting at the Engineers' Club of Philadelphia, April 8.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

The National Metal Trades Association will hold a convention at the Hotel Astor, New York City, on April 19 to 22, 1920. H. D. Sayre is the secretary.

The National Chamber of Commerce will meet in Atlantic City, N. J., on April 26, 27 and 28.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21 at the Hotel Traymore, Atlantic City, N. J.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The spring meeting of the American Iron and Steel Institute will be held May 28 at the Hotel Commodore, New York.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of Eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month. Lewis H. Kenney is the chairman of committee on papers.

Electric Hoist Maufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Pa.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Pa., Howard Evans, secretary, Pier 45, North Philadelphia, Pa.

Rochester Society of Technical Draftsmen. Monthly meeting, first Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

April 1, 1920 **American Machinist** Vol. 52, No. 14

Automobile Cylinders in the Machine Shop

How They are Handled at Five Big Shops

By FRED H. COLVIN, Editor, *American Machinist*

Air-Cooled Cylinders for Franklins

These five articles deal with the methods of machining the engine cylinders for five different passenger automobiles. The first one takes up the problems encountered in handling the singly cast Franklin cylinders and points out the effects of the air-cooling feature. The boring heads, the method of holding, the flange-drilling fixture and other devices described are worth noting.

THE Franklin cylinder is one of the few which are now cast individually, this being done in order to secure proper cooling by the current of air which is used in the Franklin system. The cylinder has a square base and 52 vertical fins, as can be seen in the different illustrations. Fig. 1 shows the transformation of succeeding operations.

The cylinder is centered by the outside just below the flange by means of the swinging jaws, Fig. 2, which are pivoted at *A*, and when clamped in position, lock under the dovetail at the top of the main casting *B*. Three jaws *C* bear against the outer edges of the cooling fins, support what is the lower end of the cylinder in this operation, and preventing movement and distortion. The driving of the cylinder is also assisted by the dog *D*, which embraces one of the corners of the bolt flange, when the jaws are closed.

This operation consists in boring out the mouth of the cylinder and facing the bolt flange to the gage shown at *E*, this being done by the regular boring tools to be seen in the head of the vertical boring machine. The mouth is the locating point for the boring operation which follows. The cylinders are bored in the fixture shown in Fig. 3, the castings being centered by the plug *A*, through the bushing *B*, in the top of the fixture. With the cylinder thus centered and held square by the bolt flange which has been previously faced, it is clamped in position by hook bolts having nuts on the top as shown at *C*. The bottom support *D*, which is practically a bolt having a special ball head, as shown in Fig. 4, is adjusted to bear against the under side of the cylinder, thereby holding it against the downward thrust of the boring cutter. Screws *E* resist the turning effect of the boring bar.

The thin wall of the cylinder makes it advisable to take three cuts, the type of boring cutter shown being used for the purpose. The first of these bores to 3.125 in.; the second, to 3.2 in., and the finishing boring head, to 3.240, allowing 0.01 in. for grinding. Details of these cutting heads are shown in Fig. 5. Both views of the fixture, Figs.

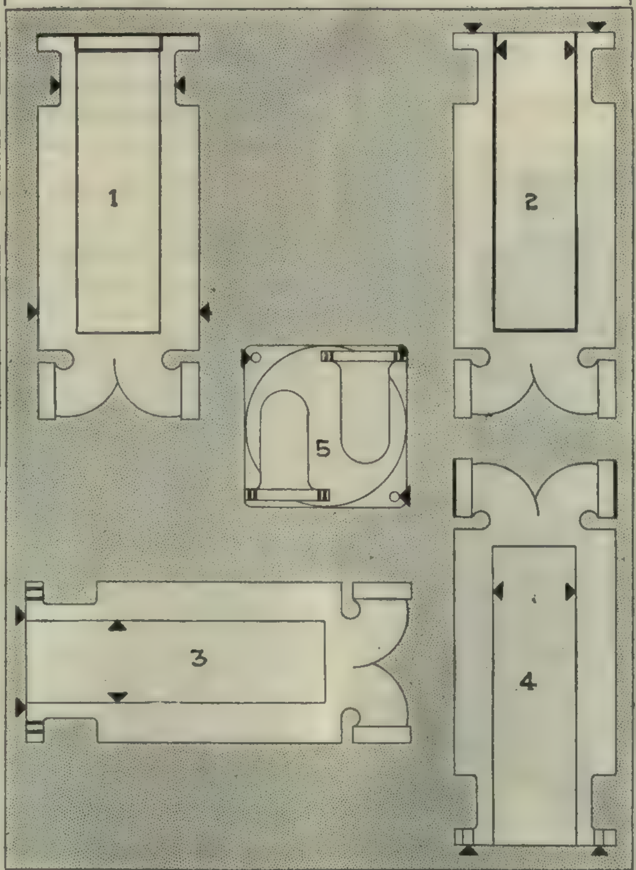


FIG. 1. TRANSFORMATION SHEET

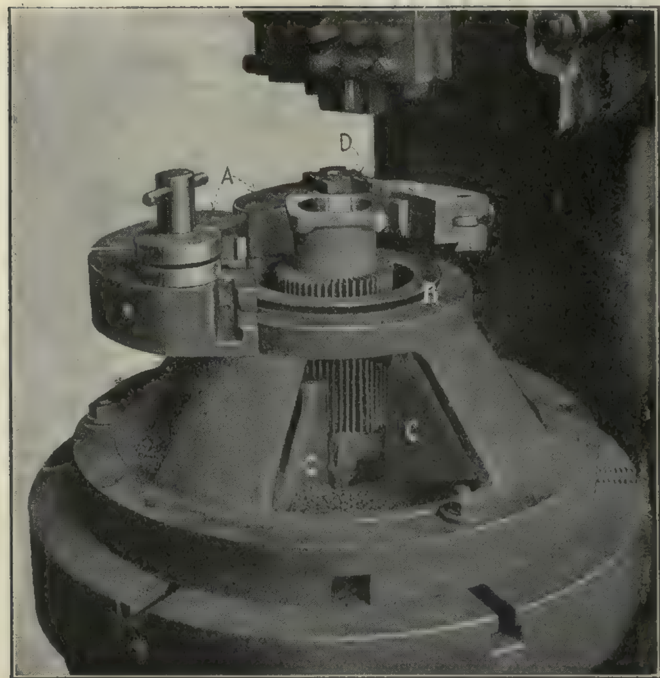


FIG. 2. FACING AND COUNTERBORING CYLINDER

3 and 4, will also show the screws *E*, which bear against the bolt flange at the corners, and assist in taking the thrust of the boring tools.

The Bearing Is Large and Rigid

The cutter shown in position on the spindle, Fig. 3, is for facing the top of the cylinder. Note should be made of the large and rigid bearing in which the boring spindle revolves, as this has much to do with the success of this operation.

The depth of the bore is determined by the stops *F*,

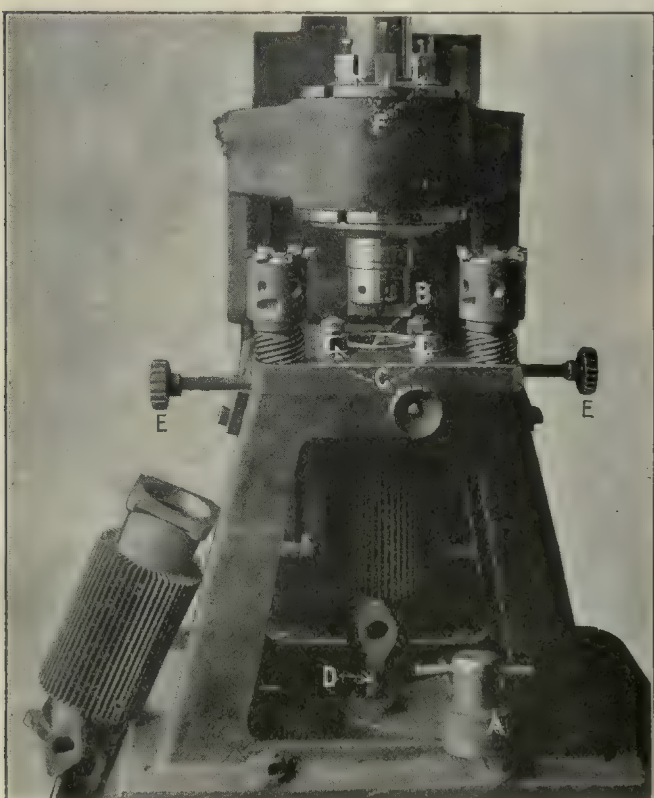


FIG. 3. BORING THE CYLINDER

which come in contact with a collar on the boring spindle when the cutter has reached the bottom of the bore. These are easily adjustable to take care of any variation in length of the boring heads.

The cylinders are then rough-ground in the regular

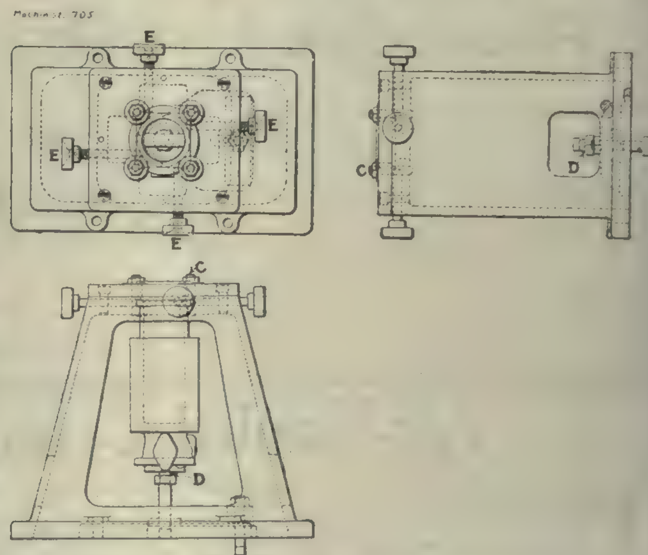


FIG. 4. DETAILS OF BORING FIXTURE

way, after which they pass to the special horizontal drilling machine, shown in Fig. 6. The cylinder is located on the pilot *A*, which is relieved on four sides, while the yoke *B* is swung down over it, and is held against the guide plate *C* by means of the screw *D*.

The four drills, driven by the special head shown, are then fed through the flange. On releasing the clamp *D*, the counterweight *E* brings the yoke up out of the way, allowing the cylinder to be readily removed, and a new one placed in position.

Milling the Exhaust and Intake Flanges

The next operation, which consists of milling the exhaust and intake flanges and the top of the cylinders is shown in Fig. 7. The fixture holds 10 cylinders, two being removed to show the mandrels *A*, which take the cutter thrust, and the clamps *B* by which they are

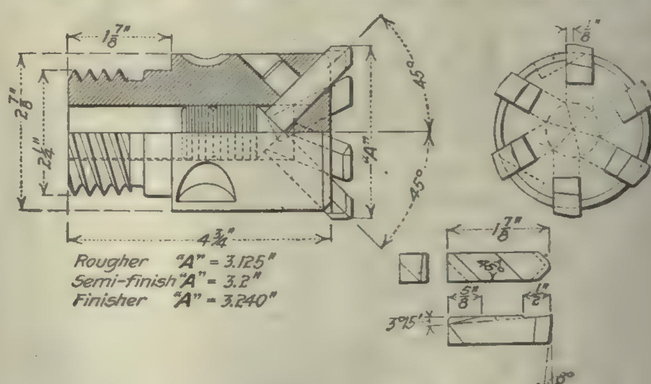


FIG. 5. DETAILS OF BORING HEADS

held. The cylinders are located by the bolt holes which were previously drilled in the flange. These fit over dowels, as shown at *C*. The clamps hold the cylinders in the fixture as seen at *D*.

Another interesting double fixture is shown in Fig.

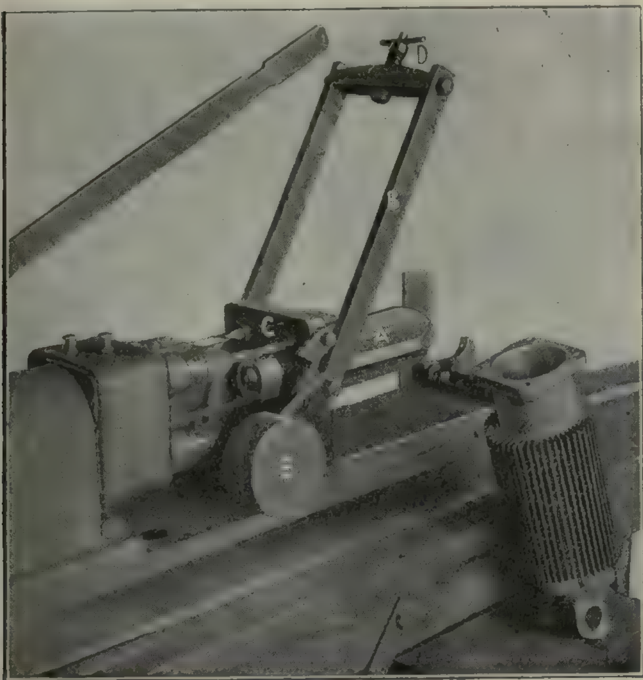


FIG. 6. DRILLING BOLT FLANGES

8, where the bolt holes in the inlet and exhaust flanges are being drilled.

This double fixture utilizes eight spindles of the multiple drilling machine shown, and shows how the bolt holes are used to locate the position of the flanges by means of the dowels *A*, the cylinder being held in position by the screw clamp *B*. The thrust of the drill is taken by the supporting pin *C*. The fixture is arranged so that one side drills the inlet, and the other side the exhaust flanges. The cylinders are removed from one side and simply transferred to the other after being turned half over.

The Finishing Touches

After the other holes are drilled, reamed and tapped, the outside diameters of the flanges are ground when necessary and the cylinder bore is then finish-ground.

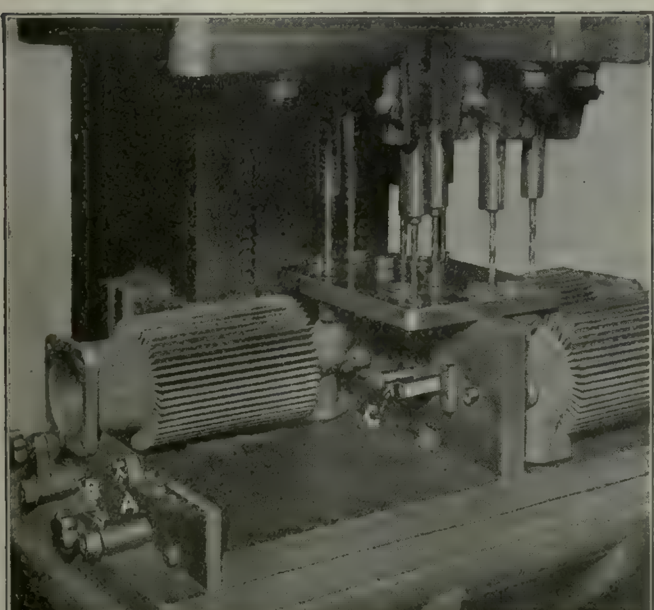


FIG. 8. DRILLING OUTLETS ON BOTH SIDES

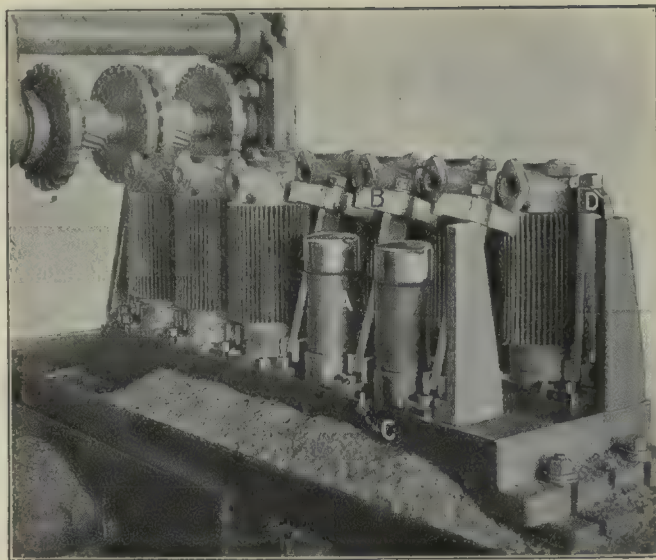


FIG. 7. MILLING INLET AND EXHAUST OUTLETS

The finishing touches are then put on the valve seats, and special care is taken to secure accuracy and uniformity of cylinders at all essential points.

Water-Cooled Cylinders for the Eight-Cylinder Peerless

Although the output of the Peerless Motor Co. is not large as compared with quantity production shops, the arrangement of the machines so as to avoid undue handling of material, and the methods employed, indicate that production costs have been considered.

The principal machining operations are shown in outline in the transformation sheet, Fig. 1, and in more detail in the halftone illustrations which follow. Fig. 2 shows the way in which the gang of cylinders are held on the milling-machine table, so that the top, bottom, and sides can be milled at the same time. In addition to this, an angular head has been added, as can be seen at *A*, for the purpose of milling the seats for the water connections to the cylinders. This view also shows some pin gages at *B* for testing the distance between some of the milled surfaces.

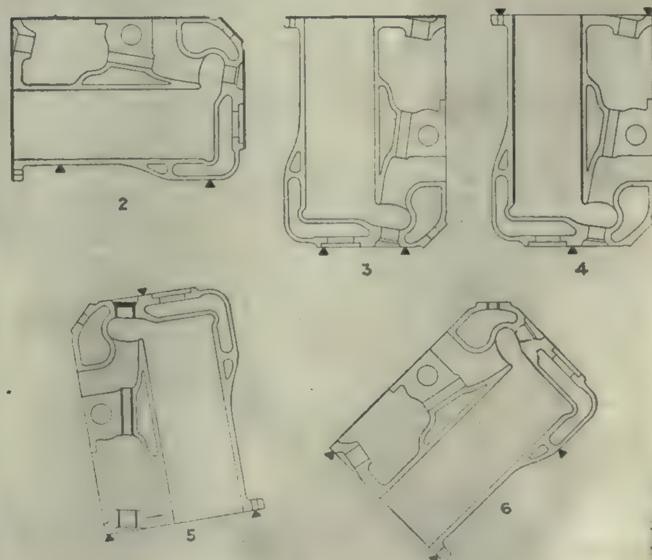


FIG. 1. TRANSFORMATION

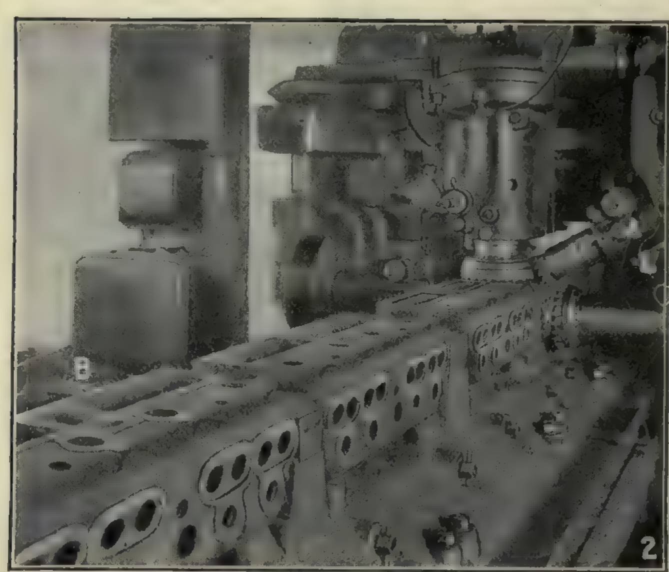


FIG. 2. MILLING CYLINDER BLOCKS

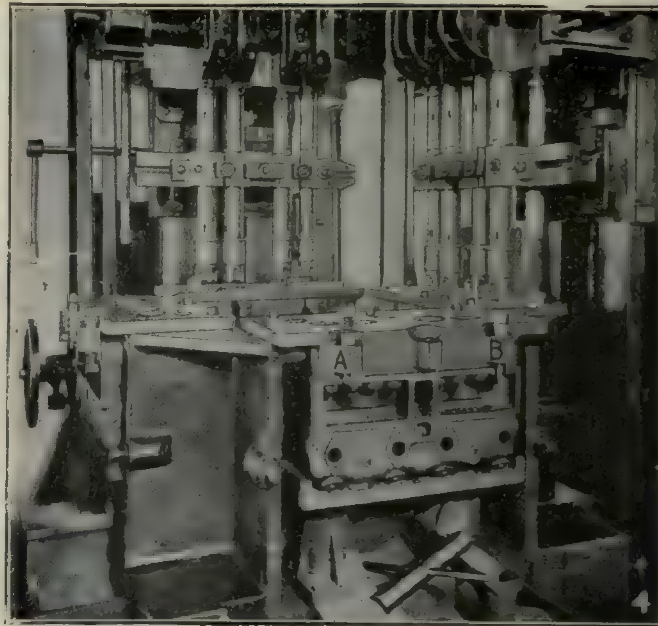


FIG. 4. BORING THE CYLINDERS

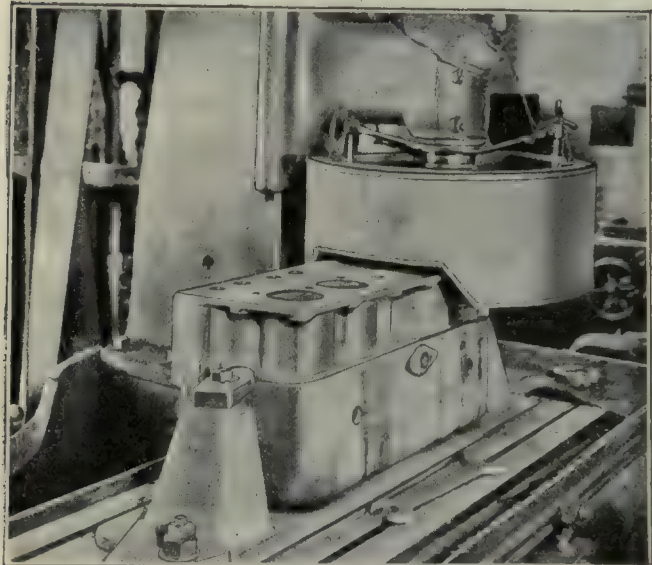


FIG. 3. GRINDING CYLINDER BASE

Before proceeding with the drilling and boring operations, the base flange of the cylinder is ground on the vertical spindle machine shown in Fig. 3. Here the cylinder is simply clamped to the grinding-machine table by means of the simple fixture shown, the upper milled surface being used for locating the flange squarely with the grinding wheel.

The boring is done on the special machine shown in Fig. 4, which carries two sets of four spindles each, set 90 deg. apart, so that one can be roughing while the other is finish-boring the cylinder which has already been bored, making it ready for grinding. This machine has a heavy and substantial table which can be readily revolved so as to bring the cylinder blocks successively under the proper set of spindles. The cylinders are located by bolt holes previously drilled on a multiple-spindle drilling machine, and the cylinder flanges are fastened to the upper plate of the boring fixture by means of the hook bolts *A* and *B*.

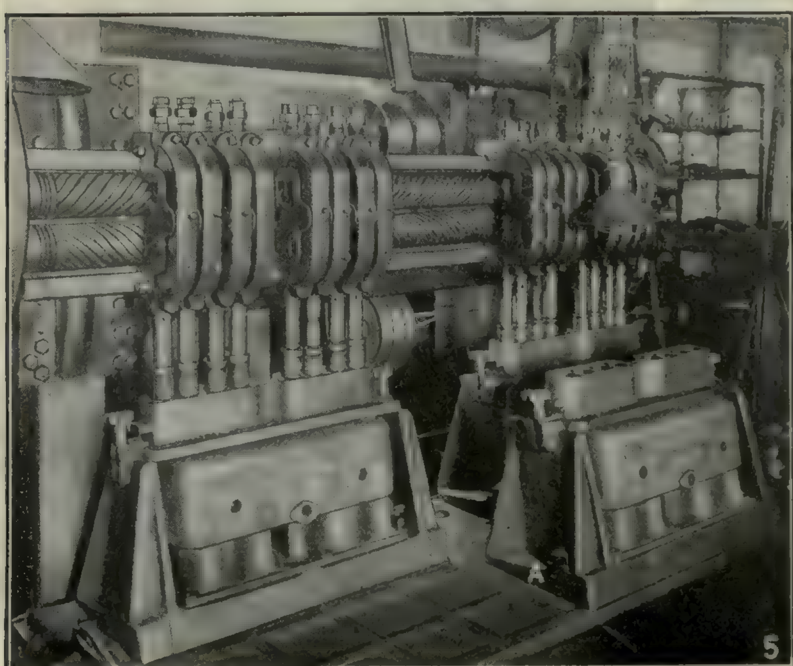


FIG. 5. BORING VALVE SEATS

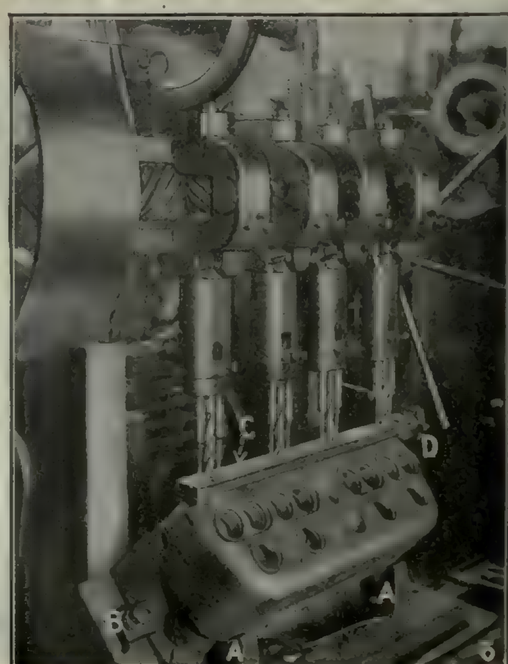


FIG. 6. DRILLING WATER OUTLETS

Then comes the boring of the valve seats on the type of machine shown in Fig. 5, which handles two cylinder blocks at the same time. This also shows an extra block with the cylinder in place so as to avoid lost time in handling the work to the different cutting machines. It will be noted both in Fig. 1 and in Fig. 5 that the valve stems and seats are not parallel to the bore of the cylinder, but are at an angle to it. This is taken care of by the fixture shown at *A*, Fig. 5, the base of this fixture giving the proper angle for the valve stem and seat.

Another interesting angular fixture is shown in Fig. 6, where the water outlet is being drilled by four spindles, while on each side of these is a small drill, drilling the holes which are soon to be tapped for the water-connection flanges.

In all of these cases the cylinders are located by means of dowel pins which fit the bolt holes of the base flange. The supporting arms *AA* make it easy to put the cylinder block in place, where it is held by the clamp *B*. The bar *C* which carries the drilling bushings is located by V-blocks on the under side and held by screw *D*.

The Packard Twin-Six Cylinder Blocks

The use of conveyors greatly facilitates the handling of cylinders in the Packard shop, while the use of multiple boring bars, which bore two blocks, of six cylinders each, at one setting, assists greatly in speeding production.

THE cylinder shops of the Packard Motor Car Co. are well equipped with multiple-bar boring machines, multiple drilling machines, and Matthews conveyors for handling cylinders from one machine to the next. This is equally true in both the passenger-car and truck motor shops. The sequence of operations is shown in Fig. 1.

These machines are for the most part of the horizontal type; Fig. 2, giving an idea of their size and general construction. Large square tables are used for holding the work, two cylinder blocks being held in position on each side, as can be seen. The men at the left load the fixtures, and afterward remove the cylinders when they have been faced and bored. This illustration also shows the conveyor system for handling the cylinder blocks. An idea of the details of these fixtures and the way in which one cylinder block is milled while the other is being bored may be seen in Fig. 9, which shows a machine in the truck cylinder shop.

The bolt holes are next drilled under a multiple machine as shown in Fig. 3. This also gives a glimpse of the boring machine at the left and shows how the conveyor handles the material from one machine to the next. The milled surface and the bolt holes locate the cylinders in future operations.

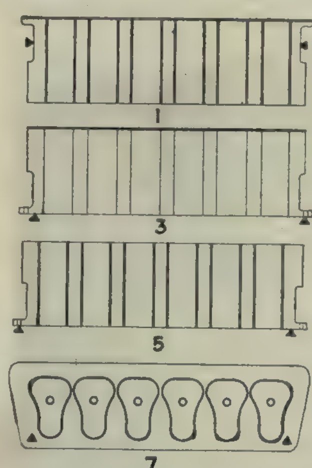


FIG. 1. TRANSFORMATION SHEET

The top and sides of the cylinders are next milled on machines of the planer type, gang cutters being arranged so as to finish all necessary surfaces. The rather

FIG. 2. MILLING AND ROUGH-BORING TWIN-SIX CYLINDERS

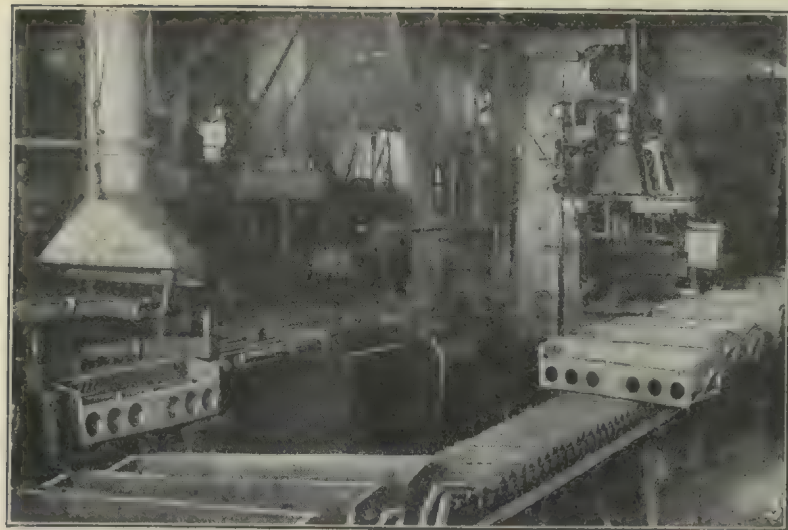


FIG. 3. MULTIPLE MACHINE DRILLING BOLT HOLES IN FLANGE

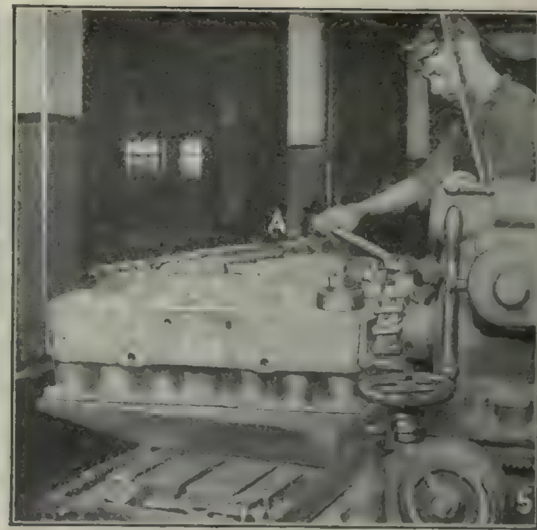


FIG. 5. MILLING THE ENDS OF THE CYLINDERS

FIG. 7. FOUR-SPINDLE FACE-MILLING MACHINE FOR CYLINDER HEADS

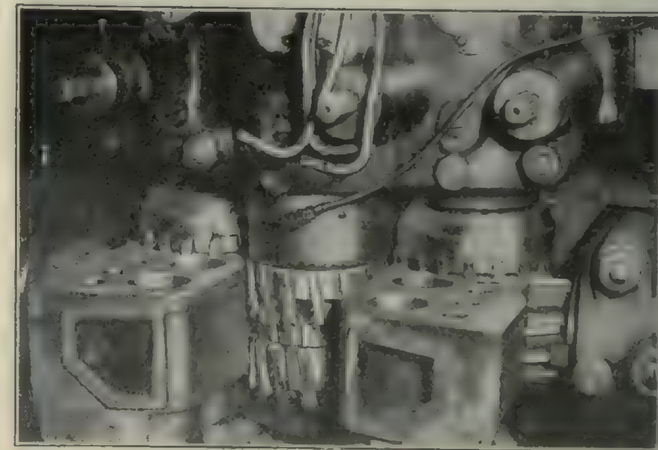


FIG. 4. MILLING TOP AND SIDES

unusual arrangement of milling heads is shown in Fig. 4. Then the ends are milled as shown in Fig. 5, on a heavy knee-type machine, the cylinder blocks each being located by suitable dowels and held in place by a stud and collar through the first hole as can be seen at *A*.

The mouths of the cylinders are then chamfered by suitable cutters in boring bars, and finally finish-reamed in the special machine shown in Fig. 6. A heavy fixture carrying four cylinder blocks is mounted on a square table, two of these blocks being operated on at the same time. Each set of reamers is at 90 deg. or forms two sides of a square, and each bar carries its own bushing as can be seen. Here again the conveyor system is in evidence and it will be noted that the round piece

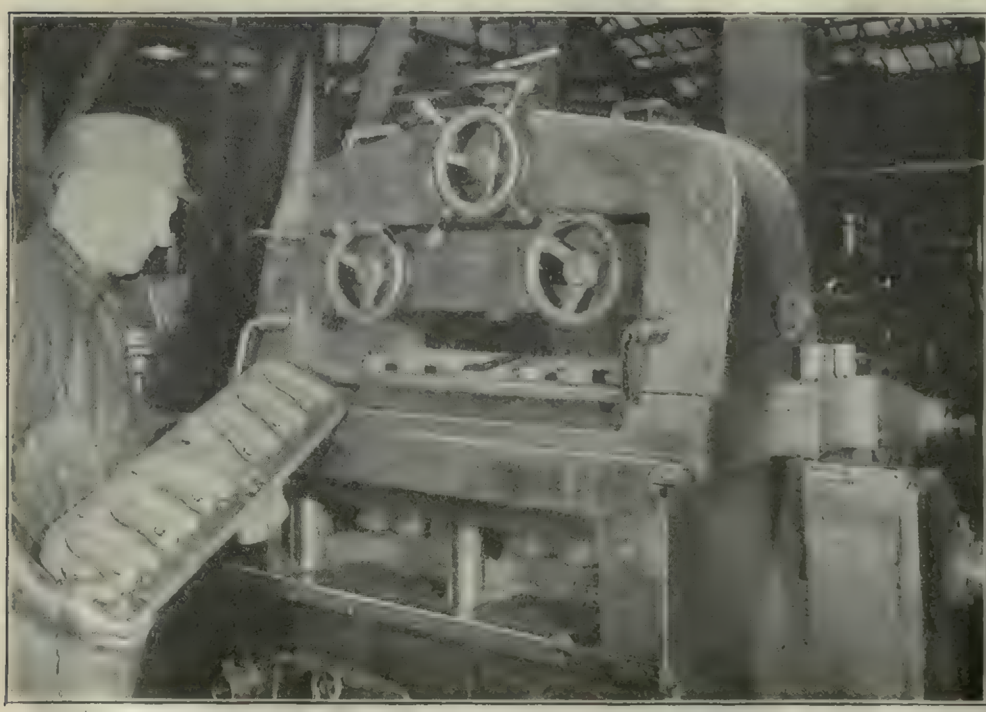


FIG. 8. PROFILING DOMES OF CYLINDER HEAD

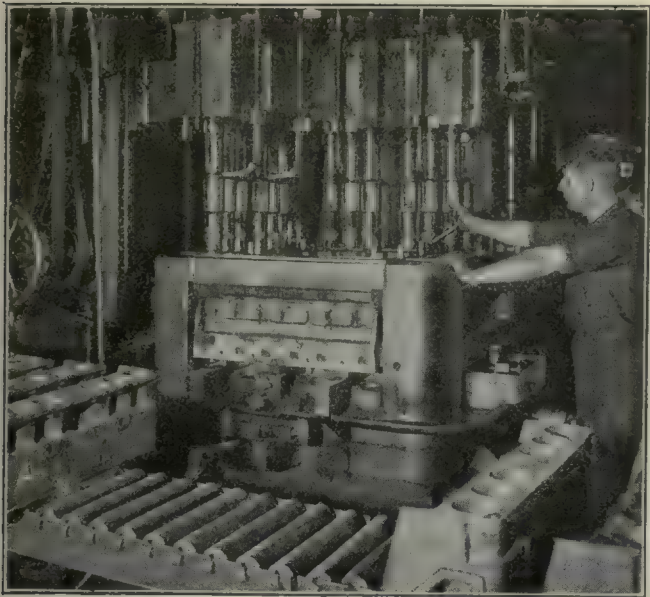


FIG. 6. FINISH-REAMING CYLINDERS

placed between the rolls at *A*, effectually prevents the cylinder blocks from moving on the conveyor until it is desired to have them do so.

The cylinders are afterward finished by grinding, an allowance of 0.012 in. being made for this purpose.

The cylinder heads are first drilled for the spark plugs, these holes being used in bolting them to the milling fixture shown in Fig. 7. This machine carries four spindles, two horizontal and two vertical, only the horizontal spindles being shown equipped with cutters. Six cylinder heads can be held horizontally on the top of the fixture, the studs for holding being plainly seen. Three additional cylinder heads are held on the other side of these fixtures making it possible to machine 12 at one setting.

In order to secure equal compression space in the cylinders, the dome for each is carefully profiled on a special machine shown in Fig. 8. The head, placed in position over the six cutters shown, is carefully located by dowels, clamped in position, and the machine started. By a special arrangement of cams on the back and gears

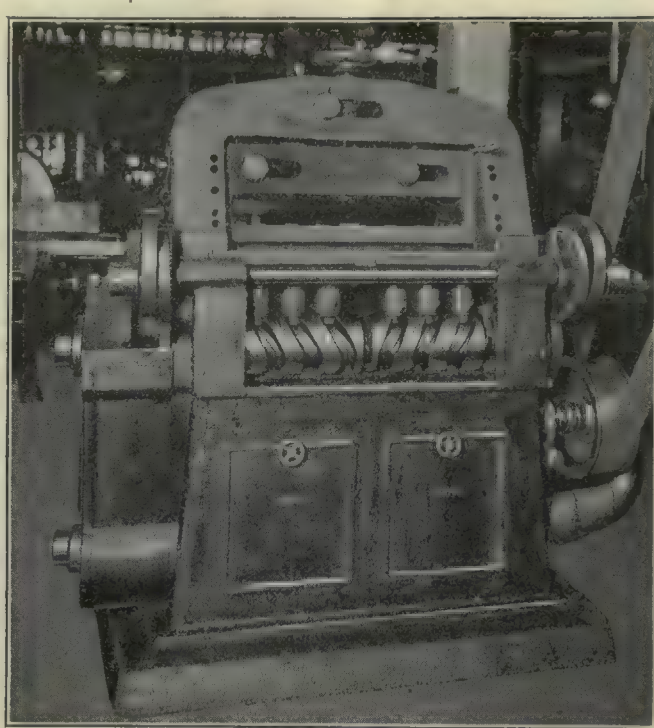


FIG. 9. DETAILS OF THE PROFILING MACHINE

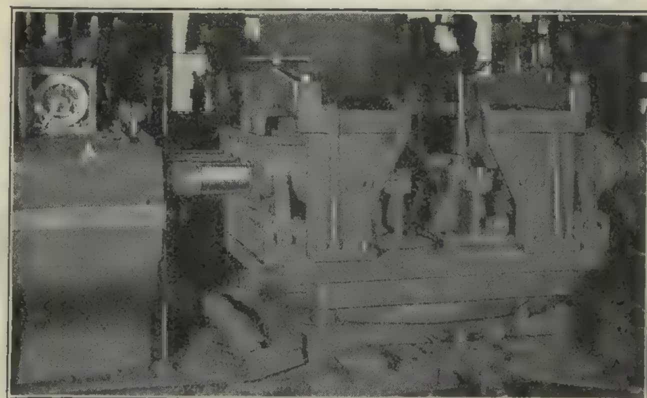


FIG. 10. FIXTURE FOR TRUCK CYLINDERS

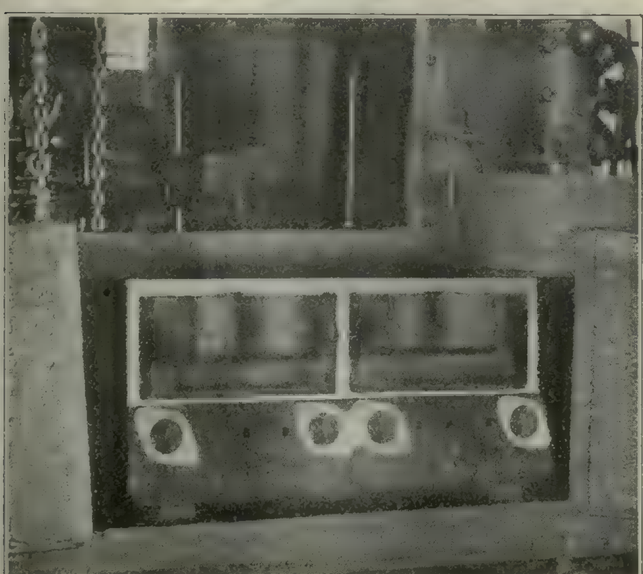


FIG. 11. GRINDING BASE FLANGE

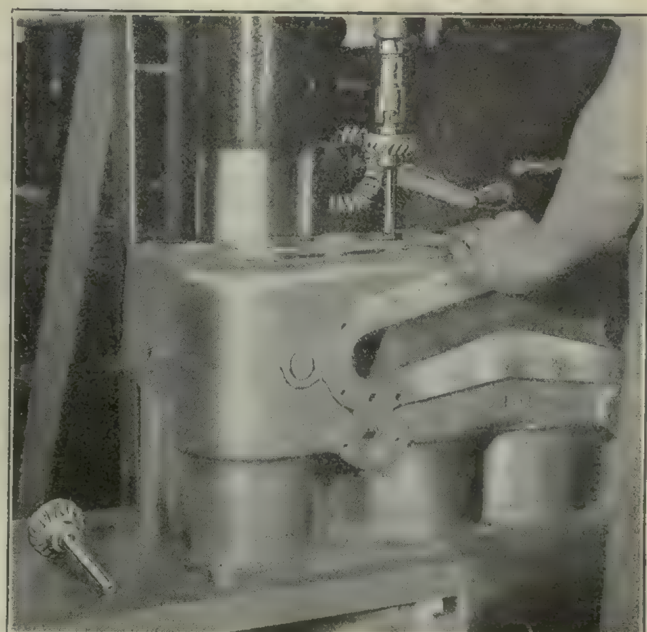


FIG. 12. MACHINING VALVE SEAT

at the sides of the machine, as shown in Fig. 9, the profiling cutters are moved sideways while the cylinder heads move back and forth producing the desired results.

Similar methods are used in building the Packard truck motor. Fig. 10 shows the fixture and machine for milling the base and rough-boring the cylinders at the same time. It shows the construction of the fixture and also shows the device used for testing the cylinder bore, this being kept in the box at A. The different clamping methods are well worth a careful study as much depends on locating the work in the first operation. Cylinders are then drilled and the face flange is ground as shown in Fig. 11. The cylinders are then finish-bored and reamed, after which the valves are seated as shown in Fig. 12, the large pilot fitting the valve opening, while the small one guides the reamer.

The Cylinders for the Cadillac Eight

Considering the size and cost of the car in question, the production in this factory is extremely large and the methods are worth careful study.

BEFORE the cylinder block is machined in any way, it is heat-treated, or annealed, after which two locating holes are drilled as the first operation. The block is then chipped and cleaned and goes to stock, from which it is drawn for the actual machining operation. The sequence of operations is shown in Fig. 1.

The first milling operation is shown in Fig. 2, where the base flange, the side, and the top of the cylinder block are milled at one setting. It will also be noted that by a special combination of milling cutters, the face of the manifold connection at A is milled at the same operation. It will also be seen that the proper setting of the milling cutters for the top and bottom faces is indicated by the dial gages B and C. After this, the bottom of the block is finish-ground under a vertical-spindle machine so as to present a true and smooth surface to the cylinder base, this being shown in Fig. 3.

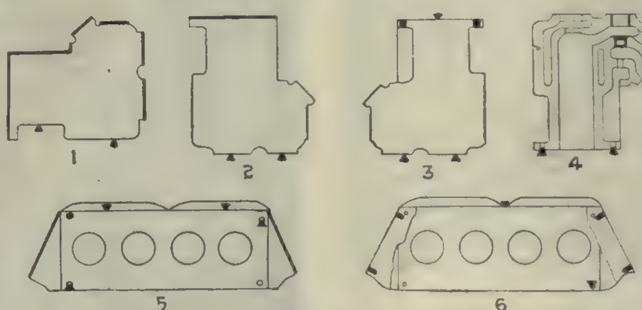


FIG. 1. TRANSFORMATION OF CYLINDER OPERATIONS

Next comes the drilling of all the holes in the base flange as shown in Fig. 4. It will be noted here that drills are set at various lengths so as to reduce the power required for drilling and also the pressure required. The drills in the center break through about the time those on the end are really getting down to work. The ground surface of the work is held against the upper plate of this fixture, the flange being clamped against the upper plate by cams operated by the handles A and B. The cylinders are bored in the usual manner, two cuts being taken, and they are also reamed ready for grinding. Then all the holes in the top and sides are drilled and tapped, the ends of the barrels chamfered, the holes counterbored, and the flange bosses spot-faced.

The next operation illustrated is the machining of the valve seat as shown in Fig. 5. Here again the cylinder block is located by the face flange with dowels in the bolt holes, and the swinging top A holds it firmly in place. The machine at the left drills the holes for the valve-stem guides, the drill guide bushings being shown at B. After the valve-stem bushing holes are reamed and the spring-seat bosses spot-faced, the angular ends of the cylinder blocks are milled in the special machine shown in Fig. 6 and then drilled in another special machine, Fig. 7. The cylinder is clamped against the angle plate A, Fig. 6, by means of two hooks F and C, these being operated simultaneously by means of the cross-bar D and the screw E. This makes a very quick-acting clamp and also one which holds the work effectively. The flange is, of course, located by dowels in the bolt holes.

The clamping fixture for the drilling operation is somewhat different, the arm A, Fig. 7, reaching over the cylinder block which is held by means of the shoe B forced into place by screw C. It will also be noted that these drilling heads carry their own guiding plates, as at D and E, so that it is only necessary to advance the drilling heads until the guide plates are set firmly

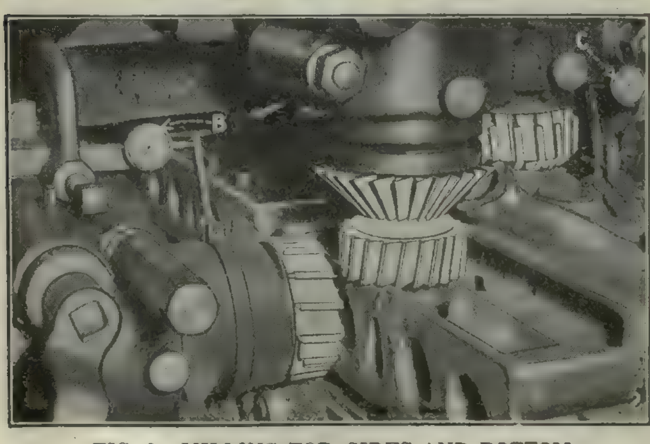


FIG. 2. MILLING TOP, SIDES AND BOTTOM

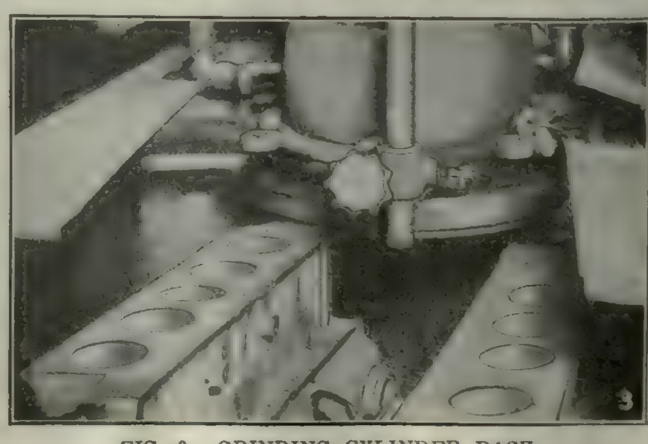


FIG. 3. GRINDING CYLINDER BASE

against the cylinder by the springs shown. The drills are then fed in to the required depth.

These holes are then tapped, the cylinders are washed, the bore ground, connecting-rod clearance cut on the side, and the cylinder block tested for water-jacket leaks in the fixture shown in Fig. 8. In order to close the angular openings on the end, special pads *A* and *B* are provided, these being both operated by the handle *C*, through the rods *D* and *E*. The cylinder block is held down in position by means of the upper strap *F*, and the double handle nut *G*. This makes an apparatus which can be very quickly handled, the gage shown at the right indicating the pressure applied.

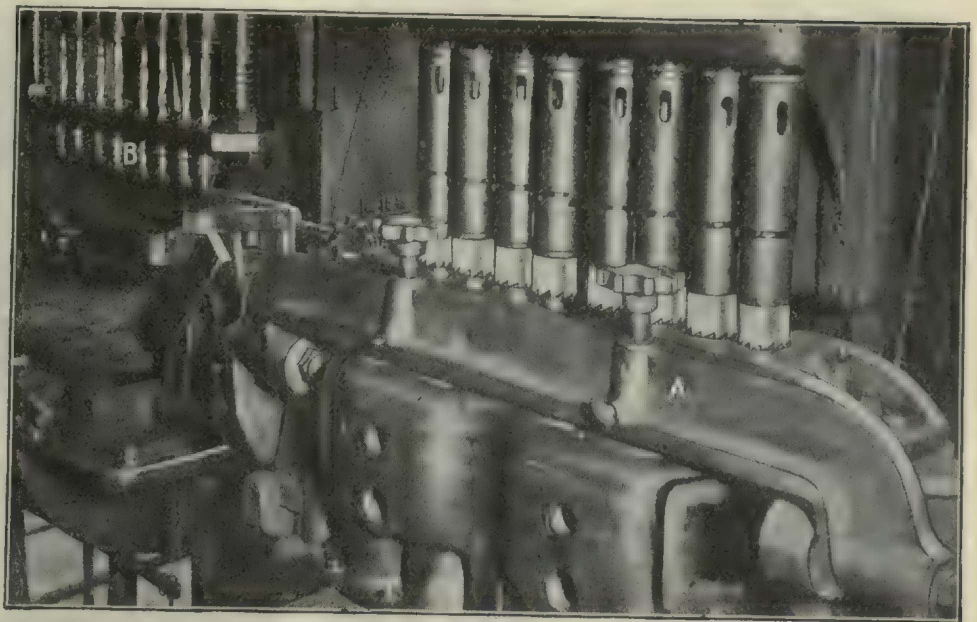


FIG. 5. MACHINING VALVE SEATS

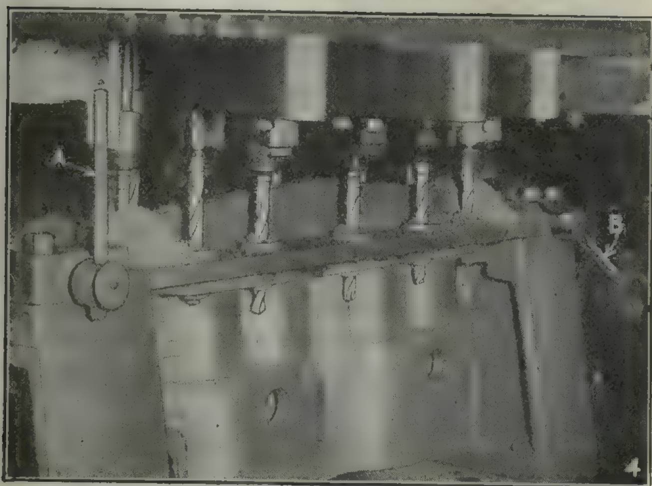


FIG. 4. DRILLING FLANGE BOLT HOLES

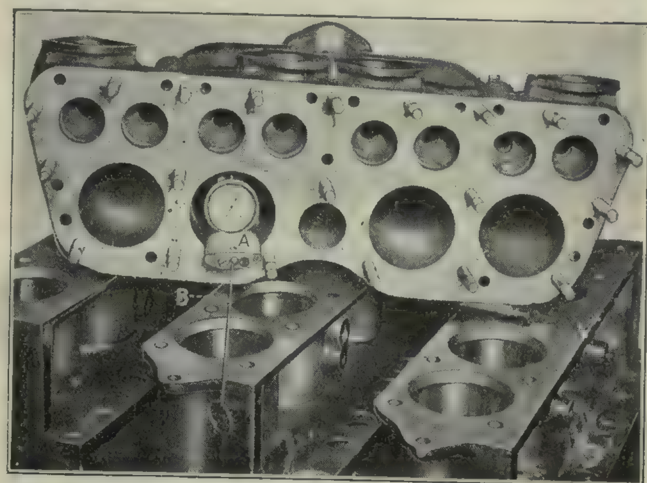


FIG. 9. MEASURING THE CYLINDERS

A dial gage is used in inspecting the cylinder bore as well as its uniformity of diameter from end to end. This arrangement is shown in Fig. 9. Here the dial gage is mounted on the block *A* which has two bearing strips on its lower side so that these, together with the point bearing on the gage, give a three-point contact. In order to handle this gage in and out of the cylinder bore without cramping it, and in this way securing a false reading, the handle *B* is connected to the base *A* by means of the ball joint shown. In this way it is practically impossible to cramp the gaging fixture as it is being pushed into the cylinder.

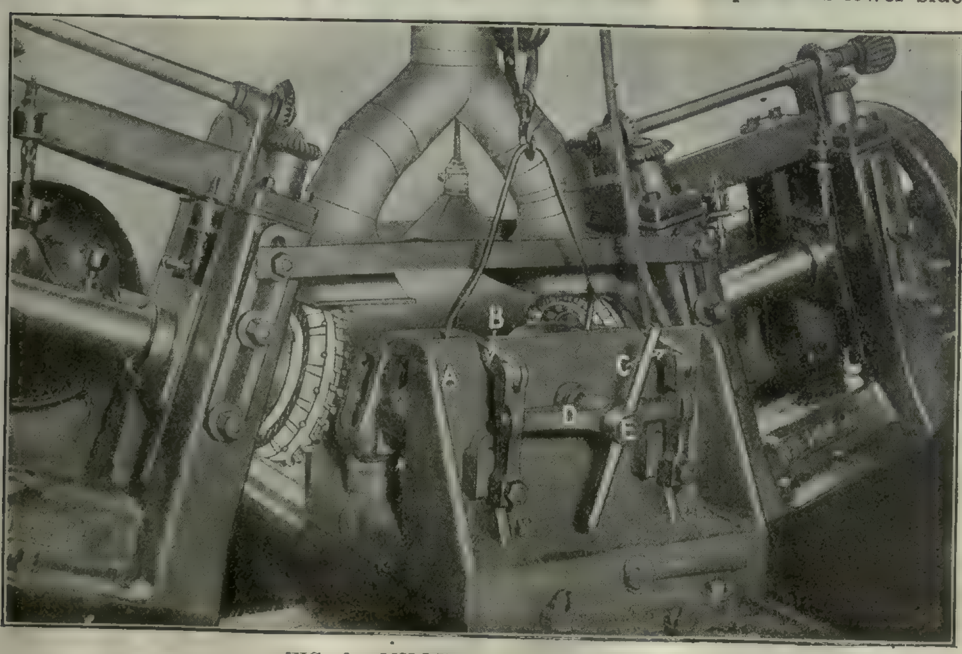


FIG. 6. MILLING ANGULAR ENDS

The main machining operations on the cylinder head are shown in the transformation diagram in Fig. 10. The bosses on top of the cylinder head are first spotted in a profiling machine, as can be seen in Fig. 11. The casting is held in position on the face of the fixture, which contains

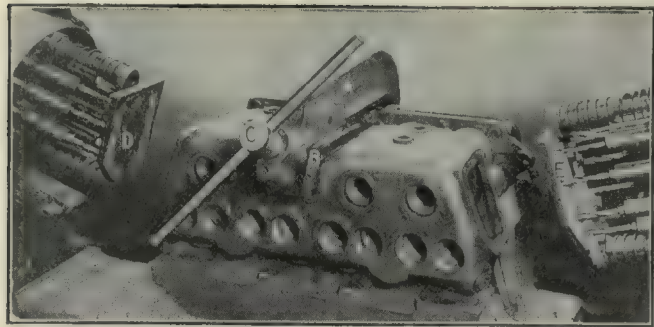


FIG. 7. DRILLING THE END HOLES

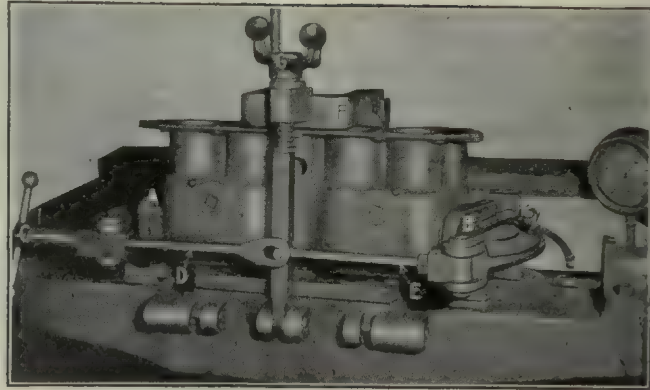


FIG. 8. WATER-TESTING FIXTURE

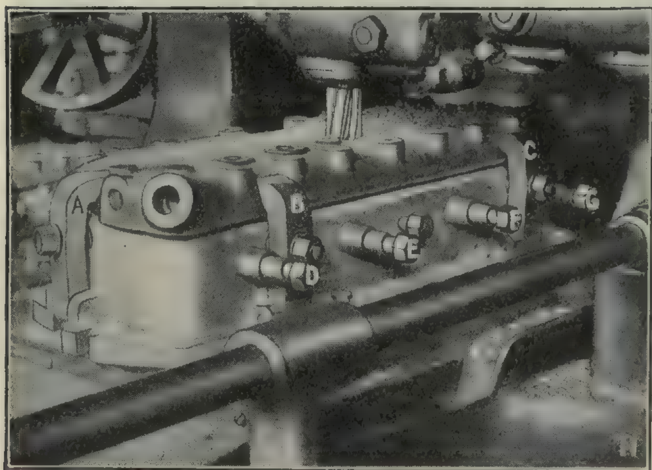


FIG. 11. SPOT-FACING LOCATION BOSSES

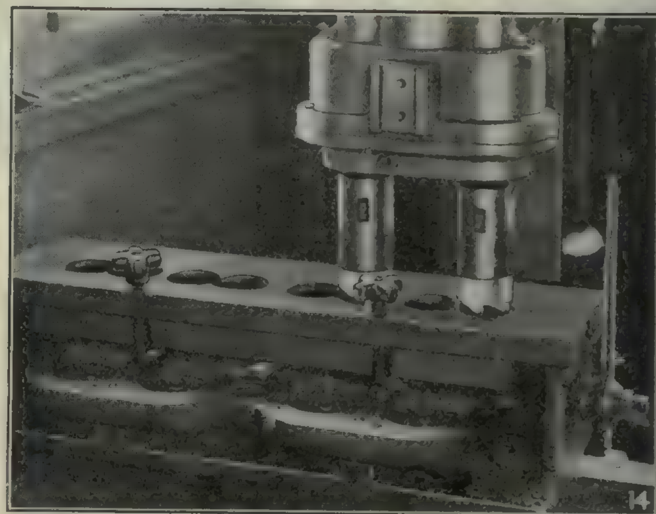


FIG. 14. ROUGHING OUT COMPRESSION SPACES

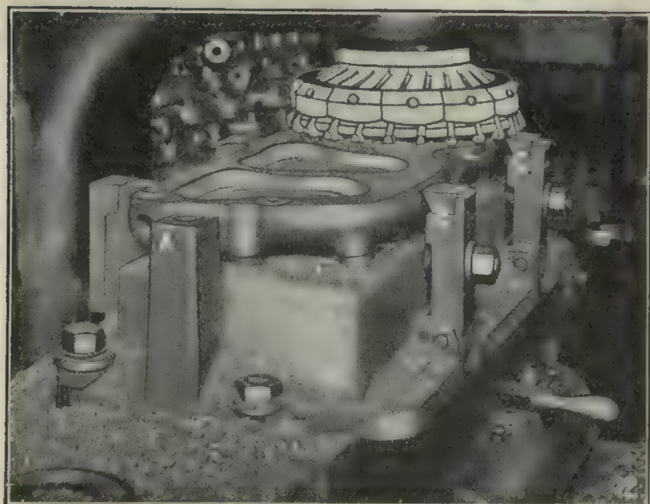


FIG. 12. MILLING FACE OF CYLINDER HEAD

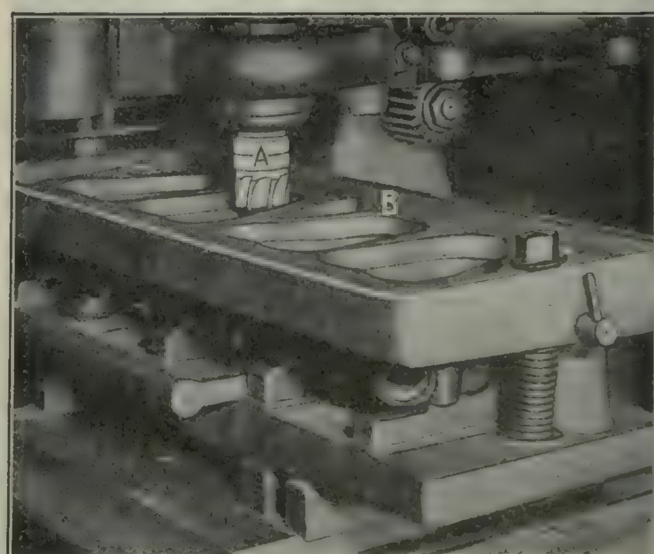


FIG. 15. FINISHING ON PROFILING MACHINE

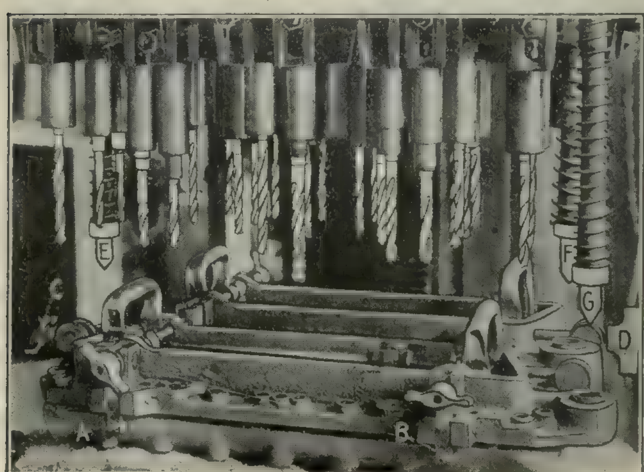


FIG. 13. DRILLING BOLT HOLES

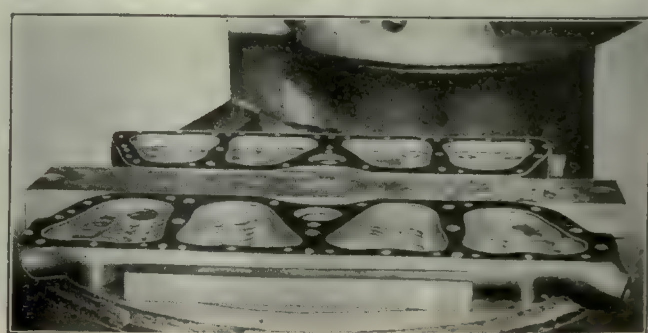


FIG. 16. GRINDING CYLINDER-HEAD JOINT

raised points to secure an even bearing, by means of the wedging clamps shown at *A*, *B* and *C*. The points on which the castings rest can be raised or lowered by means of screws *D*, *E*, *F* and *G*, so that inequalities in the casting can be readily taken care of.

Resting the cylinder head on the points which have been faced, the next operation faces the joint in a vertical milling machine with the large, inserted tooth cutter shown in Fig. 12. Here, too, the wedging type of clamp jaw is used, three of these being shown at *A*, *B* and *C*.

Next is the drilling of the bolt holes through the cylinder head, the head being held in the portable fixtures shown. These fixtures carry two heads and are held to the heads themselves by the wedge clamps *A* and *B*, Fig. 13, the clamps on the other side being operated by means of screws *C* and *D*. These drilling fixtures are located under the multiple spindle drilling machine by means of the spring-actuated pilots *E*, *F* and *G*, a fourth pilot being at the left but hardly distinguishable behind the drills.

The next operation is to machine the compression spaces in the cover, the second stage of this being shown in Fig. 14. Here double circles are faced by means of the special double-spindle boring head and the guiding plate shown which locates the bars in their proper position.

Then the profiling machine comes into play, as shown in Fig. 15, the cutter being guided by the roller *A*, working in the former plate B. This secures uniform compression space in all cylinders.

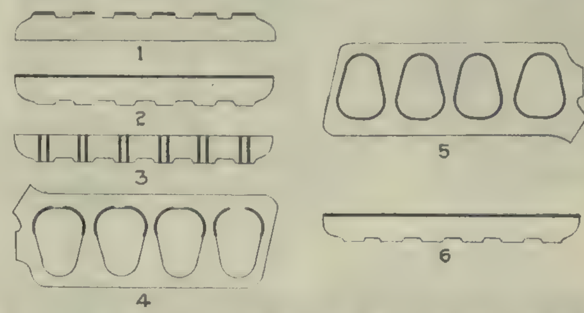


FIG. 10. TRANSFORMATION OF OPERATIONS ON HEAD

The final operation is the finish-grinding of the flat surface, on the Blanchard machine shown in Fig. 16. This fixture carries two cylinder heads and a magnetic chuck, enabling the work to be handled rapidly and accurately.

The Chandler Cylinder

These methods include the use of pneumatic fixtures, indexing fixtures, special tools for recessing the upper end of cylinder and for boring connecting-rod clearance, as well as an inspection device for cylinder bores.

THE machining of the three-cylinder blocks for a Chandler six-cylinder car includes a number of interesting operations, beginning with the milling of the tops and bottoms of the cylinders and the sides containing the valve-stem bushings and exhaust openings, as in Fig. 2. The transformation, Fig. 1, shows the sequence of the operations. Following the milling is the drilling of the holes for the inlet and exhaust flanges, as is usual, and a counter-boring in the dome, as this motor does not have a removable cylinder head. Then comes the rough-boring as shown in Fig. 3, the two cylinder blocks being operated on at the same time. The cylinders are positioned by their flanges and bolt holes and are held in position by the wedges *A*, *B*, *C* and *D*,

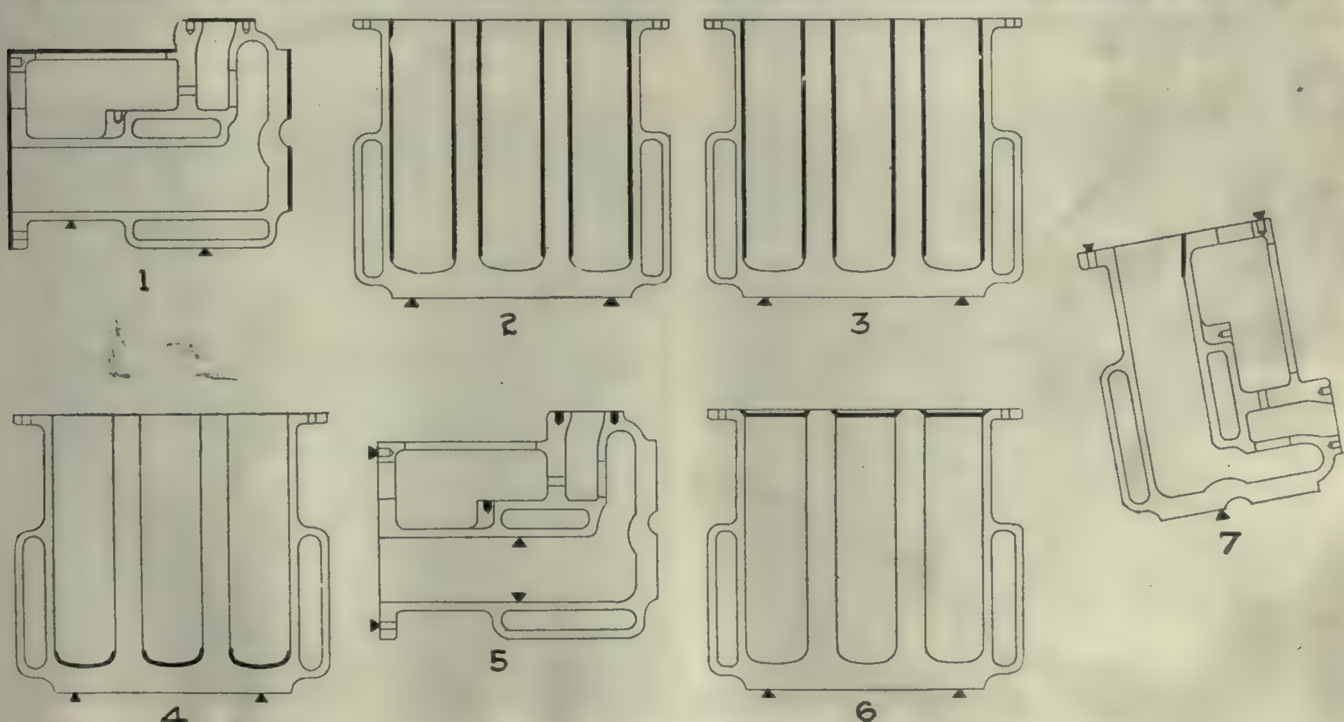


FIG. 1. TRANSFORMATION

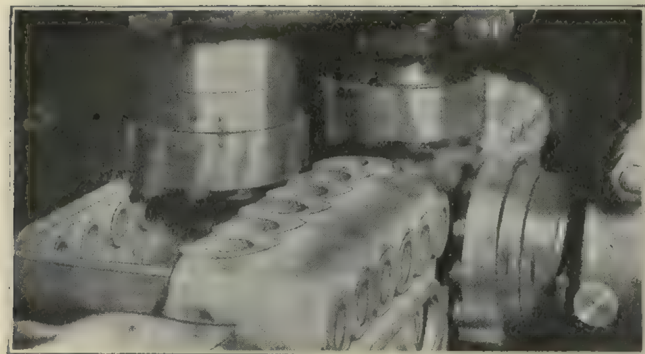


FIG. 2. MILLING THREE SIDES OF CYLINDER BLOCK

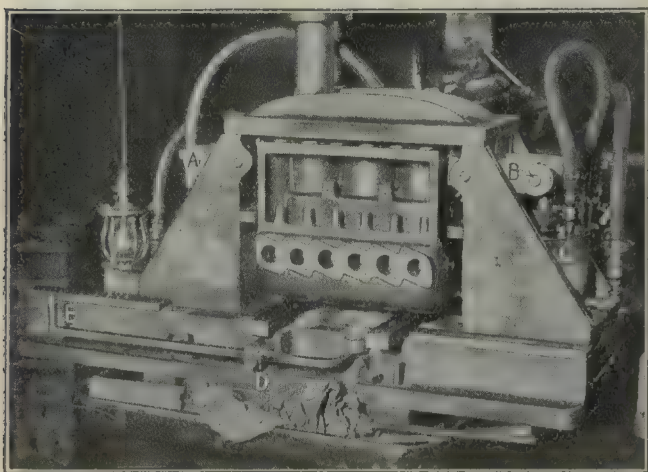


FIG. 4. PNEUMATIC FIXTURE FOR FINISH-BORING

operated by the adjoining handles. The center handles control another clamp at the back, and altogether this makes a boring fixture which is very readily operated.

A somewhat different fixture is shown in Fig. 4. The details of this fixture are given in Fig. 5. This is a pneumatically operated fixture, in which the cylinder block is firmly held by the arms *A* and *B*, operated by cylinder *C*. The pressure being applied at the top of the cylinders pulls the levers down, forcing the cylinder block up against the under side of the fixture. This fixture is used under a heavy single-spindle drilling machine and each of the three cylinders in the block is indexed in proper position by means of the pin *D* controlled by the handle *E*. The hose provide sufficiently

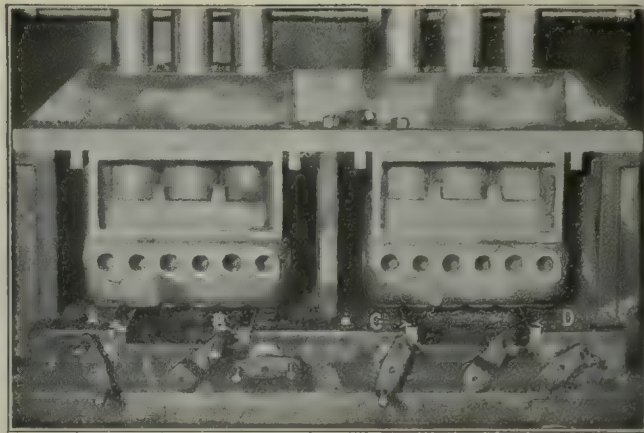


FIG. 3. ROUGH-BORING TOOL BLOCKS IN DOUBLE FIXTURE

flexible connections to the air supply to enable this movement to be easily made.

How the Pneumatic Fixture Is Made

Details of this fixture can be seen in Fig. 5, which shows the locating dowel pins *F* at the top, all the other parts being lettered to correspond with Fig. 4.

The fixture used for boring push-rod holes is shown in Fig. 6, this being a double fixture somewhat similar to that used for rough-boring, and shown in Fig. 3. The cylinders are located from bolt holes by means of the dowels *A*. The cylinder is held in position against the upper plate by means of the pins *BB*, which are forced up by the screw *C* operating against the wedge *D*. This makes a very substantial fixture, but is not quite as rapid in action as the one previously shown.

In Fig. 7 the dome of the cylinder is being faced to a given depth, this being determined by the ball collar *A*. This is also done on a single-spindle machine, but no in-

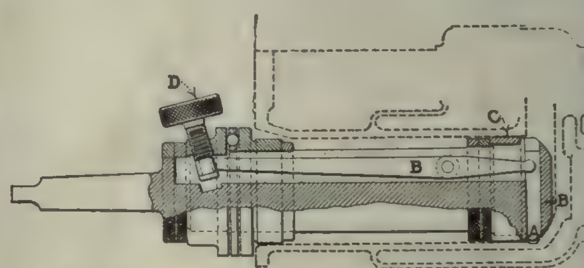


FIG. 8. RECESSING TOOL FOR CYLINDER

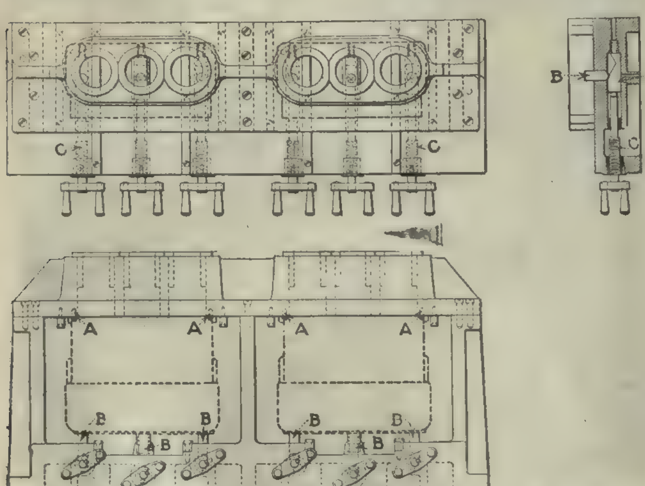


FIG. 6. FIXTURE FOR BORING PUSH-ROD HOLES

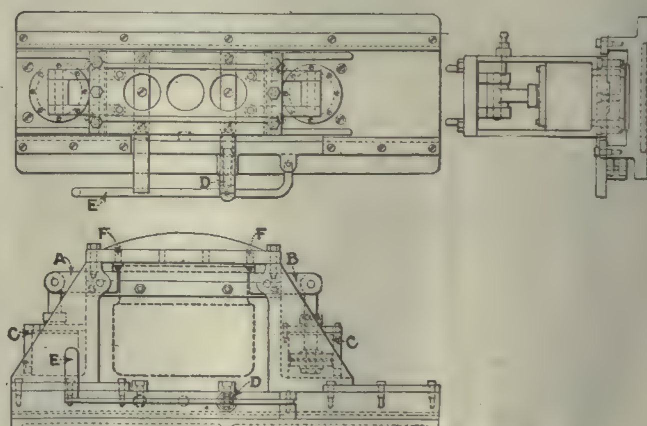


FIG. 5. DETAILS OF PNEUMATIC FIXTURE

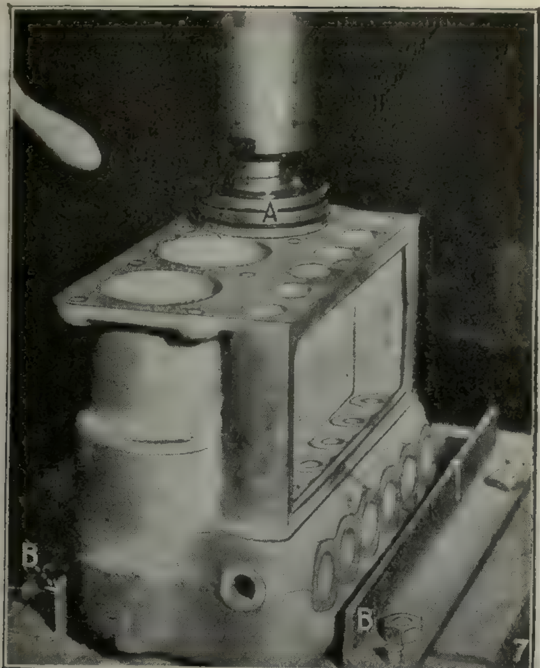


FIG. 7. FACING INSIDE THE CYLINDER DOME

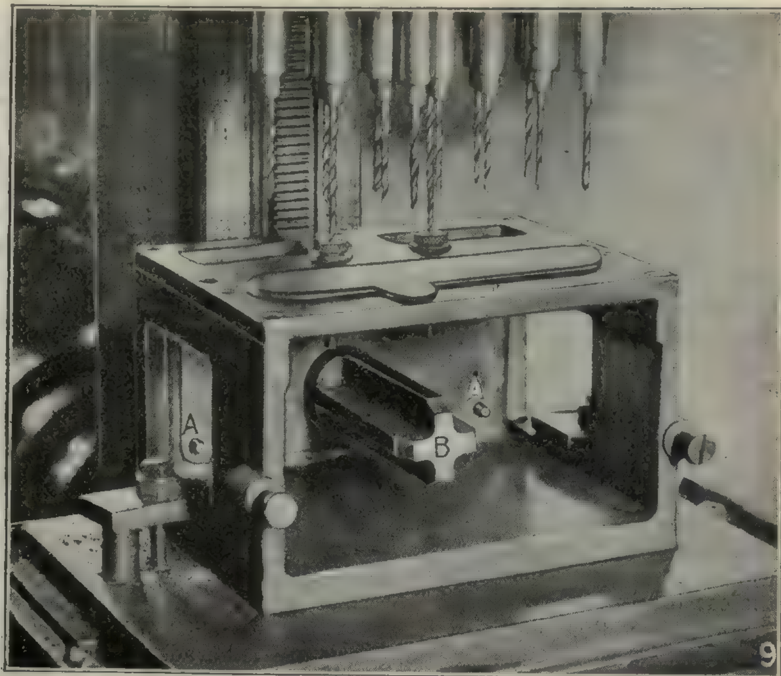


FIG. 9. FIXTURE FOR DRILLING EXHAUST BOLT HOLES

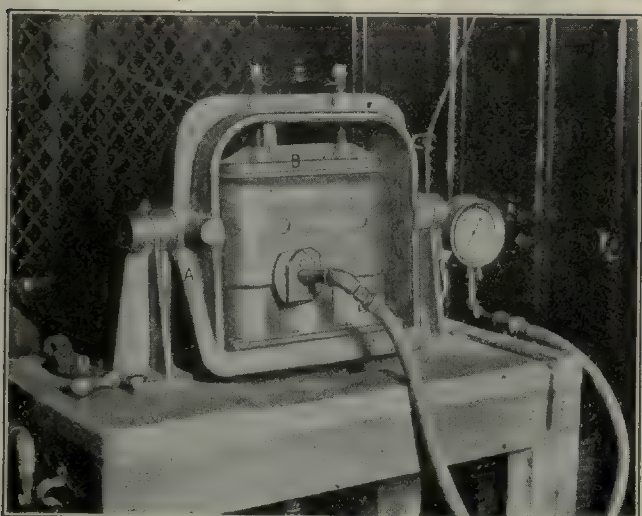


FIG. 10. THE WATER-TESTING FIXTURE

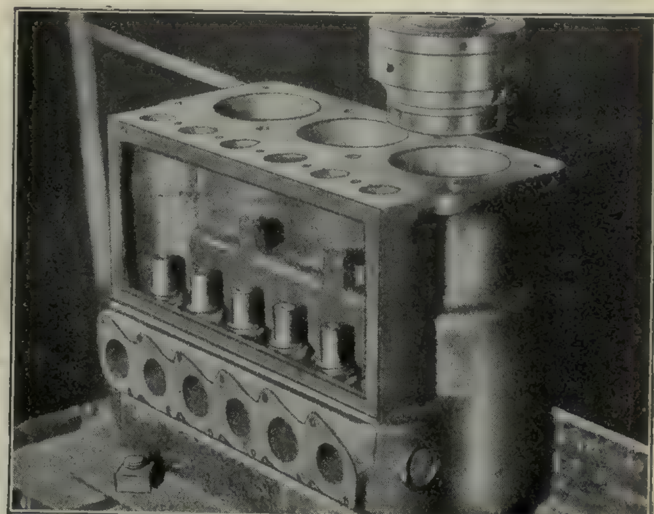


FIG. 11. CHAMFERING LOWER END OF CYLINDER BORE

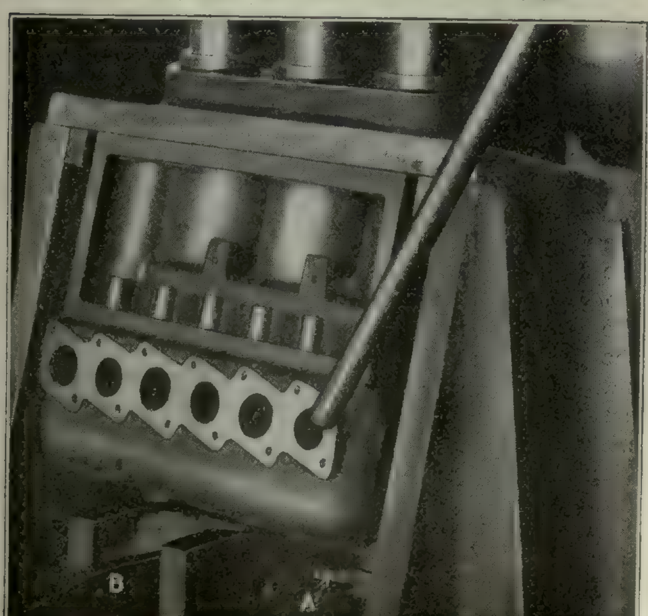


FIG. 12. BORING FOR CONNECTING-ROD CLEARANCE

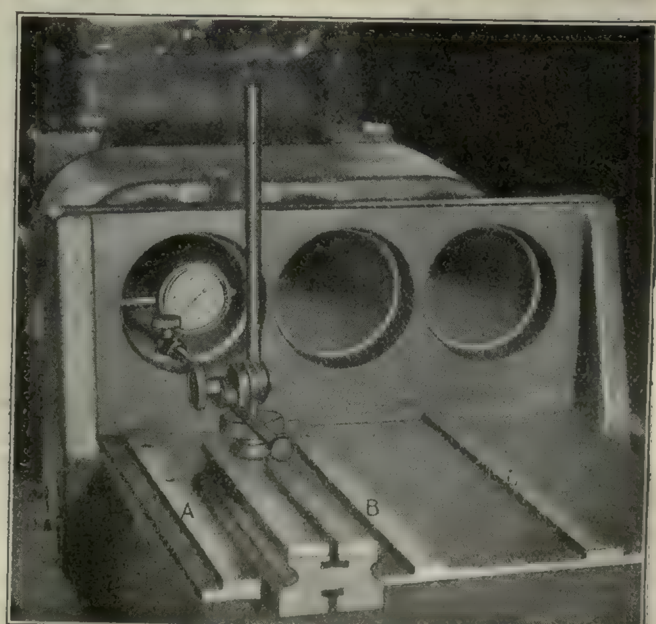


FIG. 13. METHOD OF INSPECTING CYLINDER BORE

dexing fixture is required, as the cylinder is easily moved along between the angle irons *BB* until the bore is in proper position.

Then the recess, to allow the overrun of the piston at the end of the stroke, is cut by the special tool shown in Fig. 8. This shows the recessing tool in position in the cylinder with the cutting point *A* advanced into the work. The bar *B*, guided by the sleeve or bushing C, seats on the cylinder dome and the tool *A* then is fed into the cut by means of the lever *B*, which is controlled by the knurled screw *D*. The operator can easily turn the screw handle as the tool revolves and the recess is readily cut in the desired position, and to the required depth.

Drilling Holes for the Manifold

The drilling of the holes for the manifold is done in the box jig shown in Fig. 9. Here again the dowels *AA* locate the cylinder while the pilot *B*, relieved on four sides, enters the center cylinder and acts as support for it. A strap across the outer side of the fixture holds the casting in place.

Next comes the water test for which the device shown in Fig. 10 is used. This consists of the pivoted cradle *A* and the plate *B* held in position by screws *C*, these being easily handled by the crank wrench *D*. This fixture allows the cylinder block to be swung in any position for examination. There is a pressure tank beneath the stand on which the cradle rests.

The cylinder bores are chamfered by the cutter shown in Fig. 11, the cylinder being held between angle irons as in the previous operation shown in Fig 7. Then comes the boring or relieving of the side of the lower end of the cylinder for connecting-rod clearance, utilizing the fixture shown in Fig. 12. The cylinder block is located by dowel pins as before, and held in position by jack-screws as at *A*. The lever *B* assists in placing and removing the cylinder block in the fixture. The three boring bars shown cut out a sufficient segment from one side of the bore to allow connecting-rod clearance.

Combination Surface and Dial Gage

After the cylinders are ground, the combination surface and dial gage shown in Fig. 13 is used for determining the diameter and straightness of the bore. The three hardened strips *A*, *B* and *C* guide the base of the indicating fixture in its movement. This makes a quick method of inspection, and one which has been found satisfactory.

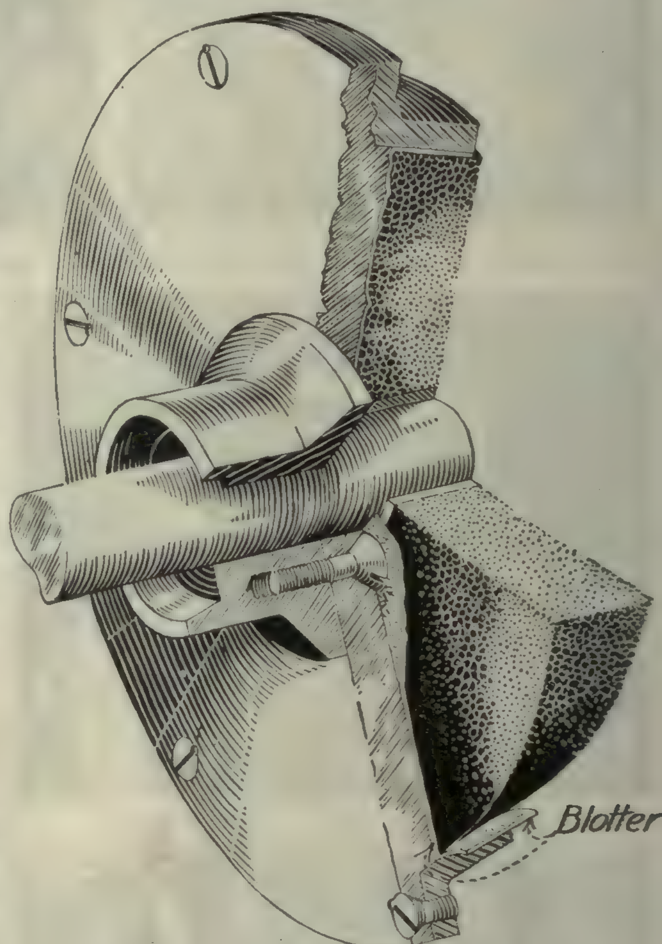
Adapter for Using Side of Grinding Wheel on Regular Stand

By H. H. Parker

While this is not to be construed as favoring the practice, for certain reasons it is sometimes desired to use the side instead of the face of a regular straight-face grinding wheel, perhaps when disk or cup wheels are not available. It is not at all satisfactory to use the side of a wheel as ordinarily mounted on the grinding stand; however, the illustration shows an arrangement by which it may be properly held, though in most cases the spindle would have to be cut off flush with the plate in order to make the whole side of the wheel effective.

A steel or iron plate, a little larger in diameter than the wheel to be used, is turned up, bored to a push fit on the spindle and attached to the rear wheel flange by three flathead countersunk machine screws. If the flange does not fit the spindle snugly it would be better to make a new one, or to bush it and re-bore. The plate should be carefully trued up and a groove turned off of one edge, leaving a boss slightly smaller than the wheel diameter. A tapered flange is made up, turned from either a steel or iron ring forged to shape and machined all over, or else cast from a wood pattern in tough bronze. Cast iron would not be dependable.

The ring flange should make a push fit over the plate and is held by six or more countersunk screws put in from the back of the plate as shown. After the screws are turned in tight, a small punch can be used to burr over the metal into the screw slots and this should prevent them from working loose.



HOLDING A WHEEL TO GRIND ON THE SIDE

Before fastening the ring for good, the face of the wheel is beveled off, by means of a grinding-wheel dresser, to correspond to the inside bevel of the ring; the final diameter should be such that, with a layer of blotting paper between the wheel and ring, the side of the wheel will project about $\frac{1}{8}$ in. beyond the side of the ring. Another blotter is placed between the back side of the wheel and the plate and when the screws are tightened the wheel should be held securely but without excessive pressure.

As considerable weight will be added to the revolving portion of the stand, the parts should be carefully trued and balanced before putting the apparatus into use. As the side of the wheel wears down near to the ring, the wheel may be taken out, beveled again and replaced, using enough packing back of it to allow it to project the desired amount.

Making Forged High-Speed Twist Drills

By J. V. HUNTER
Western Editor, *American Machinist*

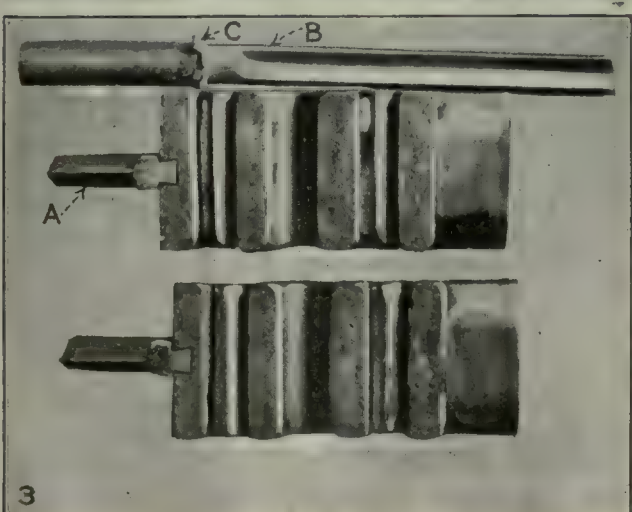
Very little has been generally known regarding the methods employed in the manufacture of forged high-speed twist drills, and the following article which describes and illustrates the methods used by one concern in its manufacture should be of interest to all users of that class of tools.

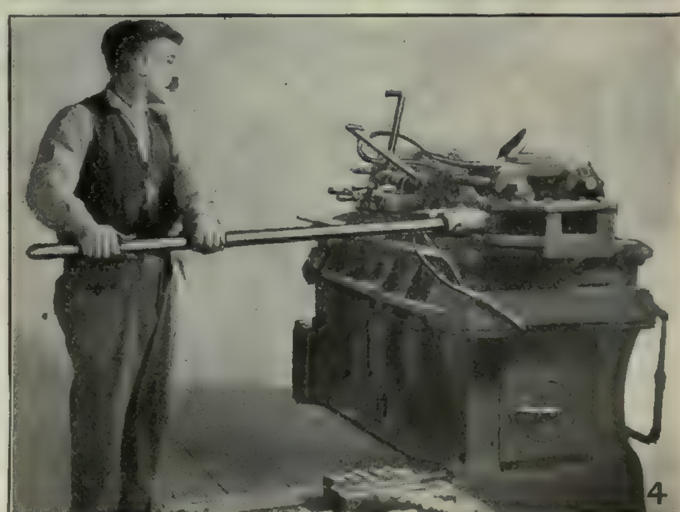
DURING the past few years tools of all kinds were in urgent demand and consumers found it difficult to obtain supplies to take care of their own needs. One user, the Ketler-Elliott Erection Co., Chicago, Ill., organized its own shops for the manufacture of small tools, and later has expanded its facilities to produce tools on a commercial basis. Among its products, forged high-speed twist drills are now being turned out in considerable quantities.

It has been observed by many manufacturers and users of high-speed steel tools that the cutting properties and life of the steel are noticeably improved by hot-working with proper forging methods before the tools go to the finish-machining operations. The drills are forged from round stock of a diameter suitable for machining the shanks without waste. The bars are cut to lengths that will be sufficient to make a single drill.

The forging operation, Fig. 1, is handled under Bradley hammers by expert operators who, while they forge the blanks very rapidly, are possessed of the requisite skill to handle the work without risk of injury to the steel. The blanks are heated to the correct forging temperature in oil furnaces, but few pieces being heated at a time so that each shall receive sufficient attention that there will be no danger of overheating.

With the heated blank held in his tongs the operator rapidly subjects it to the hammer blows, passing it back and forth through dies, such as are shown in Figs. 2 and 3, until the correct shape of groove, which can be seen at *A*, Fig. 2, is formed. There are several passes in these dies which are used to break down the stock and partly shape it before the finishing pass is used. The first blows on the blank, when working with the dies shown in Fig. 2, will flatten it slightly for the required length between the die passes *B*. The blank is then





FIGS. 1 TO 4. FORGING AND WELDING OPERATIONS
Fig. 1—Forging a drill blank. Fig. 2—Forging dies and a forged blank. Fig. 3—Forging dies and a blank showing the welding fin. Fig. 4—Butt-welding shanks

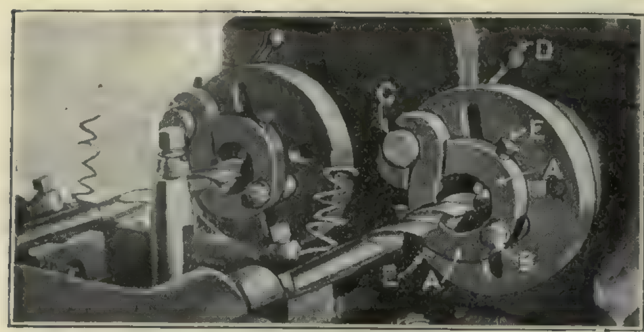


FIG. 5. TURNING DRILL SHANKS ON A DUPLEX LATHE

passed several times through the groove C which is shallower than the finishing groove, and between each pass it is rolled in the round pass D, which is the exact diameter of the desired forged section. Lastly, it is worked several times through the pass E which indents the groove to the final depth, being alternated each time through the pass D until the final form is completed. The entire operation is usually so rapid that a drill will be completely forged at a single heat without danger of working at too low a temperature.

Many of the dies are provided with hot chisels such as A, Fig. 3, by which the end of the forging may be clipped off at a single blow of the hammer. After forging, the drills are annealed by placing them in a box of mica powder.

In the drill forging B, Fig. 3, high-speed steel stock has been used up to the point C, which shows the fin thrown up at the point where an alloy-steel shank has been butt-welded on. It is claimed for this type of shank that superior strength is obtained at the tang, which will lessen the tendency to break at that point. It is also claimed that the welding of the shank does not

FIG. 6. MACHINE FOR TWISTING DRILL BLANKS

decrease its strength because the area at the point of weld is so much greater than the area of the fluted section that any breakage will always be in the smaller section. The saving of costly high-speed steel which is thus effected is of interest to both the maker and the consumer.

The welding operation, Fig. 4, is carried out on a Federal welding machine. Special effort has been made to assure the thorough training of the welding operators to obtain the best possible skill in making perfect welds. After inserting the pieces to be welded in the holding dies, the operator usually strikes an arc several times, so that the heat will reduce any projecting high spots,

FIG. 7. PLATES USED IN TWISTING MACHINE

and thus insure that when the final pressure for the weld is put on, the pieces will be uniformly heated.

After heat-treatment and box-annealing of the forgings to insure softness for easy machining, and to further refine the grain they are transferred to the machine shop. Here the shanks are centered and, with the drill end held in female center and clamped by a special dog, the shanks are turned in a Schmidt-Norgren duplex turning lathe, Fig. 5. The use of this lathe permits the operator to handle two spindles at one time, using one to make the first cut on the taper shank, and the other to turn to size ready for grinding. As each tool is set for one operation it is only necessary to make adjustments for tool wear. Sufficient stock remains on the shanks after turning so that there will be ample for grinding after certain other operations have been completed. The quick-acting clamping dogs used have been devised especially for this class of work. The two arms A are pivoted on the center B while their short ends surround the camshaft C. A quarter turn of the camshaft by the lever D, causes these arms to firmly grip the work. As may be seen these dogs can be adjusted within certain limits by turning the setscrew E.

At this point there is a divergence in routing the blanks; some go to milling machines, where they are mounted in rows, and a gang of cutters mills the grooves and the clearance on the lands. However, the majority are sent to the forge shop after turning the shank and there the flutes are twisted to their spiral form. This twisting is similarly performed on the drill blanks which have been milled as before noted.

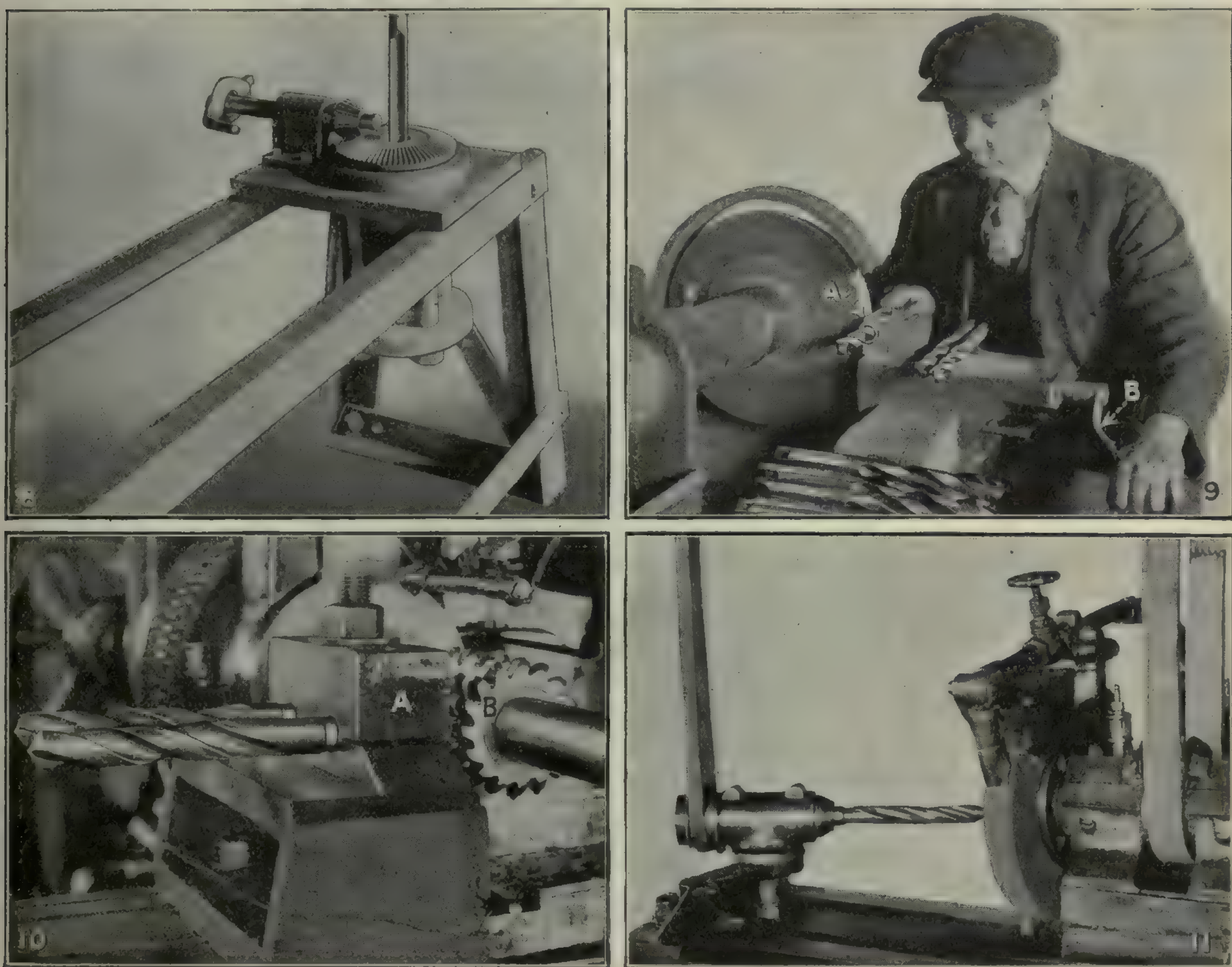
The twisting is accoplished by means of the small device shown in Fig. 6. The blanks are heated in an oil

furnace and when withdrawn, a holding lever or dog *A* is clamped to the shank. The fluted portion is then inserted in the hole *B* in the center of the bevel gear *C*; this hole being a loose fit for the drill section, the blank slides through it until the end of the flute stops further descent. The handle *D* at the right of the fixture is revolved, driving the bevel gear *C* through the pinion *E*, and this turning movement, which twists the hot drill blank, is continued until a positive stop is reached.

The stop in the turning movement of the twisting machine insures that the proper and constant angle of twist has been obtained. By reversing the crank motion very slightly in order to relieve the pressure, and by lifting and revolving the drill, it may be withdrawn from the device. After clearing away the drill the crank is revolved in reverse until the opening again stands in the original position for the insertion of another heated drill blank.

The twisting device was designed to give a uniform helix angle regardless of any tendency of one part to twist faster than another because of any difference in local temperature. In order to accomplish this, the barrel *F* of the device is filled throughout its height with plates similar to those shown at A, Fig. 7. These plates have an opening *B* in their center which is a loose fit for the forged section of the drill blank. Near the outer edge of each plate are two slotted holes *C* whose lengths depend upon the thickness of the plate and the angle of twist that it is desired to impart. At 90 deg. from the center of each slot are placed two dowel pins *D*, which project into the slots of the plate above them in the pile.

It will be noted that in the plate *A* the dowel pins are directly in line with the long axis of the drill section and the slots are across the short axis, while in the plate *E* the dowels are across the short axis and the slots in line with the long axis. The barrel *F*, Fig. 6, is filled entirely with these two types of plates which alternate one with the other throughout its height, the top plate having two pins that fit into the under side of the bevel gear. In operation, when the gear is revolved it rotates the plate immediately below it. When the ends of the slots come in contact with the pins of the plate below, that one starts to move in turn. In sequence, all the plates of the series rotate until the drill has been twisted throughout its length. The twist is absolutely uniform because each plate represents, by its thickness, a certain amount of the length of the drill and can only travel through the angular distance allowed by the length of the slots. In actual use the plates move somewhat uniformly as the pressure is applied, until they all reach the limit of their travel.



FIGS. 8 TO 11. TWISTING, GRINDING AND WELDING

Fig. 8—A later type of twisting machine. Fig. 9—Grinding the clearance. Fig. 10—Milling the tangs. Fig. 11—Grinding a center on drill ends.

The character of this machine is such that there is practically no limit to the length of drill blank which

may be twisted, and very long drills may be twisted by inserting them first to their full length up to the shank, and twisting the upper section, and then gradually withdrawing and twisting an additional amount in each successive operation. However, the regular machine which is in use has sufficient length to handle all drills of standard length without resorting to any such method. By the proper design of the plates, any desired angle of helix may be imparted to the drills. In the later types of twisting device, Fig. 8, the main barrel has been eliminated, and the plates are simply held in position by four long columnar bolts which extend from the top to the bottom plate of the device. The illustration also shows the steel frame or bench which is being used for the support of the device and which permits a series of different sizes to be assembled in a row.

Grinding Drills for Clearance

Drills which have been twisted before providing for the relief or clearance are now taken to grinding wheels where the clearance is produced in the manner shown in Fig. 9. The drills are inserted through the close-fitting steel bushing *A* which brings the greater part of the land into contact with the face of the wheel. By turning the handle *B* the device may be fed closer to the wheel as the grinding progresses. A locating screw is provided in the bushing and the operator in drawing the drill forward and back through the sleeve holds the side of the land in contact with it which insures that the clearance will follow the twist. In holding the drill against this locating screw the operator's hand imparts the necessary twisting motion as he pushes it forward and back. The operation must be repeated to grind the clearance on the opposite land.

The flutes of the unmilled drills are ground to a smooth finish on a formed grinding wheel having slightly less radius than that of the flute. While doing this, the drill is supported and steadied by a small rest that fits loosely into the opposite flute. Three or four passes over the wheel are usually sufficient to clean it up. After the hardening and tempering has been completed a finer grade of wheel is used to polish the flutes to a good finish.

A holding fixture *A*, Fig. 10, for two drills is used in milling the tangs as they are fed against the form-mills *B*. The milling cutters are set in pairs to give the proper thickness of tang and the operation is very quickly performed.

Oil-Fired Furnaces in Hardening Department

From the machine shop the drills go to the hardening room where the usual heat-treatments for hardening and tempering high-speed steel are employed. All the furnaces in this department are oil-fired and the temperature is regulated by pyrometer to insure correct and uniform heat.

To give a true center on the drill end for use during the grinding operations, the turned shank is inserted in a collet and the drill run at an angle against the side of a grinding wheel in the manner shown in Fig. 11, thus providing a center on the end that is true with the turned shank. In grinding both the taper shank and the body the drill is supported at the point in a pivot chuck while the shank end runs on a center. From this point, after suitable inspection, the drills are ready to be placed in stock.

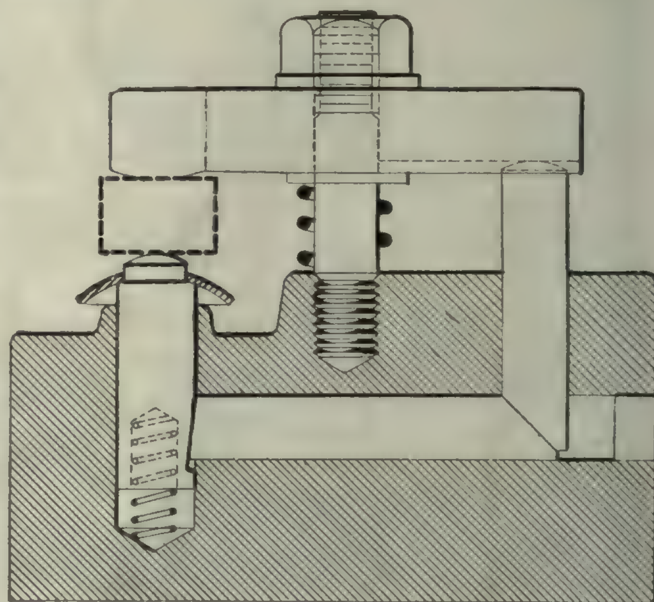
Clamping Device With Automatically Locked Spring Plunger Support

By R. W. Belmont

We had been having considerable trouble with jigs in which the work is partly supported by movable spring-actuated plungers which are set screwed to a fixed position after the work is clamped in place, but before the operations are begun. The trouble is due to the fact that the operator forgets to tighten the spring plunger, and the work is sprung. To overcome this we have designed a clamp which tightens the plunger automatically, thereby taking this responsibility off the operator.

The illustration shows the principle upon which the device operates. Tightening the clamp brings the pressure to bear upon the spring plunger through the medium of the two bevelled end studs.

[We are somewhat skeptical as to the practicability of this device. It looks to us as if the purpose of the spring-actuated support was being frustrated.—Editor.]



CLAMP TO TIGHTEN WORK AND SPRING PLUNGER

To the Men Who Served

One of the neatest and most satisfactory tributes to the men who left the shops to fight in the great war has been issued by the Geometric Tool Co., New Haven, Conn. It consists of a splendidly printed book of eighty-four pages, entitled "To the Men Who Served," and contains portraits of all but three of the thirty-nine men who went from that shop, together with a brief history of the activities of each.

Nearly every branch of the service is represented, some even going into the British and Canadian ranks. Only one made the supreme sacrifice, being killed at the battle of the Marne. Thirty-one have returned to the shop, and a few are still in service. This makes a touching token of appreciation which may be preserved by each and it cannot fail to bind all in a close bond of human sympathy.

The Pattern Shop at Balboa

By R. D. Gatewood, Commander U. S. N.

If you had to equip a pattern shop a thousand miles from its nearest neighbor, to handle any kind of a job that came along, what machines would you select and how would you lay out the shop? Here is the way they did it in Panama and also some of the work they turned out.

PATTERN shops are, as a rule, shops contributing only indirectly to production, and therefore treated as secondary in importance and given inconvenient, inefficient and oftentimes an out-of-the-way housing. The pattern shop at the Balboa shops of the Panama Canal, however, has been given quarters as convenient, efficient and up-to-date as its machine shop, boiler shop or any of the other departments. It has been appreciated that pattern work must be done well and expeditiously if the foundry and shop work is to be turned out in the shortest possible time; and, in accord with the general policy pursued by Canal officials, it has been realized that a well-equipped and properly lighted shop is necessary for any body of workmen from whom maximum output is expected.

The building which houses the pattern shop is a two-story concrete building with steel trusses to support the roof, the upper floor constituting the pattern shop and the lower floor being fitted up with a modern, sanitary lunchroom with all conveniences. Adjoining this building and connected with it by a covered runway is the pattern-storage building, a two-story building devoted entirely to the storing of patterns.

A 20-ton traveling crane runs from the foundry to the pattern-storage building so that a pattern, upon completion, may be placed in storage or sent direct to the foundry.

The floor occupied by the pattern shop has no columns to interfere with the work and has been provided with all possible conveniences for the workmen, for the purpose of getting out the work expeditiously as well as for their personal comfort. The office is centrally located, adjoining the runway entrance, while toilet conveniences and a sanitary drinking fountain have been placed

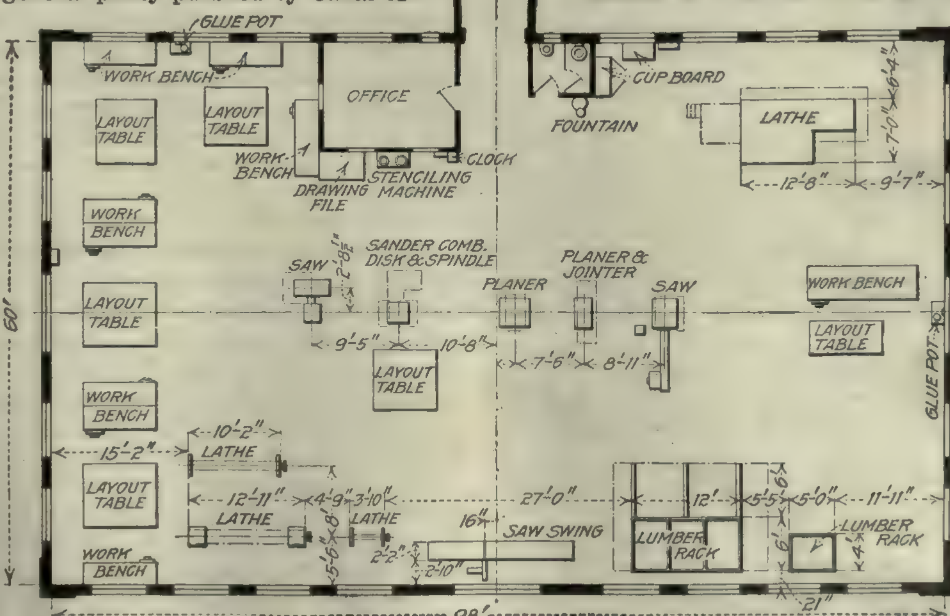
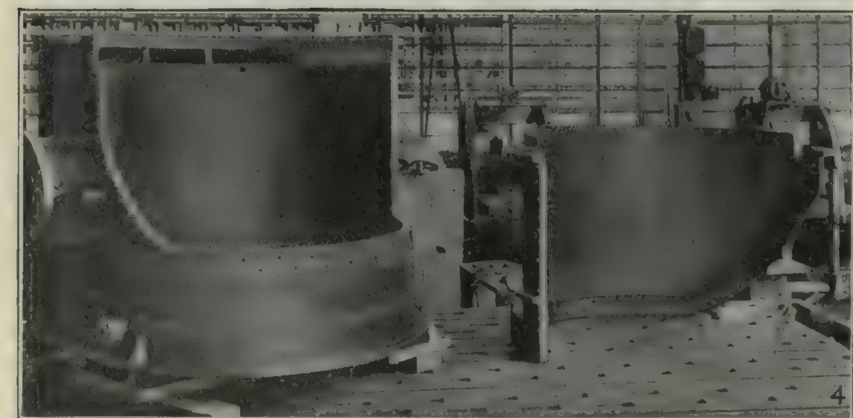


FIG. 2. THE SHOP LAYOUT

along one side. The windows on all sides give an abundance of light throughout the room and adequate electric lighting has been arranged so that work can be carried on at night as well as during the day.

All the machinery is motor driven and the arrangement can be seen in the headpiece and in detail in Fig. 2. The lathes are all so located that the operator faces the light. They are driven from overhead lineshaft, all of them being in one group. There are three of them here, the smallest taking work $12\frac{1}{2}$ in. in diameter by 2 ft. long, and the largest one, $20\frac{1}{2}$ in. in diameter by 7 ft. and 1 in. long. In Fig. 3 can be seen the large lathe which is located in the opposite corner of the room and is individually motor-driven. It is capable of taking work 88 in. in diameter over the bedplate and 158 in. in diameter at the rear of the headstock.



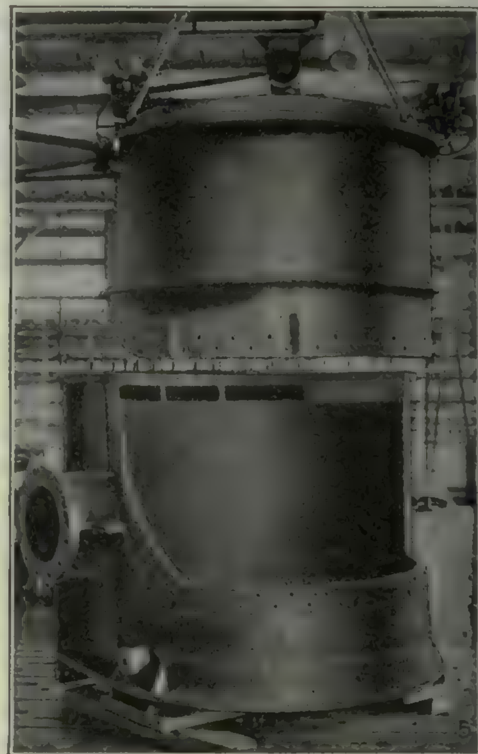


FIG. 3. SOME OF THE JOBS WHICH COME IN. FIG. 4. A DAMAGED GERMAN CYLINDER.
FIG. 5. THE PATCH THAT WAS MADE

The Equipment of the Pattern Shop

The other machines listed in Fig. 2, are located through the center of the room and are on the same group drive, except the bandsaw which has an individual motor. The lumber rack is along one side of the room with swing cut-off saw adjacent. There are also four hand trimmers which will take material from 4 x 4 in. to 9 x 17 in. One of these can be seen in Fig. 1, near the bandsaw.

Several electrically heated glue pots are conveniently placed around the room and along the end wall is an individually motor-driven grinding machine for sharpening edged tools.

This shop also has two stenciling machines for stamping letters and numbers $\frac{1}{4}$ and $\frac{3}{4}$ in. high respectively. These machines stamp the entire number and name on a zinc strip and provide nail holes in each end for fastening to pattern. This does away with the antiquated methods of using separate letters and numbers which become loosened and drop off, thus dsetroying the record on the casting.

There are 11 journeymen, one apprentice, and a foreman employed here and as the work is of such a varied character, it calls for men with the highest skill. Since the majority of the work done in the entire plant is of the nature of repairs to vessels transiting the canal, it means that very many of the patterns must be made from castings and the broken parts themselves, there being not enough time to allow drawings to be made. In Fig. 3 can be seen a number of pieces sent in to be used as samples for making patterns.

Patterns were made here for the entire engine and parts of the U. S. Coast Guard cutter "Manhattan," completed by the Balboa shops, and turned over to the Navy on Jan. 1, 1919. A few others that have been made are propellers, bitts, chocks, hawse pipes, anchors, gears, pulleys and all work necessary for plant upkeep and extension, and for the complete overhaul of five large ex-German steamers badly vandalized by their crews.

Among the many interesting and ingenious repairs made on these ex-German ships were the repairs to the cylinders of the main engines, all of which, except the high-pressure cylinders, had been dynamited or broken with hydraulic rams. Figs. 4, 5 and 6 will give a good idea of the quality and efficiency of the work turned out by this shop so far away from all ordinary plants and shop facilities. In Fig. 4 is shown the intermediate-pressure cylinder of a 9000-ton cargo carrier with the cracked portion removed and machined away. As will be seen, from noticing the 5-ft. rule laid across the top of the cylinder, it is 48 in. in diameter and slightly more than that in height.

From the cracked portion, the patternmaker takes his pattern for the cast-iron patch shown alongside the

cylinder. After machining, this patch is lowered in place as shown in Fig. 5, and in Fig. 6 it is seen fitted neatly to the cylinder, ready for bolting, boring and final testing. By this method seven large cylinders were saved with about 20 per cent. of the amount of work in pattern, foundry and machine shop required for new cylinders.

All the rolling stock of the Panama Railroad is repaired in the Balboa shops and this also means that patterns for this class of work must be made as well as those for traveling cranes, wrecking cranes and derricks. The miscellaneous floating equipment of the Panama Canal, including the great dredges and heavy machinery of the locks, are also repaired in these shops.

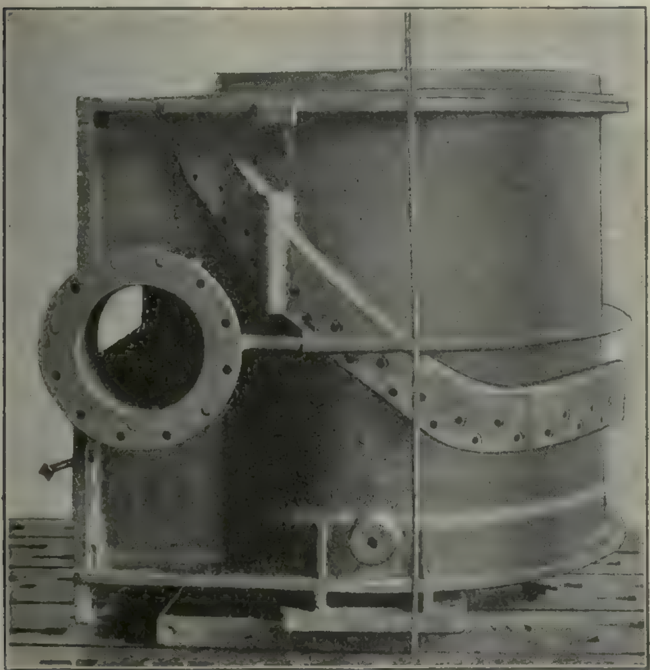


FIG. 6. PUTTING THE PATCH IN PLACE

This shop is really the only well-equipped pattern shop within a radius of a thousand miles. Its working force is extremely competent and experienced and the facilities of the shop as a whole are fully equal to meeting the demands that could be made on it for any pattern of any size or intricacy, that might be required from North or South America for marine, mining, railroad or any other class of equipment.

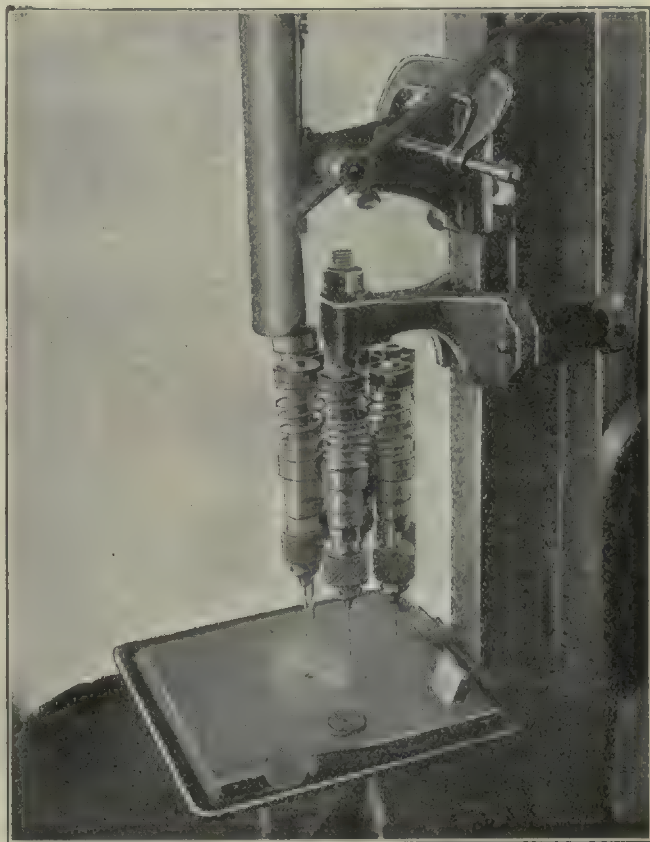
Multiple-Spindle Drilling Device

By Amos Ferber

A rather ingenious device for drilling several sizes of holes at one setting of the work is shown in the illustration. Ordinarily, this work would require a six-spindle drilling machine and engage the attention of two or more operatives, but where the output is comparatively limited or the larger machine not available, this device offers a short-cut that is worth the notice of shop men who have work of this character to do.

The spindles are held in a revolving turret which is suspended from a bracket clamped to the column of a single-spindle sensitive drilling machine. The point of suspension in this device is fixed, but the designer called the attention of the writer to the obvious fact that if a slot had been provided at this point the fixture would have been easily adaptable to any small drilling machine.

On the upper end of each spindle is a cone-shaped friction disk faced with fiber, with two oblong holes in its web. An inverted cup-shaped steel driver is attached by a taper shank to the drill spindle, and has on its under surface two sturdy pins which engage the holes in the web of the driven disk. Thus, when the spindle of the drilling machine is brought down upon any one of the auxiliary spindles, the latter is first accurately centered by the cup settling over the cone, then started revolving by contact of the fiber surfaces, and finally locked by the driving pins entering the holes of the web. The operator, however, takes no note of this sequence; the spindle is brought down and the drilling done as quickly and as though an ordinary single spindle was being used.



A SIX-SPINDLE DRILLING DEVICE

The turret, or "caster," as the designer calls it, is free to be revolved by the operator's hand any time the cup is lifted from a cone. The length of the spindle is adjustable, so that counterboring or other operations requiring a fixed depth may be controlled by a single stop on the main spindle. All spindles are returned to their extreme upward positions by coil springs as soon as the main spindle is raised. The C-clamp shown in the cut is put on as a matter of convenience to keep the main spindle from going too far up when the operator's hand is removed from the lever.

The quill and part of the spindle of the machine is covered by a sheet-metal guard to protect the operator from flying oil and to keep stray curls away.

The designer of this device is Charles Cuno and it is in constant service at the shops of the Cuno Engineering Corp., Meriden, Connecticut.

The Evolution of the Workshop—VII

By H. H. MANCHESTER

In this period the lead in shop methods and devices passes from Italy to France as the result of the progressive policies of Louis XIV and Colbert in this direction. Sweden enters the lists with an iron-slitting machine, only to have the idea promptly stolen by Englishmen. The first micrometer makes its appearance.

(Part VI was published in our March 11 issue.)

By FAR the most abundant and best evidence in regard to the evolution of the workshop in the first part of the 18th Century comes from France. For this there are various reasons. France was still the leading power of Europe, and Louis XIV, who was yet on the throne, had been a splendid patron of the practical as well as the more æsthetic arts. Colbert had started a systematic policy to make France industrially supreme. He had built up French industries, to take the place of goods which had been imported, by protective tariffs, exhibitions, and prizes for excellence. He had brought in trade secrets and special workmen from abroad, and encouraged new inventions. With the paternal idea of government, he had passed various regulations controlling manufacture, and had organized the corporations, as the guilds in France were then termed, into bodies which were kept in close touch with the government. Colbert was dead but his general policies were for the most part maintained.

On the other hand, Louis had revoked the Edict of Nantes, and in doing so had driven many of the Huguenots abroad. These largely belonged to the manufacturing classes, and their absence soon made itself felt in industry.

A good idea of the new inventions which were occupying the attention of the French savants may be judged from the "Machines Approved" by the French Academy of Science. In 1666 the academy began to publish brief descriptions, and in many cases cuts of the machines of which the descriptions or models had been submitted to them and had passed their inspection.

The very title of the series indicates that the idea of the machine as a device to lighten muscular labor was in the air. In general the designs show considerable ingenuity. The great lack was power, and it will be remembered that Savery had already invented his steam engine.

In 1705 the list of "Machines Approved" included the new micrometer, Fig. 40, by Le Fevre which suggests a growing demand for exactness.

In 1725 Fardouel attempted to invent a machine for cutting both large and small files, Fig. 41. The large ones were cut with a direct stroke of a sharp hammer; while for the small files, the machine worked a chisel and mallet, as was the custom in hand cutting the same tools.

A large lead rolling machine was invented by Fayolle in 1728. The rollers on this were shaped to give the lead various designs. In the same year Fayolle likewise invented a more important machine for drawing lead pipe, Fig. 42, which in its essentials was long in use.

In 1729 we find the Academy occupying itself with the new designs for lathes which were submitted to it by M. Grandjean. They included, according to the titles, one lathe to turn all sorts of contours, another to cut various kinds of rosettes, and a third to produce every variety of screw, Fig. 43.

A more automatic coining machine was invented by M. du Buisson in 1731, and in 1735 a new micrometer by M. Grandjean for use on such fine material as gold and silver.

Nothing further of great interest to our subject appears among "Machines Approved," until 1751 when we find a very important idea presented by Focq for a machine to plane iron.

As an indication of the contrast between France and England in regard to the progress being made in the machine shop in the first part of the 18th Century, it is significant that the British patents on iron and other metals did not disclose a single new metal-working machine between 1700 and 1759, at which date we find a patent allowed to Thomas Blockley for rolling metals with shaped rollers.

Turning from the new inventions as represented in

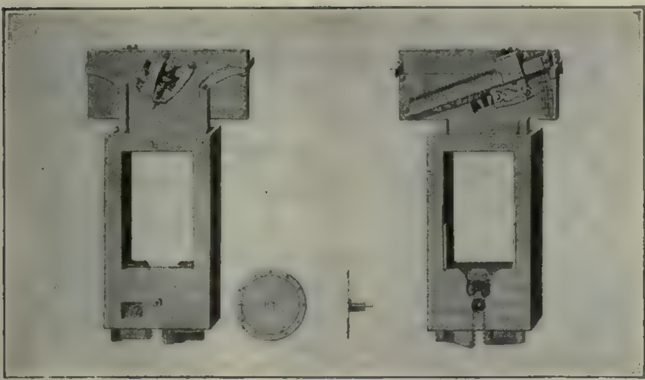


FIG. 40. LE FEVRE'S MICROMETER

the French "Machines Approuvées," and the British patents to machines in actual use in shop practice, we again find the best illustrations from France.

Two of the trades where the need of machinery was felt, in order to lighten the tediousness and quicken the results of hand labor, were the allied ones of nail and pin making.

A treatise on pin and incidentally nail making, published in 1718 and republished in 1761, gives an idea of the machines used in these trades at this period. It includes a cut of 1702 where the work seems to have been done by hand. Hand work, of course, continued to be extensively used as is shown in a view of a pin-making shop of 1718. Fig. 44 illustrates preparing brass wire, dressing it by drawing it between pegs, cutting it into lengths, and pointing on small grindsones turned by large flywheels.

In another cut from the same source, however, we find machines already introduced, Fig. 45. This cut illustrates the turning of the wire into little rings for the heads of the pins, cutting it by hand, and heading the pins by machines. Two such headers are shown, one for a single workman and one for several. The heading was done by small stampers which bit the head into shape. According to a third illustration, much of the polishing was done by shaking the pins together in a bag. It is expressly stated that machines similar to these pictured for heading pins, were also used for heading nails.

A series of illustrations on iron work was published in 1716 and 1717, and the pictures were repeated in a treatise of 1767. One of these engravings, Fig. 46, dated 1716 is very important in illustrating the drilling of iron in a machine shop. The machines employed are small lathes which were run by bows in much the

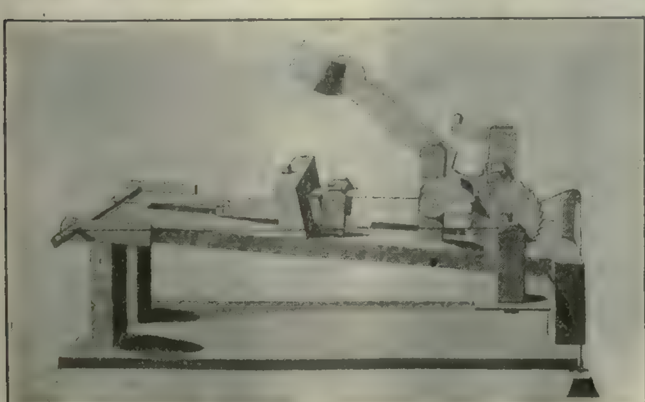


FIG. 41. MACHINE FOR CUTTING TWO SIZES OF FILES

same manner as the old Egyptian bow drill of 5000 or 6000 years before. In 1716, however, the lathes were horizontal and held the tools so as to leave one hand to manage the work while the other ran the bow. In the picture, the lathes are probably being used to drill the holes in scissors, but they were employed for general work of the sort. In the background of the picture may be seen scissors, keys, and other products of the shop, as well as the forge and bellows.

Other engravings of the same series, dated 1717, illustrate the manufacture of ornamental iron and show various processes of forging, punching, and beating, but these are carried on so exclusively by hand as not to demand reproduction of the pictures.

An important engraving, dated 1734, is given in

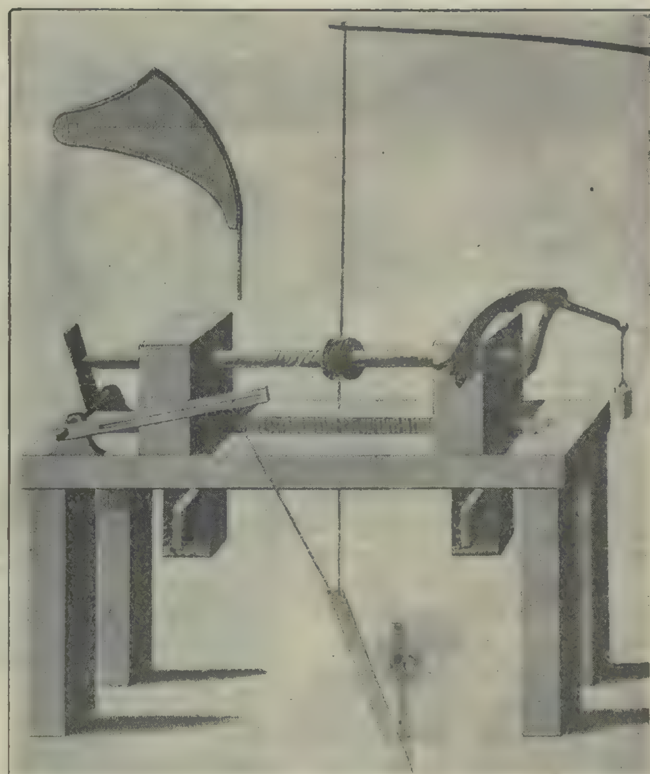


FIG. 43. GRANDJEAN'S SCREW-CUTTING LATHE

Swedenborg's treatise "De Ferre" or "Concerning Iron." It is a splendid representation of a mill, for slitting iron, run by a waterwheel, Fig. 47. The furnace, waterwheel, and construction of the mill are all plainly shown, and it should be noted that the mill had advanced to a point where it could slit several bars at once.

Taking the first illustration of such a mill from Swedish sources is highly appropriate, for it has been currently stated that successful slitting mills were first developed there, and were introduced from there into England.

An interesting legend of their introduction is preserved in the recollections of the great English author, Samuel T. Coleridge. He says that the slitting mills of Sweden were seriously interfering with the iron workers of England. A fiddler by the name of Foley who lived near Stourbridge, England, a center of the iron industry, conceived the idea of going to Sweden and learning the secret of the bar-slitting mill. He disappeared without telling anyone his destination, and

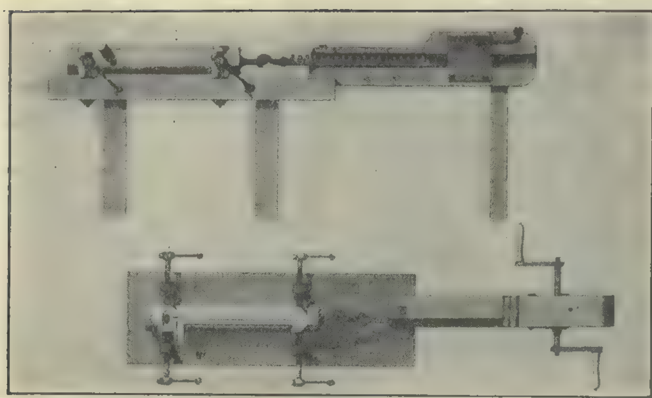


FIG. 42. LEAD-PIPE-DRAWING MACHINE

begged his way to Sweden and the location of the mills. There he fiddled for his living, watched the operations, and as soon as he thought he understood them, quietly decamped and fiddled his way back to England. There he made connections with a man by the name of Knight, who with some others put up the funds to construct the mill. When it was all completed, however, the partners were struck with consternation upon finding that it would not work. Foley, therefore, disappeared again, and returned to Sweden, using his art as a fiddler to get another opportunity of examining the mill. This time he made rude sketches of the machinery before he trusted himself to return. After he had made his way back the various alterations which he suggested were made in the new mill, and it was found to work satisfactorily. Coleridge narrates this story as the most remarkable instance he knew of enthusiasm and devotion to an idea, but it strikes us that the scale of business honor was not as high that as it is now. There is some doubt as to the truth of the legend, but it is certain that the same surreptitious methods were used in bringing a knowledge of silk-throwing machinery from Italy into England.

An important reason why the iron-working shops of England showed as few evidences of progress as we have noted in the first part of the 18th Century, was on account of the growing difficulty of getting fuel for the smelting and other furnaces. These had previously been fed with charcoal, and the scarcity of wood was becoming so great that in 1740 the number of furnaces in action was reduced to only fifty-nine. From about this time, however, the use of coke, which had been experimented with for some years previously, was gradually made a success, and the prosperity of the iron industry was greatly increased under the encouragement of the new fuel.

In William Hutton's "History of Birmingham," there is a notice of the nailers of the district which is important for several reasons. It indicates that in 1741 machinery for nail making was not as yet introduced, and that women were regularly employed in the industry. It likewise pictures a situation in the industry which was part way between the old guild system and the factory system and remained quite common for more than a century.

FIG. 44. PIN-MAKING BY HAND

The passage from Hutton is as follows: "When I first approached Birmingham from Walsoll in 1741, I was surprised at the prodigious number of blacksmiths' shops upon the road; and could not conceive how a country, though populous, could support so many people of the same occupation. In some of these shops I observed one or more females stripped of the upper garments, and not overcharged with their lower, wielding their hammer with all the grace of the sex. The beauties of their faces were rather eclipsed by the smut of the anvil; or in poetical phrase, the tincture of the forge had taken possession of those lips which might have been taken by the kiss. Struck

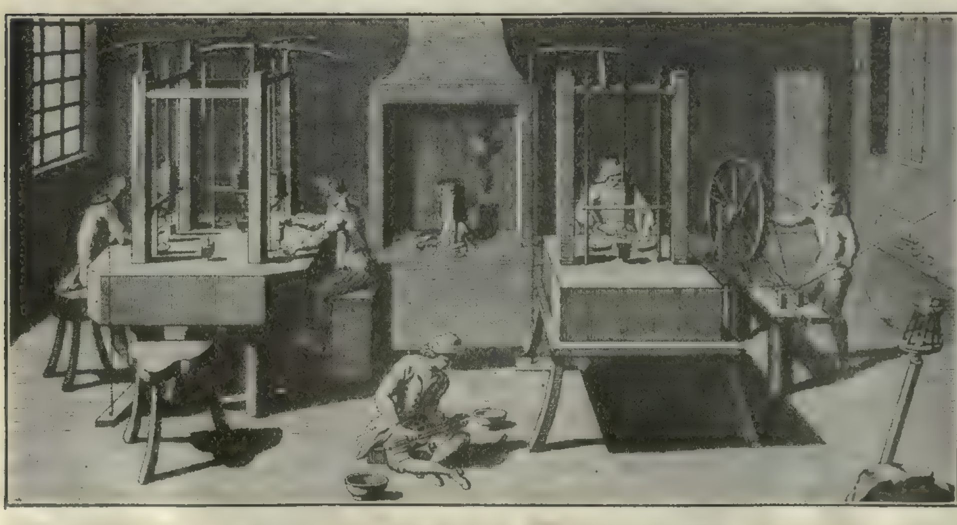


FIG. 45. MACHINES USED IN MAKING PINS

with the novelty, I enquired 'Whether the ladies in this country shod horses?' but was answered with a smile, 'They are nailers'."

It is perfectly evident that Hutton's description indicates neither a guild nor factory system of organization, but a contract system. The guilds, and along with them the old Elizabethan law concerning apprentices, had been falling into decay. In the lines where water power was used, the guilds were replaced by the factory or large shop built around the mill. Where the work was done by small foot machines or by hand, it became quite customary for contractors to purchase the materials and give them out to men or women who did the work at home. To this class belonged the thousands of nail makers, many of them women, whom Hutton describes. They probably received their raw material from a contractor, and were expected to return him a stipulated number of nails at so much a piece. In this connection we may remark that the average guild wages per week were then nine or ten shillings ($2.16 to $2.40 per week), at a time when the price of wheat ran from $1 to $1.50 a bushel—a rate at which the guild workman could purchase only about two bushels for his week's work.

FIG. 47. SWEDISH IRON-SLITTING MACHINE

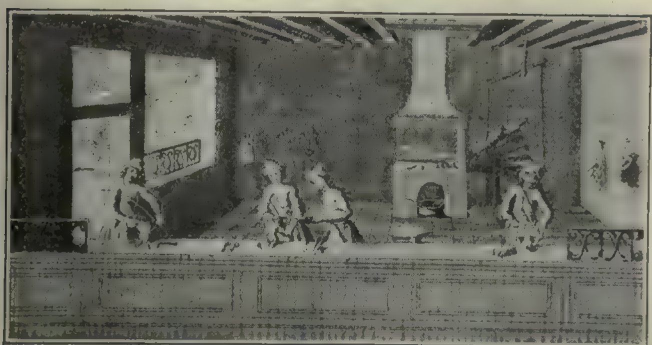


FIG. 46. BOW-LATHES FOR DRILLING IRON

Spacers for Step Milling Work

By George H. Thomas

It is one of the well-known principles of accurate machine work and of tool making to make all measurements from the same basic line. The principle is founded on the fact that measurement points will be more exact from a consistent base than with respect to each other both in actual position and the measurement thereof.

Sometimes the principle can be well carried out into production work. Fig. 1 shows the base frame of a calculating machine mounted on a profiling-machine table. Like all machines of this kind, the frame presents on its upper face numerous steps whose differing heights become a complexity of dimensions with respect to each other, but less confusing with respect to the base face. Naturally, in machining, measurements would be taken from the base line and the extended use of the principle is found in the employment of the series of space blocks shown in Fig. 2. The difference in the length of these blocks corresponds to the steps of the frame to be machined. At *A* in Fig. 1 is a slide member found on most milling machines of the profiling type, and the blocks are positioned in the manner of slip washers so as to effect the varying height of the cutter with respect to the work. The blocks are numbered for their respective employment.

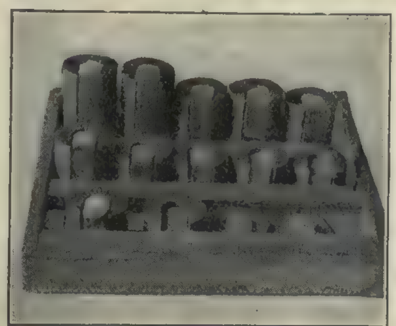


FIG. 2. SET OF SPACING BLOCKS FOR MACHINING DIFFERENT HEIGHTS

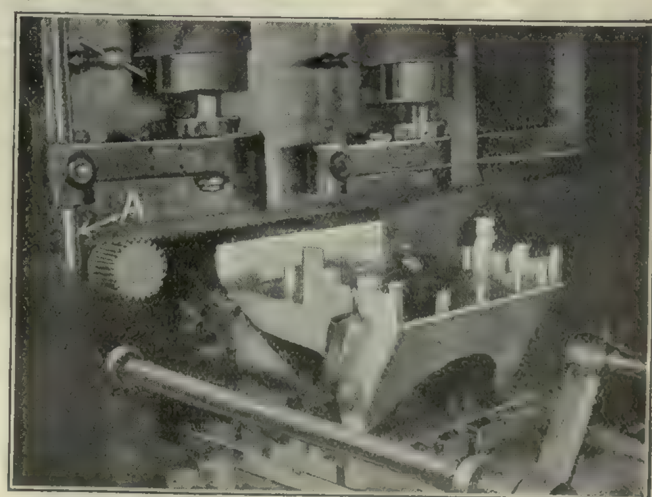


FIG. 1. PROFILING MACHINE WITH CALCULATING-MACHINE FRAME IN PLACE

The Lubrication of Ball Bearings*

By H. R. TROTTER

Ball-bearing lubrication is a subject of which little is known, and this is chiefly due to the fact that there is no accepted method of determining the lubricating value of an oil or grease. As a step toward the development of a satisfactory method the author has devised an instrument for such a purpose, a brief description of which is given in this paper. The operating characteristics of a ball bearing as related to the problem of lubrication are also discussed, and the specifications for a satisfactory oil are given. The use of grease and graphite as a lubricant is next presented and the paper concludes with a suggested procedure for the analysis of lime-soap greases.

An investigation of existing literature on the subject of ball-bearing lubrication reveals the fact that a comprehensive study of the particular phase of lubrication has not as yet been published.

In 1885 Beauchamp Tower completed a series of experiments to obtain data regarding the behavior of a lubricant under various loads and speeds. The outstanding feature of these experiments was the discovery of the wedge-shaped film of oil. Professor Reynolds later gave the rule for efficient lubrication, which is that where two surfaces are in sliding contact a satisfactory film of oil cannot be maintained unless the surfaces are at slight inclination to each other.

The formation of such a wedge-shaped film of oil can be described as follows: In Fig. 1 is shown a pan or tray *A* containing a small amount of oil. A flat plate *B* is loaded with weights *C*. When in a stationary position the surfaces of the plate and pan are parallel to each other, but if the plate is now pulled along the surface of the pan the leading edge will rise and the plate will flow on an oil film with the surfaces at an inclination to each other. The oil film assumes the shape of a wedge, as shown in Fig. 2.

The Michell thrust bearing, which is manufactured in Great Britain, and the Kingsbury thrust bearing, made in this country, are designed to take advantage of this phenomenon and both have proved very successful. The main features of a bearing of this type are shown diagrammatically in Fig. 3. *A* is the rotating member. *B* is the stationary member. The parts *C* are supported on pivots *D*. A bearing of this type with a diameter of 18 in. will successfully accept a thrust load of 160,000 lb. at a speed of 35 r.p.m. Loads of approximately 10,000 lb. per square inch of bearing surface at a mean surface speed of 54 ft. per second have been carried successfully on short tests on a bearing of this type. At this load the babbitt facing of the blocks flowed in all directions without temperature rise, thus showing that the pressure limit is controlled by the strength of the metal, and not by the breakdown of the oil film.

The final choice of a lubricant is at best the result of a compromise between the engineer and the chemist. This compromise is very often unsatisfactory and due in part to the chemist's inability to thoroughly comprehend the engineer's problem and in part to the engineer's lack of chemical knowledge.

The Testing of Lubricants

At the present time there is, unfortunately, no instrument which will accurately indicate the true lubricating value of an oil or grease. A viscosimeter gives a comparative reading of the inertia of a liquid, but it does not indicate the value of a lubricant under working conditions. It should have sufficient body to withstand the pressures. The lubricant film will therefore consist of three layers, which in operation approximate the features of a ball bearing in that one element is stationary, one rotating and one an intermediate layer consisting of globules similar to the balls in a ball bearing. From this description the importance of body in a lubricant will be realized, and as the best and toughest material is required in the balls of a ball bearing, so is body required in the intermediate layer of a lubricant.

The author has designed an instrument which may possibly be the means of obtaining data of value regarding lubricants. This instrument is shown diagrammatically in Fig. 4. The appliance consists of a revolving element driven by a small motor and a stationary element similar to a block used in a Michell or Kingsbury bearing with suitable means of obbtaining readings of the inclination angle of the block to the revolving element.

Referring again to Fig. 4, *A* marks a casing consisting of an inner chamber which contains the lubricant to be tested and an outer chamber containing oil which is electrically heated and which transmits its heat to the inner chamber. At *B* is shown a small electric motor with a shaft extension on which is placed a flange, the face of which is highly polished. The motor swings on a pivot *C* which allows the flange to take various positions with relation to the block, thus enabling readings to be taken at various rubbing velocities. By means of the lever *D* various pressures may be obtained. The

*From a paper presented at the annual meeting, December, 1919, of the American Society of Mechanical Engineers, New York.

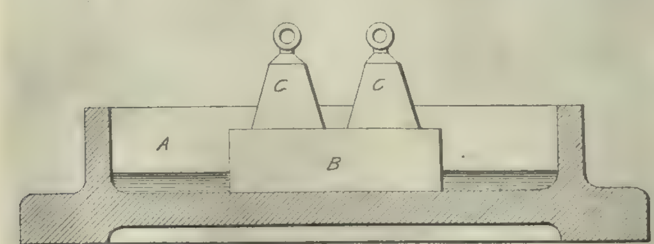


FIG. 1. FORMATION OF OIL FILM (INITIAL STAGE)

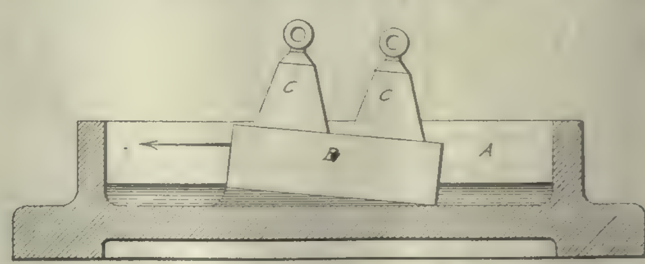


FIG. 2. FORMATION OF OIL FILM (FINAL STAGE)

movement of the block is magnified by minimeters and transmitted to the dial indicator. Holes are drilled in the block and can be connected to a manometer to obtain pressure readings, or as there is practically no pressure difference, the holes can be connected to each other in such a manner that there will be practically no velocity through them. Temperature may be obtained at the leading and trailing edges of the block. Readings may be taken at constant speed with varying loads or with constant load at varying speeds.

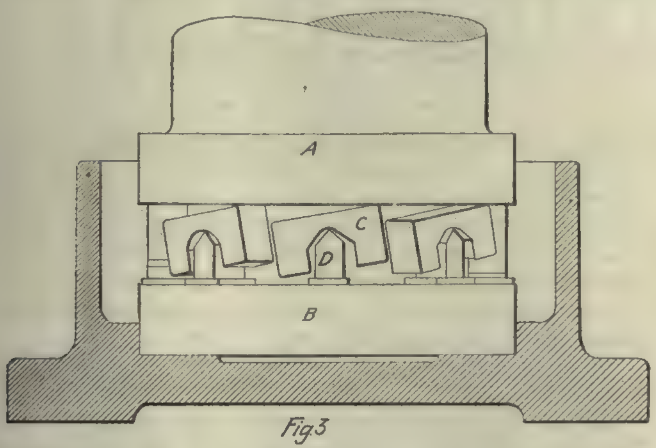


FIG. 3. DIAGRAM OF MICHELL TYPE OF THRUST BEARING

Operating Characteristics of Ball Bearings

With a ball bearing the important points to be remembered are:

(1) The coefficient of friction is practically constant throughout wide ranges of loads and speeds;

(2) Metal-to-metal contact (an oil film only possible at very high speeds when slippage may take place);

(3) The coefficient of friction is lower in an unlubricated ball bearing (at light loads and moderate speeds).

The first point is, of course, generally known, but the conclusion to be derived from this point has not been stated before to the author's knowledge; namely, the impossibility of an oil film between balls and races.

In Fig. 5 curve *A* shows the change of friction coefficient of a plain bearing under constant load and varying speed. This curve is self-explanatory and shows that a satisfactory oil film is not formed till a certain speed is reached. In the same figure curve *B* gives the friction coefficients of a well-made ball bearing, and shows that the friction loss of a ball bearing is practically constant throughout wide ranges of speed. If an oil film were formed between balls and races, curve *B* would possess the same general characteristics as curve *A*.

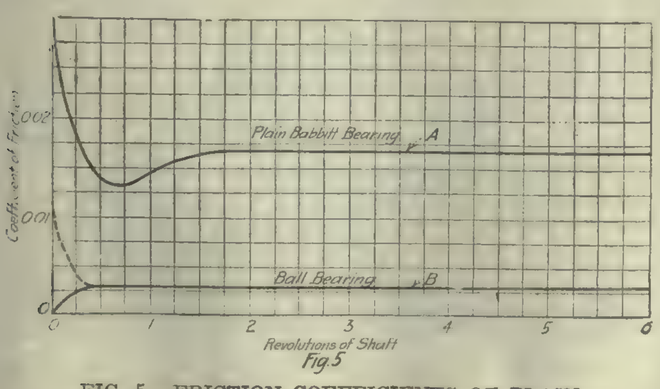


FIG. 5. FRICTION COEFFICIENTS OF PLAIN AND BALL BEARINGS

The difference between the friction coefficient of a lubricated and unlubricated ball bearing is shown in Fig. 6. This property of a ball bearing is not generally known, and should not be used as an argument in favor of operating ball bearings without lubrication. From the foregoing statements it should be evident that plain bearings and ball bearings possess such radically different characteristics that a true comparison is impossible. It naturally follows, therefore, that practically all the accumulated experience of the lubricating engineer is of little value when analyzing ball-bearing operation.

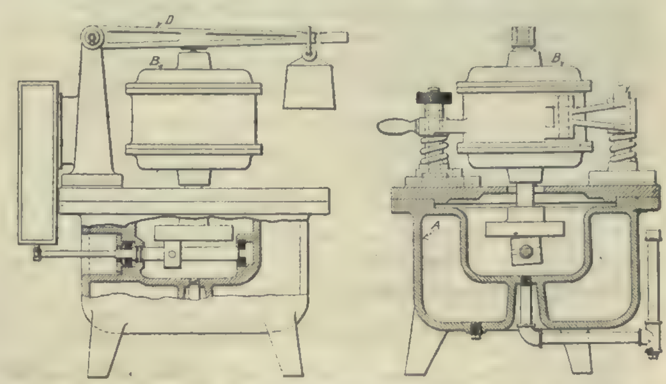


FIG. 4. DIAGRAM OF AUTHOR'S DEVICE FOR OBTAINING LUBRICANT DATA

Requirements of a Ball-Bearing Lubricant

The principal requirement of a ball-bearing lubricant is chemical neutrality. The lubricant used must not contain over 0.10 per cent acid or alkali. There are many commercial lubricants on the market which come within this limit, but very few are acceptable because of their tendency to develop acid with age or when operating at high temperatures.

Most of the high-grade oils can be used with safety, but many of the lubricating greases, while suitable for general purposes, are a positive menace to successful ball-bearing operation. There are now on the market a few greases manufactured especially for ball bearings, but, with one exception, all those tested by the author have proved worthless.

Experience shows that the most satisfactory lubricant for ball bearings is a highly refined mineral oil having the proper viscosity and cold test for the installation. Greases should be used only where operating condi-

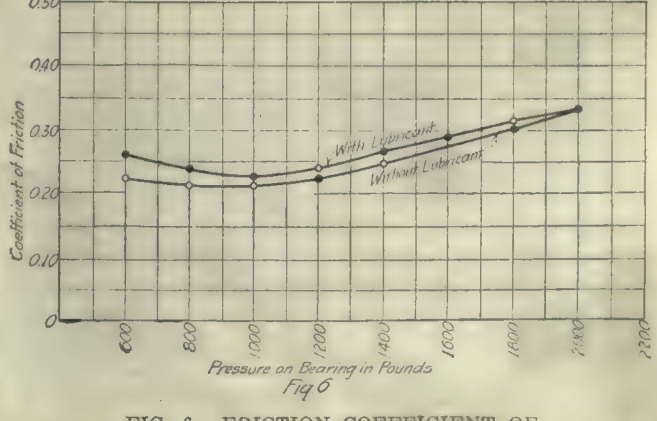


FIG. 6. FRICTION COEFFICIENT OF A BALL BEARING

tions require viscosities greater than can be obtained with a mineral oil.

Whenever a ball bearing is operated at high speeds, it is not advisable to run it submerged in a lubricant, and provision should be made to supply the oil from a pressure system. If such a system is not available, good results may be obtained by a large sight-feed oil cup. A few drops of oil per minute is all that is required.

At moderate speeds a heavy oil will generally give better results than a light oil. The substitution of a heavy oil for a light oil will generally result in a decreased operating temperature. This peculiarity may be explained by the fact that when the bearing is running at the actual operating speed, less opposition is offered to the rotation of the balls by the oil because of the inertia of the oil. In addition, there is less churning and frothing, with their resultant air pockets. Air pockets in a lubricant act as insulators and prevent the transmission of the heat generated to the outer casing where it can readily be dissipated.

Lubricating Greases for Ball Bearings

Many of the greases now on the market are entirely satisfactory for general purposes, but lack certain characteristics which experience shows to be highly important for successful ball-bearing lubrication.

A large number of greases contain lime-soap as thickeners; a few are of the soda-soap type, while others are a combination of both. The lime greases are valuable in that they can be used without harmful results where moisture is present. Their consistency, however, is more easily changed by heat than greases of the soda type.

The following specifications are accordingly suggested: Free acid (calc. as oleic acid), maximum, 0.10 per cent.; free alkali (calc. as sodium hydroxide), maximum, 0.10 per cent.; free lime (calc. as calcium oxide), maximum, 0.5 per cent.; neutral saponifiable oil, maximum, 1.0 per cent.; viscocity of mineral oil (minimum 200 sec., Saybolt universal, 100 deg. F.); abrasive particles (sand, etc.), absent.

The highest-grade ball-bearing greases are put through a milling process after compounding. This treatment insures very intimate mixing of all constituents and pulverizes any chance impurity to an impalpable powder. It is strongly recommended that all greases for ball bearings be so treated.

Graphite, despite its unctuous qualities, cannot be regarded as a true lubricant. It can, however, be used with success in plain bearings as it fills in the interstices in the bearing surfaces and allows the true lubricant to operate efficiently. A modern well-made ball bearing with mirror-like finish has, however, practically no scratches when magnified 100 diameters, and, furthermore, were there irregularities present, graphite would not eliminate them as there is considerable difference between the sliding action of a plain bearing and the rolling action of a ball bearing.

Graphite, moreover, has a tendency to pack in the ball retainers and raceways, and a bearing which has been lubricated with graphite grease generally has a distinct wavy appearance in the ball paths. A recent brief test of a grease containing graphite revealed the fact that while the graphite did not pack in the raceways, and the wavy ball paths were absent, the complete raceway presented a burnished appearance quite different from that obtained by the use of ordinary greases. The graphite packed hard in the ball retainer and could not be removed by dipping in gasoline.

The use of graphite in ball-bearings cannot therefore be regarded as beneficial, and its application is purely a question of economics. Its use in ball-bearing automobile transmissions and rear axles is advisable only if the increased efficiency and life of the gears offset any possible harmful effect on the bearings.

Erasures on Tracing Cloth

By D. C. Howard

In making machine detail tracings general layout plans, etc., it frequently becomes necessary through error or change in idea, to make erasures. These often cover considerable area of the cloth and it sometimes occurs that the same area has to be subjected to the scrubbing process several times. The usual result is a mussy spot on the tracing and a corresponding cloudy area on the finished blueprint.

Many draftsmen and detailers, who make a tracing neatly finished in other respects, either through inability or carelessness stumble over these erasures. In the ideal tracing the eraser should not be used, but this degree of perfection is seldom attainable.

If the following suggestions are adopted, there will be found no difficulty in removing inked lines and lettering from the same area on standard tracing cloth as many as eight or ten times. Obviously the better grades of cloth will stand greater scrubbing.

At the beginning, remove the dirt and grime from the spot to be erased with gasoline and a clean cloth. Use a celluloid erasing shield in preference to one of metal, and a pencil eraser. The popular Ruby rubber is about as good as any. Do not use ink eraser on tracing cloth at any time. Rub very carefully across the lines, at no time allowing the eraser to generate any heat. Cleanse the eraser frequently on emery or sand paper, using care than no grit becomes embedded in the rubber.

When all trace of ink is removed, use a few drops of Three-in-One oil on a flannel cloth to carefully rub the erased area. Wipe off all excess and dust lightly with fuller's earth or talc powder. Replace the polished surface of the tracing cloth by rubbing in finely powdered soapstone.

If care is used throughout the above method, new inked lines and lettering may be placed in the erased area several times and there will be no cloudy spot on the blueprint. However, if the fibres of the cloth are raised in the process, they may be burnished down at the time the oil is applied, with the rounded end of a right line pen handle.

Remember—careful erasing is slow work.

Shops which get a reputation for dropping men as they approach any age limit whether it is 40 or 50, find that valuable men seek other jobs several years before they reach those limits. Actual years have little relation to working capacity. Overanxiety, anger, worry, and most of all fear, all contribute more to age a man than even physical dissipation. More people suffer from fits of anger than from drink, more from fear than from late hours. Men who live in the fear that at some definite period they will begin to go down hill, and instead of choosing jobs will be lucky to have one, cannot do good work.—*Brass World.*

US
ARMY ORDNANCE NEWS

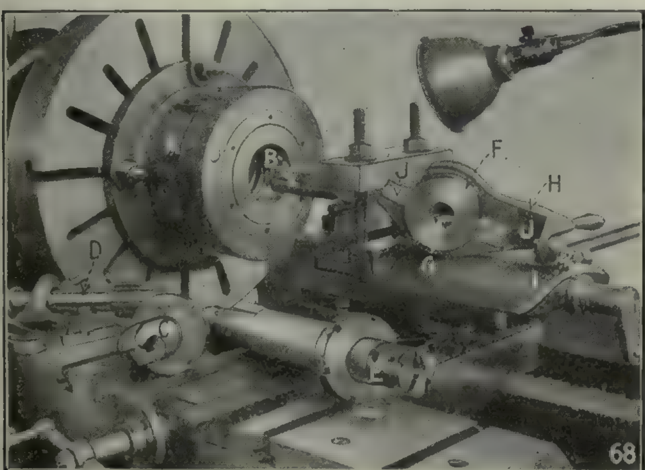
Machining Problems Solved In Gun Making—V

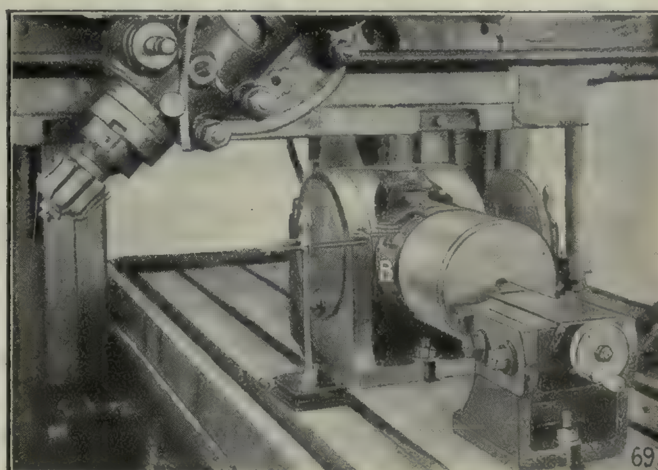
By J. V. HUNTER
Western Editor *American Machinist*

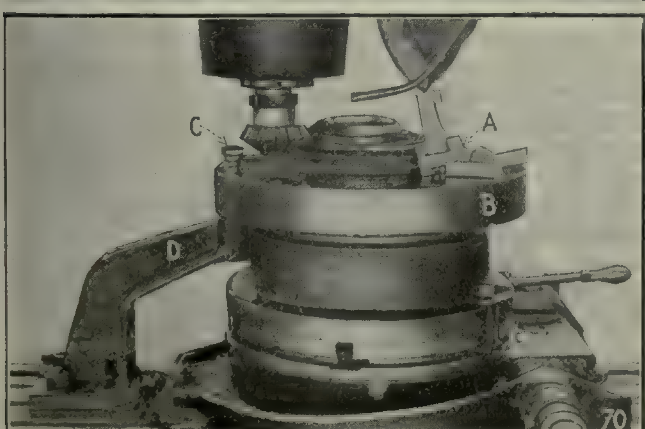
Previous installments have shown how the major parts of the 4.7-in. gun were machined. This last article of the series tells how the same careful methods and accurate tools and fixtures have been applied to finishing some of the remaining parts of the breech mechanism.

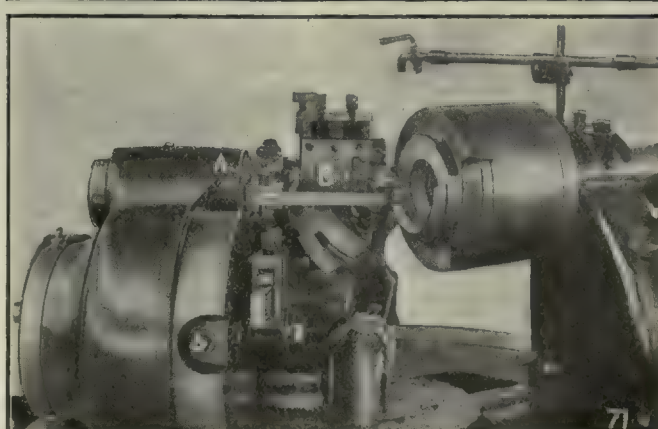
(*Part IV appeared in our March 18 issue.*)

THE set-up of the breech block shown in Fig. 68 is used for several operations. The block is held in the large pot-chuck *A*, and the illustration shows the cutting of the internal threads using the threading tool *B*. Other tools which are used in connection with this work are the three-lip end mill *C*, the reaming bar *D* and the wood-packed reamer *E*. The latter is similar to the wood-packed reamers used for gun-boring operations. A special tool-guide bushing *F*, which is used during the bore cuts in the small interior pocket, has the large bushing *G*. The latter fits in the large open end of the block, and this has an extension arm *H* with a pin *I* which fits over the chuck and locks it into position. The hardened-steel guides *J* then serve for marking the quarter lines for determin-









FIGS. 68 TO 71. SOME OPERATIONS ON THE BREECH MECHANISM
Fig. 68—Finishing the interior of the breech block. Fig. 69—Set-up for milling the sectors on the block. Fig. 70—Relieving the section for the bevel gear. Fig. 71—Cutting the bevel-gear sector.

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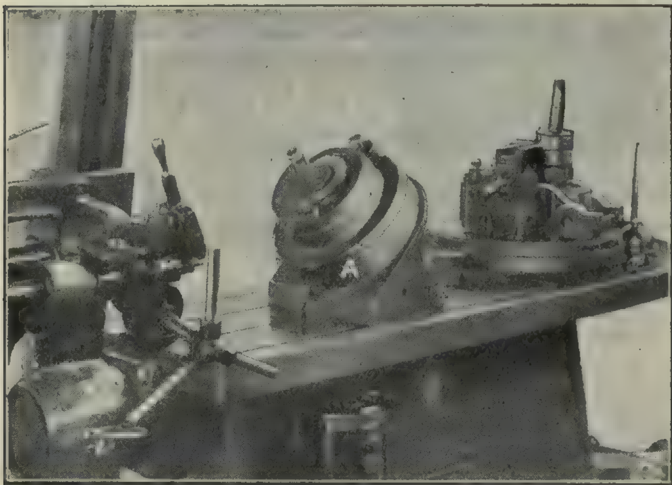

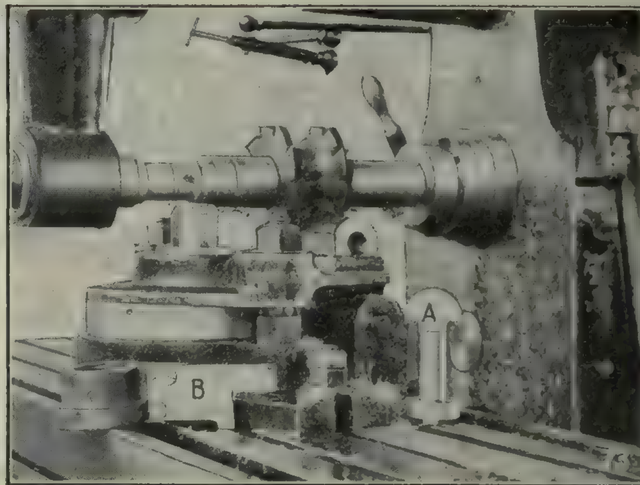

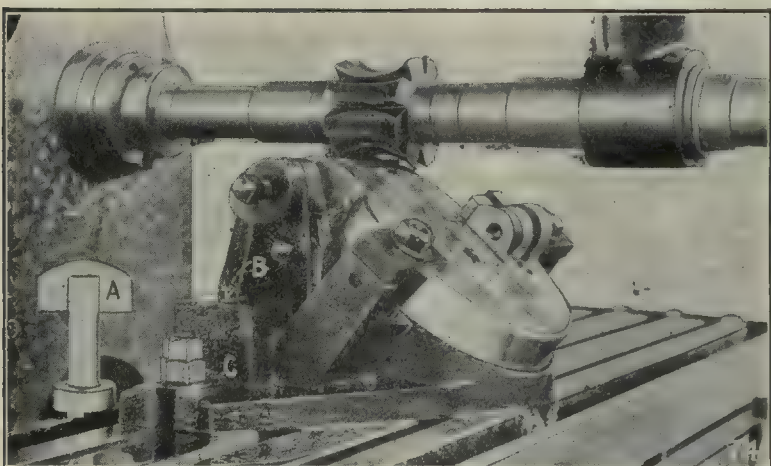

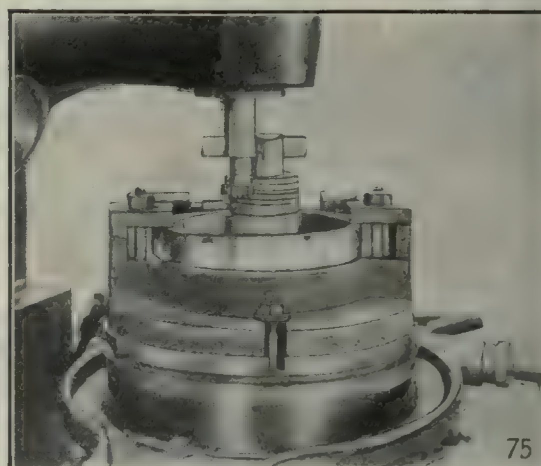

FIGS. 72 TO 75. DRILLING, MILLING AND REMOVING FEATHER ENDS

Fig. 72—Drilling vent holes through the block. Fig. 73—Milling the radius on the hinge section of the carrier. Fig. 74—Milling the back radius on the carrier. Fig. 75—Removing the feather end of the square threads.

ing the position for the start of the thread The set-up which is shown in Fig. 69 is used for milling out the sectors in the threaded outside surface of the breech block. As here shown, the job is being set up ready for the start of the first cut, and the surface gage and indicator *A* are in service gaging from a point on the plate *B* of the holding fixture, which is also used for a guide for setting the cutter in position. Certain portions of the rear end of the block are milled away by a series of operations; the one shown in Fig. 70 is relieving the section that will later be cut into the beveled-gear sector which turns the block to lock together the interrupted thread of the block and breech. Some of the gages used in connection with this work are shown at *A*. The piece during this operation is held in the body chuck *B*, which can be indexed around to any required position by the pin *C* which locks into the extension arm *D*.

A Gleason gear shaping machine is used to generate the teeth in the bevel-gear section previously mentioned and the work is shown being set up, Fig. 71, using gages *A* and *B*, which are provided for this purpose. The drilling of several vent holes through the block is done on a Barnes horizontal drilling machine with the block held at the proper angle by the indexing fixture *A*, Fig. 72.

The early operations on the inside of the breech block carrier forging are performed on Gisholt turret lathes which finish the back and turn the interior and center lug.

Milling-Machine Operations

Following this are a number of milling machine operations on the hinge lug; that shown in Fig. 73 is the milling of the 1-in. radius on the outer end. The gage which is used for setting the table up to the proper height with respect to the milling cutter is shown at *A*, while the gage *B* is fitted over the center lug of the block carrier when setting the table for distance with respect to the longitudinal axis of the cutter. The use of the gage *A* for setting the table for height is handled in the same way as another gage *A*, Fig. 74, in connection with the milling cut on the rear surface of the hinge lug, as handled on a Cincinnati milling machine. It will be noted that this milling-cutter setting gage *A*, has a key in its base which fits into the keyway *B* cut on a side shoulder *C* of the milling fixture. When this gage has been pressed down to a full bearing on this shoulder, the cutter may be set by it, to exactly the right height for finishing this portion of the block carrier.

A milling operation used for the removal of the end

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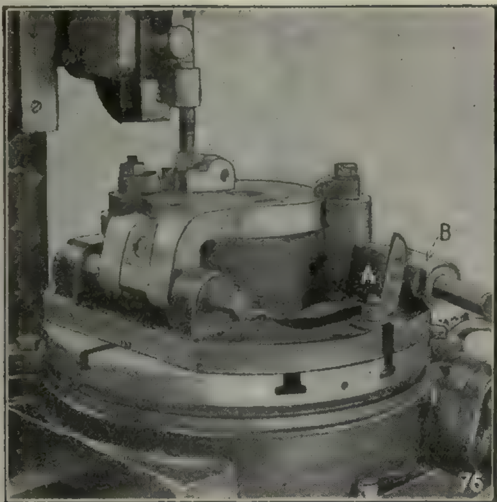
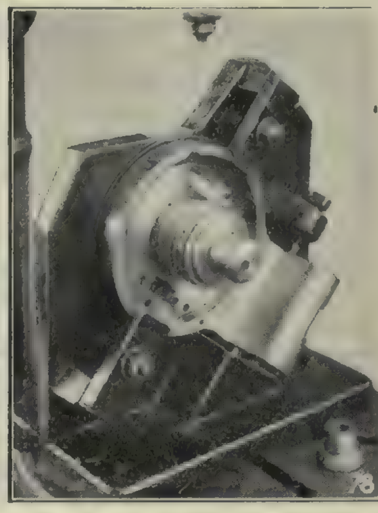
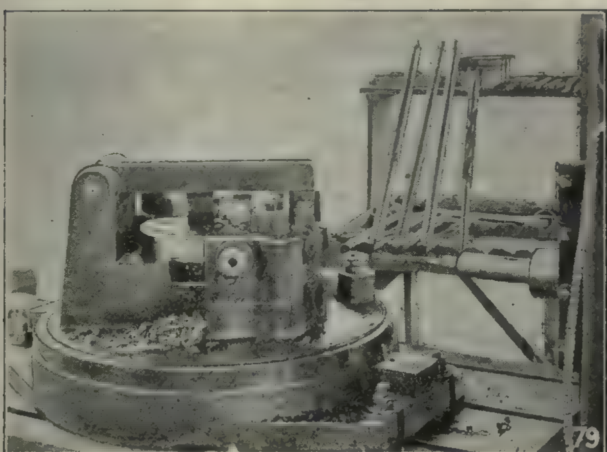
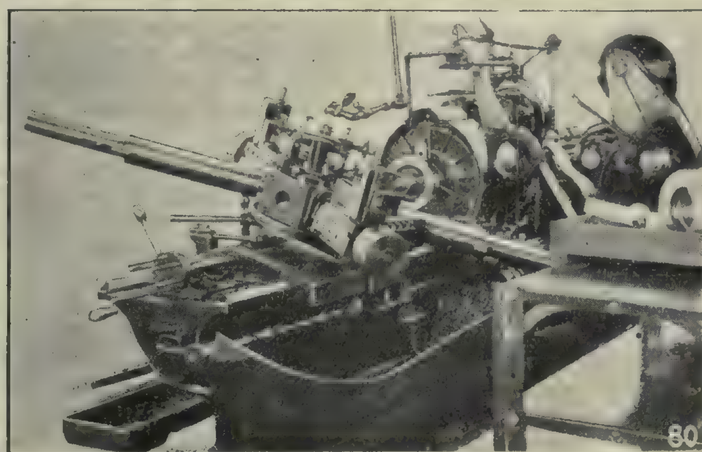








FIGS. 76 TO 80. OPERATIONS AND JIGS USED ON THE BREECH MECHANISM
Fig. 76—Slotting holes through the carrier. Fig. 77—The box jig for drilling operations on the carrier. Fig. 78—Drilling operations on the carrier. Fig. 79—The revolving and indexing jig. Fig. 80—Turret-lathe operations on loading tray forgings.

or narrow points of the thread on the inside lug is shown, Fig. 75, on the table of a Milwaukee milling machine. The slotting of the irregular shaped holes in the face of the block carrier to receive the operating lever and other parts is accomplished on a Pratt & Whitney vertical shaping machine, Fig. 76. The fixture used for holding the parts during this operation and some of the gages *A* and *B* used in connection with this work are also shown.

Two drilling operations showing the types of jigs used illustrate the methods by which this work is handled, Figs. 77 and 78. A third drilling jig and fixture, Fig. 79, is mounted on the bed of a Barnes horizontal radial drilling machine so that it may be indexed around and lined up with the spindle for the drilling of the several holes required in the edges of the block carrier and through the operating lever lug.

The loading tray is furnished as a peculiar-shaped steel casting, and requires a number of interesting operations for its completion. One of these is the Gisholt turret-lathe operation, Fig. 80, which finishes the major portion of the outside of this casting, turns the flange and completely bores it. The loading tray actually occupies only about one-third of the circumference of the breech section of the gun, and by this manufacturing method it is first machined in the form of a complete circle, and later sawed into three segments which are finished to produce three loading trays.

Hardening Duralumin

Duralumin, an alloy of aluminum, can be hardened by quenching at temperatures below its melting point and allowing it to stand at ordinary temperatures. The hardness is not produced by quenching alone, but increases during the period of aging, which may be from one to three days. The composition of duralumin usually varies within the following limits:

	Per cent
Copper	3 —4.5
Magnesium	0.4—1.6
Manganese	0 —0.7
Aluminum	Balance
Iron (as impurities)	0.4—1
Silicon (as impurities)	0.3—0.6

Its density is about 2.8. It is used only in the forged or rolled condition.

This alloy has been produced for some years commercially and is in demand for the fabrication of parts for which both lightness and strength are required, such as for aircraft. Its tensile strength will average 50,000 to 60,000 lb. per square inch after appropriate heat treatment.

The Standardization of Grinding Machine Classification

BY CAPTAIN S. M. HENRY

The engineers of the Bureau of Construction and Repair in our Navy Department have done much to standardize shop practice. It is their endeavor to have this work constructive, to utilize accepted standards as far as possible. This example shows their endeavor to get logical and understandable definitions for the different kinds of grinding machines.

THE absence of a generally recognized system of nomenclature for grinding machines proves embarrassing in endeavoring to investigate the equipment that should be supplied for an industrial plant doing work requiring this important class of machine tool. Whether an endeavor is being made to see whether the equipment in a plant is satisfactory, or a layout is being made for carrying on a particular class of manufacture, the first questions that arise are, "What are the classes of grinding machines, what are their uses, and what are their differences?"

There seems to be little uniformity among manufacturers of these machines or the manufacturers of the wheels used by them, or among the writers of handbooks and reference books. In one case a particular machine is referred to as a grinding machine, while in another place the same machine is referred to as a grinder. In one book a grinder is a plain grinder while in another it is a cylinder grinder, and so on.

The first step in the consideration of a plant's equipment of grinding machines should be to divide all of them into their main classes, and if the investigator feels so disposed, his next effort may be to attempt to devise some logical system of nomenclature by which the same machine may always be referred to in the same way, or if he calls a machine by a certain name one day that he will be able to recognize the next day what it was that he had in mind.

THE NATURAL SUBDIVISIONS

The first natural basis for a subdivision that would suggest itself is the class of work that is to be performed, and perhaps second, the type of construction of the machine, and finally, the type of wheel used, taken in conjunction with the use or non-use of water or other lubricant.

A suggested division of the more usual classes of grinding machines (and it is proposed to refer to them all as grinding machines rather than grinders) is as follows:

Cylindrical grinding machines.
Surface grinding machines.
Hand grinding machines.
Portable grinding machines.
Tool grinding machines.

If this proves to be a reasonably logical division there must be a further subdivision, so that each of the various types of machines can be referred to with an assurance that some one else, seeing the reference, can form a reasonable mental picture of the machine referred to. Taking the first classes, it is clear that there are grinding machines for working on the outside of cylindrical surfaces, and others for working on the inside of such surfaces. These may perhaps be fairly referred to as "outside cylindrical grinding machines" and "inside cylindrical grinding machines." The universal grinding machine also belongs in this class, and, as it can be employed in either class of work, it may perhaps be consistent to call it a "universal cylindrical grinding machine."

The class of grinding machines used for cylindrical work, therefore, can be divided reasonably logically on the basis of the class of work for which they are used, without any serious departure from common nomenclature, though what we are now calling an "outside cylindrical grinding machine" is much more frequently referred to as a "plain grinder" or "plain grinding machine."

SURFACE GRINDING MACHINES

When the surface grinding machines are considered, the rules which seem to apply so well in the first group fall down, and it is necessary to make a distinction, based on the construction of the machine rather than on the character of the work it is called upon to do. Even the name itself is not a very fortunate selection, for all grinding machines are used for grinding surfaces, but if the term "surface" is replaced by "plane" or "flat," it is not more correct because irregular surfaces are ground on this class of machine as well as flat surfaces. Assuming that it is necessary to adopt the construction of the machine as a basis of reference, the principal machines of this type can be divided into the following four classes:

Open-side surface grinding machines.
Planer-type surface grinding machines.
Vertical-spindle surface grinding machines.
Side surface grinding machines.

In many shops the only type of grinding machine used is what is commonly called a "double grinder," used for snagging work, for miscellaneous grinding such as the removal of burrs, sharp edges, etc., and this particular machine appears to be the one most difficult to properly label; as there is nothing in the type of work, the construction of the machine, or the form of the wheel, that is reasonably descriptive. For want of a better name, it may be called a "hand grinding machine," as the work is usually held against the wheel by hand. This type, in turn, can be divided into the "bench" and "pedestal" types, depending on the design of the machine, whether based on installation on the floor or on a bench. The next class of machine in this group is the "disk grinding machine," which has the disk or wheel so arranged as to grind with the side rather than with the edge of the wheel. Its general characteristics, other than in this particular feature, are in agreement with the hand grinding machine.

Buffing and polishing is essentially a grinding operation where the coarser wheels are replaced by a much finer cutting surface, but, in a general classification, can be included in this group, the machines being essentially the same as the hand grinding machines, except as to the type of wheel used and the speed of revolution.

The next group includes the portable grinding machines, which may be classified according to their method of drive, the usual method of classifying hand or portable tools, and may, therefore, be divided into:

Pneumatic portable grinding machines.
Electric portable grinding machines.
Flexible-shaft portable grinding machines.

The greatest variety of grinding machines will naturally be found in the group devoted to tool work, and the most reasonable classification for this group would appear to be based on the class or character of tool for which the machine is supplied. This group would include:

Band-saw grinding machines.
Circular-saw grinding machines.
Cutter and reamer grinding machines.
Drill grinding machines.
Drytool grinding machines.
Knife grinding machines.
Universal tool grinding machines.
Wet tool grinding machines.

The outline of the difficulties connected with the classification of grinding machines suggests the desirability of the manufacturers adopting some uniformity in referring to the various machine tools of this class, and the table given below, based on the brief description of the uses and characteristics of the different machines, may serve as a basis for further discussion that will lead to a greater uniformity than at present seems to exist.

CYLINDRICAL GRINDING MACHINES

Inside cylindrical grinding machine.
Outside cylindrical grinding machine.
Universal cylindrical grinding machine.

SURFACE GRINDING MACHINES

Open side surface grinding machine.
Planer type surface grinding machine.
Side surface grinding machine.
Vertical spindle surface grinding machine.

HAND GRINDING MACHINES

Buffing and polishing machine.
Disc grinding machine.
Hand bench grinding machine.
Hand pedestal grinding machine.

PORTABLE GRINDING MACHINES

Electric portable grinding machine.
Flexible shaft portable grinding machine.
Pneumatic portable grinding machine.

TOOL GRINDING MACHINES

Band saw grinding machine.
Circular saw grinding machine.
Cutter and reamer grinding machine.
Drill grinding machine.
Drytool grinding machine.
Knife grinding machine.
Universal tool grinding machine.
Wet tool grinding machine.

Secrecy in Wage Scales

BY FRED B. COREY

On page 438 of the *American Machinist*, the question is asked, "Is the principle of secrecy in granting increases of wages ethical and expedient?"

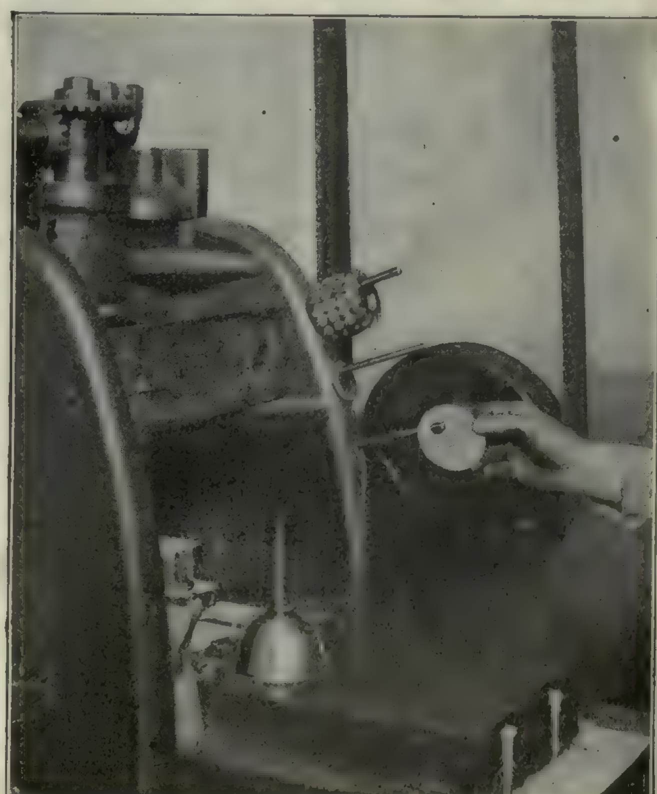
While various organizations and professional bodies have formulated codes of ethics that are generally recognized among their members, the writer knows of no such code that is considered as applying with special force to the conduct of manufacturing corporations in dealing with their employees. However, the principles of ordinary business ethics are pretty well understood—although it is quite true that such ethical principles have been subject to great changes, coincident with important steps in the upward progress of the human race. All men whose memory runs back twenty-five years or more will recall transactions which were considered to be "good business" and unquestionably ethical at the time, yet which would now be called "sharp practice," if not even criminal. We fail to see that any ethical objection could be raised against a secret wage agreement between employer and employee, as it is usually a matter which concerns only the contracting parties. The only ethical point involved in this matter seems to be that wage rates should be, as nearly as possible, fair and equitable to all.

The question of expediency is quite another matter. To be expedient, a thing must be both desirable and practicable. Among salaried employees, secrecy in regard to the amount received is the general rule. This, undoubtedly, is desirable as to its effect on both the relations of the employee to the employer and the relations of the employees to each other. It is wholly reasonable to expect that secrecy in regard to wages and wage increases among the working force generally would have the same desirable result. But, who ever heard of a shop in which such secrecy prevailed? Who believes that such a shop ever will exist? "There ain't no such animal" and, in this case, there never will be.

Pins Set into Machine Frame to Hold Tools

BY PETER F. O'SHEA

A foreman in the Greenfield Tap and Die Corp. uses pins, set into the frames of the milling machines in his department to hold tools. He selects a point where the curve of the housing brings it to an angle of about 45 degrees, and then sets in three pins as shown.



A Gasket Cutter

By S. E. Frew

The sketch shows a device for making gaskets, washers, etc., from thin sheet metal, fiber, or cardboard, and for cutting round holes in these materials.

A cast-iron plate *A* is faced true on the top surface. A central bolt *B* passes through a ⅜-in. hole in the plate and is held in place by a wingnut on the under side. A steel sleeve *C* is a running fit on the bolt, and *D* is a thin brass washer to take the wear and to make vertical adjustments for the bar *E*. *F* is a sheet of metal or other material to be cut into gaskets, etc.

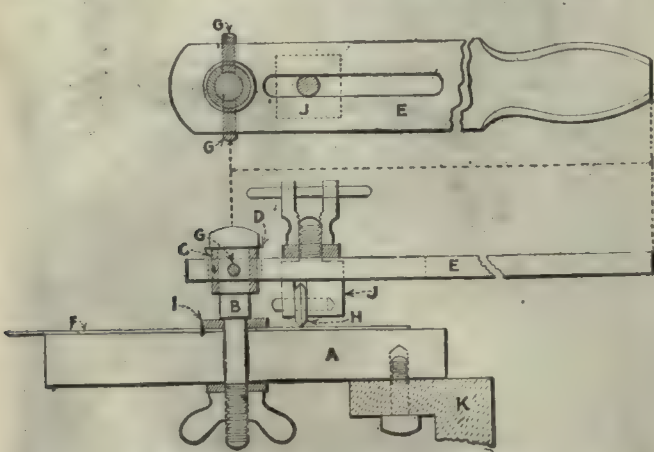
A flat steel bar *E*, ⅜ x 1½ in., is hinged by two pins *G;* these pins pass through the bar and into the steel sleeve *C*—but do not pass into the bolt *B*.

These pins also provide for a vertical movement of the cutting wheel *H;* the handle being held down by strong pressure as the bar *E* is rotated in a circle, the pressure causing the wheel to cut circular grooves.

The sheet metal being cut is kept from moving by being held down or clamped to the plate by the shoulder of the central bolt bearing on the washer *I* which in turn bears on the surface of the sheet. A ⅜-in. hole must be made in the sheet for the bolt to pass through.

The movable block *J* carrying the cutting wheel has an adjustment of 3 in. radially. A tongue on the block fits into the slot and holds the block firmly when the latter is fastened by the thumbnut.

An angle piece K, fastened to the plate by suitable screws, enables the device to be held in a vise, or, if two angle pieces, one on each side, be used the device can be placed on a bench or floor for cutting holes.



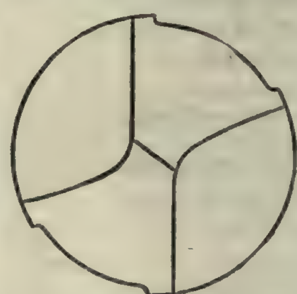
A DEVICE FOR CUTTING GASKETS

Boring Cored Holes

By H. W. Johnson

During several years' experience in boring cored holes, both in grey and malleable iron castings for harvester parts, I have given the matter of speeds and feeds considerable study. I have tried to follow the recommendations of the drillmakers who advise fast speeds and light feeds, which does fairly well in solid metal, but which, for cored-hole boring, does not seem to give good results.

Because of close competition in the harvester business, which is our line, it is necessary that cored holes be sized in one cut, without any reaming operation to follow. Tolerances as small as 0.003 or 0.004 in. are regularly held with one cut. Fast speeds and light feeds produced more sizes of holes and varieties of finish from one size of drill than even the most tolerant inspector could find use for. Reduction of speed made for better holes, but raised piece rates. Then came heavier feeds. The drills sized well, and produced a lot of holes per day. Then I started to study the problem from the standpoint of inches of feed per minute and inches of feed per grind. The heavy feeds proved best both ways.


IMPROVISED CORE DRILL

I have used a three-lip, high-speed drill on cast iron, boring a 1½-in. hole with a tolerance of 0.004 in. from a cored hole 1⅜ in. in diameter at a speed of 40 ft. per minute and a feed of 0.068 in. per revolution. This drill would run one hour on a grind. The same drill, however, would fail in a few minutes at 65 ft. per minute, even with a feed as fine as 0.032 in. per revolution.

I have used proportionately heavy feeds on smaller drills and in malleable iron with similar results—and that is not all. These drills, under heavy feed, sized closely to the plug gage, whereas the high-speed and low-feed method produced a miscellaneous collection of tapered holes mostly oversize. I have talked this matter over with harvester men, who agree with me, and with drill-demonstrators, who do not.

The worst trouble I have had is with the tangs. The stub tang is the only thing which will stand the gaff in this kind of cutting.

I would like to hear an expression of opinion from men who have similar work to do, as I believe that this condition extends to lines other than ours.

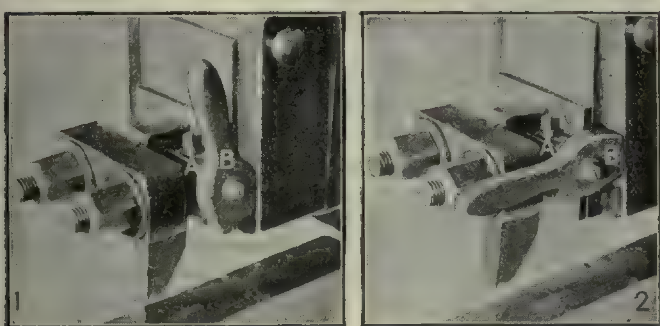
Another troublesome side of this cored-hole boring is the difficulty in boring out small cored holes in malleable castings, using the ordinary three-lip core drill which is so shallow in the flute and so thick in the center as to give poor chip clearance. Worse still, a cored hole slightly out of place would cause the solid center of the drill to run against solid metal. This is soon followed by a wreck.

I took a regular two-lip drill, too large for the job, ground it down to the correct size, and backed it off, leaving two bearing points instead of one on each land, as shown by the sketch. The extra bearing points stopped the tendency displayed by a common twist drill, to wabble when drilling a cored hole, and produced holes within the requirements of the job. The deep flutes gave ample chance for water to reach the cutting zone, and the thin center permitted the boring of crooked cored holes with a notable absence of strain or wedging.

Lifter for Planing Tools

By E. A. Dixie

Most of us are familiar with lifting devices such as the strap hinge, piece of leather, or clock spring used between the tool and the clapper block of a planer to lift the tool from the work on the return stroke, all of which are excellent for deep lifts such as are



DEVICE FOR LIFTING AND HOLDING PLANING TOOL

necessary when one is planing T-slots; but with work of this character the lift is high and the gibs of the toolslide are not very tight the drop at the end of the reverse stroke is apt to jar the tool and slide to a deeper cut. For this reason many operators prefer to lift the tool by hand, especially on particular jobs, as they can then lower it to its cut as gently as they please.

However, on long work it is tedious to hold the tool up for the duration of the return stroke and in the illustration is shown a simple tool lifter for such work.

It consists of a rectangular piece of machine steel or cast iron *A* which is drilled a loose fit for one of the studs in the toolblock. A setscrew provides means for securing it in place when once set.

On one side it is drilled and tapped for a $\frac{5}{16}$-in. machine screw upon which the member *B* is swung. This part may be made either of wood or metal, the one shown being of wood. The short end is cam shaped.

During the cutting stroke the handle stands vertically and the tool is in cutting position. When the cut reaches the end of its stroke the operator pushes the handle down to a horizontal position and the cam in contact with the stationary part of the clapper block lifts and holds the tool up until the end of the return stroke is reached.

Lifting the handle then lowers the tool gently to its former position. Thus the device requires the attention of the operator only at the ends of the stroke and the tool can be lowered to its cut as gently as the operator desires.

Setting Nuts by Power

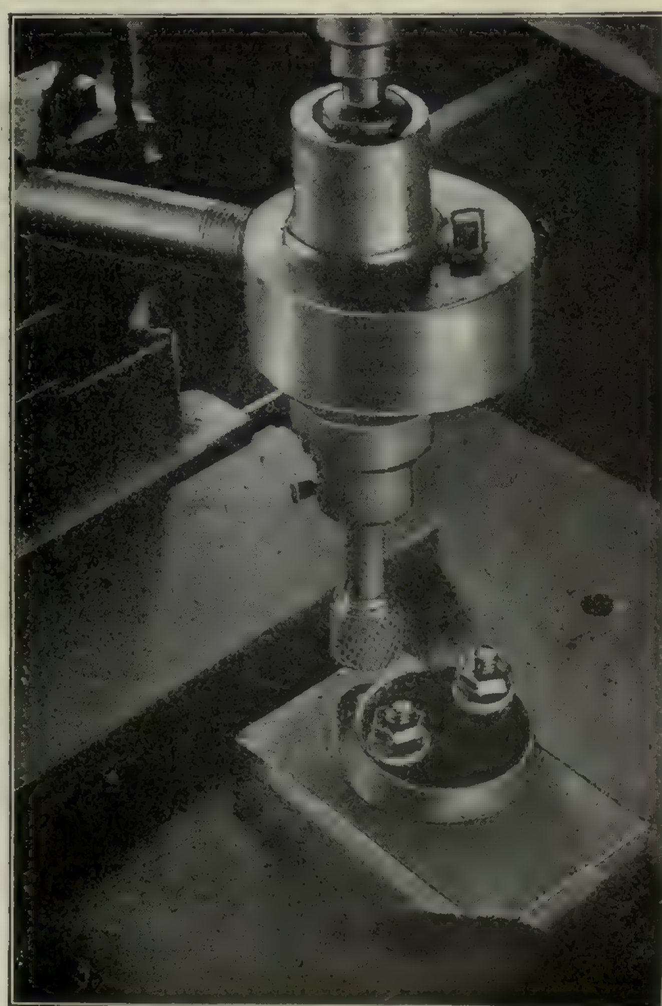
By Amos Ferber

In a shop manufacturing electrical devices there was a job of setting up the brass nuts of the connectors on the back of some of the manufactured articles.

There were hundreds of thousands of these nuts to be put in place; the length of stud was two or three times the thickness of the nut to allow room for wire connections, and the nuts must be set up tight so that they would not jar loose in transit.

The nuts have to be started on the studs by hand in any case but to turn them down, pick up a wrench and tighten each one, was a tedious job. It was the work of but few minutes to saw off a socket wrench, put it in an ordinary tapping head, and adjust the friction to run the nut down to the right degree of tightness.

With the arrangement shown in the illustration an operator can handle more work in an hour than was previously done in a day, and with infinitely less fatigue and blistering of the fingers.



SETTING NUTS WITH TAPPING HEAD

Waste and Salvage

By E. F. CREAGER

There are no more important items in shop management than the prevention of waste and the salvage of work which may be made serviceable by minor repairs. Much waste can be eliminated by careful designing which, after all, is the basis of economical manufacture.

I ALMOST said "prevention" and "elimination" which should mean 100 per cent cure. We cannot reach so high a figures as long as the human element is in contact with the operations. A careful study of the subject shows that too little attention is paid to the scrap pile. Big production demands efficient methods, and in investigating results in manufacturing plants I first ask to see the scrap pile. This usually gives a clue to the efficiency of the weakest department.

Recently, owing to high labor and material costs, owners have been giving more attention to the subject of waste, but the amount of complacency with which many of them are still viewing the situation is remarkable.

"The blindness of men is the most dangerous effect of their pride; it seems to nourish and augment it; it deprives them of knowledge of remedies which can solace their miseries and cure their faults."—LaRouchefoucault.

The Waste You Can Never Salvage—Time

It costs money to run your shop right, but it costs a lot more not to, and of all waste, *time* is the most important factor. We can replace a lost piece but we can never replace a lost minute. Wasted time is much greater than is usually given credence. A prompt start at the beginning of work periods and not stopping operations before shop signals are sounded, are two essentials of time saving. In these days of high labor cost neglect of these items is more expensive than usually realized.

In a recent study of this subject in three different factories, I found that operations and production began to slow up, not 5 or 10 min. before the whistle or gong sounded, but actually 45 min. before. This was proved by taking hourly productive records and power-meter readings. The meter readings showed that the peak load was not reached until 30 to 40 min. after starting and began to fall off slightly at 45 min., and very decidedly at 30 min., before stopping time.

Machine tools not run at their proper speed is another frequent cause of lost time. A hard lot of castings is received and the machine is slowed up but never "put in high" again.

In one instance I speeded the main line shaft 50 r.p.m. without the knowledge of the department foreman and had no complaint from him or the men, but did have a noticeable increase of production. Many factories permit "clean up" periods just before quitting time, but I have never known this to produce 10 per cent of anticipated results.

In one factory I was connected with, female employees were allowed 10 min. grace before the men in leaving the factory at noon and evening, and 10 min. additional on each weekly pay day. Each day the factory departments were swept up during working hours, the average lost time per operative was 5 min. on this. This gave a yearly loss on 500 female operatives of approximately 66,000 working hours at 20c. per hour, approximately $13,000, eliminating the usual lost time before quitting and ignoring the fact that the men in the department quit work at the same time the girls did.

It was not hard to see that providing a separate exit for the women and separate pay windows on pay day, provided the needed segregation at the congested hours. Sweeping at night cut out the disturbing expense incident to doing this in the daytime.

Assigning Work Promptly

Another very large factor in loss of time and production is in not properly or promptly assigning work to the operator, with the result that as the job nears the finish the operator drags or "stalls" until quitting time. A working knowledge, and records of machine-tool capacity, will largely eliminate this if properly utilized.

In plotting the productive machine-tool hour capacity versus the production per hour in a recent case, I found that the production was only 40 per cent of the total capacity. The chart used showed these results; tardiness, 10 per cent; absent operators, 10 per cent; machine break-down, 2 per cent; lack of stock (next order not promptly assigned), 10 per cent; out of material, 5 per cent; machines running below speed and cuts under capacity, about 20 per cent; indifference and lack of pep, 25 per cent; lack of proper fixtures 25 to 50 per cent; defective castings and unnecessary work, 20 per cent. These can be rearranged to suit your individual case, but they affected approximately 60 per cent of those in the plant in question. These conditions have been more than proved for after correction and within the past six weeks, the production has been increased from eight sets of machines per month to sixteen, and will be increased to twenty during the current month. I could cite many other instances and their corrections. But I know from practical experience how hard it is to convince the average manufacturer that "such conditions exist in our plant."

Begin Saving by Having Designs Right

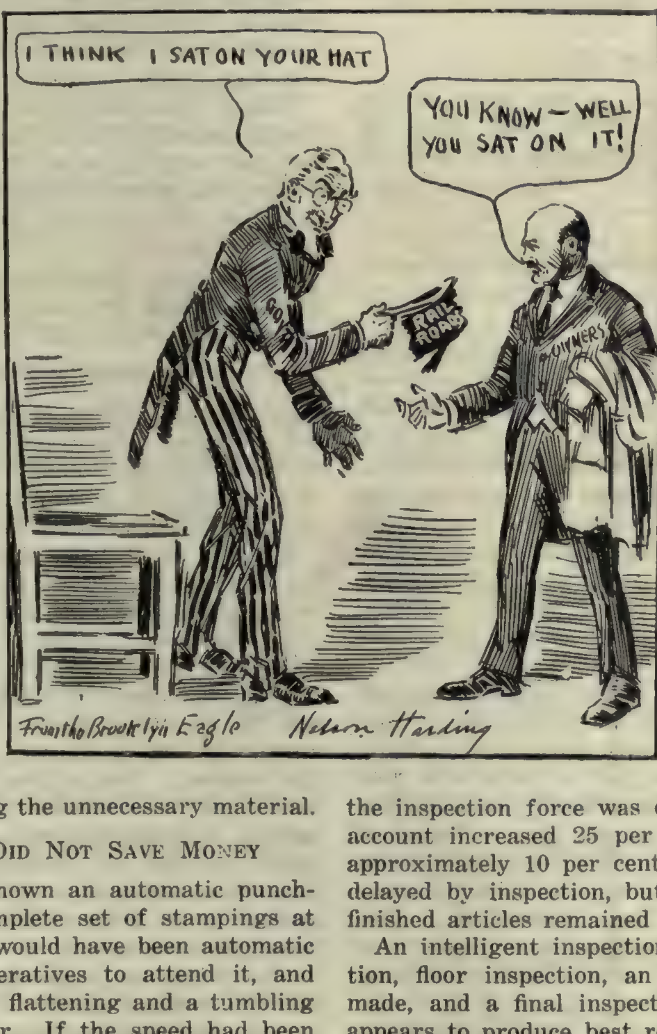
I believe that better education of the employees on these points is the best solution, and managers are awakening to this fact. Too few managers appreciate just where to begin saving. The proper place is in machine design, in the engineering department. It is so easy to execute some cute little apparent saving on the drafting board, which gets into production in many cases because the practical man in the factory is denied the right to even suggest a change on anything approved by the engineers.

I found in one factory that 20 per cent of certain castings was rejected after partial machining because of "dirt" showing up on the working face, caused by trying to save 1 lb. of metal in 75 by casting a narrow groove the full length of the piece. In pouring, the small sand projection washed away; result, no saving in weight and a "dirty" casting.

Another instance was the casting in of four tubes as oil ways, to save drilling four holes. Owing to the position of the tubes a special flask was required, which increased the cost of the casting 2c. per pound. Special core prints were required to locate the tubes, steel tubing with thick walls was also required, since the mass of the casting melted ordinary iron pipe. For tubing, core prints, and special work the cost was $1.59 per casting; for extra flasks and time in molding the cost on a casting weighing 125 lb. was $5. The actual cost of drilling these holes is 10c. each or 40c. per casting, but they had been paying $6.59 for saving this operation.

A cored slot was cast in the same piece to save 10 min. planing time. But the work had to be "set up to the slot" and the planer hand was taking 30 min. to do this. Since the slot has been eliminated he sets up and planes three pieces in less time than he formerly did one. An assembly fixture that was used in only one position had an adjustable graduated base. The designer said that "some day" they might want to use it in "some other position."

In one plant a collar was required on a shaft to prevent an assembly from shifting. The shaft diameter required was $\frac{3}{4}$ in. The stock that used to make the collar integral with the shaft was $1\frac{1}{4}$ in. By making the collar separate and swaging it into a neck on the shaft, saved this firm $150 per day in material alone, not considering the expense of removing the unnecessary material.



AN AUTOMATIC THAT DID NOT SAVE MONEY

Recently, I was proudly shown an automatic punch-press outfit, producing a complete set of stampings at one stroke of the press. It would have been automatic had it not required two operatives to attend it, and had the work not required a flattening and a tumbling operation to remove the burr. If the speed had been 150 strokes per minute instead of 60, a larger quantity could have been produced.

I was told that the dies had cost $2,800, and that they could not be worked a full day without taking them down for grinding and readjustment. This usually took place at the end of a 6-hr. run and about 3 hr. were required to "set up" again after grinding. I have done the same type of work in an ordinary press at 150 strokes per minute with hand feed. No burring or flattening was needed and the dies could be taken down, ground and reset in less than 1 hr. with a "run" of 75,000 to 100,000 pieces between grinds. The cost for the complete die set was approximately $650.

In the same shop I saw disks being flattened by hand on a surface plate in 1 to 3 min. each that could have been done in a press at the rate of fifty per minute.

NOT EXCEPTIONAL CASES

- know that many readers will say that these are exceptional cases, but they are now occurring, or have occurred, in plants of wide reputation, which shows that some executives are not locating the hidden leaks of that important factor, *time*, as well as of material not actually required.

I remember an eastern promotor's advertisement some years ago of a "pound of screws from a pound of wire." While we cannot all do as well as this, we can come much closer than many of us are doing now in conserving time, material and effort, and seeing that when we spend the firm's money we get all we can for it. Education, not only for the operative but for the executive, will prove to be a large factor in reducing your scrap heap. I am a great believer in making all jigs and fixtures as nearly complete and self-contained as possible. In many instances they can be made to do the inspection of castings or operations previously done. This eliminates the chance of bad work going through the succeeding operations, and finds defects at a primary stage. Inspection is frequently carried to excess and some managers seem to think that an inspection department and a bunch of men with an inspection badge is all that is needed to produce perfect work. In one instance I know of where the inspection force was doubled, the salvage or scrap account increased 25 per cent. Production decreased approximately 10 per cent. because so much work was delayed by inspection, but the percentage of defective finished articles remained the same.

An intelligent inspection between and during operation, floor inspection, an inspection of assemblies as made, and a final inspection of the completed article appears to produce best results.

A "salvage department" through which *all* material must pass before it finds its final resting place in the scrap heap, is essential to economical handling of the matter. Many times I have found defective material in the scrap heap that should have been returned to the maker. When properly conducted and with prompt comprehensive reports to the front office, such a department will assist in locating the cause of much of the defective work. Discover the *cause* of your losses and then *correct* them. Begin at the source of your possibilities, the design. Follow through the pattern making and tooling, and organize your salvage department with a good man at the head of it. Then organize the intermediate sections of the work. Inspect at proper

intervals during the progress of the work. Educate the operative to the enormous expense of bad work, to the fact that a spoiled piece requires another one to replace it, and that the expense of replacement depends upon whether it is found in your factory, or by your customer in Portland, Ore., or in Hindustan.

As to percentage of wastage through spoiled material and defective work, 5 per cent is considered a conservative figure; more plants are running over than under it. I have seen this figure kept as low as $\frac{7}{10}$ of 1 per cent, as the average for the entire factory. Each factory, or type of production, has a base that may be taken as normal but which depends largely on the article produced.

Johnson Plans to Store Labor

By John R. Godfrey

Johnson seems to have taken a new lease of life since he took hold of the shop actively, after firing the firm of high binders who worked out a real 100 per cent scientific Santa Claus for him. He's looking better and is sure doing some good work for a man of his years. If he wasn't young inside he'd be content to let things run along in the same old way. But he's going to leave a real business built on a solid foundation for that son of his.

Just now he's figuring on keeping his men busy when the present boom in gas motors slacks off, either from sympathy with other things, or from a lack of fuel which the oil men tell us isn't so far off. Of course it isn't good form to even hint at a slackening of business, but Johnson and everyone else knows that business, like typhoid and politics, goes in cycles. He knows that the present boom can't last always without a sag in the sales curve, and he's planning as to how he'll meet it. When I dropped in the other day he was figuring furiously with pencil and pad and then making notes of the results.

"Don't think I'm a calamity howler Godfrey, but you and I are both too old not to know that every high tide has its ebb. Now I believe it wiser not to pretend that it will never ebb *this time*, but to make some plan that may act as a shock absorber when the time arrives.

"The great trouble usually comes from a bunch of fair weather optimists who tell you to believe the boom will never end, getting cold feet the minute orders slack off and shutting down their plants cold. They holler about being patriotic and not even *thinking* of a slacking off, but they don't risk a cent in building stock when the slack time comes.

"What I'm trying to figure out is what parts of our motors have the most labor and the least material. The thing I'm after is to keep from laying off men. I want to be able to keep every man going; what I dread most is having to tell my men that we can't keep them at work. I'm going to have all plans made so as to build stock on standard parts. I'm going to store labor instead of material. Then when the business comes back we can assemble complete motors in a hurry.

"You remember how our old friend F. E. Reed used to build lathes for stock during every dull period. Stocked Worcester full of lathes while all the other builders were working short handed or not at all. Sold 'em all too—you remember when the demand came back. Had 'em all ready to deliver in bunches when they were wanted. And the other fellows kicked themselves for not having any lathes to sell. I figure that there's no safer investment in business than in the standard machines you build—and I've got faith enough in this old motor of ours to tuck away parts of a lot of them.

"But it isn't all with the idea of making a *killing*, Godfrey, because it isn't dead sure how costs of material are going to be next year. What I want most of all is to keep the shop family together—to keep every man on the payroll. Whiting Williams tells us that the prayer of the average worker, particularly the unskilled worker, is 'give us this day our daily job.' And when I look back at the panic of 1892 to 1894, I can readily believe it. I counted ties myself that year and there ain't a darn bit of fun in it. Don't know of anything that will make a man see red any quicker, specially when he also sees a limousine roll by with a fat gent in a high hat, or a bejeweled damsel with a pug dog.

"Heard Otto Kahn, the banker, a while ago and he told us frankly that in times of stress we must keep the men working, even if we don't make a cent ourselves. Not much like the banker talks in the old days when we were younger—but it's a darn sight better in many ways.

"I'm hoping some others in this town have some thoughts along the same line."

Motor Gasoline Survey

In a report written by N. A. Smith and C. R. Bopp and published in the Monthly Reports of Investigations of the Bureau of Mines for February, 1920, the results of a recent test upon the volatility of gasoline used as motor fuel throughout the country are given.

In seven large cities, each in a different district of the country, samples of gasoline of the kind that was being sold to motorists for fuel during January, 1920, were analyzed. The data taken comprised the specific gravity at 60 deg. F.; the corresponding Baumé gravity; the first drop or initial boiling point; the 20, 50 and 90 per cent points; the end or dry point, the average boiling point, and the percentage recovered in the receiver. The values found were checked against those taken in a similar test made in April, 1919, and against the specifications used in the purchasing of motor gasoline for Government use. These specifications were adopted in November, 1919, after being drafted by the Committee on Standardization of Petroleum Specifications.

The comparison of the results of the two tests shows that the average quality of the gasoline on the market in this country varied but little during the period between April, 1919, and January, 1920. Furthermore, the average volatility of the gasoline was somewhat higher than that required by the Federal specifications. These points are presented in the original article in the forms of both tables and curves. In some of the tests it was found that the samples contained an excess of low-boiling fractions, probably due to an admixture of too large an amount of "casinghead" gasoline. Other samples showed too great a volatility at the upper part of the distillation range, a condition which is often due to the use of an excess of high-boiling naphtha in blending.

The article concludes by urging the refiners to exercise greater care as a means of bettering the quality of motor gasoline.

Something New in Automotive Articles

IN this issue we begin a series of automotive articles arranged in an unusual manner. It has been the general custom to publish manufacturing articles of various kinds as they were obtained, regardless of their bearing on any similar articles from other shops.

We have realized for some time that in certain lines—and especially in the automotive field — the old method of handling articles from different companies did not give the production manager, engineer or designer information in a form most convenient and available for study and subsequent reference.

For this reason we gathered, under the personal direction of Fred H. Colvin, Chief Field Editor, an enormous amount of material on the machining and handling of various automobile parts from a considerable number of shops.

This material has been arranged so that we can group articles describing certain parts from different concerns in one issue.

For instance in this issue we show motor-cylinder work as done in the shops of the Cadillac, Chandler, Franklin, Packard and Peerless companies.

In subsequent issues will be grouped articles on piston work, connecting-rod work and other important automobile parts.

Never before, we believe, has such live material been placed before the automotive engineer in such accessible form.

Details of machining an material handling are shown that only close study can bring out, and that few have either the time or opportunity of doing. It amounts to an exchange of ideas between some of the best automotive engineers in the world on subjects on which they are experts.

No one who has anything to do with the manufacture or handling of automobile parts can afford to miss the opportunity to study the latest practice of some of the greatest factories in the world.

The machine-tool builder will also find in these group articles an opportunity to study out methods whereby his machines may best be applied to the work.

Ethan Viall

Editor

EDITORIALS

Getting Time to Read the "American Machinist"

FINDING time to read—or not finding it—is largely a matter of habit. We've had some pretty positive notions on this but feared they might be biased. But here's what an old reader writes us:

"When I hear a man say he hasn't time to read the *American Machinist*, or if I find unopened copies on his desk, I know he isn't the man or the manager he might be and ought to be. I often think of the *American Machinist* as I do a fine micrometer or a set of "Jo" blocks. You don't use them all the time nor for all purposes. But the man who keeps a set of either on his desk, unopened, would hardly be called efficient.

"Every business man reads his daily paper—sometimes two or three. Yet it is safe to say that not 10 per cent of the time spent benefits his business. I read my *American Machinist* much the same way as I do the dailies. I run over the headlines—if one interests me I read the synopsis. If it's along the line I want I read the article.

"I don't try to read the whole paper. If I find one or two articles in my line, I've got more than my money's worth. The other articles are of equal value to some one else, because you cover a wide field."

The man who doesn't take time to know what the *American Machinist* prints in his line every week is letting a good tool lie idle—his overhead is too high.

Another friend who has subscribed for the paper for years was chagrined to find that his friend Chordal had written several of his old-time articles during the year and that he had missed some of them. He had thought himself too busy to read—when in reality he had just got out of the habit.

Don't lose the habit of looking over every issue—you're sure to miss something.

To help you to pick out the articles you want to read we are introducing a "readers' page" which is intended to bulletin the contents of the issue and to supplement the regular contents page. It begins with this issue.

Manufacturing Tools in the Shop

TEN years ago no shop was considered complete without a well-equiped toolroom. This meant a large variety of machines capable of handling almost any kind of work. Such an equipment is undoubtedly justified in shops having large mass production, such as automobiles, machine tools, or other products. But for shops whose business is the making of tools for others, the toolroom seems to have no place as a separate department. The tools for home use should take a shop order and go through the shop in the regular way.

Small shops of any kind, except tool shops, can very often save time, trouble and expense by having their tools made by a reputable contract shop which specializes in tool work. Even some of the large shops find it more profitable to do this than to maintain a toolroom of their own.

All sides of the question should be carefully considered before deciding which is the best policy, not forgetting that toolroom machines are not, as a rule, used as continuously as those in the productive part of the shop.

Foundation of Economical Manufacture

ECONOMICAL manufacture depends upon many things, including proper machine equipment, suitable jigs, fixtures and tools, correct cutting speeds and broad-visioned management. The foundation on which economical manufacture depends, however, is too often overlooked—that is, the design and the specifications to which the article must be made. For without a design as simple and as easily machined as possible, and specifications which do not demand unnecessary labor and expense, no manufacturing can be done on a truly economical basis.

The article by E. F. Creager on Waste and Salvage in this issue brings out this important point very clearly. Economical manufacture must begin with the design; otherwise, it is impossible to secure best results.

Mr. Creager also shows how the practical shop man can assist in making the design easy to manufacture, emphasizing the benefit to be gained by having regular channels by which this practical advice can be easily secured. No matter what the method, whether by committees or direct consultation with the men most familiar with the work, the results cannot fail to be gratifying when co-operation is really secured.

The designing engineer can work out many problems which would be impossible for the man in the shop. But when it comes to deciding on coring a hole, or casting slots or projection to save planing, as compared with leaving it to be machined, the man who will actually handle the job can often save the firm real money if consulted before the work goes too far. We need the combined intelligence of the shop to secure the very best results.

The Danger of Inadequate Housing Facilities

THE final report of the President's Industrial Conference sounds a warning regarding the intolerable housing situation in many of our large cities.

What building was done during the war was confined to the enlargement of existing manufacturing plants or the construction of new ones. Little thought was given to the houses needed for the many new workers which the big plants would employ, and consequently some of them will either be without homes this spring or the victims of rent profiteers. This is essentially a community problem, but the manufacturer is vitally concerned and it will pay him to offer prompt co-operation to the public bodies struggling with the problem.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Betts-Bridgeford 9-Speed Geared Head

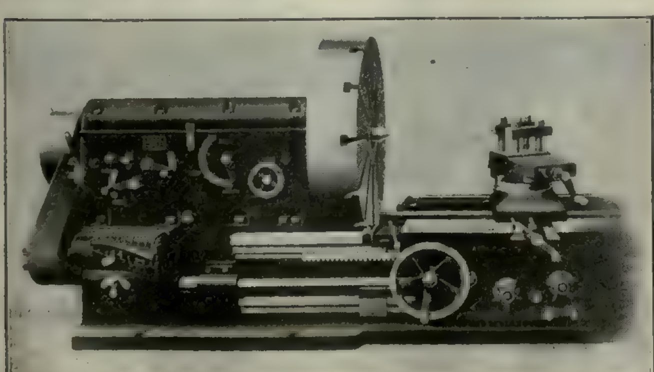
To meet the present-day requirements an all-geared head has been designed by the Betts Machine Co., of Rochester, N. Y., and applied to its full line of heavy-duty engine lathes from 32 to 48 in. swing.

The headstock, shown in the illustration, is of the all-geared inclosed type and is operated from the apron by a powerful expanding ring friction clutch upon which is mounted the driving pulley. The same movement which disengages the clutch automatically applies the friction brake, thereby stopping the machine instantly. The nine spindle speeds are of the selective type, three direct, three back gear, three triple gear, and are obtained and controlled by three conveniently located levers on the front of the headstock.

All speed changes are in geometric progression and are obtained through hardened-steel sliding gears and positive clutches running in oil. The edges of the gear teeth are rounded to allow for instant and easy engagement.

There are 12 gears including the faceplate and pinion gears. All back- and triple-gear speeds are through faceplate gear, the driving pinion of which can be disengaged when using direct-spindle speeds. An interlocking device is provided so that no two speeds can be engaged at the same time.

All shafts and gears are located in the base of the headstock, thereby allowing easy access, it being necessary only to remove the cover. All shaft bearings are bronze bushed, and lubrication to bearings is obtained by a pump located in the headstock which distributes oil to all of the bearings, eliminating the possibility of any bearing running dry, it being necessary only to keep the oil at the height designated. When the machine is motor driven, the motor is mounted on top of the headstock cover and direct connected through gearing to the main driving shaft.



BETTS-BRADFORD 9-SPEED HEAD

Streine Toggle Type Forming Press

The Streine Tool and Manufacturing Co., New Bremen, Ohio, has brought out the forming and roofing press shown in the illustration.

This machine is designed for making all kinds of roofing and special shapes in any length, up to twelve feet and has a large die space which enables the operator to use dies of most any description.

It also has four removable wooden tables which are supplied with gages on both sides of the machine. This makes it possible to work two kinds of dies in one operation.

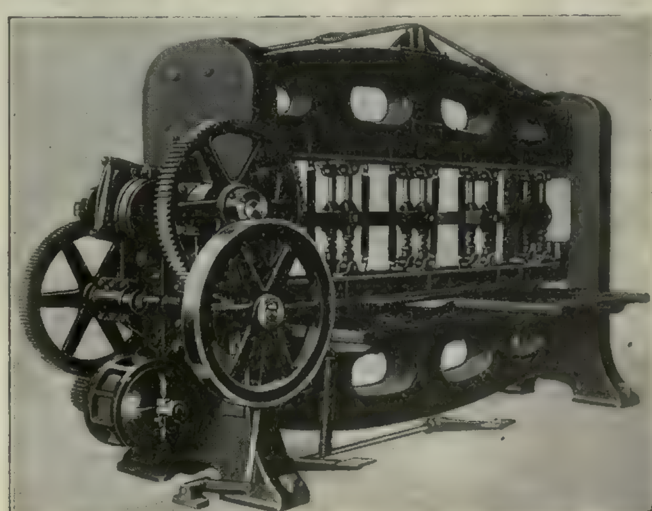
The dies can be removed either from the side of the machine, or from the end. The table arms are of a height so as to bolt gages by removing the wooden tables. The dies are located in the machine by means of tongue and groove, which assures their being in alignment at all times.

The forming bar and hold-down bar are well balanced with springs. The toggles and shoes are accurately finished, allowing the machine to work very smoothly.

The machine is also fitted with machine cut gears and with a positive clutch.

The eccentrics are made of steel and keyed to the eccentric shaft. They are very large in diameter and have a wide face, thus having a large bearing surface.

The machine is also fitted with a box type cam which is keyed to the eccentric shaft. This makes it possible to use a die under the hold-down bar for the forming of light gages of metal.



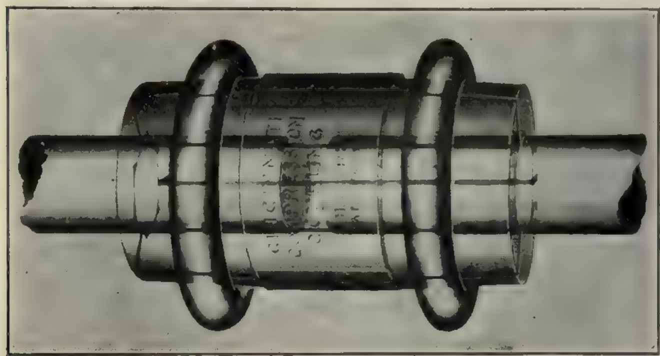
STREINE TOGGLE TYPE FORMING AND ROOFING PRESS

Cincinnati Compression Coupling

The Cincinnati Ball Crank Co., Cincinnati, Ohio, has placed on the market a coupling of the compression type as shown in the illustration herewith.

This coupling consists of five parts—three jaws and two clamping rings—and the only tool necessary to apply it is a hammer.

In applying the coupling the jaws are placed around



CINCINNATI COMPRESSION COUPLING

the shaft and held in position by notches and corresponding projections. The forged clamping rings are then pushed over the tapered ends and hammered tight.

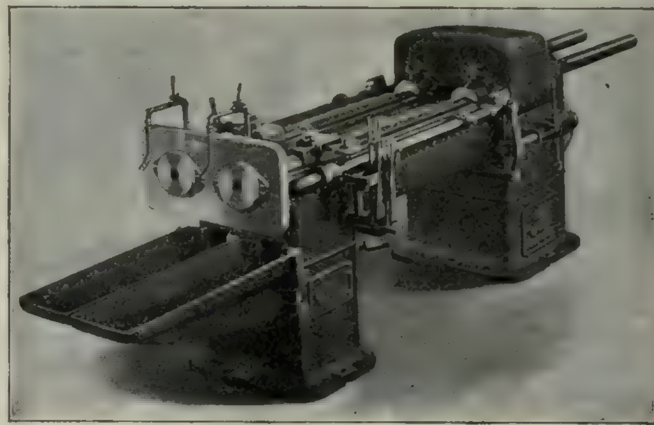
The assembled coupling forms a compact shaft-joint and there are no projections to catch a workman's clothing. When shafts of two sizes are to be coupled, the only additional parts needed are three strips of cold-rolled steel of the proper size to fit between the smaller shaft and the jaws.

The coupling is made in standard sizes from $\frac{15}{16}$ to 3 inches.

Lapointe No. 3 Duplex Broaching Machine

The Lapointe Machine Tool Co., Hudson, Mass., is now manufacturing, in addition to its regular line of broaching machines, a double machine known as the No. 3 Duplex. The machine is intended for use in factories where production is handled on a quantity basis and where floor space is limited. The machine is heavily built and conveniently arranged for operation. The power is controlled through the medium of a patented clutch that furnishes a positive drive, and is easy to operate. The two screws act independently, the drive and control for each being entirely separate, they may be used singly, or both together, and by regulating the speed, two broaches of different lengths may be used at the same time. Both screws are controlled from the right-hand side of the machine, and the left-hand screw has an additional control lever on that side, permitting independent control from either side of the machine. Two cutting speeds of 39 and 74 in. per minute are provided for each screw, and the especially fast return speed of 196 ft. per minute assures a minimum amount of time lost during the return stroke. Large roller bearings are employed for the thrust, and the driving nuts are 10 in. in length.

The gears run in one direction, are submerged in a bath of oil, and completely inclosed. An oil gage on the outside of the gear case registers the amount of oil. The draw-heads are made from steel billets; they have extra long bearings on the slideways to prevent possible chatter, and are fitted with renewable bronze shoes. A reservoir is located in the front pedestal of the machine, from which a steady stream of lubricant is supplied to the work by a No. 4 Brown & Sharpe pump. The machine is provided with a single driving pulley, mounted on ball bearings; is easily adapt-



LAPOINTE NO. 3 DUPLEX BROACHING MACHINE

Specifications: Size, No. 3 double-screw. Capacity, will cut keyways up to $1\frac{1}{2}$ in. wide, or broach square holes up to 3 in. across flats from drilled holes in steel. Maximum stroke, 50 in. Holes in faceplate of machine 5 in. (Center distance between holes 13 in.) Driving screws $2\frac{3}{4}$ in. in dia., $1\frac{1}{2}$ Acme threads per in. Length of driving nut 10 in. Driving pulley 19 x $6\frac{1}{4}$ in. Pulley speed 450 r.p.m. Speeds; fast cutting, 74 in.; slow cutting, 49 in.; return, 196 in. per min., vertical adjustment of draw head $1\frac{1}{16}$ in. below and $1\frac{1}{8}$ in. above center of faceplate. Floor space, allowing for travel of screw and broach, 180 x 28 in. Motor size recommended 15 hp.

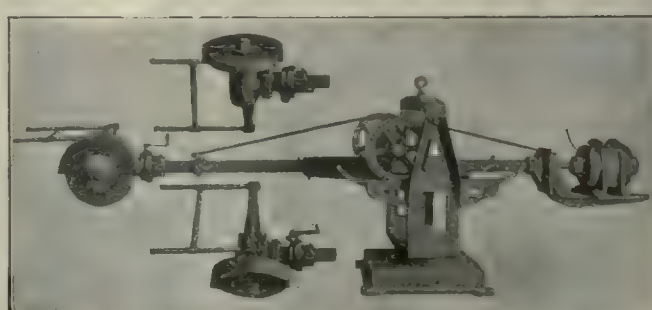
able to motor drive, and when thus specified the motor is mounted on a bracket at the side of the machine and connected to the drive shaft by means of a silent chain.

Mummert-Dixon Portable Radial Grinding Machine

The Mummert-Dixon Co., Hanover, Pa., has placed on the market the portable radial grinding machine shown in the illustration herewith.

The machine is self-contained, the frame being mounted on a substantial base. The trunnions connected with the frame are mounted on balls making the movement very easy.

The head can be revolved by means of a convenient crank handle operating through worm gearing and can be held at any angle.



MUMMERT DIXON PORTABLE RADIAL GRINDING MACHINE

Specifications: Grinding wheel; face, 3 in.; diameter, 20 in.; hole, 2 in. Speed of wheel arbor, 1,000 r.p.m. Motor, hp., $7\frac{1}{2}$; speed, 1,200 r.p.m. Length of arm, trolley to head, 7 ft. Working area; annular 36 in.; radial 6 to 8 ft. Dimensions; height over all, 5 ft.; length overall, 13 ft. Weight with motor; net, 2,600 lb.; crated, 2,800 lb.; boxed for export, 3,000 lb.

The grinding head and the trolley cross-shaft are both fitted with ball bearings, which, together with the large track wheels, provide easy movement.

The grinding wheel is driven by motor, through bevel gears which are inclosed in a tight case packed with transmission grease.

As the weight is suspended below the center of the trolley cross-shaft and as the head and motor counterbalance each other, the arm naturally assumes a horizontal position.

All moving parts except the lower half of the grinding wheel are inclosed.

The motor mounting can be adapted to any type or style of motor. The motor control can be mounted on the side of the frame, but as this makes a rather cumbersome arrangement it is usually mounted on the wall or on a near-by post or column.

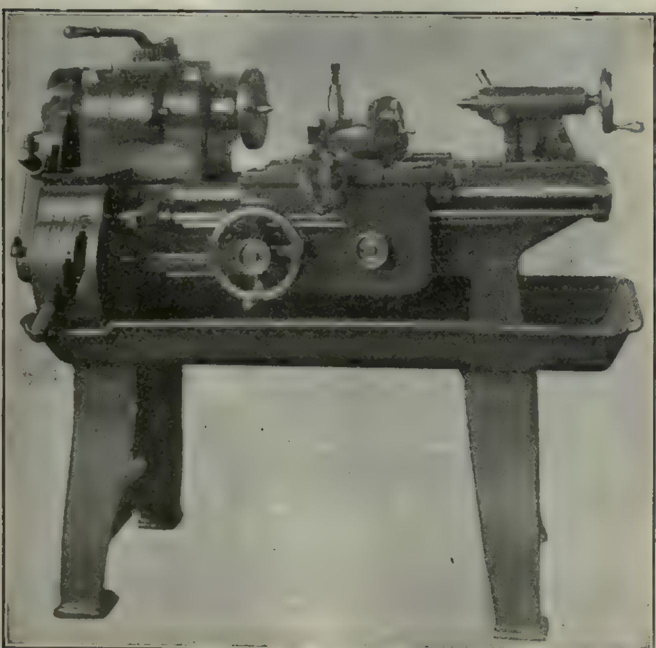
Adams Short-Cut Lathe

The O. R. Adams Manufacturing Co., Inc., Rochester, N. Y., has placed on the market the lathe shown.

The headstock has six changes of speed, ranging from 43 to 375 r.p.m. and speeds can be changed while the lathe is in operation. When the starting lever is in the neutral position the spindle is held by a brake. The spindle runs in taper-bronze bearings and the thrust is taken by self-aligning ball bearings. All gears run in an oil bath.

The feed-gear box is of the tumbler type and provides for four changes of feed from 0.006 to 0.025 in. per revolution, and by changing gears at one end of the lathe a second ratio of feeds from 0.010 to 0.042 is provided for.

The gear case at the end has reverse gears for changing the direction of the feed as well as an intermediate gear for changing the ratio. The apron is of the double-plate type and is provided with multiple-automatic stops which operate a jaw clutch on the feed rod.



ADAMS SHORT-CUT LATHE

Specifications: Swing, over bed, $13\frac{5}{8}$ in.; over carriage, $7\frac{3}{4}$ in. Distance between centers 20 in. Length of bed 48 in. Weight 1,350 lb.

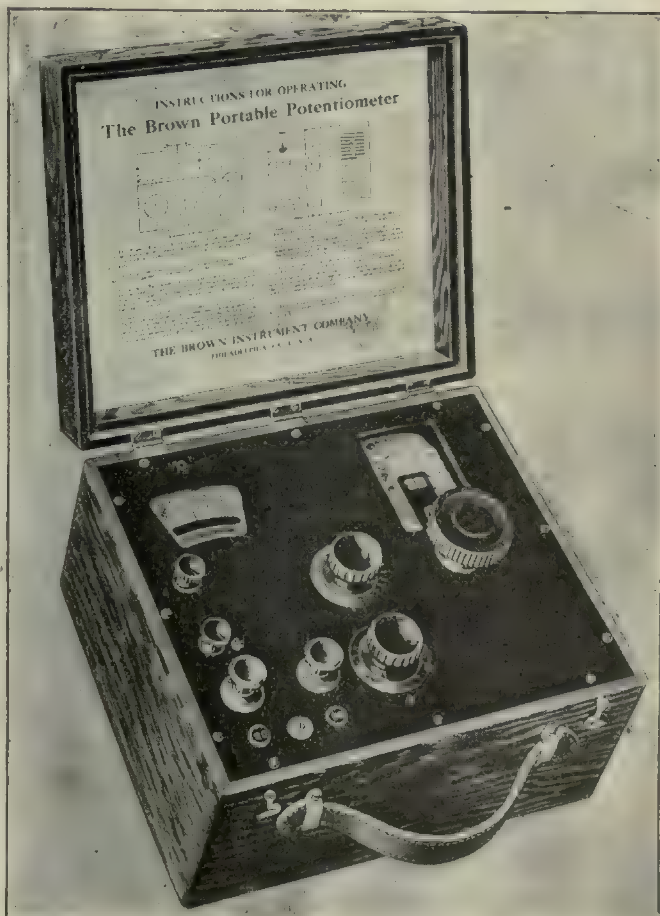
The carriage is provided with shear wipers both in front and rear and can be locked in position when using the cross feed. The tool-block base is so designed that it can be used for either a plain or a compound rest. The compound rest operating-screw is offset, making it impossible for the cross-feed and compound-rest handles to interfere. The compound-rest base is graduated in degrees and both cross-feed and compound-rest screws are graduated to 0.001 in.

A taper attachment can be supplied and will turn tapers up to $1\frac{1}{2}$ in. per foot, the whole distance between centers. Other extras include front and rear tool blocks, back forming attachment and draw-in-chuck. Motor drive can be arranged for. It is claimed that this lathe will take a cut equal to that of a standard 16-in. lathe.

Brown Precision Portable Potentiometer

The potentiometer illustrated has been developed by the Brown Instrument Co., Philadelphia, Pa., to permit the exact measurement of all e.m.f.'s required in pyrometry. While its use is not restricted to such measurements, the ease with which it can be operated makes it specially serviceable for checking millivoltmeters and potentiometers and directly determining the e.m.f.'s of thermo-couples.

The limit of accuracy in an instrument of this type is determined by the scale length, usually about 10 in. If a 10-in. scale is calibrated to 50 millivolts, one millivolt will have a length of one-fifth of an inch. The scale of the Brown potentiometer is nearly 96 in. in length. With a range to 50 millivolts each millivolt is nearly 2 in. in length, graduated to one-fiftieth of a millivolt.



BROWN PRECISION PORTABLE POTENTIOMETER

The potentiometer has a drum wire of 150 ohms resistance and the total instrument resistance for 50 millivolts is approximately 4,000 ohms, including rheostats. This is gradually reduced to a minimum of about 3,400 ohms, when the dry cell is exhausted and must be renewed. The current required to operate the Brown potentiometer is never more than 0.00036 ampere.

Browning Quenching Machine

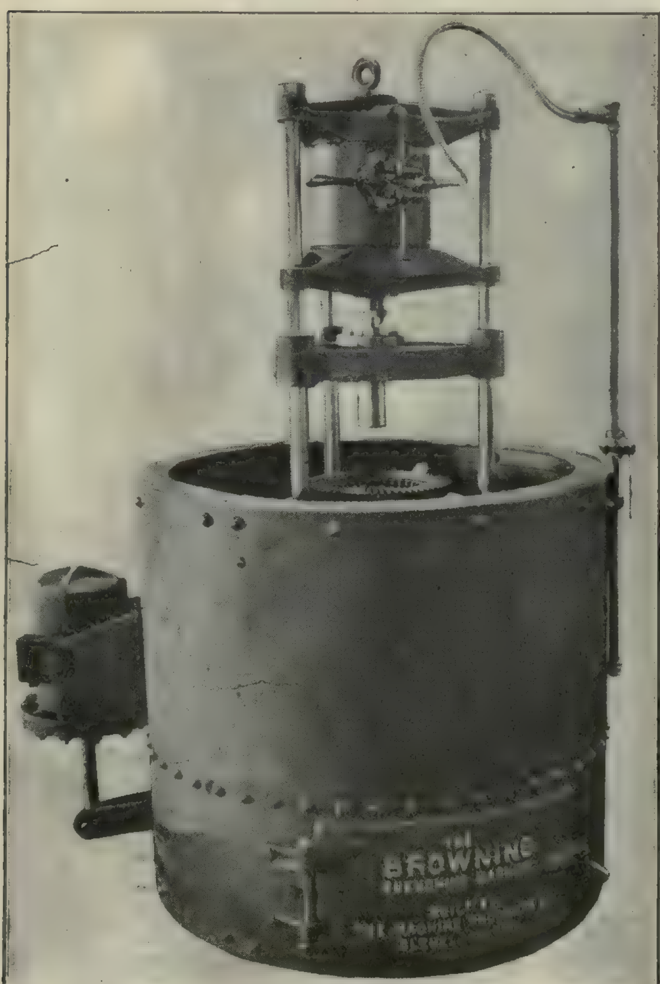
The Machine Products Co., East 179th St., and St. Clair Ave., Cleveland, Ohio, has brought out the Browning quenching machine illustrated herewith.

This machine was developed to prevent the warping of gear blanks while being quenched after heat treatment. A liquid-tight diaphragm is placed above the bottom, the portion above being used as a tank for the quenching fluid. Two die castings are provided to which special dies made to fit the gear blanks are to be fastened. The gear blank is clamped between the dies by compressed air controlled by a four-stage valve.

The clamping cylinder is at the top and its alignment is assured by three rods fastened to the cylinder heads and to a casting secured to the diaphragm, the rods also serving as guides for the upper dieplate. The submerging cylinder is held at the side of the tank in a trunnion casting which allows it to adjust itself to the necessary position. Air is furnished through one of the trunnions. A lever connects the piston rod of the submerging cylinder to a vertical rod passing through a stuffing-box in the diaphragm. The lower die is fastened to the die casting on this vertical rod while the upper die is fastened to the die casting secured to the piston rod of the upper cylinder.

With the four-stage valve in the first position both dies are raised out of the liquid. In the second position the upper die is still further raised and at this time a gear blank can be placed on the lower die. In the third position the upper die descends, clamping the gear blank between both dies. In the fourth position the dies and gear blank are submerged.

The door in front is for access to the stuffing-box and all mechanism below the diaphragm. Pipe connections are provided for attaching the tank to a refrigerating line for cooling and circulating the liquid. The machine is 42 in. in diameter and 38 in. high.

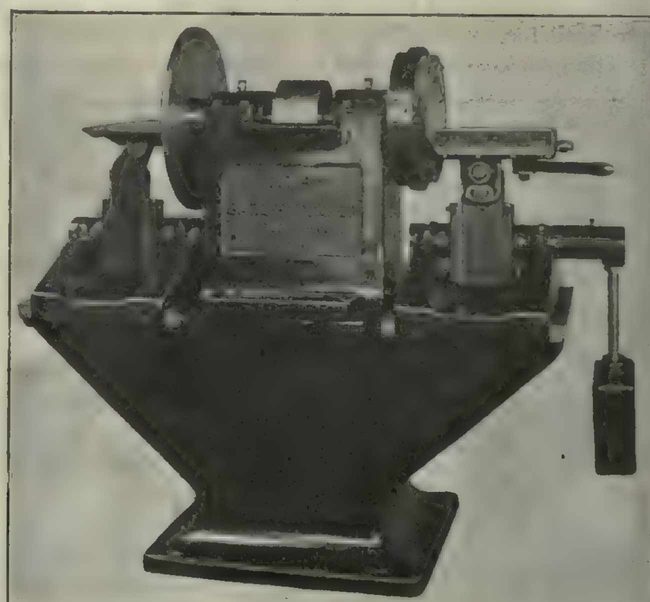


BROWNING QUENCHING MACHINE

No. 4 Badger Grinding Machines

The Badger Tool Co., Beloit, Wis., has added to its line the No. 4 grinding machine shown in the illustration. The spindle is mounted in both radial and thrust-ball bearings and carries on one end a disk for abrasive paper and on the other end a chuck for a cylinder wheel. The table at the left-hand side is a plain swinging table while the one at the right is provided with a lever feed.

The machine can be furnished with dust hoods for dry grinding and with guards, pump and connections for wet grinding.

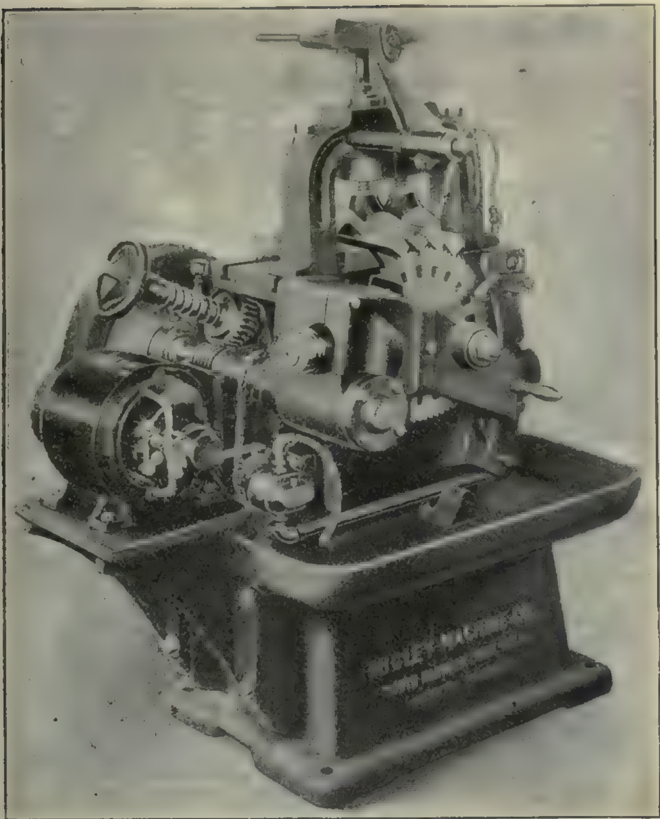


NO. 4 BADGER GRINDING MACHINE

Capacity: Disk, 18 in.; chuck, 14 in. Diameter of spindle, 2 in. Pulley, 7½ x 4¼ in. Weight complete with countershaft and press for gluing disks, 2,300 lb.

Higley Cold Sawing Machine

The Higley Machine Co., South Norwalk, Conn., with offices in the Singer Building, New York City, has added another sawing machine to its line. This latest model, known as the "11½ B" has a capacity up to 3 in. on either square or round stock. With the work clamps arranged as shown, four 1½-in. rods may be cut off at the same time and by shifting the V-plate on the table one-quarter turn, two 3-in. rods may be cut off in a like manner. The ¾-hp. motor is connected to the



HIGLEY COLD SAWING MACHINE

BERWICK ELECTRIC RIVET HEATER

drive shaft through heavy spur gearing. The shaft runs in bronze-bushed bearings and carries on its right-hand end a worm of hardened steel, meshing with a bronze gear. On the same shaft is carried the sprocket that is geared to the saw. The worm is provided with thrust bearings of ample size that are easily accessible. An automatic arrangement regulates the depth of the cut and returns the saw to its lowest position when the cut is completed. The machine base is used as a reservoir for the lubricating oil which is circulated by means of a vane type suction pump of large capacity. The machine is made for belt drive as well as for motor drive, the multiple clamping arrangement being furnished with either type.

Berwick Electric Rivet Heater

Electric rivet heaters of the type shown are manufactured by The American Car and Foundry Co., 165 Broadway, New York City. The design employs the step-down transformer principle and it is claimed that it reduces the percentage of spoiled rivets; that there is no smoke or heat, and but slight fire risk.

On account of the low voltage, there is no danger to the operator, either when placing the rivet in the heater or when removing the same. Plain, uninsulated tongs can be used, and it is not necessary for the operator to wear gloves or goggles to protect himself.

Each heating-unit in the furnace, called an electrode, consists of an open, flexible, secondary link, with two solid copper terminals called the jaws. The lower jaw is connected to a treadle which, when pressed down, makes an opening according to the capacity of the machine, into which is inserted vertically the rivet to be heated. This lower jaw ascends and holds the rivet firmly in place when the operator removes his foot from the treadle. It is through these jaws that the low-voltage high-amperage current passes to the rivet.

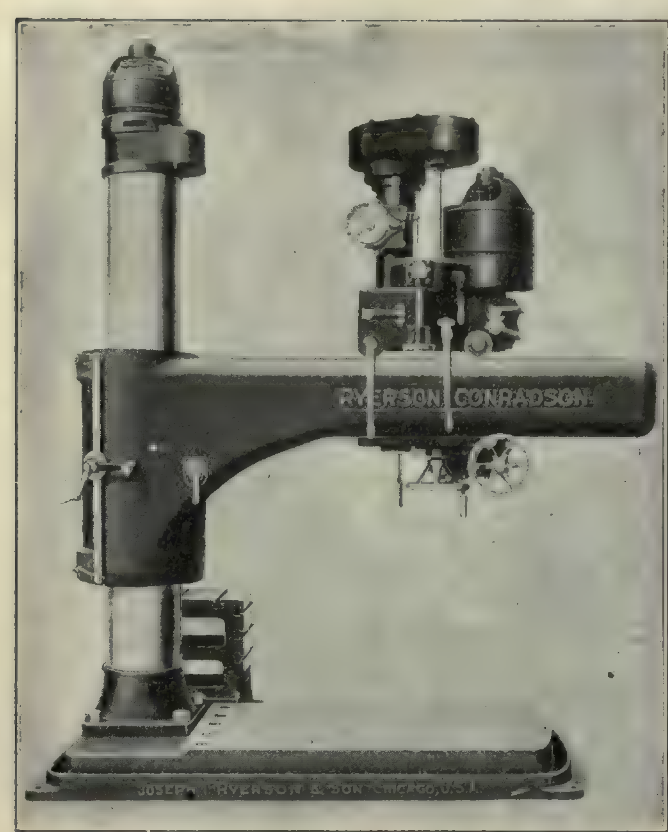
In addition to the service switch a heat-control device is provided, giving three changes, low, medium and high. Low heat is used for the smaller size rivets, or when only a limited hourly capacity is demanded. Medium heat is used for the intermediate size rivets, or for a larger volume. High heat is used on the largest size rivets, within the capacity of the machine; or when a maximum volume of the smaller sizes is required.

The heater is provided with chain-hooks so as to be lifted with a crane, the smaller sizes are fitted with wheels when required, and when so ordered a pressed-steel hood is furnished as a protection against the weather. The heater is made in a number of different sizes.

Ryerson-Conradson Plain Radial Drilling Machine

A radial drilling machine, known as the Ryerson-Conradson two-motor high-power radial drilling machine is shown in the illustration. It is being placed on the market by Jos. T. Ryerson and Son, Chicago, Ill. This machine is built in three sizes, with 4, 5 and 6-ft. arms. Among the principal features is the gearing which has been greatly simplified so that only four shafts and sixteen gears are required for the full range of speeds and feeds. The spindle and driving shafts are all contained in a single cast-iron box. Only spur gears are employed, eliminating bevel gears altogether.

The head is mounted on S.K.F. ball-bearing rollers and travels on the top face of the box-section arm to which it is held by a plate, guided by parallel V's on the under side of the arm. The plate also serves to hold the head in alignment with the arm. The ball-



RYERSON-CONRADSON RADIAL DRILLING MACHINE

Specifications: Built in three sizes, 4, 5 and 6 ft.; base height, 7½, 8½ and 9½ in.; base size in front of column, 36 x 53, 42 x 65½, 48 x 78 in.; vertical range of arm, 38, 42, 48 in.; horizontal range of head, 39¾, 51½, 64 in.; maximum distance from spindle to base, 62, 70, 80 in.; minimum distance from spindle to base, 8, 10, 12 in.; number of spindle speeds, 16; range of spindle speeds, 19 to 310; number of spindle feeds, fine set, 8, range 0.005 to 0.078 in., coarse set, 8, range 0.023 to 0.370; motor, main drive, 5, 7½, 10 hp.; motor, elevating, 2, 3, 5 hp.; spindle, vertical traverse, 16, 18, 20 in.; bored to Morse taper, No. 5; total height, 120, 133, 144 in.; floor space, 78, 97, 116 in. radius; weight without motors, 9,000, 12,000, 15,500 lb.; weight of motors and electrical equipment, 850, 1,000 and 1,200 lb.

bearing rollers on which the head is mounted are provided with eccentric shafts which permit adjustment for wear.

The spindle drive is from a vertical reversible motor mounted on the head which is direct-connected to the drive shaft by a self-aligning coupling. Conical friction-type clutch gears provide connection to the drive shaft, and four gears keyed to the clutch shaft drive the spindle sleeve through change gears on an auxiliary shaft. Sixteen spindle speeds, from 19 to 310 r.p.m., can be obtained by shifting levers, all of which are on the head.

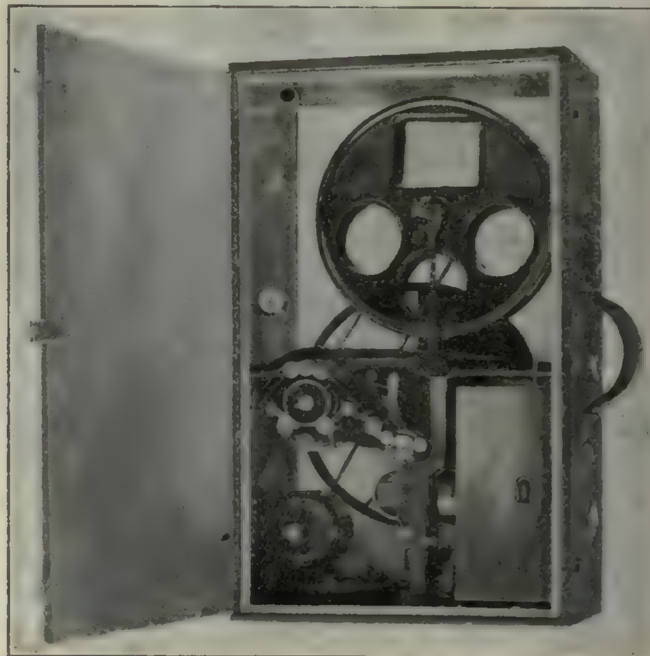
Two series of 8 feeds each are provided and these range from 0.005 to 0.078 in. and from 0.023 to 0.370 in. per revolution. All feeds are disengaged instantly by a friction clutch on the hand wheel shaft, and this may also be controlled by an adjustable stop which disengages the feed when the desired depth has been reached. For tapping, the motor is reversed, which can be accomplished instantaneously without shock on the transmission or wear on the friction clutches.

An independent motor is mounted on the top of the column for raising and lowering the arm, driving the elevating screw through a reducing gearing. Limit switches are provided which open the motor drive circuit and thus protect the machine.

The arm is attached to the column by a long sleeve and is mounted on ball-bearings. A pneumatic clamping device for the arm can be furnished if desired.

Portable Graphoscope Projector

A motion picture machine designed especially for the use of salesmen has been introduced by the Graphoscope Development Co., 50 East 42nd Street, New York



PORTABLE GRAPHOSCOPE PROJECTOR

City. The complete unit, ready to run, is contained in a case the size of an ordinary suit case. It has a motor drive and is simply constructed, as may be seen from the illustration and is said to be fireproof. It uses standard film and will project a good picture 10 ft. square, at a distance of 35 ft. For a quick demonstration, such as showing the operation of machinery, etc. in motion, the pictures may be projected on a blotting pad or other improvised screen placed at a distance of 2 or 3 ft. from the lens. A picture thus displayed shows clearly in subdued daylight without darkening the room. About 1,000 ft. of film will carry a very concise story to prospective customers.

Gammons Taper Pin Reamer

The spiral reamer shown is a product of the Gammons-Holman Co., Manchester, Conn. It is claimed that the spiral design permits holes to be reamed at any reasonable speed and feed with a minimum risk of breakage.

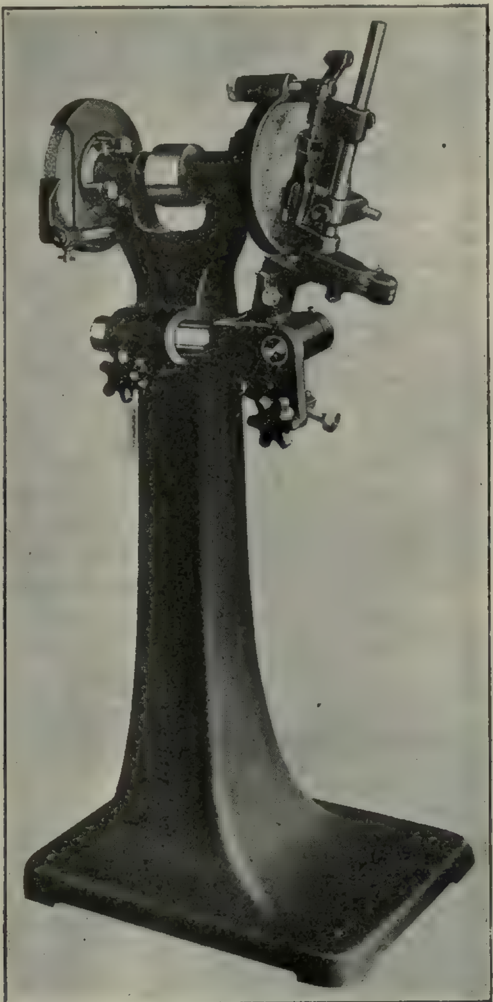
It cuts rapidly and freely; the chips resembling steel wool. It is intended for use in drilling machines, and in addition to reaming holes for taper pins is said to be useful in die making for removing the metal between holes that have been drilled close together. The reamer is made in all standard sizes for taper pins having ¼ in. taper to the foot, and can be furnished on order with special taper if required.

GAMMONS TAPER PIN REAMER

Grand Rapids Tap-Grinding Machine

The Grand Rapids Grinding Machine Co., Grand Rapids, Mich., has added to its line the tap-grinding machine illustrated herewith.

This machine is intended for grinding the taper at the end of a tap and the clearance back of the cutting edge thus formed. Any desired taper can be ground. The clearance produced is convex and eccentric.



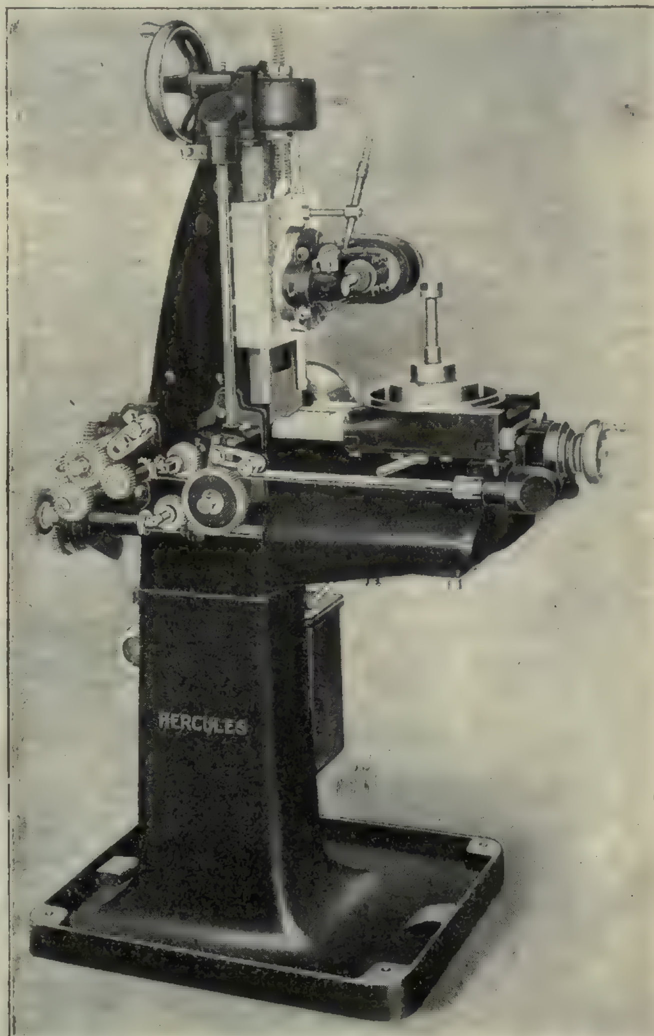
GRAND RAPIDS TAP-GRINDING MACHINE

In grinding, the tap is held between centers and swung into grinding position. An adjustable stop and an indexing finger provide means for grinding the same taper and clearance on each of the lands. Either right- or left-hand taps from $\frac{3}{8}$ to 3 in. diameter can be ground.

The regular equipment includes a truing device complete with diamond.

Hercules 8-In. Gear-Hobbing Machine

The Hercules Machine & Tool Co., Astoria, N. Y., with sales offices at 404 Broome St., New York City, has improved the design of its 8-in. gear-hobbing machine. A special device providing means for exact adjustment is now used for centering the hob. For generating spiral gears a differential is employed which simplifies adjustment and assures precise machine operation. Automatic stops are provided for disconnecting the feed when machining either spur, spiral or worm gears. An effective cutting lubricant supply system is furnished when required, which includes tank, pump, piping, etc., complete. A special arbor support designed to hold securely a gear blank with small bore is furnished as an extra. As may be seen from the illustration, this is held in a position that allows the chips to drop free from the cut.



HERCULES 8-IN. GEAR-HOBBING MACHINE

Specifications: Capacity, generating steel gears, 10 D.P.; outside diameter of largest gear cut, 8 in.; width, 6 in.; minimum distance from center of work arbor to center of hob mandrel, $\frac{5}{8}$ in.; size of countershaft pulleys, 8 x 3 in.; speeds of countershaft, 180 and 360 r.p.m.; floor space of machine, 24 x 36 in.; net weight, 1,050 lb.; domestic shipping weight, 1,250 lb.; export shipping weight, 1,350 lb.

White Lines on Blueprints

By D. C. Howard

It frequently is desirable on blueprints to have some lines, such as section designations, stand out from the others in point of whiteness in the finished blueprint.

To secure this result, and to do cross-hatching, etc., with very fine lines and still have strong white lines on the print, use vermilion moist color of any of the standard French or other makes.

Mix the water color very thick and apply to the pen with a camel's-hair brush. The color will cake quickly in the pen and will necessitate frequent cleansing. However, the resulting white lines on the blueprint will be deeper and purer than can be obtained by the use of india ink.

WHAT to READ — for the man in a hurry

Nobody who is holding down a man's job has time to read all of the American Machinist. On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials —they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.

A PAGE like this is such a departure for a conservative old paper like the *American Machinist* that we have hesitated a little about introducing it. Not that we haven't had special features to talk about; we have. Every issue of 1920 has had at least one.

We almost let it go last week to congratulate ourselves on the leading article, but decided to hold back until the first issue of the new month. This number happens to bear the date of the Feast of All-Fools. We hope that there will be no significant connection between our innovation and the usual events associated with this joyful occasion.

In this issue and in several of the succeeding ones we have gathered together careful, detailed information on machine work in the shops of some of the best-known automobile manufacturers. We are limiting the discussion this week to cylinder operations and to make the material as useful as possible have put the methods used in five different plants under one head, with the idea that comparison will be easier that way.

This information is so timely that it has been given leading space. It was secured by Fred Colvin who has been devoting a good part of his time for the last six months to a study of the machine-shop end of the automobile industry. Unfortunately we couldn't get all the cylinder data into one issue. The rest of it has been printed in previous numbers.

To get some of the well-known "human interest" into this subject we have secured photographs of several of the big men of the companies represented by these articles. Here we have Alvan Macaulay, president of the Packard Motor Car Co. since 1916, and general manager from 1910 until now. Mr. Macaulay, general-managed the Burroughs Adding Machine Co. for ten years before the Packard got him and before that he was attorney and director of engineering and development for the National Cash Register Co. He is a Lehigh man and studied law at George Washington University.

John Wilkinson, vice president of the Franklin Automobile Co., is one of the real pioneers of the motor game. He built his first four-cylinder motor in 1898 and his first six in 1905. The Franklin people claim that these were both "firsts" in their field. In 1902 Mr. Wilkinson started his campaign for weight reduction by switching from water to air as a cooling medium. This change took nerve but the present standing of his company and its product vindicates him.

The other gentleman is F. F. Beall, vice president of manufacturing for Packard. He is both a practical and a technical man and has been with his company for more than ten years. Much of the excellent modern shop equipment in the Packard shops and many of the efficient manufacturing methods are due to his efforts.

The men from the other companies included in our series will get their turn later. Space prevents putting them all in at once as we would like.

We haven't much room left to talk about the other articles this week, but we want to call attention to Commander Gatewood's description of the Balboa pattern shop and Captain Henry's suggestions for standardizing the classification of grinding machines. The latter offers an excellent opportunity for come-backs and a chance to get your name in print, for there is still much to be said.

Commercial Aviation, Its Development Since the War and Its Scope in the Future

BY F. HANDLEY PAGE

THE DEVELOPMENT of aviation, from primitive to modern times, the needs in this field today and the prospects of the future regarding the airplane as a commercial factor, were the salient features of a most interesting and instructive address, delivered last Tuesday evening by F. Handley Page, one of the world's foremost aëronautic engineers and constructor of the famous Handley-Page aëroplane. The occasion was a joint meeting of the Aëro Club of America and the New York Electrical Society. Mr. Page spoke in part as follows:

"There are three ways in which man can travel over the earth—by land, by sea and by air.

"The first development of the world's history in the primary geological formations was the development of sea travel by the lowest order of life, when the only living forms which existed were of the jellyfish variety.

"With the coming of the secondary geological formations, there appears on the earth those strange reptiles, of which remains have been found all over the world, and this development traveled by crawling all over the world.

Traveling on Foot

"When man first appeared in this world his means of progress were limited to the use of his arms and feet. His speed of travel for long periods was not more than 5 miles per hour, due to the fact that his weight per horsepower was high, being of the order of 1,500 lb. weight per horsepower. To improve this method of land travel, he trained mammals which were then on the earth, such as the horse, elephant, buffalo, etc., and combining his weight with theirs, attained a total less weight per horsepower than in the case of his own undivided effort.

"The invention of mechanical devices, such as the wheel-barrow by the Chinese, added to the facilities at man's disposal and increased the speeds to which he could attain.

"The ultimate development of natural land travel is seen in the development of the stage coach in the last century and the fast trotting sulkies that race today. You will notice in each case that high speeds are only attained where the weight per horsepower is reduced, and where this is made extremely small, carrying capacity is also practically reduced to nothing. Higher speeds than these were not attainable by an altered mechanical development. As you can readily realize, some inventor might have endeavored to place the horse inside the stage coach driving through a cog wheel mechanism, and by such a means endeavor to have obtained a bigger mechanical efficiency than by allowing the horse to run on the ground and both support its own weight and drag after it the vehicle to which it was attached. Such a development, as you can see, is quite an impossible one, and no further progress can be made until the prime mover driving the vehicle was reduced in weight and cubic feet capacity per horsepower.

"With the development in the last century of the steam and gasoline engine, a great progress was immediately made which you see perfected in the automobile and railroad engine. If you realize the small weight per horsepower and space occupied by the gasoline or steam engine, you can readily understand the basic reason for the increase in speed that has been obtained with these improvements.

"On the sea, developments proceeded on much the same lines. Man in his primitive state could swim—an art learned, no doubt, from imitation of the fishes—and later he was able to improve his speed by the use of boats carved out of the trunks of trees. The development of transport on the sea was a slow one and eventually the motive power of the wind was utilized and replaced multiplication of man power that was used in the old Roman galleys. Higher speeds were attained, owing to the reduction in the weight of horsepower that was obtained by the use of sails and the small amount of room which they occupied, compared with the necessary men that would otherwise have been required to row such a vessel.

"Sails had, however, their limit, the motive power was fickle and not to be relied on and the development of man power as a rower was impossible. As man develops an average of 1/8 hp. for continuous effort, it would require something like one quarter of a million men to develop the horsepower sufficient to drive the Mauretania across the Atlantic, a number of men which has only once been exceeded and carried in one ship. I refer to the crossing of those millions of people in the good ship Mayflower.

"Steam and the gasoline engine made high speed ocean travel possible, and were it not for ocean weather, further developments would be possible on the lines of the hydroplane and skimmer.

Problem of Aviation

"When, however, one turns to the problem of aviation and its use by man as the means of transport, one is confronted by the fact that it has never been possible to have birds large enough on whose back man might mount and learn to fly. In the secondary period of the world's geological formation, there existed great flying reptiles known as pterodactyls, and the development of the lizard into a large flying bat. These, although 30 or 40 ft. in span, did not exist concurrently with man and their influence on air transport was nil. Birds existed at the same time and we have the evidence of the remains of the Archeopteryx to show what they were like. They were a bird developed from a lizard and had a very large tail in comparison with the winged formation. It has always seemed to me that the early development of these birds was very much like airplane development in that they started with large tail area, which was progressively decreased as the development of the bird or machine was progressed.

In the great blank which separates the secondary from the tertiary period of geological formation, all these teeming masses of reptilian life disappeared, so that when we turn to the development of mammal life,

man had no means at hand to indicate how he could achieve successful flight.

"Let us briefly review then the stage to which mechanical transport had reached before the present flying era. Speed on the ground was about 100 miles per hour, although some special experimental trains were built and operated near Berlin about 15 years ago which attained a speed of 120 miles per hour. On the ocean, the fastest torpedo boats had reached speeds of between 40 and 50 miles per hour, and both these means of transport had reached the economical limits of weight per horsepower development, and for further progress, man had to turn to the new element, namely, the air, the invention of which had been made possible by the development of the gasoline motor.

"Aviation in the early days was a case of managing to keep off the earth at all cost but without any thought of efficiency. The weight per horsepower was in the neighborhood of 40 to 50 lb., the modern starting point of successful flights for the Wright Brothers in this country in 1903. Then followed the improvement of machines from an efficiency point of view, the stream lining of the body, the improvement of plane areas, the reduction in weight per horsepower of the motor, together with improved methods of carburetion. All these lessened the weight per horsepower of the air vehicle and permitted of the atainment of higher speeds. So from the old machines doing about 40 to 50 miles per hour with a weight per horsepower of 40 to 50 lb., we have progressed to the modern scout whicn only weighs 7 or 8 lb. per horsepower all told and has a top speed of 150 or 160 miles per hour in still air.

War Speeded Development

"The millions which have been spent in every country in air development have made this great progress possible and aircraft movement is exceedingly fortunate in that amidst the great suffering caused by the war, the aircraft industry has reached a point of development which it could not have attained by years of normal peaceful achievement.

"Of this development full advantage should be taken so that the investment so made is not lost. In this direction, with the coming of peace, we have devoted our energies in the research department to the perfecting of an airplane with less weight per horsepower but still a high speed of travel.

"The type of machine which we now have flying has a useful weight of 3,500 lb. apart from petrol and oil or crude, a speed of 115 miles per hour and a non-stop flying capacity of 500 to 600 miles. With the later improvements that we now see possible, we expect to reduce to 300 the horsepower required for this performance, with a corresponding decrease in cost of operation. The same advantage too can be gained in small machines and we can visualize a small machine of 25 horsepower capable of carrying pilot and passenger at a speed of 100 to 110 miles per hour for a non-stop distance of 400 to 500 miles. If we now look back along the whole long-drawn-out history of the world's economic development, can we not at this moment feel that we stand at a new point of development in the world's history and that the airplane, developed as it is today, improved still further as it will be tomorrow, points the finger-post along the line of commercial development and shows us the instrument at hand for future development?

"Of this development we, in England, have been able to take advantage and with the ground work available and large machines converted from war purposes to those of peace, it was easy to start services. The results have been very satisfactory.

"Although we have been operating only during the winter months, for flying outside England was not permitted before Sept. 1, 1919, we have flown no less than 82,428 miles, have carried 4,201 passengers and 49,457 lb. of freight without injury to a single passenger or loss of a pound of freight, a record which can surely challenge any other means of transportation. These records show what can be done even with a new improvised service organized quickly on the coming of peace.

"The influence of air transport is going to be enormous in the world's development. To a great country such as the United States of America, where towns are separated by great distances, the airplane will act like a gigantic hand and squeeze these towns and cities closer together. Distances are measured by mankind by the time which it takes to go from one place to another. The distance of 1,000 miles or so from New York to Chicago means nothing to the business man. He knows only of the 20 hours on the train. By air, in 7 or 8 hours, or less with a following wind, Chicago moves closer to New York and is no further away from the point of view of time in the air than Syracuse is on the railroad today.

"If I have spoken of the development only on the other side and left out the great flights which have been made here, such as the continual service between Washington and New York, the flights of Colonel Harts on the Martin Bomber around the Rim, Mr. Lawson's great flight on the Lawson air liner, Commander Reade's great work with the NC-4 as well as the work all over the country of Curtiss machines and many others—if I have not referred to these, it is only because I am a stranger to this country. I have touched more fully on the work done on the other side, because with it I am more acquainted."

Following the address, the flight of the giant Handley-Page airplane from London to Warsaw was shown in moving pictures. Mr. Page explained the features of the flight as the pictures appeared on the screen.

EMPLOYMENT—One day a stalwart Scandinavian appeared in the employment office looking for "vork." The agent had on his desk a requisition for more help in the press department, so after the few preliminary questions dear to the heart of an employment agent, he asked the Swede if he "ever worked on a press?"

"Yas," replied Eric, "I run plenty prass."

"What kind of press?"

"Plenty big prass," and here the applicant made motions with his hands to indicate that the presses with which he was familiar would occupy all the space in the room in which they stood. The agent was duly impressed with the magnitude of the machinery but wanted more specific information.

"Yes; but what *kind* of press was it? Was it a drawing press; a punch press; or a hydraulic press?" What did it make?"

"Cider," answered Eric.

He was not hired.

What Other Editors Think

Beware of the Metric System Propaganda

HENRY HARRISON LEWIS, EDITOR OF *Industry*

IT IS intimated that in the near future a bill will be introduced in the House of Representatives by a member of the Committee on Coinage, Weights and Measures to make the metric system compulsory in the United States after a certain period, possibly within five years. During the last two or three years there has been a persistent campaign going on in this country to induce Congress to change our system of weights and measures and substitute the metric system. This propaganda, in its present form, had its origin on the Pacific Coast, and it has spread widely and has been handled apparently very effectively. The result is to create what appears to be a demand for the metric system, whereas the situation really is that a limited number of persons are interested in it to such an extent that they are willing to finance a campaign of so-called education.

The manufacturers of the country are specifically concerned with any legislation which would impose upon them the metric system. Such a system would compel great changes in machinery, impose unnecessary expenses, and also make it necessary to educate their employees in the new system. The education of employees would not be an easy task, and, aside from the expense, there would be found in an excellently regulated shop a great deal of chaos and confusion. The British Parliament, at one time, considered the adoption of the metric system, under the pressure of propaganda such as we are experiencing now, and after full consideration and study rejected it as impracticable.

The arguments offered in favor of the metric system are that it is in universal use, except in the United States, the British Empire and Russia. That argument does not offset or minimize the difficulties of establishing the system in a country of 110,000,000 people educated in their own system, and perfectly satisfied with it. It is further argued that the adoption of the system is easy and the transition period short. That is a gratuitous statement, based on guess work and easily contradicted by testing the average school boy who has studied the metric system and finding out his ability to apply it in the ordinary daily intercourse of life.

It is also argued that the system leads to important saving of time in calculations. That may be true, if we assume a perfect knowledge of the metric system, but in the United States we should first have to instill in 110,000,000 people, who had no desire for the information, that perfect knowledge of the metric system. It will be admitted that this is difficult, if not impossible.

The chief argument is that the adoption of the system is important, in the interest of foreign trade. That argument does not stand up very well in the light of the enormous export business we are doing today and have done for years.

Speaking frankly of the proposal, it savors merely of an attempt on the part of some faddists to make a change in the ordinary and necessary methods of doing business in the country. Even if a period of five years is permitted for education, it cannot be assumed that each citizen is immediately going to familiarize himself with the metric system. No one will pay any attention to it until the day it goes into effect, and then there will be chaos and confusion.

The small trader, the small shopkeeper and the ordinary housewife will find themselves at daggers' points, and finally trading on the old basis, but with the suspicion engendered on the part of the housewife and fear for the loss of customers on the part of the storekeeper. Should this bill be introduced, the basic facts in the case should be made plain to the committee of Congress and to the members of Congress themselves.

The Aviation Service

FROM *Harvey's Weekly*

GLOSS over the matter as you will, the one outstanding fact concerning the aviation service is that for every American-made plane that reached the front we spent nearly five million dollars. That is to say, there were just 213 such planes, and our war aviation service cost us $1,051,000,000. A simple exercise in long division completes the story. It was natural and inevitable that we should have to pay the penalty of our neglect of preparation. It is true that we purchased thousands of planes and engines from other countries, and that we conducted extensive training schools for aviators. It is also true that we established plants which at the end of the war were producing at the rate of many thousands a year. But all these considerations cannot dispel the feeling that there was monstrous waste somewhere in the department directed by one of the ablest public servants the President has ever known.

There is, proverbially, no good in crying over spilled milk. But there is some good in penalizing anyone who caused the spilling through mischief or greed, and also, we should certainly say, in saving the pail for another milking. In other words, if some considerable part of that billion dollars was invested in plant and fields and training schools, that investment should not now be permitted to go to waste or to be neglected. We should have now a pretty complete and extensive aviation establishment, sufficient to afford a reasonable degree of preparedness for future needs. It would be sheer profligacy to let it fall into desuetude.

We should not, of course, keep on spending money at such a rate as during the war. But we should see to it that our aëronautical establishment is maintained comparably with our army and navy, both in size and in quality. That will mean much experimenting, since air navigation is still in the experimental stage. But we should do it. It would be a national disgrace for us to sit down in idleness, waiting for other nations to do the experimenting and to perfect the airplanes. We ourselves should take the lead in invention, as we have done in other directions.

SPARKS FROM THE WORLD

Valentine Francis

New International Chamber of Commerce To Be Formally Organized

The new International Chamber of Commerce, projected at the International Trade Conference at Atlantic City last October, will be formally organized, it is announced by the Chamber of Commerce of the United States, at Paris during the week of June 21, 1920. Invitations have been sent out by the American group of the International Organization Committee to business and industrial associations, asking them to name delegates to participate in the organization meeting. About 100 American delegates are expected to attend.

The International Organization Committee, which was provided for at the International Trade Conference, is to meet at Paris in advance of the general organization meeting, which will be held in June, to prepare and report a plan of permanent organization, the basis of which was drafted and approved at the International Trade Conference. Plans will be presented by the Organization Committee for a strong and active International Chamber. Steps will be taken for the creation of a permanent international headquarters; officers will be elected and the work of the chamber will actually begin.

In view of the disturbed conditions in international trade brought about by the exchange situation this meeting is expected to assume considerable importance aside from the fact that the International Chamber is to be organized. The important question of international credit, as well as shipping, tariff regulations, unfair competition in international trade, and other problems of equal importance affecting stability in international trade and production in all the principal countries in the world, will be discussed.

American members of the Organization Committee whose names are now announced are:

A. C. Bedford, chairman of the board of the Standard Oil Co., and member of the National Foreign Trade Council, New York, chairman.

Thomas W. Lamont, of J. P. Morgan & Co., New York City.

Edward A. Filene, president, William Filene's Sons Co., Boston.

Richard S. Hawes, president of the American Bankers' Association, St. Louis.

John H. Fahey, of Boston, formerly president of the Chamber of Commerce of the United States.

IMMENSE PLATE BENDING ROLL

These large rolls have a total weight of 160 tons—the top roll measuring 30 in. in diameter, 35 ft. 6 in. in length and weighing about 45 tons. The two bottom rolls each have a diameter of 20 in., are 35 ft. 6 in. in length and weigh about 22 tons each. This machine measures 35 ft. 6 in. between housings with a capacity to bend $\frac{3}{4}$-in. mild steel plates. The high speed and roll bearings are bronze bushed; all other bearings are babbitted. These rolls were purchased from the Southwark Foundry and Machine Co., Philadelphia, by the Petroleum Iron Works Co., Sharon, Pa.

S. C. Mead, secretary of the Merchants' Association of New York, vice chairman and secretary.

The foreign members of the committee, as just cabled to this country, are:

BELGIUM

Louis Canon-Legrand, chairman, president of the Chamber of Commerce; consulting engineer, Mons, Belgium.

Prof. Paul Van den Ven, University of Louvain, Delegate of Belgian Minister of Finance at Paris, Brussels, Belgium.

Alexander De Groote, vice president, Antwerp Chamber of Commerce, Antwerp, Belgium.

Two additional members of this committee will be named by the Central Committee of Industry of Belgium.

FRANCE

M. Eugene Schneider, chairman, head of Creusot Steel Works; president, British Iron and Steel Institute; former member of Chamber of Deputies, Paris, France.

M. Tirman, Councilor of State, Paris, France.

M. Roche, delegate of General Syndicate of Chemical Products, and Administrator Delegate of the firm of Poulenc Brothers, Paris, France.

GREAT BRITAIN

Lord Desborough, chairman, president, president of the British Imperial Council of Commerce, and formerly president, London Chamber of Commerce, London, England.

Sir Arthur Shirley Benn, K. B. E.; M. P., managing director, Hunter, Benn & Co., London, England.

Edward Manville, president, Association of British Chambers of Commerce; vice president, Federation of British Industries, Coventry, England.

Stanley Machin, president, London Chamber of Commerce, London, England.

One member of the committee will be named to represent the banking interests of Great Britain.

R. B. Dunwoody, secretary, Association of British Chambers of Commerce, London, England.

ITALY

Comm. Ferdinando Quartieri, chairman, president of the Italian Corporation for Chemical Industries, Milan, Italy.

Comm. Prof. Vittorio Meneghelli, president, Chamber of Commerce of Venice, Italy.

Comm. Giorgio Mylius, president of the Italian Master Cotton Spinners' and Weavers' Association, Milan, Italy.

Comm. Pietro Giovanni Lazzerini, Lazzerini Brothers, Shipping, Carrara, Italy.

Comm. Augusto Jaccarino, Banco di Napoli, Rome, Italy.

The International Chamber succeeds the old International Congress of Chambers of Commerce which ceased to function with the outbreak of the World War in 1914.

The specific aims of the organization as outlined by the Committee on Organization are:

To create a permanent international headquarters to centralize all data concerning economic subjects and social conditions, the facts relating to the respective needs, present production and future possibilities of each country.

To act as an instrument of coordination which will suggest trade regulations and legislative measures to facilitate and encourage the development of economic commerce.

To inform public opinion through the publication of facts with regard to

LD'S INDUSTRIAL FORGE
News Editor

business conditions and through the dissemination of views of technical experts and business men.

To put at the disposal of all official organizations the reports and conclusions prepared by these experts and business men.

The Committee on Permanent Organization of the International Trade Conference agreed tentatively that the constitution of the new chamber should provide, among other things, for:

A board of directors composed of two members selected by each nation.

An international headquarters, with one representative of each nation attached to it, assisted by technical experts; all to be under direction of a general secretary.

A corresponding bureau in each country.

Membership to consist of chambers of commerce, commercial organizations, banking and similar associations, firms, corporations and individuals, holding associate but not voting membership.

Meetings of the membership every two years.

A system of referenda to be issued during the interval between the bi-ennial meetings of the members.

Other objects of the association are:

To make import and export trade easier.

To remove international friction, much of which begins with commercial differences

To safeguard international trade against waste and fraud.

To increase the total production of the world, and make the product available to the people of the world.

To standardize international documents, practices and laws affecting commercial intercourse.

To increase mutual profitableness of international transactions.

To cultivate personal acquaintanceship among business men and bankers of the different nations of the world, and thus lessen misunderstandings.

At the first meeting in June only the five countries participating in the International Trade Conference, the United States, Belgium, Great Britain, France and Italy, will be represented.

Employees' Reading Room

The Laidlaw Works of the Worthington Pump Corporation, Cincinnati, Ohio, has innovated many things for the welfare of its employees, among which may be commended is the reading room shown in the accompanying illustration. The room has been plainly furnished and is open for the use of employees from 12 o'clock to 12:40 daily, being in charge of a librarian at this time.

Current issues of all the well-known technical magazines are kept, which are supplied to any employee interested.

THE LAIDLAW WORKS' READING ROOM

Any magazine may be taken home by permission of the librarian, but must be returned within a reasonable time. Such books as the "American Machinist Handbook" may be either bought or borrowed by the employees. In order to keep alive the interest in the reading room the company's paper devotes a page of short articles each month under the title "Reading Room Notes." This scheme has worked successfully, as many suggestions have been made by readers through these columns which have been carried out to the benefit of the reading room.

The popularity of the reading room may be judged from the fact that many employees eat their lunches there so that they may have an opportunity to peruse their favorite technical magazines and incidentally profit by the knowledge that they gain.

Trade Currents from New York, Cleveland and Chicago

NEW YORK LETTER

With March business virtually all in, the volume of business handled by the local machine-tool houses compares favorably with the corresponding periods of any previous year. In many lines, the month just closed returned high-peak results.

Large lists are more frequent of late. The General Electric has a substantial list out for its Bridgeport plant. The Lehigh Valley sent out a list of twenty-six tools with numerous attachments. The B. & O. will issue a large list within two weeks.

The Otis Elevator Co. has practically completed purchases on its most recent lists. The S. S. White Dental Supply Co. was a buyer last week, and the Edison Lamp Co. is reported out of the market with the completion of a recent list. The American Locomotive Co. is said to be in the market for hand screw machines.

The incorporation list for the past week includes the Brooks-Steel Corporation, manufacturer of motor wheels, with R. L. Wood of 1221 Bedford Ave., Brooklyn, receiving inquiries. Capitalization, $531,000.

The National Electric Water Heater Corporation, with $2,000,000 capitalization, is represented by Robert R. Vanvooris, Jersey City, and Cornelius A. Cole, Hackensack. It will manufacture a general line of electric water heaters.

The Haverford Cycle Co. has increased its capital stock from $350,000 to $500,000 to take care of coming increases in production, and the General Insulate Co., of Brooklyn, gives a like reason for an increase of $200,000 on its original $50,000 capitalization.

The delivery situation is still unchanged, and, due to the coastwise stevedores' strike, water shipments of machine tools have been greatly impaired. No improvement in the rail transportation outlook is noted, and the delay in delivering machine tools both to branch houses and to customers is giving the factories no little concern.

Cleveland Letter

Some recovery in the machine-tool demand in the Cleveland and northern Ohio territory is noted in the past week. While many of the bigger interests, including automobile and parts builders, still show a disposition to hold out, there has been a decided increase in inquiries and orders from among the smaller manufacturers.

Machinery manufacturers and distributors point out that it is difficult to meet the demand for immediate delivery. This is bringing in considerable inquiries for used equipment, but few establishments can offer a good selection of used equipment at this time.

That the more distant months of this year will be productive of bigger business in at least one direction is indicated by the tentative plans of rubber companies in the Akron section of this territory, which indicate that they are preparing to increase their production, and this is further substantiated by tentative inquiries along certain specialty lines.

One of the newest firms to open up possibilities for additional machinery demand in this section is the Freeman Motor Co., which has established temporary quarters in Whitney Power Block, Power Ave. and East 12th St. The company proposes to manufacture 500 trucks and twenty-five passenger automobiles during the present year. A feature of its production will be a four-wheel driving device for trucks. The device is the invention of F. L. Freeman, one of the incorporators. J. H. Albrecht is chief engineer. Other officers of the company are: M. O. Stonebreaker, president; Paul Reiff, vice president; George H. Reiff, secretary-treasurer.

Extent of the activities of the Fisher Body Corporation for its activities here is recognized in the plan for its new factory at East 140th St. and Coit Road. Here a six-story structure, occupying a tract of 613,000 sq.ft., and containing 1,600,000 sq.ft. of operating space, will be built. The New York Central Railroad tracks will run through the building, which will cost about $6,000,000, and which is said to be the largest single manufacturing unit in the country.

Chicago Letter

Quiet prevails in the machinery trade in this district. The recession in volume of new business, which was noted last week, has become more pronounced. Not only is the amount of actual business being booked undergoing shrinkage, but a decided falling off is noted in inquiries received. The most important single factor evident is the complete withdrawal of the automobile industry from the buying market.

Very circumstantial reports are to the effect that the auto builders of the Detroit district have practically cut their 1920 output schedule in half. They are said to have been governed by four considerations: Difficulty in securing raw material, difficulty in securing labor to operate on a high-production basis, danger of overproduction toward the end of the year, and a desire to avoid making too much profit in 1920 in view of the uncertainty of future tax requirements. It is probable that the overproduction feature is the determining consideration as, had their original schedules been adhered to, there would at the close of the year have been an automobile in existence for every twelve people in the country.

Present plans seem to be to finish the year with the equipment so far ordered, but to proceed no further with plant extensions. Tractor builders, particularly those controlled by automobile makers, seem to be following the same idea. No new orders or inquiries are being received from the tractor interests and one concern is said to be negotiating for the cancellation of orders for certain equipment.

The thing which all dealers are awaiting with interest is the entrance of the railroads into the buying field. Nothing has yet appeared to indicate to what extent railroad buying will develop. An inquiry for six tools for the Chicago Junction Ry. is the only rail activity that has been noted. Similarly, machinery orders from makers of railway appliances and equipment are dependent on orders from the various roads.

Aside from the foregoing, no particular activity or lack of such has been felt in any certain industry. Such orders as are still coming are widely diversified, both as to class of material and as to origin. Large plant extensions announced by the Western Electric Co. foretell considerable business from that source.

Decision by a large tractor concern to equip each of its service stations with a uniform type lathe shows possibilities for sales in that direction.

It is not to be assumed that business in the Chicago district is poor, or is going to be poor. Far from it. Back orders exist in sufficient quantity to insure prosperity for some time to come, and deliveries are still fearfully slow. Furthermore, a reduction of the recent heavy buying pressure will give small machinery users a chance to have their needs supplied.

What One School Gained by the Caldwell Bill

To the Editor:

The Tamalpais Vocational School of Mill Valley and Sausalito, Cal., announces that it has purchased the following machine tools foom the Government at fifteen cents on the dollar: One planer, seven engine lathes, two hand screw machines, two bench drills, one back-geared drilling machine, one universal toolroom grinding machine, one wet tool grinding machine, one cut off saw, one hand milling machine, one combination drilling and milling machine and one cylindrical grinding machine.

These, in addition to the school's present equipment of one universal milling machine, three engine lathes, three bench engine lathes, one speed lathe, one shaper, two drilling machines, one cut off saw, one arbor press, will enable it to do all kinds of machine construction and tool making.

The management of the school, considering this the chance of a lifetime, sent W. T. Elzinga, vice principal and machinist in charge under the Smith-Hughes Act, on a flying trip to Chicago and Detroit to purchase these machines several days before other school representatives could arrive on the ground.

The faculty of "Tamalpais" thanks the *American Machinist* for its splendid support of the Caldwell Bill.

E. E. Wood, Principal, and Wm. T. Elzinga.

An Immigration Conference

A national immigration conference will be held April 7 in New York City in the Engineering Societies Building, 29 West Thirty-ninth St.

National leaders in American industry and finance will discuss the shortage of foreign-born labor and the loss of production due to unrest among the workers, and measures will be taken for united action to relieve this condition.

Invitations to attend this conference have been issued by the Inter-racial Council to more than a thousand of the directors of industrial concerns, especially those employing foreign-born labor, and to others who are interested in this problem from the standpoint of finance on national welfare.

Topics to be discussed will include pending bills on immigration, and a constructive policy will be voted upon.

All industrial executives are invited to be present.

Further details may be secured by addressing Coleman du Pont, Chairman of the Board, the Inter-racial Council, 120 Broadway, New York City.

A bill has been introduced in the Maryland Legislature which is designed to authorize the State Industrial Accident Commission to make as many inspections of machinery as it deems necessary.

Engineering Division Has a New Test Furnace

The Material Section, Engineering Division, is supervising a test of the Government furnace at Shelby, Ohio. This furnace was installed during the war for the purpose of heat-treating steel tubing in quantities for airplane construction, but was not completed until very recently. It is now completed and undergoing a series of tests to determine the feasibility of producing heat-treated steel seamless tubing of very high tensile strength and elastic limit, to particularly meet Air Service Specification Number 10,229, for axle tubing.

The furnace, located at the plant of the Ohio Seamless Tube Co., is 7 ft. in diameter and 22 ft. deep, electrically heated and automatically controlled so as to give constant temperature within very narrow limits. The tubing is lowered into the furnace, which is sunken so that the top of the furnace is level with the floor, in a steel container (capacity 1,152 ft. of 2-in. tubing) by means of a crane. On reaching the required heat the container with its cargo is hoisted out of the furnace, transported over the quenching tank, where the bottom of the container is opened and the steel tubing, at the quenching temperature, is allowed to drop into the oil quenching bath.

The tempering operation is conducted in a similar manner, except that the maximum temperature of the tubing in the furnace is, of course, lower than it was for the quenching operation. These tempers run approximately 1,400 to 1,600 deg. F. for the quenching operation and 400 to 1,000 deg. for the tempering operation, depending on the quality of steel used and the physical characteristics desired.

This furnace will be used principally for the heat-treating of alloy steel tubing with special reference to the tubing used in axles. Up to the present time no axle tubing has been produced in quantities which will meet the requirements of Specification No. 10,229 calling for a tensile strength of 200,000 lb. with a 5 per cent elongation in 2 inches.

The Material Handling Machinery Manufacturers' Resolution

The following resolution was passed at the Convention of the Material Handling Machinery Manufacturers' Association, held at the Waldorf-Astoria Hotel, New York, N. Y., Feb. 26-27, 1920:

Whereas, That the expanding commerce and industry of the United States demand that support to the industry of the United States by the Government should be continued through the instrumentality of the Bureau of Foreign and Domestic Commerce; be it

Resolved, That the Material Handling Machinery Manufacturers' Association hereby urges the Congress of the United States to appropriate the sum of $1,900 000 as originally applied for by the Department of Commerce, for this service to industry; and be it further

Resolved, That a copy of this resolution be sent to the following:

The United States Senate, the House of Representatives, daily, technical, and trade papers.

A New Milwaukee Drop Forge Company

The Interstate Drop Forge Co., of Milwaukee, Wis., has been organized by a number of prominent Milwaukee and Chicago business men to manufacture commercial drop forgings for the automotive and machinery industries.

A 9-acre tract close to the A. O. Smith plant has been obtained and building operations will be started immediately. The Northwestern Bridge & Iron Co., of Milwaukee, has obtained the contract for the forge plant and machine shop.

The president of the new company is William C. Frye, who is also president of the Chain Belt Co. and secretary of the Sivyer Steel Casting Co. Major S. M. McFedries is vice president and general manager. C. R. Messinger is the treasurer; he is also connected with the Chain Belt Co. and the Sivyer Casting Co.

New Name in Oxy-Acetylene Field

The Oxweld Acetylene Co., Newark, N. J., and Chicago, has recently extended its manufacture of oxy-acetylene apparatus and equipment to include "Eveready" welding and cutting outfits.

"Eveready" is a new name in the oxy-acetylene field, but the apparatus is not new, excepting for certain refinements of design, having been used extensively in the metal-working trades for several years under the name of "Prest-O-Lite" apparatus.

The new name was adopted by the Oxweld company to suggest the ready convenience, adaptability and general-purpose uses of the equipment. The apparatus is designed to be used exclusively with compressed acetylene in cylinders, thus providing the welder and cutter a compact and complete portable outfit.

Trade Marks in Peru

Trade Commissioner Carlton Jackson, at Lima, Peru, again calls the attention of American manufacturers to the necessity of registering the trade marks of their products sold directly or indirectly in the Peruvian market.

It is pointed out by Trade Commissioner Jackson that while the Peruvian officials are disposed to protect the rightful owners of the trade marks, they have not always succeeded in preventing the pirating of American trade marks, and it is therefore urged that American manufacturers adopt the only safe course of having the marks registered in their own names.

Meeting of Milwaukee Engineers' Society

At the regular monthly meeting of the Engineers' Society of Milwaukee held on March 17, 1920, the speaker was Percy Day, manager of the gear department of the Falk Co., Milwaukee, Wis. Mr. Day gave an illustrated talk on "Falk Gears as Applied to Mine and General Uses." The talk described some of the work of the past few years of the Falk company during which it designed and manufactured some of the largest reduction gears ever made.

American Locomotive Co. Books More Engine Orders

Further orders for a total of 51 locomotives are reported by the American Locomotive Co. The Atlantic Coast Line has ordered 25 engines, to weigh 138 tons each; the Cuba Railroad ordered ten 87-ton engines; the Maine Central, four 103-ton locomotives and four 83-ton locomotives; the Katanga Railroad (Africa), four 50-ton engines; the Koppers Co. has taken two 50-ton engines; the Donner Steel Co. one 72-ton engine, and the Pittsburgh Limestone Co., one 20-ton engine.

Extension of National Screw Thread Commission

Without objection or discussion the bill providing for the extension of the term of office of the National Screw Thread Commission until March 21, 1922, was approved by the Senate on March 17. The bill was passed by the House of Representatives on March 1. If the bill had not been passed the Commission would have expired by limitation of law March 20.

American Society Safety Engineers' Monthly Meeting

At a regular meeting of the American Society of Safety Engineers, held March 19, in the Engineering Societies Building, New York City, safety features of engineering as related to elevators were discussed in detail. Several papers, presented by experts dealing with the cause and prevention of elevator accidents, contained much valuable statistical data relative to the subject. George B. Muldar, secretary, announced the admittance of fifty-two new members since the last meeting.

Charleston Navy Yard Has Floating Machine Shop

The Charleston Navy Yard, Charleston, S. C., has recently added a floating machine shop to its repair facilities. Heretofore vessels making into harbor for repairs had to be visited by the mechanics with tools and machinery, but under the new system vessels may lay in the lower harbor and the machine can be transported there to carry on the necessary work. The mobility of the shop is its chief feature, and it will save a great deal of time.

Obituary

ROBERT ARMSTRONG, president of Robert Armstrong & Brother, one of the largest companies in the South dealing in iron and heavy machinery, died at his home in Atlanta, Friday, March 12, at the age of sixty-five years. Mr. Armstrong was the founder of the company which bore his name, establishing the business in 1886. He was prominent in fraternal and commercial circles, and a member of the Yaarab Temple of the Shriners.

JOHN H. BENNETT, founder and proprietor of the Bay State Stamping Co., Worcester, Mass., died Sunday, Feb. 22, 1920.

ANTOINE T. LANGELIER, treasurer of the Langelier Manufacturing Co., Arlington, Cranston, R. I., died Monday, March 1.

MELVIN B. NEWCOMB, aged thirty-one years, chief engineer of the rubber machinery department of the Wellman-Seaver-Morgan Co., died on March 13, after a short illness, at his home, 742 West Ave., Akron, Ohio.

Business Items

The merger of the Meldrum-Semon-Greiner Co. and the Lowry-Knise Tool Co., making one of the largest and best equipped shops of its kind in Central New York, has been completed. The new company will be known as the Meldrum-Semon-Greiner Co., Inc., and its address will be Syracuse, N. Y. It will manufacture tools and special machinery, beside manufacturing snap gages in a separate shop.

The Admiral Anchor Co., Penn Seaboard Steel Corporation and the Tacony Steel Co. will have a booth at the National Marine Exposition, Grand Central Palace, New York, April 12-17.

Announcement has been made of a new selling arrangement by which Joseph T. Ryerson & Son, Chicago, Ill., will handle the sale of the hydraulic machinery products of the Camden Iron Works, Camden, N. J.

The Black & Decker Manufacturing Co., Towson Heights, Baltimore, Md., announces the establishment of a permanent office and showroom at 1436 South Michigan Ave., Chicago, Ill. This office will be in charge of R. G. Ames, whose territory has been extended to cover the Middle West.

The Cincinnati Grinder Co. is planning a two-story addition in the rear of its plant, 3233 Colerain Ave., Camp Washington, the dimensions being 107 x 60 ft.

The Duff Jack Sales Co., Ltd., located in the Oxford Circus House, 245 Oxford St., London, W. I., England, has been formed to represent the Duff Manufacturing Co. of Pittsburgh in the British Isles, and has been given the exclusive agency in this territory for Duff and Barrett jacks.

The Sullivan Machinery Co., Chicago, Ill., announces the following appointments by the Board of Directors: Arthur E. Blackwood, formerly manager at New York City, to be vice president in charge of finance and accounting; Howard T. Walsh, vice president, in charge of sales; Gilbert K. Wilson, assistant secretary, in charge of cost accounting; Nathaniel H. Blatchford, Jr., assistant treasurer; Emil A. Krevis, general auditor; Frederick W. Copeland, manager of foreign sales.

The Graton & Knight Manufacturing Co., Worcester, Mass., recently conducted six conventions for its salesmen and dealers at Philadelphia, Atlanta, New Orleans, Cincinnati, Chicago and Worcester. Scientific power transmission and the selling of leather belting were placed on record.

The Lafayette Tool and Equipment Co., Philadelphia, Pa., manufacturers of precision tools, has elected the following officers: William M. Marion, president; Joseph M. Stryhal, vice president; Dudley Shoemaker, secretary and treasurer.

The Rickert-Shafer Co., Erie, Pa., manufacturer of the Boehm die head and a line of tapping machines, announces the following appointments in its lineup: Secretary and general manager, A. A. Shafer; general sales manager, C. W. Howard, formerly with the General Electric Co.; general superintendent, A. J. Patterson, formerly with the Crucible Steel Co.; production manager, George Patterson.

A syndicate of Atlanta and Chattanooga business men has purchased the Southern Machine Works plant and properties at Chattanooga from the United States Government, and will operate the plant under its old basis.

Charles M. Manly and C. B. Veal have announced that they established offices at 250 West 54th St., New York City, as industrial engineers, specializing in the co-ordination of engineering and manufacturing requirements in the design, production and operation of automotive power plants and vehicles.

The Thomas Spacing Machine Co., Pittsburgh, Pa., has opened an office in Philadelphia. G. L. Bohannon will be in charge. The company manufactures spacing tables, multiple punches, punches, shears, angle bending rolls, angle planers, etc.

The A. G. Clarke Manufacturing Co., Kirkwood, Ga., is seeking a new location for its machine shop and foundry, being forced to leave Kirkwood owing to the objection of nearby residents.

The Rome Wire Co., Rome, N. Y., has recently authorized an increase in capital stock to $4,000,000, 7 per cent first preferred and $5,650,000 common, the shares both being $100 par value. The company's main plant is at Rome, comprising 22 acres, while the Buffalo plant comprises 11 acres.

Personals

W. S. RUGG, manager of the railway and marine departments, and Charles Robbins, assistant sales manager, both of the Westinghouse Electric and Manufacturing Co., have been appointed to the positions of assistants to the vice president.

ROBERT H. IRONS, president of the Central Iron and Steel Co., was recently elected president of the Association of American Steel Manufacturers at its twenty-fifth anniversary meeting, which was held in Pittsburgh, Pa.

CHESTER BERT LETTE, until recently connected with the New York Machinery Exchange, is now representing the Wickes Machinery Co., and Bertolette Machinery Co., of Jersey City, in Cincinnati, Ohio. He has taken offices in the Lincoln Inn Court Building.

WILLIAM R. GUMMERE, who for a number of years, represented the Independent Pneumatic Tool Co., in Cleveland, Ohio, has again become affiliated with that company. Mr. Gummere will be connected with the Pittsburgh branch, which is under the management of Harry F. Finney.

Y. NAKASANO, connected with the Japan Steel Co., has recently arrived from Tokio. Mr. Nakasano has visited the steel mills in the Pittsburgh district and is now studying ore methods at Standish, N. Y., and will be in the states for one year.

E. R. WOOD has joined the sales force of the firm of Alfred Herbert, Ltd., 54 Dey St., New York City, and will represent this firm in the New York district in the sale of its imported and domestic machine tools and supplies. Mr. Wood was formerly connected with the selling organization of Sherritt & Stoer, of Philadelphia, Pa.

F. J. MAWBY, for a number of years connected with the sales organization of Manning, Maxwell & Moore, Inc., and located at the New York office of this firm, has resigned this position and is now a member of the sales organization of the Cincinnati Co. and the Cincinnati Gear Cutting Co., of Cincinnati, Ohio.

MYLES B. LAMBERT, for many years actively connected with the work of the Westinghouse Electric and Manufacturing Co., was recently appointed manager of the railway department of the company.

HARRY W. RUPPLE of the Cleveland Automatic Machine Co. has returned from a survey of the machine-tool situation in Europe in the interests of his concern, and will shortly leave for the Pacific Coast on a similar mission.

J. E. OTTERSON has been appointed president of the Winchester Repeating Arms Co., New Haven, Conn., succeeding Thomas G. Bennett.

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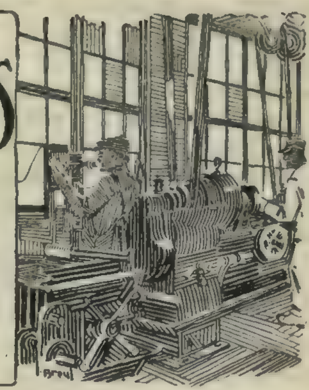
MODERN PRODUCTION METHODS

By
W. R. Basset
of
Miller, Franklin, Basset & Co.

I. What Production Planning Does

Most manufacturers have had their sad experiences with "efficiency engineers" whose principal stock in trade was salesmanship and a vast overestimate of their own ability. They have given the real "business doctors" an undeserved black eye. The first article of a comprehensive series by the president of a well-known firm of engineering accountants gives a bird's-eye view of the field to be covered in detail in subsequent installments, and points out the importance of careful advance planning of production.



IF YOUR product happens to be one in which several parts are assembled, it's a safe guess you have at times had production held up because one vital part had not reached the assembly department on time. It is no help that the other hundred-odd parts are there waiting—if a small and seemingly trivial part is late at the assembly floor, it may keep you from shipping the entire machine.

You know what that means—customers disappointed in deliveries, an assembly room clogged with waiting material, idle assemblers and a lot of money tied up in materials that should be shipped.

Sometimes, of course, this condition cannot be helped, for accidents will happen to machines and men will quit unexpectedly. But most trouble of this sort comes not from either of these causes, but from failure to schedule operations so that enough of all parts will arrive at the assembly department each day to get out that day's quota of assembled product.

Unless every step of production is planned, it is not surprising that shipments of finished product are irregular and impossible to prophesy accurately.

Where production is not planned, the method of getting work through the shop may be described as "muscling' it through. The "muscling" is done either by foremen or tracers.

Under this plan of running the shop, the foreman is given a copy of the sales order or perhaps a bill of material, and from his knowledge of the article, will pick out such parts that his department usually makes, and make them. He is in no position to judge when to start it to best advantage for he has no knowledge as to how long it will take to make the other parts that go into the assembly.

If the material he needs is on hand, he grabs it and starts as soon as he has a man and machine idle. If he can't find material, he requisitions what he thinks he needs from the purchasing agent and with a copy of the requisition in his possession to "clear his skirts," waits without further effort for the purchasing agent to get the material to him. A few energetic foremen go at production rough-and-tumble. They remind me of the "typical" American army officer of whom I recently read, whose presumably effective tactics enabled him to put through tremendous engineering projects in an unheard of short time.

This officer's success in driving his work through to a finish ahead of schedule seemed generally to be due to his knack of beating the other fellows to it in the matter of obtaining labor and materials.

Perhaps he would divert a string of empty cars to his own use which should have gone elsewhere, or again he would use material that some other branch of the work needed urgently and depended upon. The reader of this story of achievement wonders about the success of the others who were left without their transportation facilities and supplies.

Such violent methods, usually referred to admiringly as "getting things done" are not always praiseworthy. An army or a factory achieves the desired results only when it acts with all parts subservient to the whole. It does no good for one department to show phenomenal results—a "clean slate"—if it does so at the expense of other departments.

What counts in manufacturing is not a rapid production of a single part of a product, but the amount of completely finished goods shipped out at the back door. It is this that production planning aims to accomplish in a shop.

Many machine-shop executives have said to me, "Production planning is fine for those who can use it, but my business is different. It can't be planned."

Admittedly, the work of all shops cannot be rigidly planned weeks in advance. Some emergencies come up in every plant. The usual objection is that accidents to machinery, failure to get raw materials and other circumstances beyond your control may render all this work abortive. Of course, no one is a prophet, but a wise man plans ahead on the information that is available and then changes his plans according to circum-

stances. But I have noticed that at least 80 per cent of the things we plan for, work out. That leaves us only 20 per cent to handle on the emergency basis, whereas if we do not plan, the whole 100 per cent becomes an emergency proposition.

I truly believe that 80 per cent of the emergency production in any shop can, by planning, be reduced to routine. But the method of planning and the degree to which production should be planned depends upon the type of work done by the shop.

Machine shops fall into one of three classes depending upon the sales policy which governs production.

First, there are the job shops which will make almost anything that the sales force can sell. The order may be for a machine unlike any turned out before and it may be for a dozen or more of a kind.

Second, there is the shop that manufactures many types of product of a class, but always in quantity. It may make several thousand gears, transmissions, differentials, and so on to the customer's special design. Or it may make several standard styles of adding machines of its own unvarying design, to stock.

The third class of shop is the one which makes but a single style of one product. There are few such, the Ford Motor Co. being one of the few.

Perhaps he would divert a string of empty cars

The planning for this latest type is largely preliminary. It consists of getting the best possible layout of machines and of departments and supplying the proper tools and machines in sufficient quantity to give a certain production per day. The single product then flows in a perpetual stream, day in and day out.

A machine tool once started on an operation can remain on it indefinitely, barring a breakdown. Production planning as we think of it is not needed in such a plant, and the shop executives can give all of their time to keeping the wheels going round without hitches.

In the jobbing shop, it is admittedly hard at first to plan accurately, and yet it is in the job shop that planning is most needed for there the work is most irregular and losses from idle machine time are most apt to climb. In such shops, especially, it is customary to look upon every new order as an emergency. Unfortunately, the idea seems to be about that the owner of a job shop must throw up his hands in despair of bettering conditions. This is probably because the economies to be had from planning were first seen by the owners of the larger shops in the automotive industry where quantity production of a comparatively few types of product was the rule.

But work in the job shop *can* be planned. It has even been accomplished in the repair shops of industries where a repair is an emergency job indeed, as interrupted production of a large machine may cost thousands of dollars in a few hours. In one repair shop for which we planned production the repairs are now made in about one-half the time they formerly took. This not only reduces the direct cost of repairs but means an economy through increasing the running hours of equipment in the productive departments.

I do not propose in these articles to describe in detail the planning work in the strictly job shop, for the very sufficient reason that no two such shops are at all alike, either in the work handled or the equipment available; but I can give in outline the steps in planning the work.

As a basis for planning in a job shop it is necessary to know just what machines there are in the shop and what operations each can perform. Then we must gather data which will serve as a basis on which we can estimate the time needed to perform any conceivable operation. This, to many a shop man, seems impossible. It is the reason always put forward to prove that the work cannot be planned. If the shop has been in operation for a year or so, there should be a mass of information on hand to show, for jobs already done, what the job was, what machine each operation was done on and how long each operation took. A study of these operations will show that they can be grouped into a surprisingly few classifications and so tabulated that they will afford a basis for a quick and sufficiently close estimate of the time needed for any new job that comes in.

This list of jobs and operations should show the tooling, fixtures available, speeds and feeds. Then for practically every job we will not only be able to estimate the time needed for each operation, but we can give the workman full instructions for the work so that he can spend his time in doing the jobs, rather than fiddling around "getting ready to start to begin."

One thing more is needed—a means for showing the executive what work is ahead of each machine, how long the machines will be busy on work already in the shop, when each operation should be finished in order to meet the customer's requirements, what machines are now idle and when the others will run out of work.

This information allows the shop to give accurate promises of delivery based upon knowledge of the shop's capacity, rather than on optimistic guesses warped by the salesman's desire to land an order.

This information can all be given graphically on the "schedule control graph" which I shall describe in detail in a later article. Of course changes in that graph will have to be made to meet the needs of the individual shop, but the changes needed will be apparent, I think, to the reader.

The real complications in planning come in the shop of the second type, which either manufactures in quantity to the customer's order, or has a number of standard lines of its own which can be made to stock. This is the group under which the great majority of machine shops fall and this production *can* be accurately planned.

In future articles of this series I shall show in detail how the planning of production in shops of this kind is done. Each article will take up a single detail of the planning and describe it thoroughly, but first I want to give a bird's-eye view of the method as a whole.

Where the output is made in quantity it is possible by means of time study to tell accurately just how long any operation will take. This, together with the known dates when delivery must be made, gives us the basis on which to work.

When the sales department gets an order, it goes at once to the engineering department which makes up a list of the parts which make up that assembly. If new tools, jigs or fixtures are needed, they are provided in advance. The road is smoothed so that the shop's productive departments need bother about nothing but production. Naturally some of the component parts of an assembly take longer to make than others and therefore must be started sooner. Taking the delivery date as a starting point we work back and find the date on which each part must be started to meet the delivery date. This depends upon the time needed to make the part and the machine capacity available. Now we must make sure that all raw material will be in the plant when needed, so we notify the purchasing agent of our requirements as to quantity and delivery, and follow him up to see that he does as he should. From the time the raw materials come in until the finished product leaves the plant, it is under the control of the planning department—this does away with "buck passing."

The plan so far outlined may seem so rigid that if anything went wrong the whole production would be snarled up. In later articles I shall show just how the necessary flexibility is attained. Suffice it to say now, that between each two lots of parts scheduled to a machine, several hours are allowed as a cushion to take up shocks due to machine breakdowns or other delays in production. Then, too, we generally provide reservoirs of finished and semi-finished parts which will enable assembling to continue for a day or so even should a severe check come in production.

The work is actually given out in the shop by "booth men," there being a production booth for every department or two. They are close to the men and machines and have authority to assign the work to any one of several machines of a kind, depending on conditions. The central planning department thus plans only to operations; the booth to the individual machines. The booth man also attends to moving the material between machines and departments, checks the time of the men and so on.

It is apparent from this brief description that planning consists of two parts.

First, the way is made clear beforehand that the parts can be processed without a hitch. Sufficient machine capacity is provided to handle each operation. The machines are physically arranged so that the parts can be moved from operation to operation with the least possible trucking. That means that the machines, so far as possible, are arranged according to the sequence of operations. The whole shop is put in balance. This planning is preliminary; it is done before an order is taken. Second, each job is planned through the shop, and the road cleared for it so that the machine operators have nothing to do but perform productive operations on the parts. Tools that are to be used are supplied, raw materials needed are purchased and both are delivered to each operator just before he is ready to use them. Usually he does not even have to set up his own tools. The time of starting each job is worked out so that every part which goes into an assembly will be finished in time to get to the assembly floor at the right minute. Planning has a much deeper significance to a business than merely to assure smooth production. The real purpose of planning is to conserve capital so that the rate of turnover will be decreased; that is, so that the time which elapses between the purchase of the raw material and the shipment of the finished product will be a minimum. Obviously, when this time is reduced, a given volume of sales can be handled with a less investment in goods in process.

Most manufacturers are chronic believers that what they need most of all is more capital in their business, and to prove it, point to the business failures, which are usually blamed on lack of capital. It is seldom that you are able to find a manufacturer who can talk about his business for an hour or so without laying emphasis on what he could do if he only had more money.

Yet I firmly believe that most of these men not only do not need more money but would be worse off if they had it. The strange thing is that when considering the getting of more money, they almost invariably think of Wall Street and the banks, rather than realizing that very likely they would be able to pick it out of their own business.

Capital turnover is a subject which is given too little study by the average manufacturer. There is not the space here to elaborate on all of the ramifications of the subject, but the fact remains that if the time taken in manufacturing a given article could be cut in half, the value of the goods in process inventory will likewise be cut in half and the money released from the unnecessary goods in process capital will be additional working capital which may be used

in expanding the business. I could cite innumerable instances of plants where this has been done.

In one machine shop in particular, where we installed a planning system, the results were most striking. At first glance, this concern seemed to be well managed. The machines were well laid out; there was a time-study department of eight men, and nearly every operation in the plant was on piece work. And yet the planning system which we installed reduced the goods in process from $3,000,000 to $1,000,000 in spite of an actual increase in sales. That means that $2,000,000 in cash was picked out of the goods in process inventory and was available for other purposes.

In another concern, making automobile parts, the goods in process inventory amounted to $800,000

with annual sales of the finished product valued at $3,600,000. This meant that the money invested in goods in process was turned over once in 80 days or four and one-half times a year. A production planning system in this plant resulted in cutting the goods in process inventory to $450,000, giving one turnover in 45 days. This, obviously, is a cut of nearly one-half. This concern thought that it was going to have to borrow money to build a new plant in order to meet its possible increased sales. Instead, the planning system enabled it nearly to double its output without additional buildings.

To the casual observer, who might have seen the plant before and after the installation of the production system, it was evident that great changes had occurred, although at first glance it might have seemed that business had seriously fallen off. Where previously the floors of the shop had been cluttered up with partly processed parts, today the shop is clean. There are no accumulations of partly finished pieces at machines waiting for the next operation and no piles of finished parts on the assembly floor awaiting other parts which have not been started.

To sum up, a planning system accomplishes the following results:

1. It enables the sales department to make promises which are reasonably certain of being fulfilled.
2. It reduces the capital needed to handle a given amount of sales.
3. It tends to prevent delays in production. By foreseeing future requirements, it does away to a large degree with emergencies.
4. It relieves the productive departments of the plant from doing non-productive work.
5. It enables the plant to get out the maximum possible production.
6. It tends to keep all machines busy, thus doing away with the heavy loss which an idle machine entails.
7. It reduces the unit cost of the output.

These results are ardently desired by every manufacturer, but are seldom attained. I know of no other way to achieve them except through the medium of a carefully worked out planning system, but I do know that there is not a shop now operating under the hit-or-miss condition which cannot avail itself to a large degree of planning, with the desirable results which I have just mentioned.

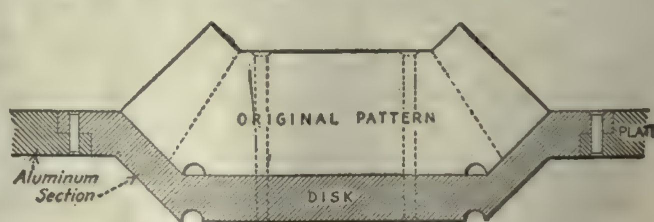
Making a Match Plate Without New Patterns

By H. W. Johnson

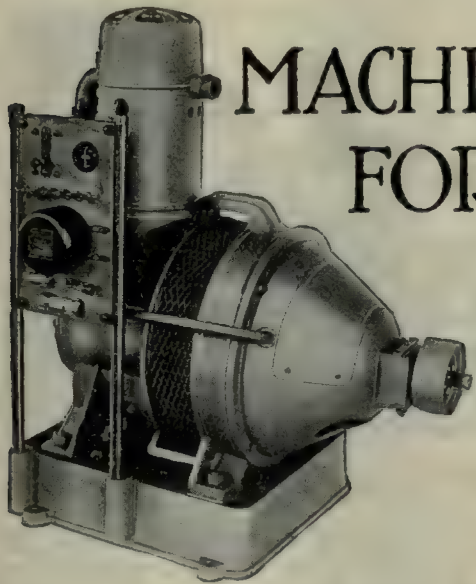
It was decided that a certain small bevel gear could be molded to better advantage from a match-plate pattern than from the hand pattern formerly used. The old patterns had accurately planed teeth and were in fine shape, so the following method was evolved, which made it possible to avoid planing teeth in new patterns.

The first move was to provide a plain aluminum match plate for a 14 x 16-in. flask. This plate was planed $\frac{3}{8}$ in. thick and centers were laid out for four patterns. Meanwhile, four aluminum disks were cast and turned up in the lathe—one side being a duplicate of the back of the gear pattern, the other side bored out so the old patterns would fit down as far as the points of the teeth. The thickness of this disk was such that the total over-all thickness of the assembled pattern and disk was $\frac{3}{8}$ in. greater than the original thickness of the pattern, to allow for the plate. To attach the disk to the plate, each disk was provided with a stepped flange, very much like a stove lid, and the plate was bored to fit. Finally, the disks were riveted through the flange to the plate with small rivets.

Of course, the impression could have been turned directly in the large plate, and the use of the little disks avoided, but I believe that the greater speed and ease of turning the small disks rather than the large plate paid for the small amount of extra work occasioned by inlaying the disks. The plate was bored by means of a sweep tool in the drilling machine.



METHOD OF MAKING THE MATCH-PLATE PATTERN



MACHINING THE GAS ENGINE FOR A LIGHTING UNIT

By J. V. HUNTER
Western Editor, *American Machinist*

The manufacture of small power internal-combustion engines has been highly specialized for several years with strong competition in all lines, and to make a success of it close attention must be given to using the most practical methods of machining. This article, the first of a series, details many of the methods which are being developed by one very successful manufacturer of this line of power units.

THE introduction of small power engines to meet the needs of modern farm life has led to various methods for driving electric generators for lighting isolated dwellings. Some lighting units have been belt driven from standard engines, but the demand for a compact, self-contained unit has been insistent and several different units of this type have been developed.

Recently several large manufacturers from different fields have combined to produce the parts required to make up a lighting unit which includes the prime mover, the generator, the storage battery and the automatic switchboard controller. This unit combines a single-cylinder kerosene engine which is direct-connected to a 1½-kw. generator, and operates in connection with a storage battery. The battery furnishes current when the unit is not operating and also operates the generator as a motor to turn over the engine for the purpose of starting.

The engine starts and runs on gasoline until warm and requires personal attention for priming and starting, but is provided with an automatic control to stop it when the batteries are fully charged and the current consumption has been shut off. The automatic switch will also open the circuit if anything happens to seriously retard or shut down the motor.

The Engine Is a Single-Cylinder Unit

The gas engine for this unit, shown in the headpiece, is made by the Fuller & Johnson Manufacturing Co., Madison, Wis., and has one vertical cylinder. The lubrication is by splash from an oil chamber in the crank case and the fuel storage is in the hollow chamber of the main base. The engine is air cooled by a blast drawn through the perforated cover over the cylinder, passing down over the cooling flanges into the flywheel chamber and expelled by a centrifugal fan which is cast as an integral portion of the flywheel.

An interesting feature of the machining operations on this engine is the fact that a large majority of the parts are handled on turret lathes and some exceptional holding fixtures have been devised for supporting the irregularly shaped castings. An example of this is the first operation on the crank case which is performed

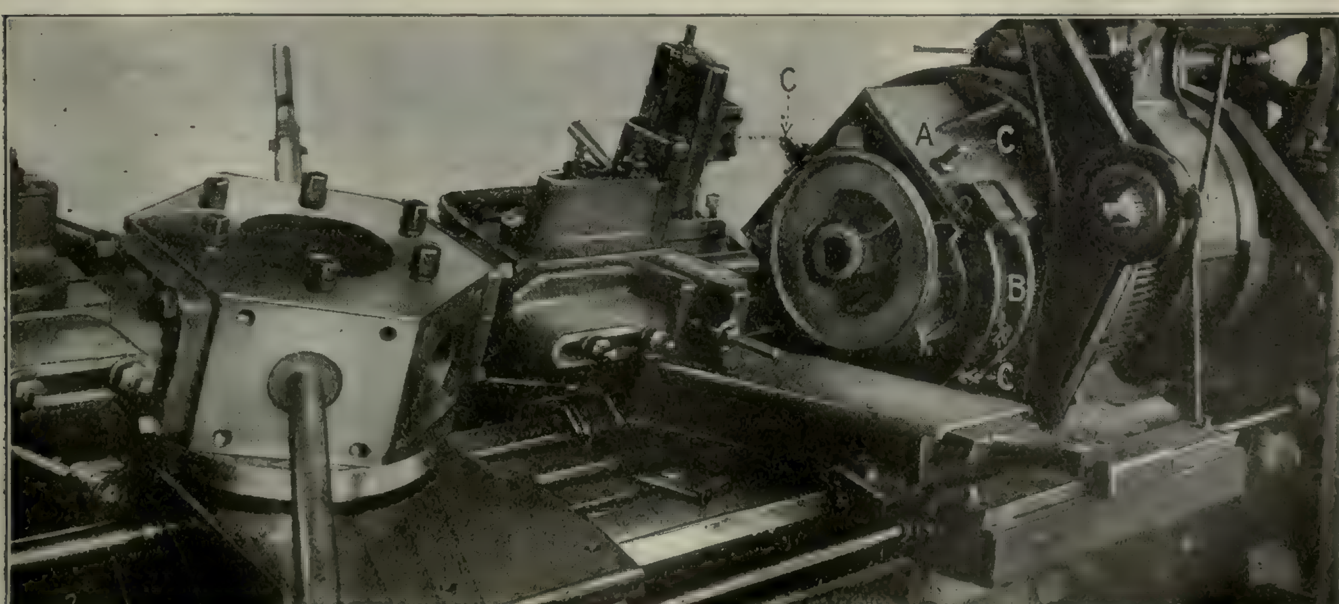


FIG. 1. FACING AND BORING FLYWHEEL SIDE OF CRANKCASE

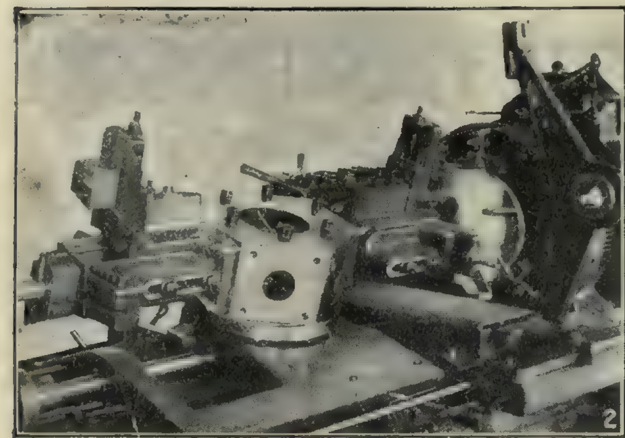


FIG. 2. FACING GEAR SIDE OF CRANKCASE

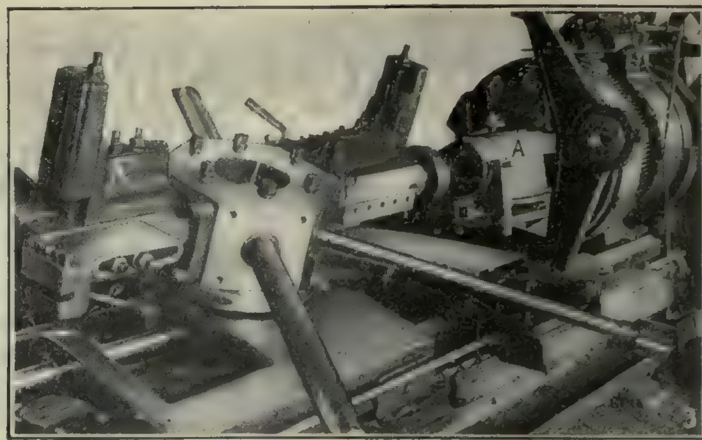


FIG. 3. BRACKET FIXTURE FOR FINISHING CYLINDER SEAT

on a Gisholt turret lathe, Fig. 1, while the casting is held in the heavy cage-like fixture *A*. The arm *B* is hinged at the back and can be swung away from the box section while the casting is being slipped into place. After this arm is replaced the various setscrews *C* are tightened to insure a firm hold. There are five turret and two tool-post tools used for finishing the flywheel side of the crank case and a number of the tools are shown in the illustration. The crank case then passes to a second lathe upon which it is mounted in reverse position, Fig. 2, and is clamped to the chuck with a bearing on the previously machined face.

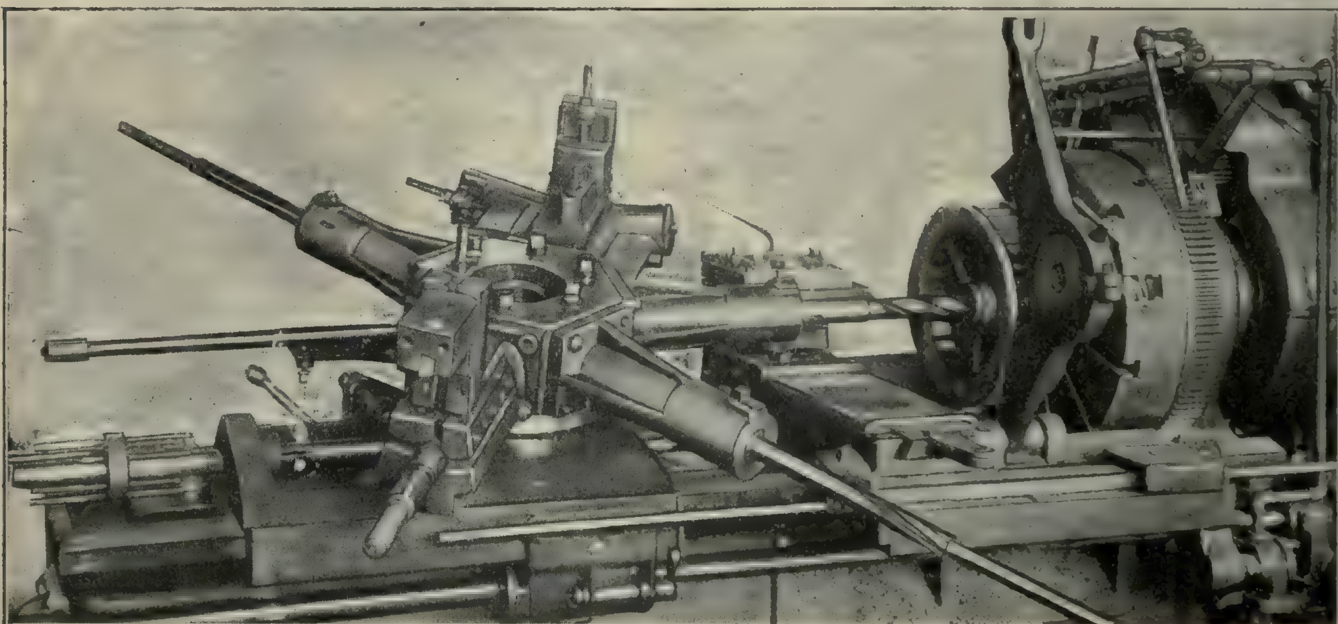


FIG. 4. COMPLETE SET-UP FOR FINISHING SIDE AND BORE OF FLYWHEEL

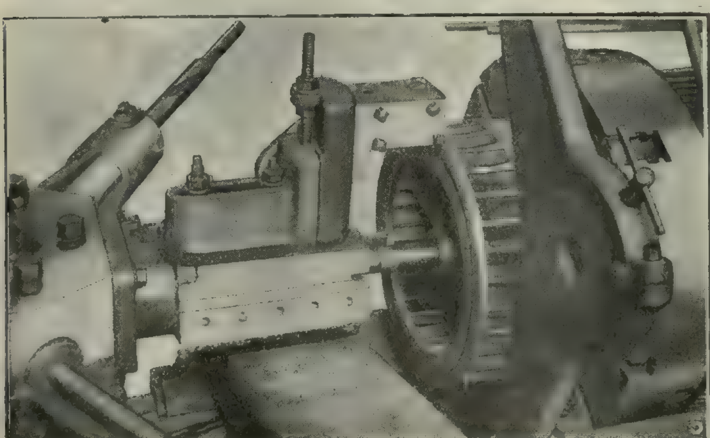


FIG. 5. DETAIL VIEW OF FLYWHEEL RIM-TURNING OPERATION

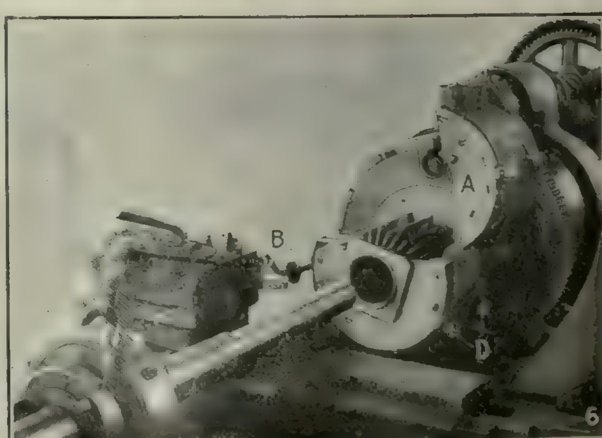


FIG. 6. ROUGH-BORING AND FINISHING BASE OF CYLINDER

The facing and boring of the seat for the cylinder is handled on a Gisholt turret lathe, Fig 3, while the casting is supported from the headstock by a heavy bolted-on bracket fixture *A*. This bracket fixture is designed to be so rigid that there will be no vibration or strain of the casting to cause irregular machining.

Turret-Lathe Work

Most of the boring, facing and turning of the flywheel hub is accomplished on the turret lathe, Fig. 4. After the engine side has been finished, the position of the flywheel is reversed in a second turret lathe and the generator side is faced off with carriage tools. The operations in the first series include boring, turning and facing the hub, and facing and turning the outside rim of the wheel to insure clearance and smooth running in the generator housing. One of the rim-turning tools in operation is shown in greater detail in Fig. 5.

Cylinders Completed in Two Series

The cylinders are completed in two series of turret-lathe operations; the first of these, Fig. 6, rough-bores and finishes the base. To hold the cylinder a heavy cage-like fixture is mounted on the faceplate, and is provided with a hinged top *A* which may be raised for placing and removing the work. In service this hinged top is locked down by swinging the side-bolts *B* and the casting is further clamped by tightening the set-screws *C* and *D*.

A similar operation, Fig. 7, finish-bores and faces the top to receive the head. It is the practice in this shop to make a very accurate job of the finish-reaming on the cylinder bores and thus avoid the necessity of internal grinding of this part. The finish-reamers are, therefore, maintained to very close limits of accuracy.

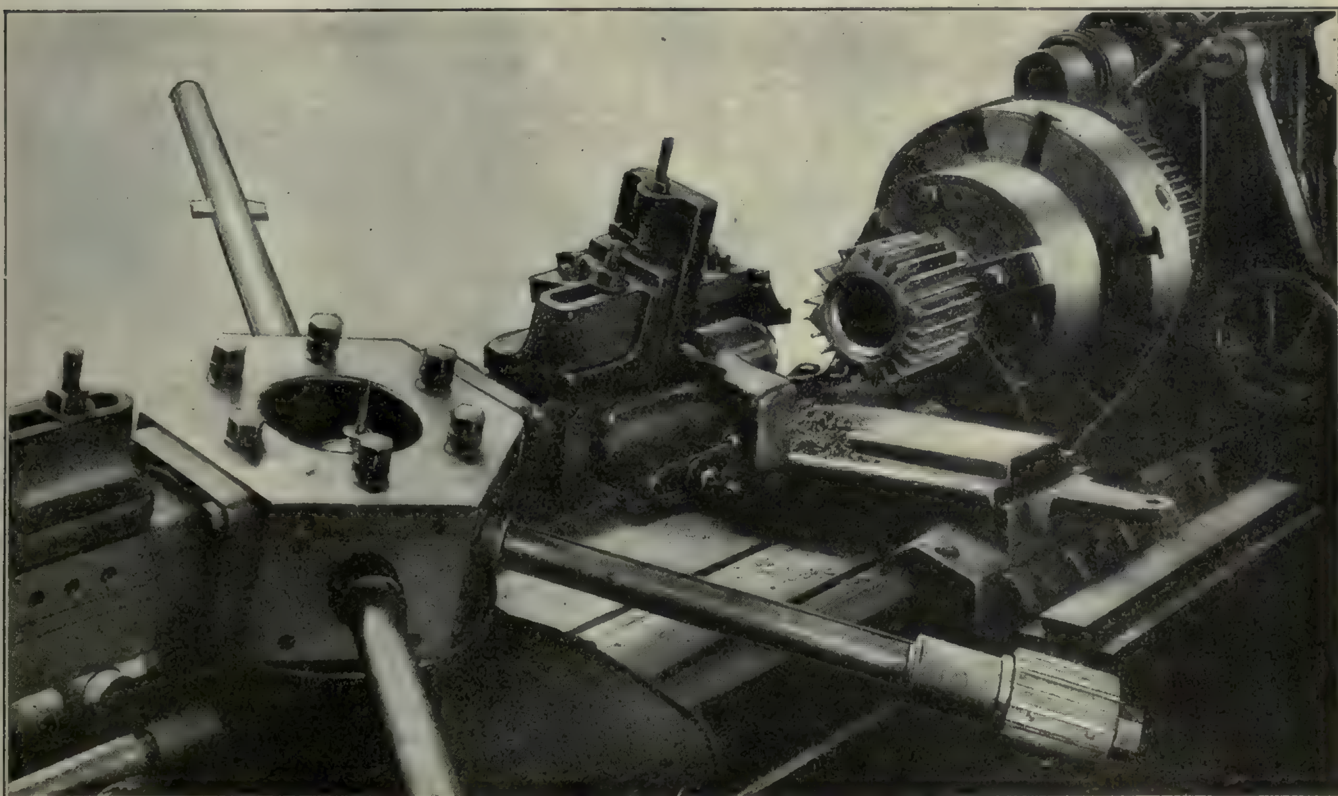


FIG 7. FINISH-BORING AND FACING HEAD OF CYLINDER

Rolling Threads on Container Caps

By Edward Dede

I read with interest the article under the above title on page 111 of the *American Machinist*. I wish to make a few remarks on this article referring to moldmakers.

Mr. Hand states that the moldmaker cuts the thread with a tool he judges near right. He is wrong. From my thirteen years' experience I have learned it is to a moldmaker's advantage to grind his tool as near accurate as possible, for when the threaded ring is completed the sample container or model must lie in it as nearly perfect as can be. In making gages for their tools most men do so as follows:

If the thread on the sample container is blown out to the right diameter or a full thread, he takes an impression of it and grinds the tool to fit; but, on the other hand, if it is not a full thread, he takes an impression inside of the container cap, which most generally comes with a sample container, and then takes an impression of the one taken from the cap.

He does not cut the thread until he thinks it is deep enough. Twenty-five years ago moldmakers used calipers, but today they use micrometers. He cuts near the depth, then makes a lead cast and tries on the cap; if it is not deep enough then he cuts more out. But he uses the cut-and-try methods only on the first one, for then his lathe is set and can make a thousand or more with no more lead casts.

For containers that have threads that the glass manufacturers have made before, they need no cut-and-try methods as the size is already known.

Mr. Hand is correct in his statement about the cold mold, but the container is not taken out of the mold

when too hot. Bottle machines are timed and the container is retained in the mold a certain time to cool.

When the nature of the glass changes, is when everything goes wrong; it may get heavy or light in weight.

In making a bottle the glass taken from the tank is in a ball and it is put in a blank to make the glass in oblong shape before being put in the mold. Blanks are bored to a diameter to contain sufficient weight of glass for the bottle.

I have seen these work perfectly for weeks, when, all at once, the nature of the glass would change and make necessary the boring of these blanks larger three and four times in one day, as otherwise they would not hold enough glass to get the correct weight. Then the thread on the container is small. It is better to see if you are right, then go ahead for there is no remedy for an unaccepted bottle but melt it over.

If Mr. Hand refers to standardizing the threads on containers, then that would be a great improvement. But to standardize the moldmakers' methods is impossible at the present day as production is the main feature in a mold shop.

[The author of the article referred to is glad to learn of a moldmaker who is using some system in his work. The statements in question were made on the authority of several moldmakers visited when obtaining data for the article.—S A. HAND.]

Selective Hardening Kinks

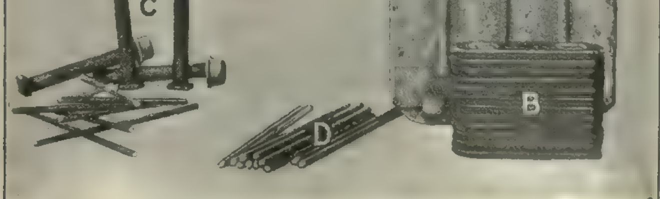
By W. H. ADDIS

Selective hardening is sometimes called local hardening and consists of hardening certain portions of dies, tools or other parts, and leaving the rest soft. It may be done in many ways, some of the more successful of which are mentioned in what follows.

At *A* in the figure are two strings of gears which have been bolted together by passing bolts through the bore. The bolt heads and nuts are then coated with fireclay, the caps of clay being of sufficient size to protect the bore of the gears. In this way the bore of each gear remains soft while the teeth and body are hardened.

The chain side bars at *B* are to have the outside edges and the inside of the pitch holes case-hardened while the sides are to be left soft. To accomplish this the bars are placed in the pot stacked just as they appear at *B* and the carburizing compound is packed around them and in the pitch holes.

One firm uses the cull stampings from tomato-catsup-



PARTS PROTECTED FOR SELECTIVE HARDENING

bottles caps for covering the threaded ends of bolts while they are being hardened. In another plant, sheets of tin are placed over the area to be left soft and coated with fire-clay. Still another way of protecting the soft parts is to coat them with a special paint. At *C* and *D* are shown bolts and silent chain pins which have had the ends dipped in such a paint.

Two very good formulas for protecting paints are as follows: Mix equal parts of asbestos flour and 42-deg. sodium silicate to the consistency of a heavy paint and apply by dipping or painting. The work should be warm, dry and free from grease. The other paint differs only in the substitution of kaolin for the asbestos flour. Both of these paints were largely used on war work with consistent success.

A Clinical Angle on Metric Compulsion

By GEORGE G. LITTLE, M.E.

In the last five years as head of the instrument shop of the Mayo Clinic (the largest of its kind in the world), the opportunity for me to study the application and possible advantage of the use of metric measurements in designing and building instruments, machines, and laboratory apparatus has been exceptional.

I have met professional and laymen from all over the world with whom I have discussed the possible advantages to be had by using the metric system.

There is a surprising lack of knowledge among the professional and laboratory men regarding the amount of time, labor and expense consumed in production. None of those who had signed the cards distributed by the "World Trade Club" took the trouble to learn who is causing the agitation, or to reason out what the results would be to our industries should the bill now pending become a law.

None have been able so far to convince me positively that the metric system has any advantage whatever over our present method of applying the English inch.

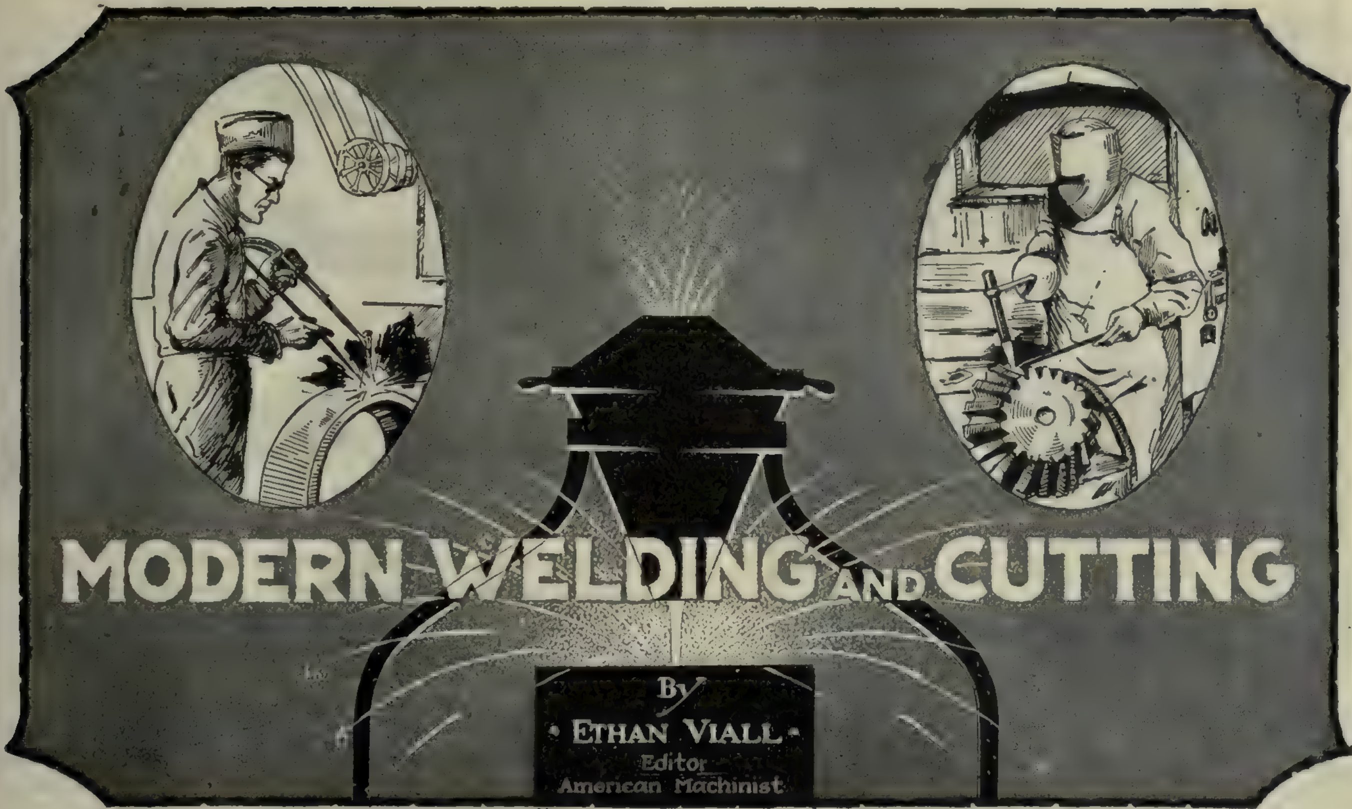
While it is sometimes required that we construct apparatus and instruments to metric measurements we have found no advantage in doing the work, making due allowances for non-metric sizes of material and tools used in such work.

The one big point those in favor of the metric system dwell upon is that it is so much easier to convert small units of measure into a large unit, or units, or large ones into smaller ones, by the transposition of the point. Also, when expressing a liquid or solid quantity that it is easier to say so many c.c.'s or m.m.'s, instead of expressing some fraction of an inch. None of them seemed to be unbiased in their convictions that the metric is better than the English system.

One man alone upon learning from me what the results would be in our industrial world and just how it would affect him in his profession (surgical) stated that he hoped the bill pending would not be passed and that he would surely do what he could to prevent it.

None are aware of the conditions obtaining today in France in the use and non-use of the metric system, or that it makes no difference in the sale of machines, that they are constructed according to the inch system.

The boosters of the metric bill are professional and theoretical and laboratory men who have no dealings with, nor thought of, the welfare and requirements of the industries of this country. Those who know what damage it would cause have no desire to see the bill become a law.



XXI. Welding Machines*

A majority of welding machines are built for straight-seam work, but a few have been developed for circular or irregular seams. Examples of both classes are shown.

(Part XX appeared in our March 25 issue.)

GAS-TORCH welding machines with automatic feed are used for a large variety of work, although straight-seam welding is the more common. In this latter class of work are included sheet-metal-cylinder side-seam welding and pipe or tube welding.

A welding machine known as the Duograph, is shown in Fig. 251. This machine was made by the Davis-Bournonville Co. and was especially designed for welding the seams of steel drums or containers, insuring a mechanical weld uniform in appearance and efficiency. It comprises a turret-top holding device with water-cooled arms and clamps for holding the steel drums in position, permitting the work being placed in position for welding on one set of arms while the work on the opposite set of arms is being welded. The turret top is then swung half around, the welded work removed and another job set up.

The gas-torch carriage is moved forward at a fixed

*For the author's forthcoming book, "Welding and Cutting."

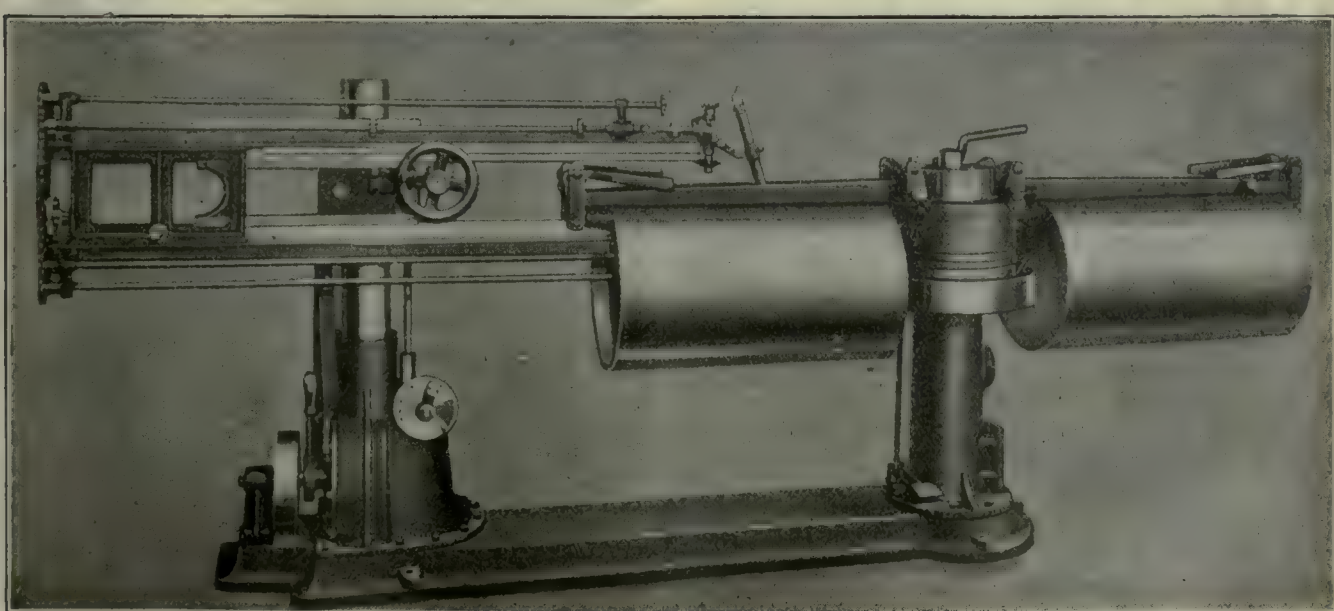


FIG. 251. DAVIS-BOURNONVILLE DUOGRAPH WELDING MACHINE

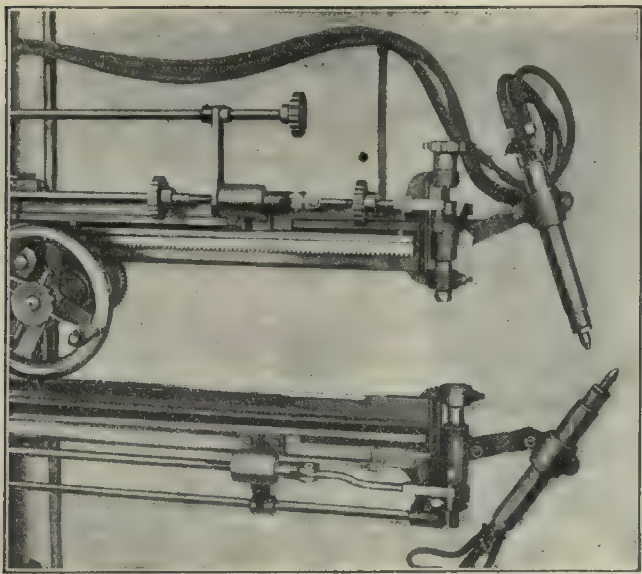


FIG. 252. TORCH ARRANGEMENT ON THE DUOGRAPH

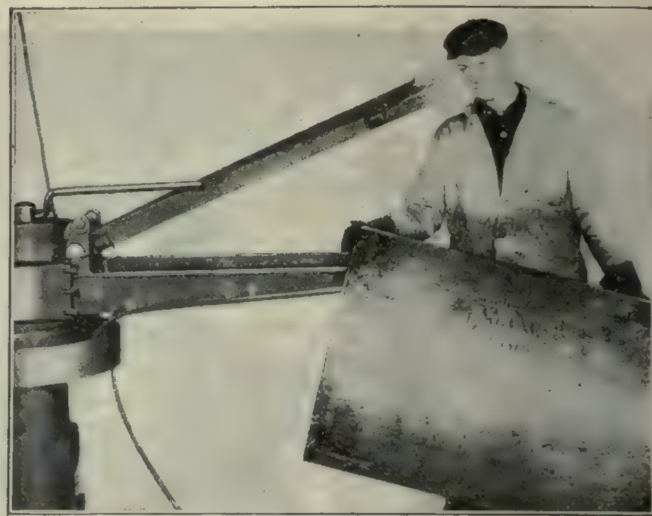


FIG. 253. PUTTING A DRUM ONTO A TURRET ARM

speed by power, belt driven, and is reversed by means of a handwheel when the weld is finished. Various speeds for different thicknesses of metal are obtained by the use of cone pulleys. The carriage is fitted with two torches—one above, the other below—as shown in Fig. 252, for welding both sides of the seam simultaneously. For very light welding, one torch only is required. Water-cooled welding torches are used. The No. 1 machine will weld a 36-in. seam, and will take containers from 12-in. to 36-in. in diameter. The No. 2 machine welds a 54-in. seam. An average speed of welding of 18-in. per minute is obtained on 16-gage sheets.

Fig. 253 is a close-up of a man putting a sheet-metal drum into position on one of the turret arms. Fig. 254 shows the drum clamped down and swung into place ready to be welded. This illustration gives a good idea of the operating mechanism. Fig. 255 shows the seam weld completed and ready to be removed.

A much simpler machine is shown in Fig. 256. The operation of the feeding mechanism is obvious.

A smaller, though very similar machine, is shown in Fig. 257. While the work shown in position is cone shaped, cylinders may be held as well.

The machine shown in Fig. 258, is for welding bottoms onto tea kettles, cans, drums or other circular work. The machine is so made as to allow for a considerable range of adjustment for different sizes of work.

A machine developed at the plant of the Edison Storage Battery Co., Orange, N. J., for welding bottoms in storage-battery cases, is shown in Fig. 259. This machine was first described in the *American Machinist*, Aug. 10, 1911. The bottom to be welded in is made of sheet steel with upturned edges. A four-part expanding form is placed within the edges of the bottom and locked by turning down the screw shown in the center of the case. With the bottom and expanding form in place as shown, the case is "shrunk" to it and sized by turning the eccentric lever *A*. The gas torch *B*, which is hinged at *C*, is then swung down into welding position and so set as to throw the flame correctly onto the upturned edges of the bottom and the case. The motor is then started and the feed thrown in by means of lever *D*.

This lever operates a clutch on a shaft carrying a pinion meshing with the oblong gear on the bottom of the frame which supports the case. This moves the frame and the seam to be welded along under the welding flame. When a corner is reached the trip *E* throws the lever *F* and slips the clutch *G* into contact with the upper teeth, increasing the speed of the driving pinion

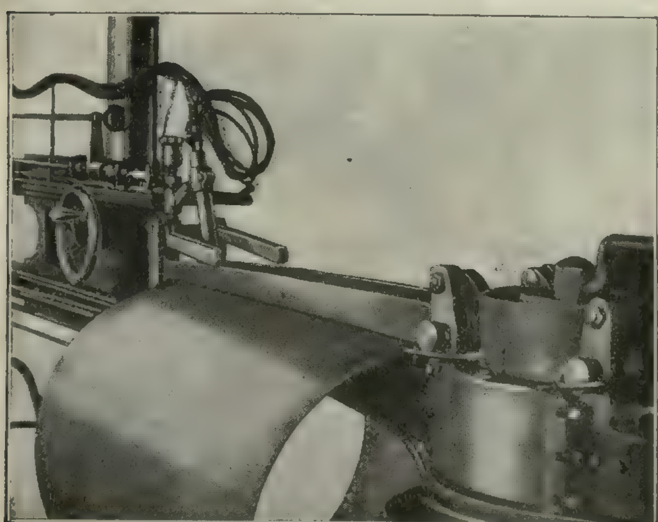


FIG. 254. DRUM IN POSITION READY FOR WELDING

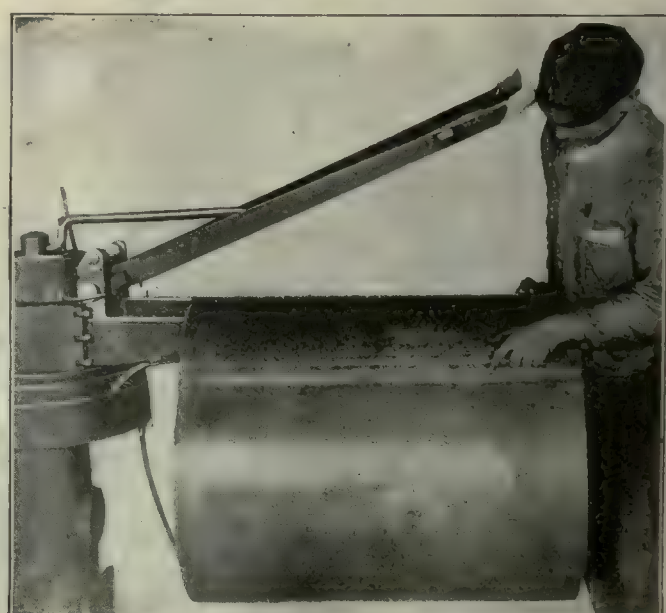


FIG. 255. THE FINISHED SEAM WELD

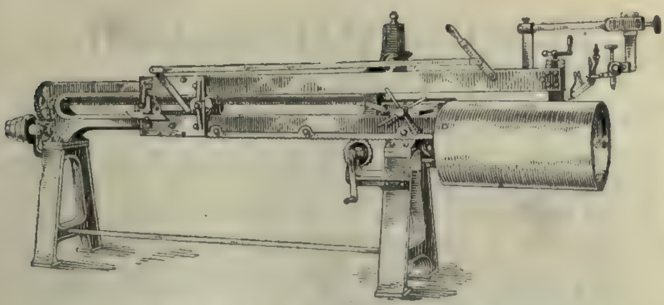


FIG. 256. HEAVY DRUM WELDING MACHINE

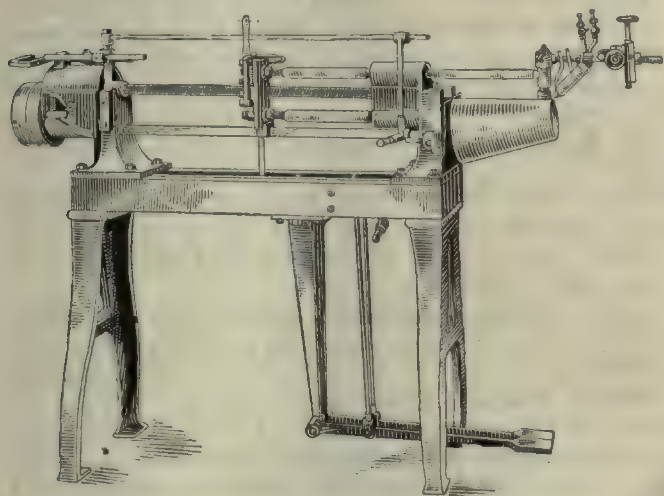


FIG. 257. LIGHT SEAM WELDING MACHINE

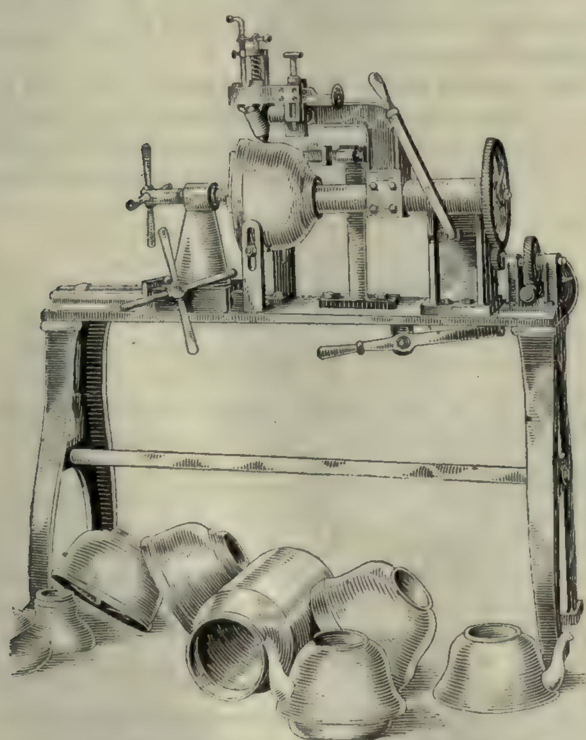


FIG. 258. MACHINE FOR WELDING CIRCULAR SEAMS

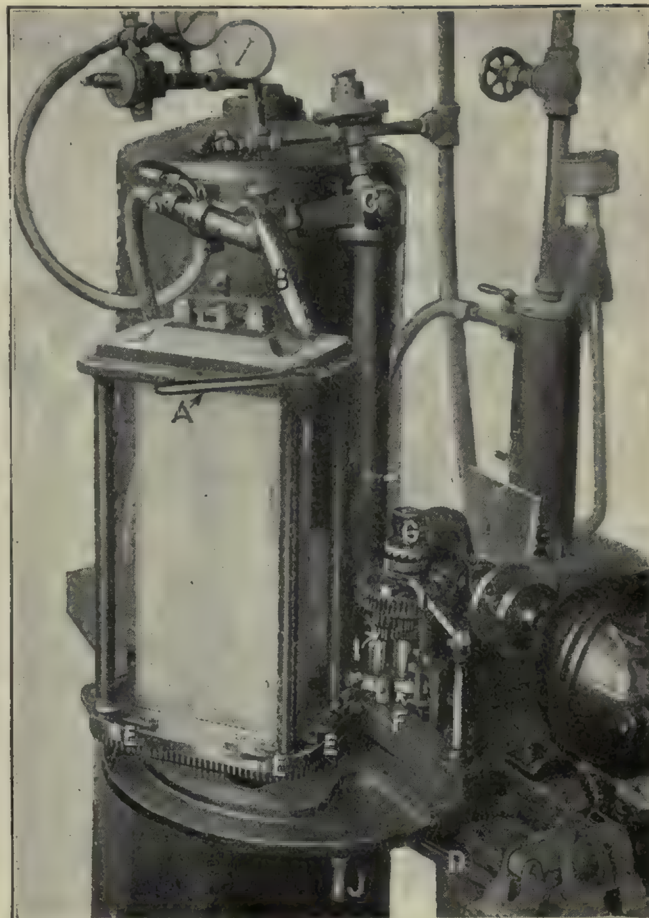


FIG. 259. MACHINE FOR WELDING OBLONG SEAMS

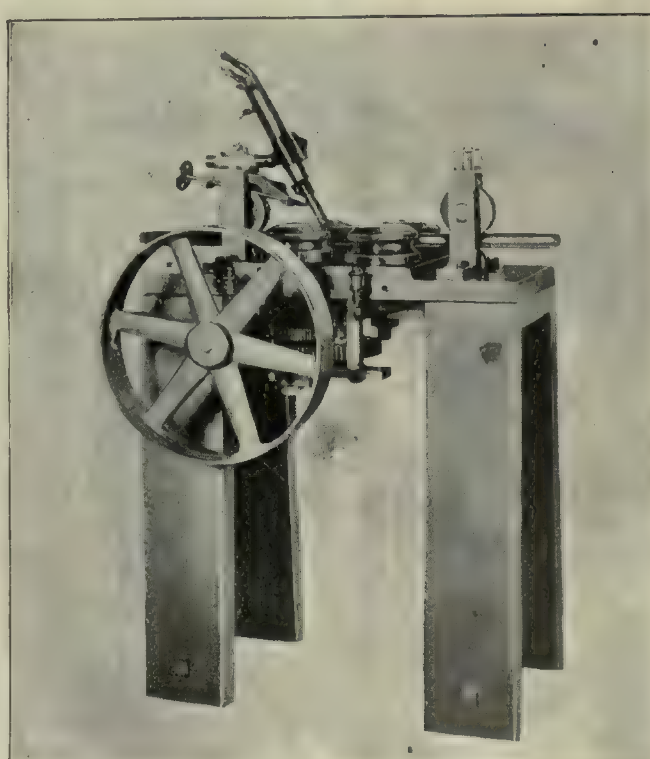


FIG. 260. SINGLE-TORCH TUBE WELDING MACHINE

so that the seam being welded moves at the same speed under the flame while turning the corner as while being driven along the straight seam. As soon as the corner has been turned the lever *F* is forced down by another trip and the sun-and-planet gearing *I* again comes into play, giving a slower movement as the straight part of the seam is fed under the flame. For bringing the mechanism back to the starting point, the handle *J* is used. A single-jet tube welding machine made by the Thermalene Co., is shown in Fig. 260. Views of a double-torch machine made by the same concern, are shown in

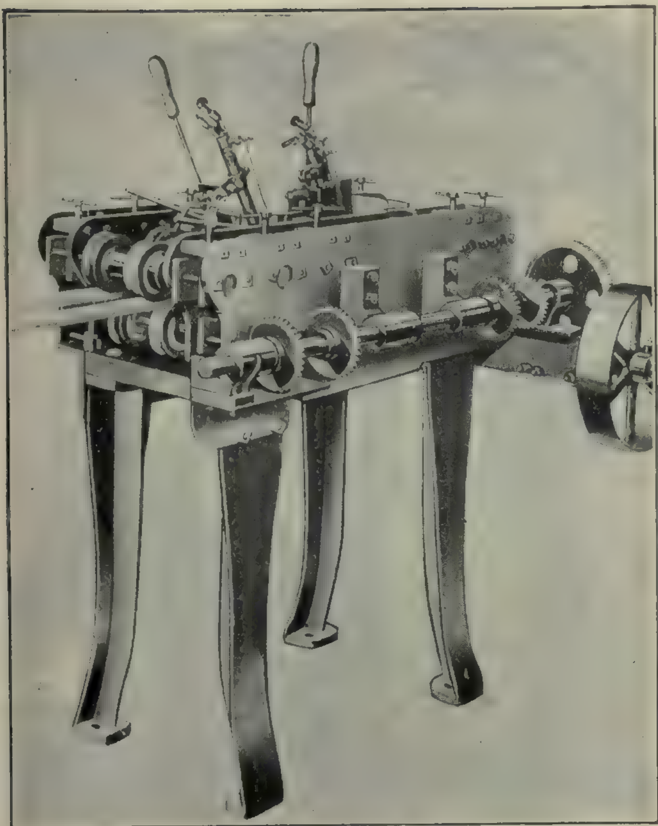


FIG. 261. DUPLEX TUBE WELDING MACHINE

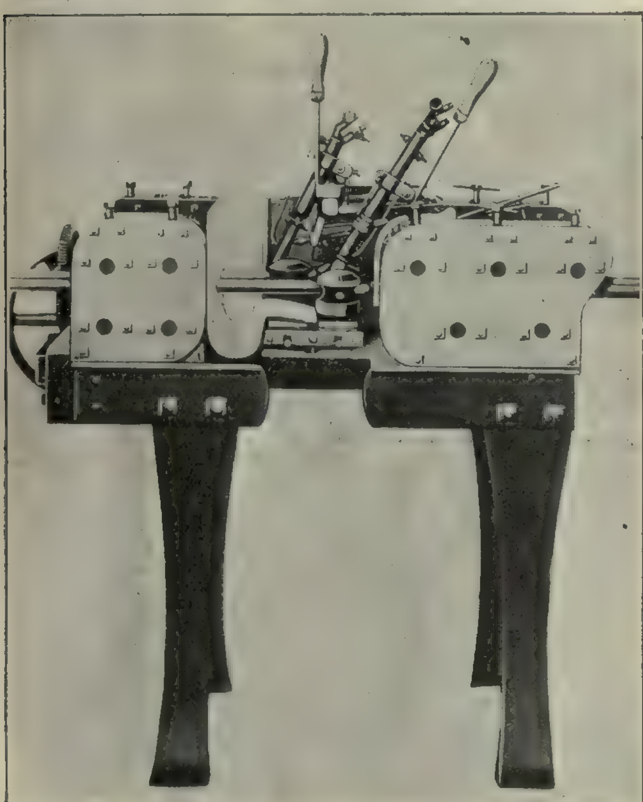


FIG. 262. ANOTHER VIEW OF DUPLEX MACHINE

Figs. 261 and 262. In a general way, these are typical of all machines designed to butt-weld formed tubes. For further information on tube welding machines and methods, the reader is referred to the article by F. W Smith on page 845, Vol. 51, of the *American Machinist*. This explains the process in a practical way.

The Trials of Old Baldy—II

By A. R. Durant

One day "Andy," a recent acquisition of the Ajax Works, was facing off a lot of cast-iron disks. It was getting toward noon and it began to look as if the one in the chuck was going to be finished a little too soon to allow him to wash up comfortably while the feed was running, so he unlocked the crossfeed and began to nurse the tool slowly along by hand.

A few minutes before 12 o'clock Old Baldy, the boss, "happened" along, and told Andy to take the apron off the lathe carriage and put it on the bench before noon. He would be told what was to be done with it later.

Andy was pretty mad, but by dint of much sweating and profanity he got the apron off and onto the bench just as the whistle blew, but he wasn't washed up. Oh no!

When he came back from dinner he asked Old Baldy what was to be done with the apron, and the boss replied, "put it back on the lathe and go ahead with your job."

Andy put the apron back (anybody who has accomplished this job knows just what a soothing and soul-satisfying operation it is) and after grinding and setting the tool, gave the crossfeed knob a whirl and sat down on a box prepared to take a good rest while the tool was feeding across, but there seemed to be a hitch somewhere; the tool was not moving. Andy, with a muttered cuss-word, got up and gave another yank to the knurled knob that locked in the crossfeed; still nothing happened. Andy turned around to find Old Baldy at his elbow. "Something's the matter with this damn crossfeed," he says.

"Yes," replied Baldy, "I took out one of the gears this noon. I saw you enjoyed feeding the cut by hand so much that it would be a shame to deprive you of the pleasure and I decided to fix the lathe so you could do it that way all the time."

Bell Cranks for Transmission of Uniform Motion

By W. B. Greenleaf

Referring to the article under the above title published on page 460 of the *American Machinist*, it strikes me that Mr. Sullivan is incorrect in his figuring.

In the first place with the ordinary arrangement of connecting the links to the bell crank by pins the motion is not uniform. This can readily be seen if the rectangular motion be carried out to the point where the bell crank travels through 90 degrees. In that case the circular motion would cease altogether, as the force of the link would be pushing directly against the axle of the bell crank.

Further I cannot see any advantage in equality of motion for the rounded surfaces on the bell crank, although they would, of course, maintain the application of the power at the same point during the whole of motion. There would be no advantage over the flat surfaces, for while it is true that the length of the radius would vary, it would vary by exactly the same amount at both ends of the crank, so that while the value of the leverage would change, it would change in an equal amount at both the receiving and transmitting ends.

Tap-End Sizes of Studs

SPECIAL CORRESPONDENCE

Studs must fit tight on one end and allow nuts to be easily screwed on the other. Should the tap end be tight on the thread or depend on being jammed on the last thread? This article gives the practice of two of the large companies making studs for the market.

THE Chicago Screw Co., through the courtesy of its secretary, Edw. H. Ehrman, gives the following information:

It is the practice of many screw companies, this company included, and also a great many customers, to round the nut ends and to chamfer the tap ends of studs, for several good reasons, and there is much to be said in favor of this practice.

(a) The rounded end serves to indicate a finger fit, as it is common practice to round the ends of bolts and capscrews which are either in the loose- or medium-fit class.

(b) The rounding, if made to a circle 1½ diameters, presents a neat appearance after assembly, even if there is considerable variation in the position of the nut relative to the end of the stud. Inasmuch as studs cannot, without difficulty, be uniformly "set," this feature has more than a casual value.

(c) It has been our experience that it is easier to produce the rounded shape either with the shaving tool or the cutting-off tool, than it is to produce a flat and chamfered end. Conversely, it is just as easy, and perhaps easier, to chamfer the unfinished end of the stud before it is severed by the cutting-off tool, and the stud may be severed with less burr than is possible if this end is rounded.

(d) Rods that are threaded on both ends to a finger fit should have the ends rounded to indicate that neither is a tight or wrench fit. This practice is as important to the manufacturer as to the user.

The illustrations give pitch-diameter limits that have proved very satisfactory in practice. Fig. 1 gives limits suitable for studs to be set in heavy sections such as those in steam pumps and engines; also for a few special studs. Fig. 2 gives limits suitable for studs to be set in light sections, such as those in gas, gasoline engines, etc.

The rationale of these two series of limits is based on practical conditions obtaining at the time of their formulation.

Steam Pump Studs

The thread limits given in Fig. 1 are such that the studs should be wrench tight in tapped holes produced in a manner that is customary in the manufacture of steam engines, steam pumps and other heavy machinery, and with commercial taps of average size. While this series was formulated over seven years ago, there has been no complaint or comment from customers to indicate that either the tolerances or the negative allowances are great. We are inclined to believe, however, that this table will shortly need revision, on account of the increasing tendency of the mean size of commercial taps to run closer to basic size.

On account of the lighter sections in which studs are set, the character of the material, the (presumably) greater care exercised in the selection of taps, and in their use, the negative allowances are made materially less than in the case of steam-pump studs. There are several factors that might be mentioned that affect both the tolerances and negative allowances. Among these may be cited:

(a) The use of soap water tends to make the tap cut closer to its size than does lard oil.

(b) The yielding of light sections, especially if of non-ferrous metal (particularly if the tap is dull and

TAP END

PITCH DIAMETER

REGULAR

SIZE	AMT. OVER SIZE	V THD.		SIZE	U.S.S. THD.	
		MAX.	MIN.		MAX.	MIN.
1/4 20	+0035 +002	.2145	.2130	1/4 20	.2211	.2196
5/16 18	+004 +0025	.2732	.2717	5/16 18	.2805	.2790
3/8 16	+0045 +003	.3308	.3293	3/8 16	.3389	.3374
7/16 14	+005 +0035	.3868	.3853	7/16 14	.3961	.3946
1/2 13	+0055 +004	.4456	.4441	1/2 13	.4556	.4541
1/2 12	+0055 +004	.4405	.4390	1/2 12	.4514	.4499
9/16 12	+006 +004	.5036	.5016	9/16 12	.5144	.5124
5/8 11	+006 +004	.5602	.5582	5/8 11	.5720	.5700
3/4 10	+0065 +0045	.6786	.6766	3/4 10	.6916	.6896
7/8 9	+0075 +0055	.7959	.7939	7/8 9	.8104	.8084
1 8	+0075 +0055	.9101	.9081	1 8	.9263	.9243
1 1/8 7	+008 +006	1.0220	1.0200	1 1/8 7	1.0400	1.0380
1 1/4 7	+0085 +006	1.1471	1.1446	1 1/4 7	1.1657	1.1632
1 3/8 6	+009 +006	1.2541	1.2511	1 3/8 6	1.2758	1.2728
1 1/2 6	+009 +006	1.3791	1.3761	1 1/2 6	1.4008	1.3978
1 5/8 5	+0095 +0065	1.4786	1.4756	1 5/8 5		
1 5/8 5 1/2	+0095 +0065			1 5/8 5 1/2	1.5164	1.5134
1 3/4 5	+0095 +0065	1.6036	1.6006	1 3/4 5	1.6296	1.6266

SPECIAL

SIZE	V THREAD	
	MAX.	MIN.
5/8 12	.5661	.5641
11/16 12	.6286	.6266
3/4 12	.6916	.6896
13/16 12	.7541	.7521
7/8 12	.8176	.8156
1 12	.9426	.9406

FIG. 1. PITCH-DIAMETER LIMITS OF STUDS FOR HEAVY SECTIONS

requires lubricant, such as soap water), contributes to undersized holes.

(c) The selection of taps close to the basic size tends to make the mean size lower than the mean size of the general run of commercial taps.

In threading studs the ordinary way, by means of opening dies or bolt cutter heads, there are many little things that tend to produce threads that have a slight general and irregular taper.

(d) The lack of straightness, rotundity, etc., of the stud blank itself, if of "hot-rolled steel," makes it difficult to chuck in proper alignment with the die.

TAP END PITCH DIAM. STUDS

Gas Engine Std.

Recommended only where careful attention is given to selection of taps.

LIMITS Size	Limits	V-THREAD Size	Max & Min. P.D.	U.S.S-THREAD Size	Max & Min. P.D.	S.A.E.-THREAD Size	Max & Min. P.D.
1/4	+.0025 +.001	1/4 20	.2135 .2120	1/4 20	.2201 .2186	1/4 28	.2293 .2278
5/16	+.0025 +.001	5/16 18	.2717 .2702	5/16 18	.2790 .2775	5/16 24	.2879 .2864
3/8	+.003 +.0015	3/8 16	.3293 .3278	3/8 16	.3374 .3359	3/8 24	.3509 .3494
7/16	+.0035 +.002	7/16 14	.3853 .3838	7/16 14	.3946 .3931	7/16 20	.4086 .4071
1/2	+.0035 +.002	1/2 12	.4385 .4370	1/2 13	.4535 .4520	1/2 20	.4711 .4696
9/16	+.0045 +.0025	9/16 12	.5020 .5000	9/16 12	.5129 .5109	9/16 18	.5309 .5289
5/8	+.0045 +.0025	5/8 11	.5587 .5567	5/8 11	.5705 .5686	5/8 18	.5935 .5915
3/4	+.0045 +.0025	3/4 10	.6766 .6746	3/4 10	.6896 .6876	3/4 16	.7139 .7119
7/8	+.005 +.003	7/8 9	.7934 7914	7/8 9	.8079 .8059	7/8 14	.8336 .8316
1	+.0055 +.0035	1 8	.9081 .9061	1 8	.9243 .9223	1 14	.9591 .9571

FIG. 2. PITCH-DIAMETER LIMITS OF STUDS FOR LIGHT SECTIONS

(e) Wear in the die head, and in the vise, or chuck, causes mis-alignment with respect to both parallelism, and angularity, either of which conduces to tapering threads in the product.

(f) The dullness of the die chasers at the throat and looseness of fit of the chasers in the head tend to produce threads that are tapering near the shoulder.

(g) The first two and possibly three threads are quite apt to be tapering as they are produced before the die is advanced far enough to equalize the cutting load on the several chasers.

In tapping holes by machine the following factors contribute to the production of tapering threads:

(h) Greatest wear of the tap nearest the end.

(i) Mis-alignment of tap shank with the threads.

(j) Mis-alignment in tapping machine.

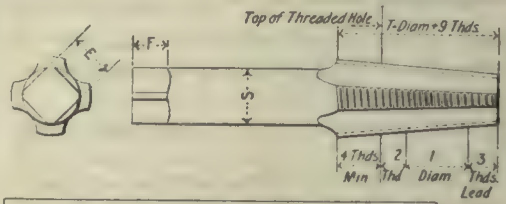
Taper Threads in Assembling

The taper in the thread in the product, as a result of one or more of the conditions just noted, need be but a very few thousandths of an inch in the used length of thread to create a situation in assembling, akin to that existing in a pipe-thread joint, although of much less taper. The tendency of the threads to be tapering has prompted a few manufacturers to make them designedly so. Several tapers have been used ranging from 1/8 to 1/4 in. per foot (0.0104 to 0.0208 in. per inch). The coarser taper answers well for thread lengths not over 1½ diameters long, while the slighter taper is suited to great thread lengths, possibly up to three diameters in length.

A tap, or die, having ten threads per inch and tapered 0.12 in. per foot (0.01 in. per inch) would increase the diameter of the hole 0.001 in. per turn (or the radius 0.005 in. per turn). The depth of the "cut" at the crest and root of the thread is therefore 0.0005 in. and at the slopes of the thread 0.00025 inch.

Tapered threads are so much better suited to tight, or wrench-fit work than are "straight" threads, that it is strange that their use has not been extended further than the making of pipe joints.

It is our belief that the making of wrench-tight fits would become simplified rather than complicated



STANDARD 1/4" TAPER SCREW THREADS

SIZE D	LNGTH THRD T	LNGTH OVER ALL L	DIAM S	SQUARE Diam E	SQUARE Lngth F
1/4	3/4				
5/16	7/8				
3/8	1				
7/16	1 1/8				
1/2	1 1/4				
5/8	1 1/2				
3/4	1 3/4				
7/8	2				
	2 1/4				

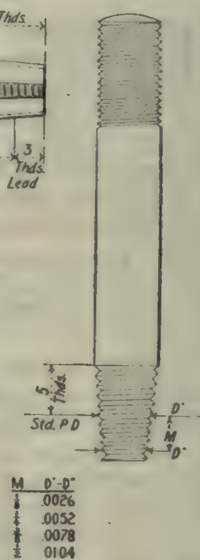


FIG. 3. STANDARD THREADS FOR SCREWS 1/4 IN. TAPER PER FOOT

through the use of tapered threads. The "good points" in this practice that appeal to us are:

(k) The hole size is determined by tapping to the proper depth and so is under accurate control of the operator (diameter changes 0.01 in. for each 0.1 in. change in depth).

(l) The diameter of the tapped hole is thus under the control of the manufacturer, so that the desired tightness of fit, of uniformly threaded studs, in metals of widely different characteristics may be secured.

(m) The dimensions of the tap-end thread on studs may be standardized and uniform, so that but one series is necessary.

(n) The diameter of the tap-end taper thread can be such that the stud will satisfactorily assemble in a tapped hole produced with a straight tap in the present customary way, Fig. 3, and vice versa, so that interchangeability need not be disturbed during the period of transition from the so-called straight to taper thread standard.

(o) The initial assembly is facilitated by the taper.

(p) The tightness of fit of the assembly is under closer control, with tapered threads, so that the make-up is more uniform than is possible with straight threads made with the same degree of skill.

The usefulness of taper-threaded studs is indicated by the fact that several concerns that have adopted and continued their use (in some instances for more than 15 years) have found them preferable to straight-threaded studs.

It is our belief that the use of a taper in making

tight fits and joints is much more logical than trying to make tight straight fits in the usual way.

This is conceded in the case of pipe joints, and we believe that before many years pass, the use of straight threads for studs will become obsolete. The application of taper threads is not confined to the Brigg's standard, but includes well-casing threads, plumber's-tubing threads, boiler-stud threads, and other taper threads.

The use of a slight taper for pressed fits, and in lieu of cylindrical pressed fits, is finding favor with some of the representatives' manufacturers in the industries. We have recently had opportunities to give the taper pressed-fit several trials in places where the cylindrical pressed-fit has caused annoyances of one kind or another, and the results have been so gratifying as to warrant an extension of the taper pressed-fit practice.

It will probably take a long time to overcome the inertia of present straight tight-fit practice, with respect to permanently set studs, just as it has taken our British friends many years to outgrow the practice of making straight steam-tight joints in pipe. When the time does come, when the straight tight screw-thread fit has been superseded by the taper tight-fit, we shall wonder why straight screw threads are ever made use of to make tight joints.

Elwood Burdsall, treasurer of the Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y., informs us that it is that company's practice to make the tap

TABLE I—PITCH DIAMETER OF TAP ENDS

Diameter Inch	Threads Per Inch	Pitch Diameter of Studs on Tap End
$\frac{7}{16}$	14	0.3961
$\frac{1}{2}$	13	0.4551
$\frac{5}{8}$	11	0.5731
$\frac{3}{4}$	10	0.6895
$\frac{7}{8}$	9	0.8085
1	8	0.9215

ends of studs about 0.005 in. larger than the nut ends, which are standard. The exact measurements are given in Table I.

Pipe Dreams of a Tramp Machinist—A Summer Sabbath-Day Idyll

By Glenn Quharity

The funniest thing that ever happened at the Brookdell shop didn't happen at the shop at all but at the Methodist church just around the corner, where the "Old Man" and Tom and Pop and Bill and George and all the rest of us went to "meetin'" on Sundays. I don't know how I am ever going to get the story into the *American Machinist* unless the Editor will consider that the necessary "shop atmosphere" is furnished by the fact that George—the hero-villain—was our senior apprentice, and that the choir-master who came to his "rescue," was Pop Sawyer who made patterns and built partitions and put up countershafts at the shop for the six other days of the week.

George was in his third year at the shop and was quite an accomplished young man in some ways. He was an excellent workman, and was well liked by everybody because of his genial disposition. He was somewhat quick tempered and prone to make "cursory" remarks when things went wrong, but he couldn't even get mad without raising a laugh. He was a general favorite with the younger set about our little town where everybody knew everybody else; was prominent in their social activities and held positions of social responsibility.

All of us boys used to go to church regular—five or six times a year, generally in the fall and winter before Christmas—but George went every Sunday because he "blew" the organ.

The organ at the Methodist church occupied an alcove built especially for it so that the organ front was flush with the back wall of the building. The instrument itself did not quite fill the alcove, but left a small space about four feet wide on each side, and to cover the space from the gaze of the congregation, the panelling, which formed most of the organ front, was carried clear across the alcove, thus inclosing a small room at each side.

Concealed doors in the panelling gave access to the rooms from the auditorium. In one of these rooms the sheep of the choir used to hang their outer wraps and overshoes, while the other served the same purpose for the goats.

In the men's room the handle of the bellows protruded from the side of the organ, nearly bisecting the narrow space, making it necessary to step over or duck under in going to the window at the back of the room. The doors of these rooms opened outward on to a narrow platform at each side of the pulpit from which broad, curved steps descended to the floor of the auditorium.

To provide access to the blower room without going out on the platform in full view of the congregation a trap door was cut in the floor and a short flight of steps—half ladder, half stairway—led to the cellar. The small door opening into the auditorium was normally held shut by a concealed finger latch and was apparently a part of the organ front.

One of George's failings was a fondness for the bright yellow lights of the neighboring city (white light would not be correct for electric lighting was not then common and the aforesaid lights were gas) and he used to hit the high spots for town about every Saturday night; coming home on the late train when he didn't miss it, or walking the seven or eight miles when he did. The kitchen door of the parental domicile was always on the latch for George and the old folks never knew when he got in, for they, of course, were the last to suspect the full import of his Saturday night trips.

On one such Saturday night in early June when George returned from his usual city jambouree (during which he had not only looked upon the *pousse-cafe* when it was red, white, and blue, but had promptly put down the temptation and ordered another) there was a strange rosy glow in the eastern sky which indicated either an exalted condition of George's mind or the approach of dawn—probably the latter.

George got in all right, and tumbled into bed, but before he was fairly asleep (or so it seemed to him) he was awakened by his mother calling him to breakfast. Reluctantly he crawled out and dressed, for though he was very sleepy he was never consciously derelict in duty, and after sousing his head in a basin of cold water he felt better and prepared himself for his usual Sunday avocation in a fairly cheerful frame of mind.

Arriving at the church in due time, George promptly secreted himself in the blower room and dutifully pumped wind into the organ for the prelude, the

anthem, the offertory and all the other musical diversions that attend the opening of an orthodox service; and then when the minister got busy, George sat down in the chair which was the only piece of furniture in the room, tipped back against the panel door and elevated his feet onto the handle of the bellows.

George hadn't the slightest idea of going to sleep during the sermon; oh no! However, the warmth of the morning, the lack of sleep the night before, and the droning voice of the minister indistinctly heard through the organ, was a combination too strong for healthy human nature, and George was presently fast asleep with the uptilted front legs of his chair directly over the edge of the trap that led to the cellar.

The minister finished his sermon and the choir made ready to sing the closing ode. The organist slid onto

the polished bench before her keyboard, pulled out the proper stops and proceeded to draw the sweet introductory strains from the soul of the organ.

But there was a hitch somewhere. Though she was going through all the motions in their proper order the strains wouldn't draw. She jiggled frantically at the dummy stop that connected with the rattle box in the blower room to indicate to George the need for wind, but there was nothing doing—nothing a *tall;* there simply was no wind in sight; not even a breeze. The choirmaster had sensed the true inwardness of the difficulty at the first symptom; he knew George. He slipped unobtrusively off the other end of the platform and quietly disappeared through a door leading to the parlor.

The congregation had just commenced to realize that something not on the program was happening when the choirmaster reached the steps leading to the blower room and slammed open the trapdoor. The edge of the trap struck squarely under the front legs of George's chair and the latch holding the panel door, already under a heavy responsibility, gave way.

The door flew open and a dishevelled young Indian accompanied by a war-whoop and followed by the remains of a chair, catapulted in a back somersault down the pulpit steps and onto the floor of the auditorium before a horrified congregation.

It was an awful moment!

Piecework in German Shops

By C. A. Heise

One of the first things following the German revolution was the abolishment of piecework in most of the factories by the workers' councils. However, on account of the apprehension caused in industrial quarters by the threatening break-up of the entire German economic system, the German Federal Board of Work has consulted the Berlin Chamber of Commerce with a view of giving expert advice as to the relative merits of the existing wage systems. The report of the chamber has just been published and makes rather interesting reading inasmuch as it recommends the re-introduction of piecework. In the course of the statement it is pointed out that from an economic point of view ordinary wages have proved an utter failure. Accordingly, the chamber has come to the conclusion that a sound and social wage system can only be based on the principles of fair piecework payment. The workers themselves as well as the unions are beginning to realize that the re-introduction of piecework was of utmost importance in trying to regain Germany's lost markets. The faults and defects of the piecework system formerly in use were freely admitted; on the other hand, it was shown that with the introduction of the eight-hour day the time-honored argument of piecework undermining the health of the workers has now lost most, if not all, of its former force.

In order to insure a fair administration of the piecework system the chamber suggests that all piecework rates should be fixed previously to the man starting on the job and the man be informed as to the rate. Furthermore, the fixing of the rates at the larger works should no longer be done by the foremen but by experienced time-rate fixers trained for the task in special classes held in industrial schools, and no cutting-down of rates so fixed and agreed upon should be permitted.

It was also recommended that workers engaged on so-called non-productive work, including clerks, etc., should be paid by a system representing a combination of ordinary time work and bonus work. It is highly interesting to note that the chamber, on account of the present German economic situation, considers the demand of the workers for profit sharing on a large scale unwarranted, it being held that no profits could be distributed at all, or only on so small a scale as not to figure as a stimulating factor.

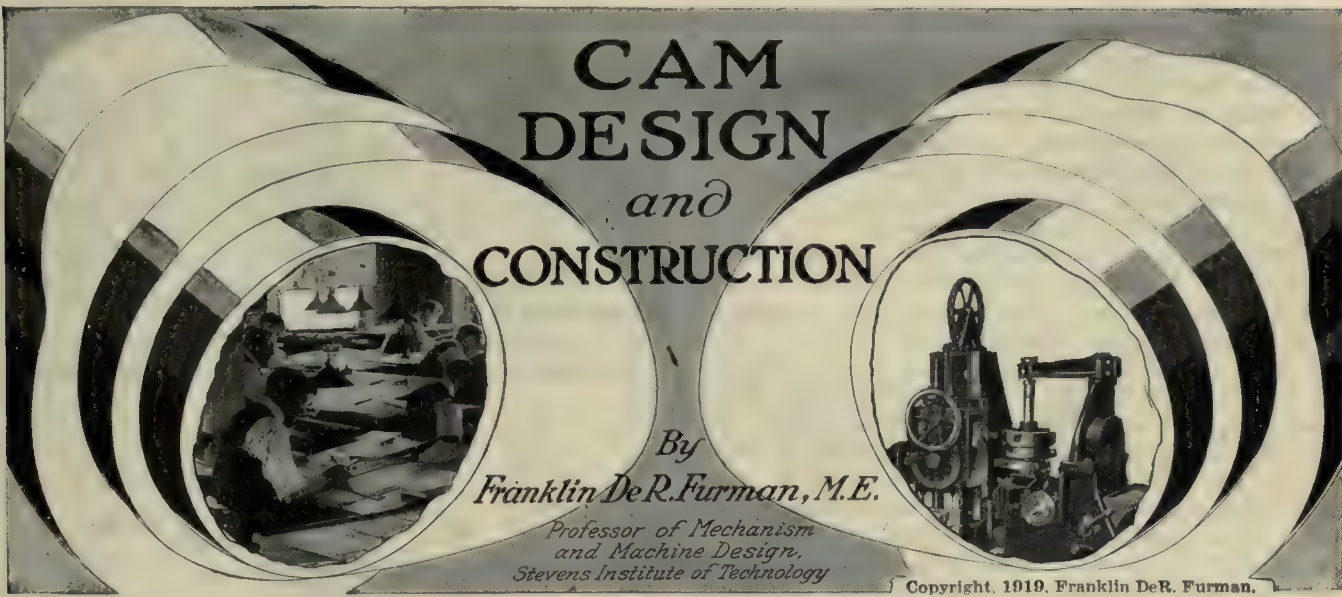
A Sample Board for the Tool Dresser

By K. Saldiz

I stumbled across a little kink in tool dressing the other day that I had not seen elsewhere, that is a real time and money saver wherever a blacksmith is kept busy all day dressing tools.

Every kind of cutting tool used on lathe, shaper, planer, boring mill, etc., is made up of wood, nailed on a board, and kept near the tool fire. This is a good way to stop quarrels and misunderstandings between the machinist and the tool dresser and eliminates waste of time resulting from the machinist (war brand) not knowing the proper name of the tool he wants or the tool dresser not being able to understand the description.

Now, if a machinist comes along and wants a tool bent to the right with the cutting edge on the point (offset parting tool), the tool dresser simply points to the board and lets him pick out the shape he wants.



X. Variable Angular Velocity in the Driving Cam Shaft

The subjects considered in the current issue are: Variable angular velocity in the driving shaft as applied to the toe and wiper cam, the determination of the amount of rubbing or sliding action in cam mechanisms where the follower surface is flat or curved instead of being a roller or a V edge, and the principles on which all sliding friction may be eliminated between cam and follower surfaces with their applications to logarithmic and computed cam curves.

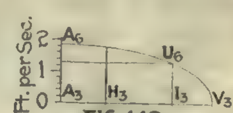
(Part IX was published on page 439.)

THE subject of variable angular velocity in the drive shaft of a cam applies to all types of cams, but it is rarely met with except in oscillating cams. The reason for this is that in machinery in general the shafts that make a full turn do so with practically uniangular velocity except in slow-advance and quick-return motions and in some special cases, and therefore the shaft that operates a cam in general is considered to have uniform angular velocity. But with the oscillating cam the motion must come through a crank and connecting-rod, or eccentric and beam, or some other device, from a shaft which in general turns with unifom angular velocity and which gives to the oscillating cam a variable angular velocity, as illustrated in Fig. 137, where the unequal arcs B_1G_1, G_1K_1 and K_1L_1 represent the distances traversed by the cam pin B_1 while the main-shaft crankpin turns through the equal arcs BG, GK and KL. The method of building a cam which has variable angular velocity will be illustrated in the following problem:

PROBLEM 24.—OSCILLATING CAM HAVING VARIABLE ANGULAR VELOCITY, TOE AND WIPER TYPE.—Required an oscillating wiper cam operated by a crank and connecting-rod from a main shaft to raise and lower a straight-toe follower through a distance of one unit while the crankshaft turns through 120 deg. Assume the following dimensions: Main crank radius CB, 4 units, Fig. 137; connecting rod length BB_1, 20 units; cam arm radius B_1O, 5 units; shortest cam surface radius OA, 2 units.

Find the distance the follower will move during each of three equal periods of time on the up stroke.

The first step in the solution of the problem is to lay out the main crank center as at C in Fig. 137; then the crankpin circle with a radius CB of 4 units, and next the connecting-rod length of 20 units on the center line, as at EJ. Lay off the assigned 120 deg. of crankshaft motion symmetrically about the main center line, as at BCD, and with B and D as centers and the length of the connecting-rod as a radius draw two arcs intersecting on the horizontal center line, thus locating B_1. With C as a center and the connecting-rod plus the crank as a radius draw the arc passing through J; with C as a center and the connecting-rod minus the crank as a radius draw the arc passing through J_1. To find the center O of the camshaft, Fig. 137, take B_1 as a center and the assigned cam-arm radius of 5 units and draw an arc on which the point O will be found later. On this arc find a point by trial and error with the compass which is the center of an arc which passes through B_1 and which



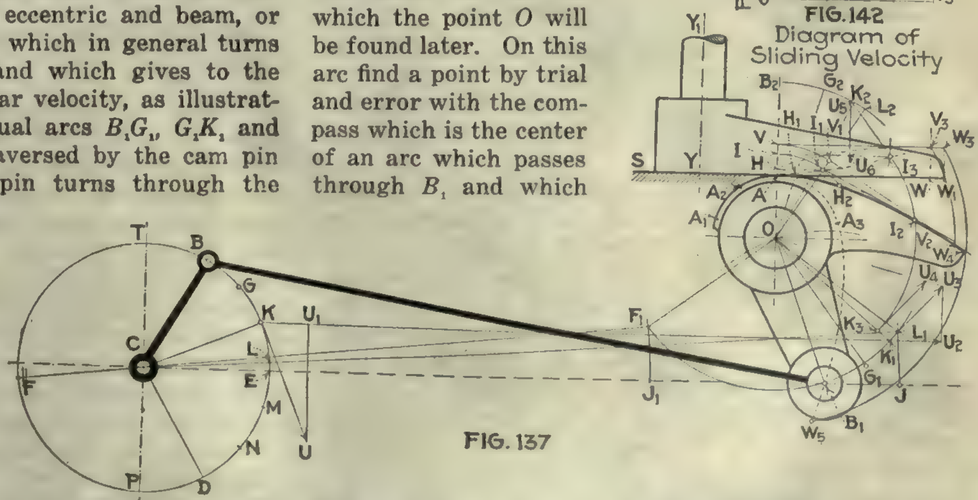


FIG. 137. OSCILLATING CAM WITH VARIABLE ANGULAR VELOCITY

intersects the two arcs through J and J_1 at the same elevation, as, for example, at L_1 and F_1. The center point so found is the point O. The arc $L_1B_1F_1$ will then be the arc of swing for the center of the cam-arm pin, and the angularity of action between the connecting rod and the cam arm at the two extreme ends of the cam-arm swing will be approximately the same. Draw a vertical line through O and mark the assigned distance OA, which is the shortest radius of the cam surface. The horizontal line through A will be the lowest position of the flat-surface follower toe. The distance AV is equal to the assigned motion for the follower.

Having completed the general layout of the assigned data the cam surface AV_2 is found as follows: Draw the arc B_2L_2 with a radius equal to OB_1 and make the length B_2L_2 equal to B_1L_1. Revolve V about O until it meets the radial line drawn form L_2 to O, thus determining the point V_1. At this latter point draw a line V_1V_2 perpendicular to OV_1. With the aid of any smooth-edged curved ruler draw a curved line tangent to AW at A and also tangent to V_1V_2 at the point where it happens to come. Such a curved line is shown at AV_2 in Fig. 137. Any other curved line tangent to the straight lines AW and V_1V_2 would have done the work in the same time, but would have given slightly different intermediate velocities to the follower as will be explained in a later paragraph.

The actual working length of the follower toe is readily obtained by revolving the point of tangency V_2 about O until it meets the horizontal line through V at V_3. Projecting V_3 down to AW and adding a short distance WW_1 to prevent a sharp-edge action, the practical length AW_1 is obtained. If the toe shaft is offset a distance AY, the total length of the follower toe will be YW_1.

To Find the Distances Moved by the Follower Toe during each of three equal periods while on the upstroke divide BL, Fig. 137, into three equal parts as at G and K. With these points as centers and with the connecting-rod length as a radius, construct short arcs intersecting B_1L_1 as shown at G_1 and K_1. Lay off the arcs B_1G_1 and B_1K_1 at B_2G_2 and B_2K_2, and draw the radial lines OG_2 and OK_2. Perpendicular to these radial lines draw other straight lines tangent to the curved cam surface AV_2, thus obtaining the lines H_1H_2 and I_1I_2. Revolving H_1 and I_1 back to the vertical line, the points H and I will be obtained and the distances moved by the follower during the three equal time periods on the up stroke will be AH, HI and IV respectively.

The Path of Contact Between the Cam Wiper and the Toe is shown by the curved dash line AV_3, Fig. 137. Points on this curve, such as at I_3, are obtained by revolving the point of tangency I_2 around until it meets the horizontal line through I.

In problems of this kind (problem 24) the follower toe takes a longer time for the down stroke than for the up stroke as shown by the length of arc LD as compared with LB, Fig. 137. This could be rectified and both times made the same, if desired, by placing the center O of the cam so that the points B_1 and L_1 would be on the horizontal line through C. This would only be possible with certain limited combinations of lengths of crank arms and rods, and in any event the intermediate velocities of the follower would be different on the up and down strokes. If it were desired to know the distances moved by the follower during three equal periods on the down stroke the equally spaced points M and N, Fig. 137, would be obtained and used in exactly the same way as explained for G and K.

The point F is the outward dead-center position of the driving crankpin and is found by continuing the straight line through F_1 and C to F. When the driving crankpin is at F the cam surface is in the position shown by the dash line A_2W_8 and A_1 is at A. While B is moving from D to F, A_1 is moving to A and the follower toe is at rest, being supported by the cylindrical surface, AA_1, rubbing against it; or it may be supported by a resting block indicated at SA.

It is sometimes thought that this toe-and-wiper cam is practically free from rubbing action, especially where

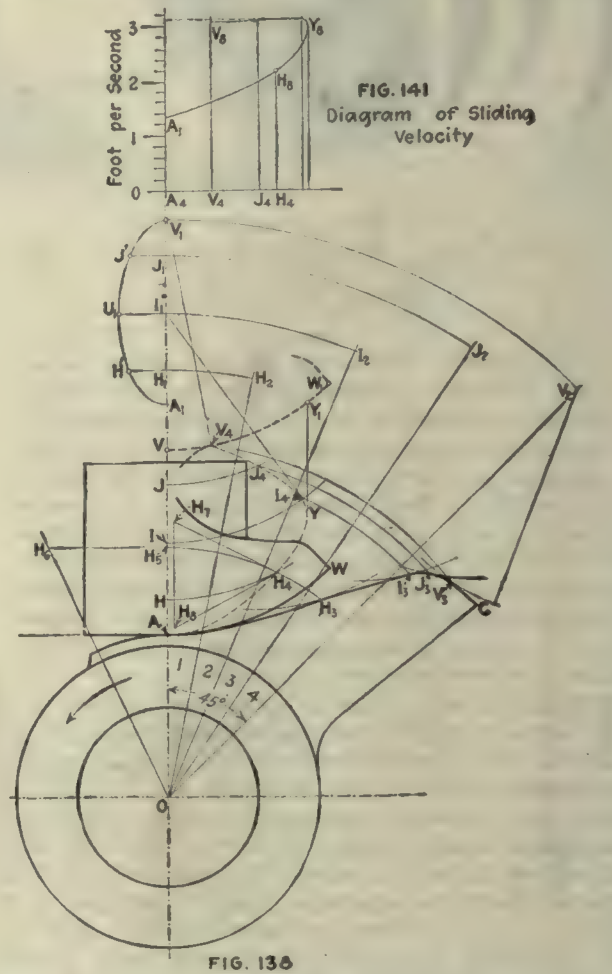


FIG. 138. OSCILLATING CAM WITH CURVED TOE FOLLOWER

the length of the toe surface equals approximately that of the wiper, but it will be seen from the velocity diagram shown just above the cam and described in later paragraphs, there may be considerable rubbing. There must be some sliding in all flat-toe followers where the acting surface is perpendicular to the right line motion of the follower, as it is in Fig. 137.

Toe and Wiper Cam Where Toe Is Curved—In the toe and wiper cam explained in the paragraphs immediately preceding, a flat surface toe YW, Fig. 137, was used. A curved toe, such as is shown at AW, Fig. 138, may be used as illustrated in the following problem:

Problem 25. Required a Wiper Cam to Operate a Curve-Toe Follower which shall move: (a) Up four units on the elliptical base curve where the ratio of axes is 2 to 4 while the cam turns 45 deg. in a counter-

clockwise direction with uniform angular velocity; (b) down four units on the same base curve while the cam turns 45 deg. in a clockwise direction with uniform angular velocity. While the follower toe may have the form of any smooth curve which is convex to the cam wiper, an arc of a circle will be assumed because of the ease in drawing. The shortest radius OA of the wiper cam, Fig. 138, is assumed. The form of the curved toe is the circular arc AW, with its center at A_1. It is convenient in such a problem as this to work with the center points of the follower arc, and therefore the

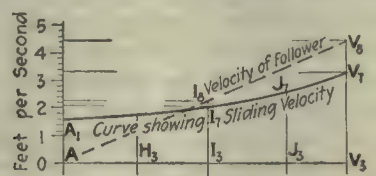


FIG. 140
Diagram of Velocities

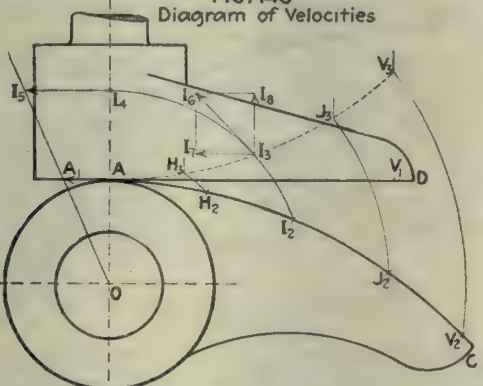


FIG 139

FIG. 139. SLIDING IN TOE AND WIPER CAMS

four units of travel are laid off first at A_1V_1 instead of AV. The semiellipse in which $I_1U_1 : I_1V_1 :: 2 : 4$ is drawn and the perimeter divided into equal parts at $J'U_1H'$. Only four construction points are used in this problem in order to secure as much simplicity as possible in the illustration. In practice more construction points should be used. The four construction centers at H_1, I_1, J_1, V_1 are revolved to their corresponding positions relatively to the cam at H_2, I_2, J_2, and V_2, and the toe arcs drawn as shown at H_3, I_3, J_3 and V_3. The wiper-cam curve AC is then drawn tangent to these arcs and the tangent points revolved back to their actual positions at H_4, I_4, J_4, and V_4, thus obtaining the locus of contact between the wiper and toe. This locus is shown by the dash-line curve AH_4V_4. The necessary length VY_1 of the follower arc is also obtained by projecting the extreme point Y on the locus to Y_1 and adding an abitrary distance such as Y_1W_1 to avoid wear at the tip end.

If an Irregular Curve Had Been Used for the form of the toe instead of a circular arc it would have been necessary to construct a templet of the desired form of the toe and to move it out radially the desired distances on each of the radial construction lines, keeping the templet always in the same relative position with each of the radial lines. At each of the four adjustments of the templet, arcs would have been drawn against the templet edge and the work then continued as described in the preceding paragraph.

The pressure angles in the toe and wiper cams are quite different for flat and curved toes. In Fig. 137 the line of pressure is always parallel to the axis YY_1 of the follower rod as illustrated by the vertical line at WV_1, and the maximum leverage with which it acts on the bearings is YW. With the curved-toe wiper the line of pressure is an inclined line and the pressure angle at the top of the stroke is $V\ V_1V_4$, Fig. 138, and when the follower is half way up the pressure angle is $I\ I_1I_4$.

Rate of Sliding of Cams on Follower Surface—The rubbing velocity of cams which are in sliding contact with the follower may be readily determined by constructing simple velocity diagrams at each of the construction points, as explained in the following paragraphs:

Problem 26. Rate of Sliding Between Cam and Flat Follower Surface—Find the curve of rubbing velocity between surfaces in a toe and wiper cam mechanism where the follower toe is a flat surface. Assume that the wiper oscillates with uniform angular velocity.

In Fig. 139 let the angle I_4OI_5 represent the uniform angular velocity of the wiper cam. Then the point I_4 on the cam will have the linear velocity I_4I_5. Laying this value off at I_3I_6, where I comes into action, and taking the component I_3I_7, the actual rubbing velocity is obtained. This may be transferred to I_3I_7 in Fig. 140, and finding other ordinates the complete sliding-velocity curve A_1V_7 is obtained. The ordinate $A\ A_1$ is quickly obtained for it is obviously equal to the linear velocity line $A\ A_1$ in Fig. 139. In Fig. 139 the detail construction for obtaining the velocity of the follower is shown only at one point I_3, the construction at the other points being the same.

The Actual Rate of Sliding in Feet per Second may be readily found at any position by means of the velocity diagram in Fig. 140. For example, if the camshaft O, Fig. 139, is considered to oscillate back and forth through 45 deg. 100 times per minute with uniform angular velocity, and if the radius $O\,I_4$ is 14 in., the line I_4I_5 will represent a velocity of

$$\frac{2 \times 14 \times 3.14 \times 2 \times 100}{8 \times 12 \times 60}$$

= 3.05 ft. per second. This value, laid off as the resultant velocity at I_3 gives a component or sliding velocity I_3I_7, which is laid off at I_3I_7 in Fig. 140. The minimum rate of sliding will be $A\ A_1$, shown in both Figs. 139 and 140, and will be 1.6 measured on the same scale that was used to lay out I_4I_5.

The Velocity of the Follower in Feet per Second may also be readily found by simply taking the vertical component I_3I_8, Fig. 139, and laying it off at I_3I_8 in Fig. 140. Taking the vertical components at other points the line $A\ V_8$, showing the linear velocity of the following, will be obtained. The line $A\ V_8$ is a straight line in this problem because this cam illustration was taken so that the follower would have uniformly increasing velocity. In general, where the cam curve $A\ V_2$ in Fig. 139 is assumed, the line $A\ V_8$ in Fig. 140 will not be straight.

Problem 27. Sliding Velocity With Curve-Toe Follower—Find the curve of rubbing velocity between surfaces in a curved toe and wiper cam mechanism, assuming that the wiper oscillates with uniform angular velocity. In curved-toe followers the general principle of obtaining the rubbing velocity is the same, although the detail of drawing the velocity diagram differs slightly. In Fig. 138 the linear velocity of the point H_3 on the cam is H_5H_6, and this value is laid off at H_4H_7. The direction of sliding at this phase must be that of the common tangent line to the two surfaces.

and its length, which represent the velocity of sliding, is found by drawing the line H_7H_8 parallel to the direction of motion of the point H_4 on the follower. The length of H_4H_8 is thus found and is laid out, as shown in Fig. 141, directly over H_4 of Fig. 138. Other lines representing the rubbing velocity are similarly found and laid out in Fig. 141, thus obtaining the rubbing velocity curve $A_7H_8V_8$.

In the case of the curved-toe follower it will be noticed that that portion of the toe from V_4 to Y_1, Fig. 138, will be traversed twice as often as the portion from V to V_4, and in addition the rubbing velocity will be much greater. In the flat-toe follower, Fig. 139, the point of contact travels regularly forth and back the full distance on each stroke, but the wear as in the curved-toe follower will be irregular, due to the variable rubbing velocity, which in the case illustrated in Fig. 140 is a maximum at the tip end.

PROBLEM 28. SLIDING VELOCITY WHERE CAM HAS VARIABLE ANGULAR VELOCITY—Find the curve of rubbing velocity between surfaces in a flat-toe and wiper-cam construction, assuming that the wiper cam oscillates with a variable angular velocity.

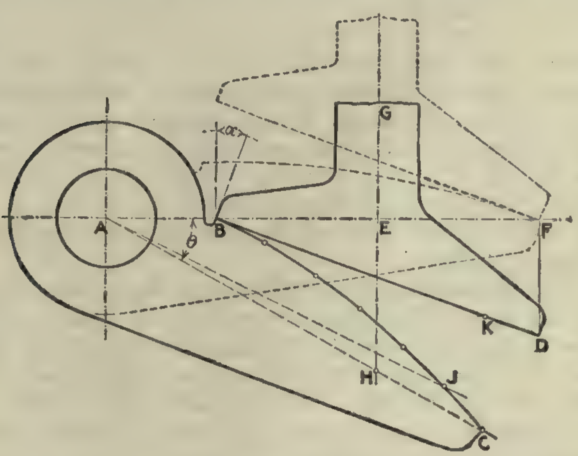


FIG. 143. OSCILLATING CAM WITH PURE ROLLING ACTION ON STRAIGHT-EDGE FOLLOWER

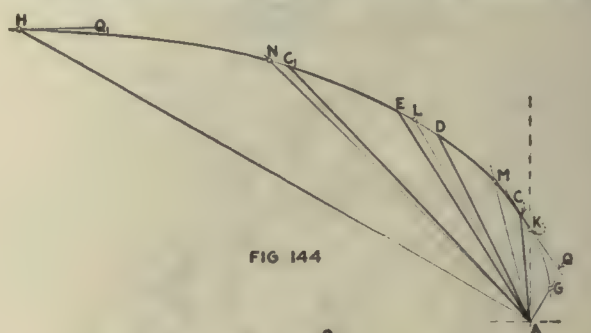
When an oscillating cam has variable angular velocity, as in Fig. 137, the extent of the sliding action between cam and follower may be found as in the following example. In Fig. 137 the length of crank represented by CE is 4 in. and the crank is assumed to be turning at 120 r.p.m. The velocity of the crank pin will be

$$\frac{2 \times 3.14 \times 4 \times 120}{12 \times 60} = 4.19 \text{ ft. per second.}$$

This velocity is represented by the line KU, Fig. 137, laid off to some convenient scale. Its component KU_1 along the connecting rod is found by dropping from U a perpendicular to the connecting-rod position $K K_1$.

The component $K U_1$ is then transferred to the other end of the rod at K_1U_2. This component gives a resultant linear velocity of K_1U_3 to the cam crankpin at the phase K_1. At the radial distance $O K_3$, which is equal to the radii $O I_2$ and $O I_3$, the linear velocity will be K_3U_4 and this transferred to I_3 will give I_3U_5 as the resultant linear velocity of I_2 when it becomes the driving point. The line I_2U_6 is the component in the direction in which sliding must take place, and this is laid off at I_2U_6 in Fig. 142. If KU represents 4.19 ft. per second, I_2U_6 will represent 1.30 ft. per second to the same scale, and the maximum velocity of sliding, which is represented at A_2A_4, will be 1.87 ft. per second.

ELIMINATION OF SLIDING FRICTION WHERE FLAT OR CURVED SURFACE FOLLOWERS ARE USED.—The ordinary toe and wiper cam mechanism operates with more or less sliding action, as shown in the preceding paragraphs. Cams resembling the toe and wiper type may be constructed so as to eliminate all sliding friction by using special curves and lines for the wiper and toe surfaces, as will be explained in succeeding paragraphs. Fig. 143 shows a straight surface toe moving up and down in a straight line, while in Fig. 150 a similarly moving toe has a curved working surface. In both there is pure rolling action. Likewise in Figs. 146 and 149 the working surface of the follower arm is straight in one case and curved in the other, yet in both cases there is pure rolling action. In all cases of pure rolling action on flat or curved surfaces it is impossible to assign various intermediate velocities to the follower as part of the data of the problem.



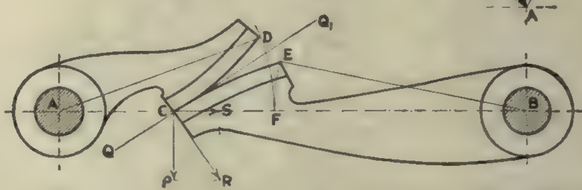


FIG. 144. BASIC LOGARITHMIC CURVE FOR OSCILLATING CAM ARMS HAVING PURE ROLLING ACTION. FIG. 145. SWINGING CAM ARMS WITH LOGARITHMIC SURFACES IN PURE ROLLING ACTION

THE PRINCIPLE OF PURE ROLLING ACTION BETWEEN CAM SURFACES.—It is a fundamental principle of pure rolling action between two rotating surfaces that the point of contact between them must always be on the line of centers. This is illustrated in Fig. 145, where the point of contact C is on the line of centers $A B$ and where the contact point between the curves $C D$ and $C E$ will always be on the line of centers. This principle also applies in Fig. 143 where the follower toe $B D$ is moving up and down in a straight line and where it must be considered that the toe is turning about a point on the line $A B F$ at an infinite distance. Then $A F$ becomes the line of centers and the point of contact between $B C$ and $B D$ will always be on the line $B F$.

WELL-KNOWN CURVES THAT LEND THEMSELVES READILY TO PURE ROLLING ACTION IN CAM WORK are the logarithmic spiral and the ellipse. Examples of these will be given in following paragraphs where the solutions are entirely graphical and comparatively simple. The parabola and the hyperbola may also be readily used for rolling cam surfaces. Any line or curve that may readily be expressed by a mathematical equation may also be taken as one surface and the equation for the other curve that will work with it in pure roll-

ing action may be derived. An example of this is given in a later paragraph. The use of the logarithmic curve for pure rolling action in the toe and wiper type of construction where the follower toe has a straight-edge working surface and moves in a straight line is given in the paragraphs immediately following.

PROBLEM 29. PURE ROLLING WITH FLAT SURFACE FOLLOWER.—Required an oscillating logarithmic cam arm that will give a straight line reciprocating motion to a flat-surface follower arm with pure rolling action: (a) The follower to move up $4\frac{1}{4}$ units, while the cam turns 30 deg.; (b) the pressure angle to be 20 deg.

This problem is illustrated in Fig. 143, where the flat surface toe $B\,D$ is moved from the solid-line position to the dash-line position while the cam $A\,B\,C$ swings through the angle $C\,A\,F$. The method of constructing the problem is as follows:

Draw the horizontal line $A\,F$, Fig. 143, and from any point B draw a line $B\,D$, making an angle with $B\,F$ equal to the assigned pressure angle. Continue $B\,D$ until the vertical distance between it and $B\,F$ is equal to the assigned lift of the follower, $4\frac{1}{4}$ units in this problem as measured at $D\,F$. Mark the point F. Assume the distance $A\,B$ sufficient to allow for the camshaft and cam hub. $A\,B$ is taken as four units in this problem, and $A\,F$ is found upon measuring to be 16 units. Substitute these values in the following general equation:

$$\theta = \frac{180^\circ \times \tan \alpha}{\pi \times .434} \log \frac{R}{r}$$

in which $r = 4$, $R = 16$, $\alpha = 20$ deg. and in which θ gives the angle whose limiting radial line $A\,C$ is equal in length to AF;

$$\theta = \frac{180^\circ \times .364}{3.14 \times .434} \times .602 = 28.8^\circ$$

The angle of 28.8 deg. is then laid off at FAC, as shown in Fig. 143, by means of a protractor. If a protractor is not at hand this angle may be readily constructed with the aid of a trigonometrical table from which the tangent of 28.8 deg. is found to be 0.55. Lay off $A\,E$ equal to one unit on any independent scale and draw a perpendicular line EH at E. On this line lay off 0.55 of this unit, thus obtaining the point H. The angle $E\,A\,H$ will then be 28.8 deg. Draw $A\,H$ and continue it to $A\,C$, making $A\,C = A\,F = 16$ units on the scale of the cam drawing. The logarithmic curve through B and C will be the one which will work in pure rolling action with the straight line $B\,D$.

To obtain other points on the curve $B\,C$ as at J, assume intermediate values for R in the above formula, r remaining the same as before. Taking R at 14 units and again solving the equation, θ is found to be 26 deg., and this angle is laid off at $E\,A\,J$. $A\,J$ is made 14 units in length. In like manner other points shown by dots between J and B may be found by taking R equal to 12, 10, 8 and 6 in successive computations and laying off the resulting angles, which are found to be 22.9 deg., 19.1 deg., 14.4 deg. and 8.45 deg., respectively.

The pressure angle between the two cam surfaces will be a constant and equal to α. The smaller the pressure angle the longer will be the toe of the follower for a given lift. As a corollary to the conditions of pure rolling action it follows that the developed length of the logarithmic arc $B\,C$ must be equal to the length of the straight line $B\,D$. The stem $E\,G$ of the follower toe may in general be taken with its center line midway between B and F.

PURE ROLLING BETWEEN TWO OSCILLATING CAM ARMS—The use of the logarithmic curve for pure rolling action between two rolling cam arms, where both arms oscillate, is shown in the paragraphs immediately following. Before taking up a definite problem it is necessary to consider, in order to obtain a satisfactory understanding, some of the properties peculiar to the logarithmic curve. These properties are:

First, that in a series of equally spaced radial lines drawn from the pole to the logarithmic curve the length of any one line is a mean proportional of the lines on either side. To illustrate, the curve $G\,H$, Fig. 144, is a logarithmic curve, the radial lines $A\,G$, $A\,K$, $A\,L$ and $A\,H$ are spaced by equal angles and $A\,K : A\,L :: A\,L : AH$, or, $A\,L = \sqrt{A\,K \times AH}$. The spacing angle may be of any size.

Second, that the difference in length between any two radial lines drawn from the pole to the curve will be the same no matter where those radial lines are taken, providing they intercept equal lengths of arc. To illustrate, the difference $C_1A - EA$, Fig. 144, is equal to $D\,A - C\,A$ for the reason that the arcs $E\,C_1$ and $C\,D$ were made equal in developed length.

Third, that a tangent and a radial line at any point on a logarithmic curve form the same size of angle, no matter where the point is taken. To illustrate, the angle between the tangent $Q\,C$ and the radial line $A\,C$, Fig. 144, equals the angle between Q_1H and $A\,H$.

PROBLEM 30. PURE ROLLING WITH LOGARITHMIC CURVED CAM ARMS—Construct a pair of pure rolling oscillating cam arms with logarithmic curved surfaces, the driver swinging through 21 deg. and the follower arm through one-half of that angle.

The first step in the solution of problem 30 consists in drawing a logarithmic curve of any desired curvature by assuming any convenient angle such as 60 deg., as shown at $K\,A\,H$ in Fig. 144, and any two lengths of lines as shown at $A\,K$ and $A\,H$. K and H will then be points on the logarithmic curve. To find an intermediate point, bisect the angle $K\,A\,H$, as at $A\,L$, and make $A\,L$ a mean proportional between $A\,K$ and $A\,H$ in accordance with the first general principle mentioned above. To find a point to the right of K make the angle $K\,A\,G$ equal to angle $L\,A\,K$; then $A\,K$ becomes the mean proportional and $A\,G : A\,K :: A\,K : A\,L$, or $AG = \frac{AK^2}{AL}$.

Having constructed the general logarithmic curve as above, lay off an angle of 21 deg. with the vertex at A, Fig. 144, and with the sides at $A\,C$ and $A\,D$, or the sides may be in any other position, according to the length desired for the cam arms. Make a tracing of the angle $C\,A\,D$ and of the arc $C\,D$ and reproduce it at $C\,A\,D$ in Fig. 145. Also draw the body outlines of the cam arm, and the driver is then completed. To find the follower, step off the arc $C\,D$, Fig. 144, into four or six steps with the dividers, and restep the distance $C\,D$ off on another part of the logarithmic curve where the newly placed arc, equal to $C\,D$, will be subtended by an angle of $10\frac{1}{2}$ deg. as specified in the data. The new position for the length of the arc must be found by trial, and in this problem it is at $E\,C_1$ in Fig. 144, where the arc $E\,C_1$ equals $C\,D$ in length and the angle $E\,A\,C_1$ equals one-half of $C\,A\,D$. The angle $E\,A\,C_1$ and the arc $E\,C_1$ are now traced on tracing cloth and redrawn at $C\,B\,E$ in Fig. 145. Upon drawing the outlines for the arm the follower is completed.

The Angular Motion of Each Cam depends on the positions on the logarithmic curve at which the equal arcs are taken. Had it been desired to swing the shaft B through a larger angle the logarithmic arc $E\,C_{,,}$ Fig. 144, would have been taken lower down. When $E\,C_{,}$ coincides in position with $C\,D$, the arm $C\,B$, Fig. 145, will swing through the same angle as the arm $C\,A$, and both arms will be of the same length and identical in every way.

Tangency of Logarithmic Cam Surfaces—The fact that the two rolling cam curves $C\,D$ and $C\,E$, Fig. 145, are tangent at C follows from the third principle laid down in a preceding paragraph which points out that the tangents at C and $C_{,,}$ Fig. 144, make the same angles with $C\,A$ and $C_{,}A$ respectively. Since C and $C_{,}$ come together on the same straight line $A\,B$, in Fig. 145, the angle $B\,C\,Q_{1}$ in the figure will equal the angle $A\,C\,Q$.

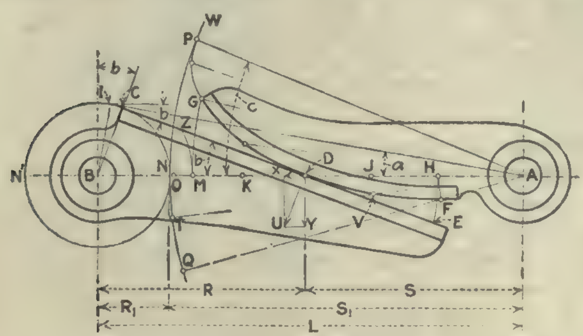


FIG. 146. SWINGING CAM ARMS WITH DERIVED SURFACES IN PURE ROLLING ACTION

Regulation of Pressure Angle Where Logarithmic Rolling Cams Are Used—Logarithmic curves of varying sizes, or expansion, may be used for rolling cam surfaces, but in general the best results will be obtained by using curves having a large expansion. The expansion may be measured specifically by noting the rate of increase in the length of the successive radial lines which are drawn at equal angles with each other. The greater the expansion of the logarithmic curve the smaller will be the pressure angle, or radial pressure, on the bearings of the cam. This is shown in Fig. 145 where $P\,C\,R$ is the pressure angle and $C\,S$ is the radial pressure on the bearings. If curve $C\,D$ had a greater expansion its normal $C\,R$ would fall nearer $C\,P$ and the pressure angle would be smaller.

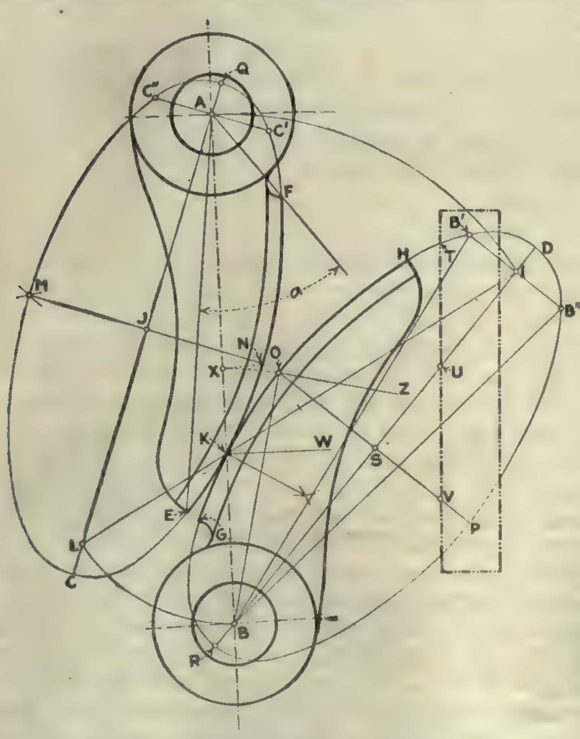


FIG. 147. BASIC ELLIPSES FOR PURE ROLLING CAM ARMS

Derived Curve for Rolling Cam Arms—Any line or curve that is expressed by a mathematical equation may be taken as the form of an oscillating cam arm, and the equation for another curve that will work with it in pure rolling action may be derived. In the paragraphs immediately following a cam arm with a straight surface is assumed and the curve that will work with it is derived. The derivation of the curve involves the use of calculus, but the results are comparatively easy to apply practically.

Problem 31. The Use of a Derived Curve for Rolling Cams—Given a straight-edge oscillating follower arm. Required a curved oscillating arm that will work with it in pure rolling action.

In solving the above problem the following notation illustrated in Fig. 146 will be used:

a = angle between the line of centers of the oscillating arms and the line of the straight follower surface for the phase in which this line, when extended, passes through the axis of the driver shaft. The angle a is a constant.
b = angle turned through by the straight follower arm, at any phase, measured from the horizontal position.
c = construction angle for the curved follower arm.
L = distance between centers.
R = working radius of follower arm at any phase.
S = working radius of driver arm at the phase corresponding to R.

Then

$$\sin a = \frac{BI}{AB} = \frac{R_1}{L} \tag{1}$$

$$R = \frac{BC}{\sin BDC} = \frac{R_1}{\sin b} \tag{2}$$

$$S = L - R \tag{3}$$

$$c = \frac{180^\circ \tan a}{\pi \times 0.4343} \log \frac{\cos \frac{1}{2}(b+a)}{\sin \frac{1}{2}(b-a)} \tag{4}$$

Assuming $L = 24$ and $R_1 = 4$ we have from equation (1) $\sin a = \frac{4}{24} = 0.1668$, and from a table of sines $a = 9\frac{3}{4}^\circ$.

Then from equations (2) and (3)

For $b = 12^\circ$, $R = \frac{4}{.208} = 19.22$ and $S = 24 - 19.22 = 4.78$

$b = 15^\circ$, $R = \frac{4}{.2588} = 15.45$ and $S = 24 - 15.45 = 8.55$

$b = 20^\circ$, $R = \frac{4}{3.42} = 11.70$ and $S = 24 - 11.70 = 12.30$

Similarly for $b = 30^\circ$, $R = 8.00$; for $b = 50^\circ$, $R = 5.23$; for $b = 70^\circ$, $R = 4.26$; and $b = 90^\circ$, $R = 4 = R_1$.

From equation (4)

$$\text{For } b = 12^\circ,\ c = \frac{180^\circ \times .1718}{3.1416 \times .4343} \log \frac{\cos \frac{1}{2}(12^\circ + 9\frac{3}{4}^\circ)}{\sin \frac{1}{2}(12^\circ - 9\frac{3}{4}^\circ)}$$

$$= 22.67 \log \frac{.982}{.0196} = 22.67 \times 1.70 = 38.6^\circ$$

$$b = 15^\circ,\ c = 22.67 \log \frac{.9767}{.0457} = 22.67 \times 1.32 = 30^\circ$$

$$b = 20^\circ,\ c = 22.67 \log \frac{.9665}{.0893} = 22.67 \times 1.033 = 22.8^\circ.$$

Similarly for $b = 30^\circ$, $c = 16.5^\circ$; for $b = 50^\circ$, $c = 9.1^\circ$; for $b = 70^\circ$, $c = 4.2^\circ$; and for $b = 90^\circ$, $c = 0^\circ$.

Plotting the above values of R in Fig. 146, $BH = 19.22$ and $AH = 4.78$; $BJ = 15.45$; and $BD = 11.70$, etc. A test of the accuracy of the work thus far may now be made by drawing a line from H tangent to the circle having R_1 for a radius and noting if it makes an angle of 12 deg. with the line of centers. Likewise a line from D tangent to this same circle should make an angle of 20 deg. with DB, etc.

Again, plot the values of c, starting with any phase in which it is desired to show the cams. In this case the phase illustrated is for the straight cam at an angle of 20 deg. Lay off the angle $D_1AP = 22.8$ deg. Then starting with AP as a datum line lay off the values of c as found above, making the arc $PQ = 38.6^\circ$, arc $PT = 30$ deg., etc.

Finally on each of the lines AQ, AT, etc., lay off the corresponding values of S. These values have already been found to be 4.78, 8.55 respectively, etc. Thus the points F, V, D .... P on the follower cam curve are obtained.

Rolling Cams Useful for Starting Shafts Gradually—The curve FDP is tangent to the circular arc having AP for a radius. This suggests an interesting and perhaps useful mechanical addition in that gear teeth might be cut on GPW as a pitch line, and also on ZCN' as a pitch line, thus permitting an oscillating shaft A to give a certain number of complete revolutions in opposite directions to the shaft B. In starting each cycle the shaft B would accelerate gradually and it would come to rest gently at the end of its cycle. The rate at which the motion of the shaft B would accelerate at starting is indicated by the ratios $\frac{HA}{HB}$ to $\frac{NA}{NB}$. Giving the actual values which these ratios have in this problem it is found that the acceleration of B increases from $\frac{4.78}{19.22}$ to $\frac{20}{4}$ or from about one-fourth of the angular velocity to five times that of the shaft A.

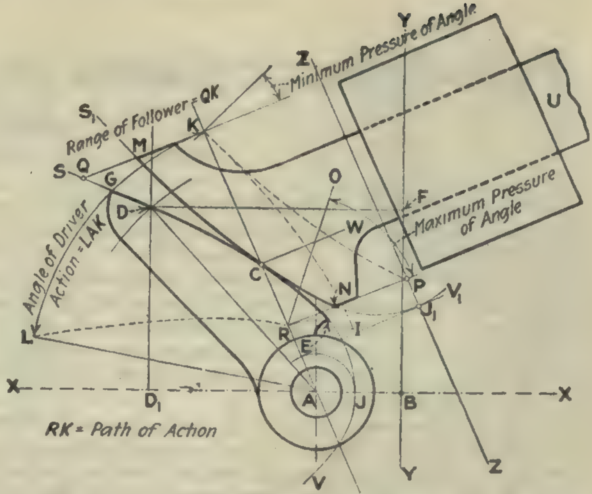


FIG. 150. PARABOLIC CAM SURFACES FOR PURE ROLLING RECIPROCATING MOTION

Regulation of Pressure Angle With Derived Rolling Curve—Returning to problem 31 and considering it only as a cam mechanism, it will be noticed that the angles taken for b in the computations become the pressure angles and show a measure of the radial thrust that goes into the bearing without producing any useful rotative effort. For example, in Fig. 146 the cams are in contact at D and the normal pressure is represented by DU. The component pressure DX goes to the bearings and DY is useful in turning the shaft B. The pressure angle UDY is 20°. When G reaches M it will be in contact with Z and the pressure angle will be 50 deg.

[Figs. 147 to 150 were printed in this issue for reference purposes only. They will be reprinted and described fully in the next installment.]

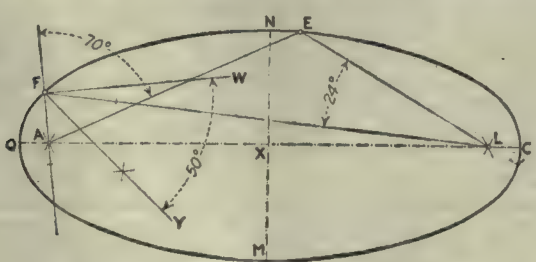


FIG. 148

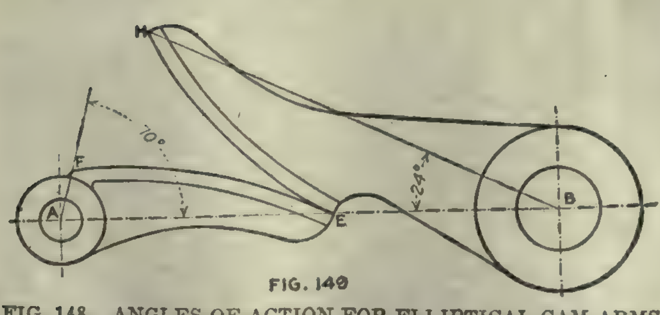


FIG. 149

FIG. 148. ANGLES OF ACTION FOR ELLIPTICAL CAM ARMS
FIG. 149. PURE ROLLING ELLIPTICAL CAM ARMS

Cast-Iron Pulley Displaces Aluminum

With a view to avoiding well-known difficulties in reversing the tables of planing machines, the need for reduced mass in the case of revolving parts has been shown. To minimize the energy of the pulley it has often been made of aluminum instead of cast iron. One case, however, has come to our notice in which a cast-iron pulley worked more successfully than an aluminum one. A planer of fair size is screw-driven by means of open and crossed belts, and for the quick return, the pulley, previously of cast iron, is now of aluminum; but at the time of reversal a very distinct bump is experienced on the table, the kick in fact resulting sometimes in the loosening of the clamps securing the job. The reason is thought to lie in the rapidity with which the aluminum pulley stops, coupled with the fact that the screw is considerably worn, but not uniformly or approximately uniformly; it is, in fact, impossible to adjust the nut. To avoid the cost implied in the employment of a new screw, etc., the cast-iron pulley is to be once more put into position, the theory being apparently that it will slow down somewhat gradually, rather than cease driving immediately, and will thus eliminate the kicking action.—From English Edition of the *American Machinist.*

Pan-Americanism in Weights and Measures*

By FREDERICK A. HALSEY
Commissioner, American Institute of Weights and Measures

AT the foundation of the case for the metric system is the claim that that system is better than others. It is quite true that some who have tried it report that they find it better, but, on the other hand, others report that they find it no better and even not so good. It is, however, impossible to take a census of individuals in this matter, and it is also unnecessary because the judgment of the world has condemned the system, and the clearest verdict of all comes from France.

The metric system was originally promulgated in France by compulsory law in 1793. These laws remained in force for 19 years, or until 1812, when, under Napoleon, who had no faith in the system, they were repealed and the people were permitted to resume their ancient measures. This they promptly did, reverting to that truly universal system in which 12 in. make a foot, 3 ft. make a yard and 16 oz. make a pound.

In order to distinguish this system from the metric system by name, it received the official title the Système Usuelle—a name which, in two words, tells the whole story. This Système Usuelle continued as the common system in France for 25 years, or until 1837 when the metric force laws were reimposed.

If the metric system is better than the ancient system, were not 19 years of its enforced use sufficient to demonstrate the fact? What other explanation of this reversion to old units is possible except that the French people found them better adapted to their purposes than the new? There is no other possible explanation, and it should be noted that we have here not the opinion of a few individuals but the verdict of a nation.

Latin-American Condemnation

To the people of no other country has this opportunity been given to express their preference between the two systems after a trial of the new, but the verdict of Latin America is unmistakable. The system was adopted in most of the Latin-American countries more than half a century ago—in the decade between 1850 and 1860 and today the people use it only to the extent that they are compelled by law.

In but one country—Uruguay—is it really adopted for domestic purchases and sales and this because of laws which, to easy-going Anglo-Saxons, seem fairly grotesque. Moreover, even those laws are but partly effective as, in spite of them, we find many exceptions.

Argentina and Venezuela also have drastic laws but they are not, apparently, so rigidly enforced as in those countries we find a much larger use of the old measures. In all Latin-American countries the use of the system is in exact accordance with the severity of the laws, and in most of them among the people it is used but little. In ten of them it can scarcely be found in popular usage, while in five, the English units are used far more than the metric—although these five, like the others, are, in metric literature, claimed to be purely metric. Is not a half a century of tutelage enough to demonstrate the advantages of the metric system, if they exist? Is it not clear that the people of Latin America continue to use the old units because they find them better adapted to their purposes than the new ones?

The facts given are the results of an extended investigation conducted by the American Institute of Weights and Measures by means of a questionnaire which was circulated broadcast throughout Latin America with the assistance of the National City Bank, the United Fruit Co., W. R. Grace & Co. and the Hill Publishing Co., all of whom forwarded the questionnaires—duly translated into Spanish and Portuguese—to their branch offices and correspondents.

*An address delivered at the Commercial Conference of the Pan American Union.

The results of this inquiry have been summarized in a Report on the Weights and Measures of Latin America, published by the American Society of Mechanical Engineers, and it should be noted that since its publication some remarkable combinations of its findings have appeared.

Latin-American Preference for English Measures

The preference of the people of Latin America for the ancient system is not confined to usage in domestic purchases and sales. We have an accurate census of the machine tools in Latin-American shops and factories which is a striking example of this preference.

For the benefit of the non-technical reader it should be explained that machine tools are the machines with which machine shops are equipped. They are the foundation of modern mechanical industry, being the parents of all other machines of whatever kind and purpose, since all parts of such machines are made thereon and on them every dimension of every part is determined. This is true even of the implements of war as the world has recently learned, war being, in fact, the child of the machine shop.

The census of machine tools in Latin America under prewar conditions shows that 39.3 per cent thereof were made in the United States and 43.2 per cent in Great Britain—a total of 82.5 per cent having been made to the English system—while the remaining 17.5 per cent were made in France, Belgium and Germany and to the metric system.

In other words, Latin-American factories have shown their preference for machines made to English over those made to metric measures in the ratio of nearly three to one. Knowing these facts as they do, do you think that our manufacturers of machinery will follow the advice of these well-meaning gentlemen who have no knowledge of the industry but who tell us that Latin America will not buy our machinery unless made to metric measure? Contrasting the facts with this claim, how much respect can you have for the knowledge of those who make it?

The Metric System Condemned After Trial

Next, I wish to point out that while the system has been repeatedly adopted under high hopes by industries in the United States and Great Britain, it has not made good its promises.

Twenty years ago, the Library Bureau was the star example of the progress of the system in this country. At the foundation of that industry the system was adopted for the manufacture of its products and I have in my office a statement made by a representative of that organization before the House of Representatives Committee on Coinage, Weights and Measures in 1906 in which the system was extolled to the skies and its supposed advantages set forth.

Nevertheless, after thirty years use, the system was abandoned by the Library Bureau which now manufactures its products to the English system. A similar example is found in Great Britain where, in the decade of the 90's, the Williams & Robinson Co., of Rugby, was organized for the production of the Williams' high-speed engine for which the metric system was adopted.

While continuing the system for the production of this engine, because of the difficulty of a change and the necessity of continuity of production, the system was, after 20 years use, abandoned for all new work, and Williams and Robinson summarized their experience in these words: "We are satisfied that the adoption of the metric system has cost us a great deal in gages and special tools without adequate return."

Similarly, the Ericsson Manufacturing Co., of Buffalo, N. Y., manufacturers of the Berling magneto, report that while ten years ago they used the system exclusively, they have now abandoned it.

The pioneer American watch factory—the Waltham factory—adopted the system early in its history. The Water-

bury (now the Ingersoll) Works was established by men from the Waltham Co. who carried the system with them but beyond that the influence of the Waltham example has not gone, all other American watch factories following the English system. Similarly, the pioneer makers of steam-boiler injectors (William Sellers & Co.) adopted the system for that product, but none of their competitors has followed their example, all other makers of injectors being to the English system.

In the cases of watches and injectors, would not the advantage of the system, if it had any, have led to its use by others than the pioneers and is not the fact that others have not used it satisfactory proof that it has no such advantage? Moreover, the firm of William Sellers & Co., which adopted the system for this purpose about 1860 and which thus has a longer experience with it than any other American manufacturer, now says: "Our experience with the metric system, extending over 50 years, does not encourage us to extend its use beyond the borders of the shop and the class of work for which it was originally started."

Another example is found in the optical industry. When, a quarter of a century ago, the making of optical instruments received its great impetus in this country, it was found necessary to import skilled workmen from Europe for the grinding of the lenses. These workmen had learned their calling in the metric system in which all their formulas and working data were embodied and they naturally continued the use of the system here. It is however a striking fact that except the lenses which, numerically, are a small part of optical instruments, such instruments are made to the English system. We thus have the two systems in use side by side in the same factories, and is it not clear that if the metric system possessed the advantages claimed for it, those advantages would have led to its adoption for the remaining parts of optical instruments?

It is to be noted, moreover, that we are now discussing scientific apparatus which, although made chiefly to the English system, is accepted by scientific men as entirely satisfactory for their purposes. This being the case, by what right do these men claim that others will not accept machinery unless made to the metric system?

The investigation of the American Institute of Weights and Measures which has been published under the title "The Metric System in Export Trade" has disclosed the fact that the greatest use made of the metric system by any American industry is found in the production of machine tools and it is a striking fact that not only was this Institute organized within the machine-tool industry, but that in that industry is found the greatest number of its members. Is it not remarkable that the very industry which has made the most use of the system is the one which has combined to resist its further extension? Moreover, not only have individuals connected with this industry organized this Institute, but the National Association of Machine Tool Builders, along with other manufacturing organizations, have repeatedly passed resolutions condemning the system.

The Intellectuals Are Opposed to the System

The metric party has endeavored to convey the impression that the intellectual people of the United States and Great Britain favor the adoption of the metric system. Against that contention is a pamphlet published by the American Institute of Weights and Measures under the title "The Metric System Condemned by Those Who Know," wherein are collected together a large number of condemnations of the system by men of whom the following are representative examples: John Quincy Adams, Past President of the United States; Sir George B. Airey, Astronomer Royal of Great Britain; Association of Railway Master Mechanics; C. A. Bates, Head of Assessment Division, U. S. Treasury Department; Rear Admiral Bowles, Chief Constructor, U. S. Navy; Sir Frederick Bramwell, F. R. S.; four British Parliamentary committees; Prof. N. F. Dupuis, Dean of Practical Science, Queen's University, Canada; Rear Admiral Earle, Chief of Bureau of Ordnance, U. S. Navy; Engine Builders' Association of the United States; James W. Evans, metropolitan inspector of weights and measures, Sydney, Australia; Furniture Association of America; Willet M. Hayes, Assistant Secretary, U. S. Department of Agriculture; H. A. Hazen, Chief, U. S. Weather Bureau; Sir John Herschel, the great astronomer; J. E. Hilgard, Assistant U. S. Coast Survey; Dean William Kent, professor Mechanical Engineering, Syracuse University; B. C. Lamme, Chief Engineer, Westinghouse Electric and Manufacturing Co.; J. H. Linnard, Naval Constructor, U. S. Navy; Hon. David Lloyd George, British Premier; Quartermaster-General M. C. Meigs, U. S. Navy; Rear Admiral Melville, Chief Engineer, U. S. Navy; National Association of Manufacturers; National Association of Machine Tool Builders; National Metal Trades Association; Napoleon; C. P. Patterson, Superintendent of U. S. Coast Survey; Charles T. Porter, past president, the American Society of Mechanical Engineers; Providence Association of Mechanical Engineers; Dr. J. W. Redway, F. R. G. S., geographer, meteorological observer; William Sellers, president William Sellers & Co.; Brown & Sharpe Manufacturing Co.; Ellis Spear, Commissioner of Patents; Herbert Spencer; Dr. John E. Sweet, founder and past president American Society of Mechanical Engineers; Standards Committee Society of Automotive Engineers; F. W. Taylor, past president American Society of Mechanical Engineers, founder of Scientific Management; Hon. R. W. Thompson, Secretary of the Navy; H. R. Towne, past president American Society of Mechanical Engineers; University Convocation State of New York; U. S. War Department, office of Chief of Ordnance; J. A. Williamson, Commissioner U. S. Land Office.

The American Institute of Weights and Measures

In addition to these names, I desire to point out the character of those who comprise the Council of the American Institute of Weights and Measures which was organized to oppose the adoption of the metric system. This Council contains three past presidents of the American Society of Mechanical Engineers, a past president of the American Manufacturers' Export Association, a past president of the Mining and Metallurgical Society of America, the president of the National Association of Manufacturers and a past president of the same organization, a past president of the Society of Automobile Engineers, a past president of the National Metal Trades Association, a past president of the Society of Naval Architects and Marine Engineers, the president of the Westinghouse Electric and Manufacturing Co.; president of the Stevens Institute of Technology and the professor of Mechanical Engineering at Yale University. No other American organization can present such a list of names as this.

Against it, I wish to contrast the character of the Council of the American Metric Association which has been organized to promote the metric system. That council contains a wholesale druggist, two wholesale grocers, a professor of pharmacy, a director of a museum, a secretary of a bourse, and an expert in precious stones.

Which of these two bodies would you select to direct the industrial policy of this country?

I believe I have shown that the judgment of the world condemns the metric system.

Pan-Americanism in Weights and Measures

My Report on the Weights and Measures of Latin America has made clear to many what was formerly known to but few—the great similarity of the Spanish and the English system. Read a few of the ratios of the Spanish system:

12 pulgadas make a pie.
3 pies make a vara.
16 onzas make a libra.
2,000 libras make a tonelada.

These ratios are equally familiar to us all and the onza, the libra and the tonelada differ from the ounce, the pound and the ton by one-half of 1 per cent—a difference so small as to be inappreciable for most purposes; a difference so small that in five of the Latin-American countries, it is now ignored as it might easily be in all.

Do you recognize what I am coming to—Pan-Americanism

in weights and measures—the unification of our weights and measures on the basis of that system which is no more English than it is Spanish and no more Spanish than it is English because it is neither. It is Roman. I am here to urge Pan-Americanism in weights and measures without change of system and with nothing but an adjustment of values to agreement. Pan-Americanism did I say? Aye, but much more than that. Great Britain and her far-flung Empire; the United States, which has taught the world how to do without kings; Latin America, the land of the great and glorious future. What more is needed to stir your blood? What more to send it coursing through your veins in the presence of a great opportunity? I am not here to deal in fine words or phrases. I am here to present a simple, sensible, practicable plan for the promotion of the commercial relations of the two Americas and of the British Empire.

Let us give up the chase of this will-o'-the-wisp which the nations of the world are always chasing but never catching.

Let us consult the experience of the past. Let us recognize that the attempt to adopt the metric system is a failure. Let us work for what is feasible, possible and practicable.

Let us unify the weights and measures of the two Americas and of the British Empire on the basis of the system which came to us all from the mother of us all—the Roman Empire.

What more sane, simple, sensible, obvious, practical, common-sense method of promoting the commerce of the two Americas is there than this? What more fruitful thing can the Pan-American Union do than promote this object?

For what are we here? Is it to promote that threadbare, discredited thing, the metric system, or is it to promote international trade and commerce?

Books As Tools

By E. A. Goeway

The American employer, still striving to overcome the many unusual business and financial conditions which have followed in the wake of the war, is becoming more and more convinced that among the most serious features of his problems are a pronounced shortage of labor and a dearth of workers skillful to the point of high proficiency.

The quantity demands of the war period no longer are maintained in many industries, and the American employer soon must face a sharp foreign competition. However, he is not losing sight of the fact that, in the long run, quality rather than quantity will stabilize "Made in America" goods in the markets of the world. But, to do this, the native manufacturer must obtain employees who are thoroughly capable, in order that the products of the United States may equal in every way the best produced abroad.

How can he obtain this much-desired efficiency on the part of his employees?

To this query there are many answers, but there is no question that one solution of this difficulty points straight to the magic gateway to erudition—books. Already, in line with this thought, many far-seeing manufacturers and heads of business institutions have installed in their plants special libraries of technical books for the use of their workers, as well as for reference by themselves. From these libraries the worker may obtain books giving the most minute information upon the industry in which he is employed, and such books are in demand both during the lunch hour and for quiet reading at home. This plan is not a tentative scheme, but an established fact; and in the places where it has been followed it has met with the greatest favor on the part of both the employer and the worker.

When the country is considered as a whole, there is still a deplorable lack of good libraries in business houses, shops, mills and factories. Every employer should be brought to see the benefits to be derived from these special libraries; and an important step toward this has been taken by the American Library Association in its Enlarged Program, which is being carried out with the significant slogan, "Books for Everybody."

At the present time the A. L. A. is supplying books to the men in the Public Health Service Hospitals, to the sailors of the American Merchant Marine, to the coast guards and lighthouse keepers and to discharged soldiers.

The Enlarged Program contemplates doing many things toward an even more general extension of the library service, emphasizing four outstanding purposes.

One of these, and a very important one indeed, is to encourage a larger use of the technical books now in

THE WELL-EQUIPPED READING ROOM OF THE NATIONAL CASH REGISTER PLANT

the public libraries and to urge employers of labor in factories and plants to install special libraries of technical books for the use of their employees. The Special Libraries Association is giving its aid toward this campaign. The A. L. A. will also endeavor to bring about the extension to all parts of the country of the county library system, which is now successfully in operation in a number of states, so that the dwellers in even the smallest hamlets may be brought in intimate touch with the newest and best books.

It will attempt to further the movement to have a greater number of books printed in the standard Braille type for the use of the blind. It purposes to assist the new Americans, who number several millions, to become better citizens by seeing to it that they are supplied with books dealing with American ideals, aims, and traditions. To carry out this latter purpose publishers will be asked to print, in various foreign languages, some standard American works which come under the above classification, so that the immigrant upon arriving in this country may have this literature placed in his hands in the language which he will understand most easily. To carry out this Enlarged Program the American Library Association will raise a fund of $2,000,000, not, however, by an intensive drive or campaign, but through the librarians, library trustees and friends of libraries.

Lapping and Measuring Small Cylindrical Plugs

BY HUGO F. PUSEP

The lapping of very small cylindrical surfaces has problems all its own, and, although not difficult of solution, the mechanic has to know how to go about it in order to attain good results with a minimum of experimenting. In the following contribution the author has endeavored to explain as clearly as possible the methods and the reasons therefore of lapping and measuring small cylindrical surfaces to a minute degree of accuracy.

IT IS a well-known fact that as tools decrease in size the skill of the toolmaker must increase in proportion. This is shown clearly when we consider the finishing of small cylindrical surfaces to very accurate limits. Small plug gages, slender piercing punches for sub-press dies, measuring wires for various purposes, and all similar work demand a high degree of accuracy which can only be attained by careful workmanship and correct practical methods.

On larger cylindrical work it is the practice to grind to within two- or three-tenths of size, after which the work is finished with a lap. This method is practical down to comparatively small diameters, but grinding becomes anything but satisfactory on pieces less than $\frac{1}{8}$ in. in diameter. Although work as small as $\frac{1}{16}$ in. in diameter has been ground with a fair degree of success, as a general rule chattering and springing of the work in sizes below $\frac{1}{8}$ in. tend to defeat the desired end. This is particularly unavoidable where the work to be ground is of any considerable length.

Drill rod is almost exclusively used for small work because it is available in the small sizes likely to be required. For purposes of illustrating the various steps that are necessary to the production of small cylinders, let us assume that a hardened steel plug 2 in. long is required to be parallel and 0.032 in. in diameter, and well within 0.0001-in. limits of accuracy.

For this plug, the most suitable size of drill rod would be No. 65 (0.035 in.). This size, it will be noticed, is about 0.003 in. larger than that of the finished plug. This oversize will take care of shrinkage in hardening and will provide ample material to be removed so as to leave a perfectly clean surface after finishing. As a general rule, the drill rod for any given size of plug or wire should be at least 0.002 in. larger to begin with.

After cutting off a piece of drill rod about 3½ in. long it is filed down as shown at *A*, Fig. 1. This is done in a bench lathe with a narrow pillar file. The clearance groove, as it is called, may be about ¼ in. long and should be filed to the ultimate diameter of the plug, or at the most only a thousandth or so smaller. The longer end of this wire is then hardened and drawn to a suitable temper, after which it is ready for finishing.

FIG. 1. THE PLUG READY FOR LAPPING

Lapping is the only method whereby accurate results can be obtained. On large work of this nature anything resembling an external lap could be used successfully whereas small work demands a lap particularly adapted to it. The operation of lapping is divided into two stages—roughing and finishing—the form of lap, however, being identical for both.

An ideal form of lap is shown at *A*, Fig. 2. It is made of close-grained cast iron and, although very simple, has some points about its construction that are, no doubt, new to mechanics not familiar with this class of work. The different stages in the making of this lap are shown at *B* and *C*, Fig. 2.

The lap is made double ended in order to utilize one end for roughing and the other for finishing. After planing up a rectangular cast-iron plate *B*, the two lapping holes *D* are drilled. It is well at this stage to mark the holes "R" and "F," as at *A*, Fig. 2, meaning roughing and finishing, to avoid confusion later on. The roughing hole is drilled out a slip fit for the hardened drill-rod plug which it is to lap, while the finishing hole is made about 0.0005 in. larger than the finished size of the plug. It is a comparatively easy matter to drill these holes to the right size by selecting the proper size twist drill, but under no consideration should one attempt to finish either hole with one drill. A drill that is a few thousandths undersize should be used first and the second drill employed as a sort of reamer. If the corners of the reaming drill are honed off care-

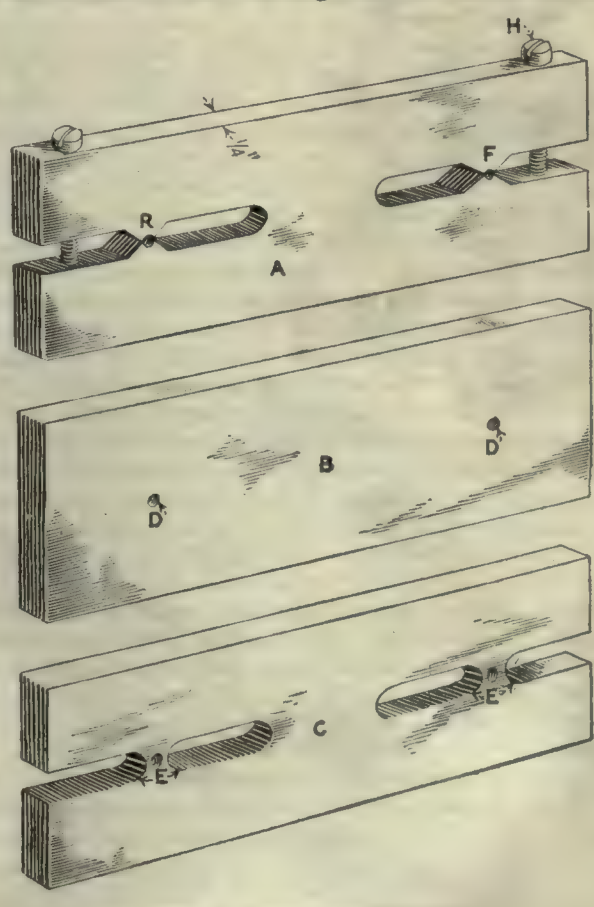


FIG. 2. MAKING THE LAP

fully, a very smooth hole can be made. Should occasion arise where the right size of drill is not obtainable, an improvised gun drill, well known to most toolmakers, can be made of drill rod for reaming to any size required.

The elongated slots *E* are now worked out to convenient size by drilling and filing. In the final stages of making this lap, a three-cornered, or a knife-edge, file according to size of the holes, is used for filing the V's in such a manner that they will just break through the lapping hole from opposite sides, as shown at *A*. A glance at the enlarged diagrams in Fig. 3 will show the futility of using a saw blade—even though but 0.010 in. in thickness—for slotting a lapping hole 0.020 in. in diameter as at *A*. Slotting the same lap if done with a small file, will leave a lapping surface which is practically unbroken. Two small fillister-head screws for adjusting the tension will now complete the lap.

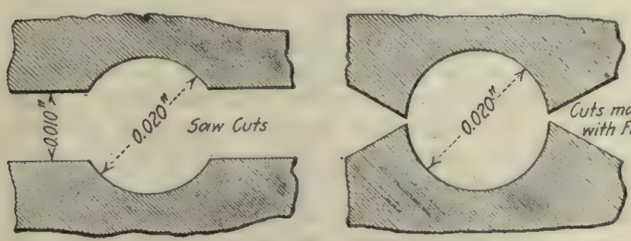


FIG. 3. FUTILITY OF SAWING OPEN THE LAP

The thickness of this lap should be about $\frac{1}{4}$ in., consequently giving that length of lapping surface. Although there is no set rule, the writer has found that even on extremely small sizes the lapping surface should not be less than $\frac{3}{16}$ in. in length in order to have the lap function properly.

The plug shown in Fig. 1 is now ready for lapping, being held by the short end *B* in the bench lathe collet or chuck, leaving the long end, and the recess *A* extending. Thus the lap will clear itself at each lapping stroke over this recess, thereby preventing the lap from wearing bellmouthed. It will also prevent it from seizing on the plug, which would surely be the case if the lapping was attempted without this clearance groove.

Should a wire be too small for the smallest collet, a simple adapter can be easily made from a short piece of round cold-rolled steel of a size to fit the smallest collet—which usually has a $\frac{1}{8}$-in. hole—by drilling a slip fit hole for the wire and then sawing it longitudinally as shown at *A* in the enlarged sketch, Fig. 4.

This saw cut does not run into the central hole, however, but comes a little short of it, so when the opposite side is split with a sharp V-form as at *B*, the collet, on being tightened, will spring the adapter sufficiently to hold the wire firmly against the strain incidental to lapping.

Although the actual operation of lapping small-diameter wires differs but slightly from that of any larger cylindrical work, there are several points of importance to be considered. Nothing coarser than emery flour should be used for both the rough and finish lapping. Very good results are obtained by using 1F grade for the rough lapping, and 6F for finishing. The 1F grade leaves a finish that appears smooth to the naked eye, but the magnifying glass will disclose a multitude of minute grooves. The purpose of the very finest grade of emery flour for finish-lapping is to practically eliminate these grooves.

After the roughing lap has reduced the plug to within 0.0005 in. of size, the lap, plug and bench lathe are cleaned thoroughly; in short, every precaution is taken that the two grades of lapping compound do not get mixed. In finish-lapping only a very small amount of emery flour is used, lubricating the lap frequently with pure lard oil. Too much emphasis cannot be laid on using only the best oil obtainable, because it will aid materially in producing a mirror-like finish. Very little pressure is exerted on the finishing lap. It should be held with finger tips alone; then all the high spots on the plug can be easily "felt" and reduced accordingly.

When the wire is getting close to size the lap is washed clean of all loose emery and then used with oil alone. Move the lap back and forth over the length of the plug in methodical strokes. Referring to Fig. 1, let us assume that the bench lathe is running at its highest speed; a good average time for the lap to travel $2\frac{1}{2}$ in. would be about one second. This stroke is necessary for the purpose of eliminating all traces of circular grooves on the surface of the plug. All high spots, however minute, will likewise be eliminated.

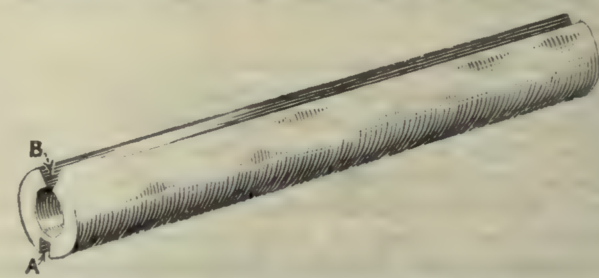


FIG. 4. ADAPTER FOR HOLDING ODD-SIZED WIRES

Frequent measuring is imperative toward the end of the finish-lapping. The micrometer which has been used exclusively up to now, is dispensed with. The degree of accuracy of the plug now depends entirely on the measuring equipment used in the final stages.

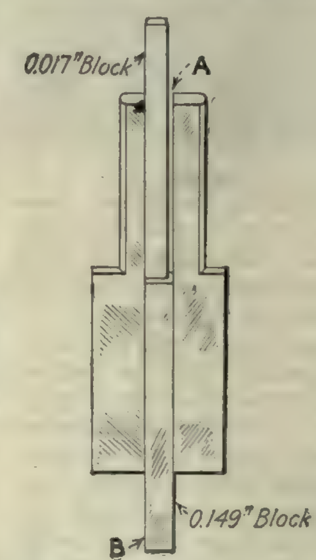


FIG. 5. THE METHOD OF GAGING

In shops where precision gage blocks are available, they furnish ideal means of measuring this class of work by direct reading. Taking our plug of 0.032 in. in diameter as an illustration, we select two blocks whose difference in size equals 0.032 in. The largest block of the two—in this case, let us say 0.149 in.—is wrung between the two regular jaws of the gage set, as illustrated in Fig. 5. Then the smaller block, namely, 0.117 in. thick, is also wrung onto one of the jaws as clearly shown on the sketch, leaving a space *A* exactly 0.032 in. wide. This set-up is secured in an upright position on a surface plate by clamping the end of the lower block *B* in a parallel clamp, protecting the gage block with fiber or other soft material.

Preparatory to measuring, the plug is washed in

clean gasoline, wiped dry and then laid on the surface plate alongside of the gage set-up. In a few moments the temperature of the plug will become the same as that of the surface plate and gages. The plug is now entered into the opening *A*, Fig. 5, and should it be possible to slide it down till it touches the lower block *B* without spreading the jaws and causing them to fall apart; then the plug must be 0.032 in. in diameter, plus or minus an infinitesimal quantity.

Two similar sets should be made up or other gage blocks, one giving the size plus 0.0001 in., and the other the minus limit; any four gage blocks will serve as jaws in this instance. With three sets thus arranged it will seem really remarkable how easily such a small quantity as one ten-thousandth inch can be measured.

The short end *B*, of Fig. 1, which has been used so far for the purpose of holding it in the bench lathe collet, is now secured in a soft-steel handle. If used for other purposes than a plug gage, this soft end is treated to suit the particular needs of the case.

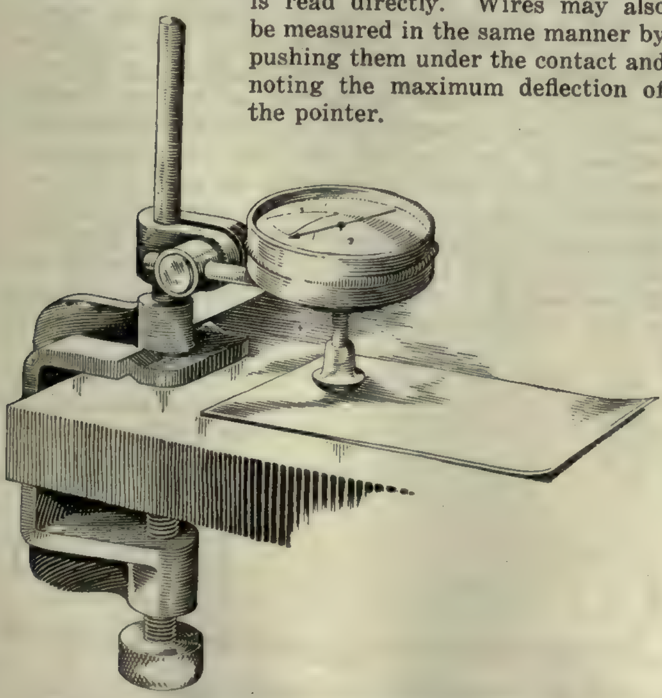
Dial Indicator Used as Direct-Reading Thickness Gage

By H. H. Parker

An ordinary dial test indicator makes a most convenient direct-reading thickness gage, and, when the accuracy of its readings is sufficient for the purpose, it saves all the trouble of handling a micrometer and figuring out its readings.

The device is merely clamped to a surface plate or other accurate and smoothly finished surface with the contact button touching the surface of the plate. After setting the pointer to zero, the piece to be measured is slipped between the plate and button and its thickness may be read at once.

Another method is to slip a standard piece under the gage and then turn the dial to register zero. After the standard piece is removed, others are slipped into place and the plus and minus amounts by which they differ from the standard (the dial reading both ways) is read directly. Wires may also be measured in the same manner by pushing them under the contact and noting the maximum deflection of the pointer.



USING A DIAL INDICATOR AS A THICKNESS GAGE

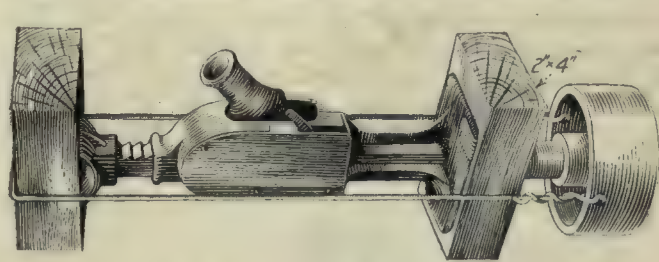
Another Use for the Jack

By Gustave A. Remacle

While jacks are made primarily for the purpose of lifting, I recently discovered that they, like the screwdriver, can be used for many purposes.

I was helping a young automobile man to take apart a Ford motor when we were brought to a halt by the disk drum which had rusted fast to the transmission shaft. The drum had resisted all our efforts to remove it by means of prying and hammering.

After a few moments' reflection the young chap brought out a little one-ton jack and rigged it up as shown in the sketch. The piece of stout wire was bent



HOW THE JACK WAS USED

and fastened to the drum as shown. The two pieces of two by four were used to keep the wire clear of the jack. With this set-up and the powerful little jack in action, the stubborn drum began to move, reluctantly but surely.

To date I have never seen a jack used in the machine shop for any other purpose than lifting or supporting. There are probably many instances where a jack could be used to advantage in the machine shop. If the line of work does not warrant having a jack in the tool crib, one can be borrowed for an emergency, from the boss' car which stands in front of the shop.

Calculating Gears for Practical Threads

By J. Crommell

All the instructions (so far as I have seen) for calculating the gears to be used in cutting fractional threads, involve the figuring of the number of turns of the work and lead screw and their relation to the gears. This is like a problem in square root; if you don't get mixed up this time, you will the next.

To find the number of threads to the inch when a fractional lead is given, all you have to do is to invert the fraction. For instance if the lead is $\frac{7}{8}$ in. the number of threads per inch will be $\frac{8}{7}$ or $1\frac{1}{7}$; if it is $\frac{5}{8}$ the number will be $\frac{8}{5}$ or $1\frac{3}{5}$ to the inch.

Suppose you get an order to cut a $\frac{7}{32}$-in. lead on a certain piece; this equals $\frac{32}{7}$ or $4\frac{4}{7}$ threads to the inch. You put a 32-in. gear on the lead screw of the lathe and multiply the lead of the latter by 7; that is, if the lead of the lathe screw is 4, then $4 \times 7 = 28$, the gear to put on the stud; if the lead is 5, then $5 \times 7 = 35$, representing the stud gear required.

In multiplying by 7 you have (probably without being aware of it) multiplied $4\frac{4}{7}$ by $7 = 32$, and to keep the proportion you multiply the lead of the lathe screw by the same number.

All apparently difficult thread problems are nothing more than simple proportion, just as you used to do it in the little red school house.

The Langelier Hot Swaging Machine

By E. L. DUNN
Associate Editor, *American Machinist*

Machine swaging in its various forms has been practiced for many years, the art of which has been described in the "American Machinist" as far back as 1896 and as recently as Dec. 11, 1919. The purpose of this article is to describe a certain type of swaging machine and its work.

SWAGING machines of modern design are not commonly known and are seldom seen in the average shop equipment, particularly the late models of large size that are designed to handle a special line of work. Such a machine, shown in Fig. 1, was recently built and tested in the shops of the

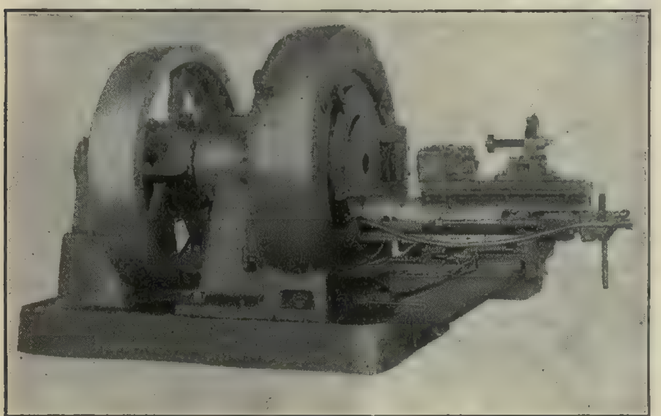


FIG. 1. THE LANGELIER 8 HS 9 SWAGING MACHINE

Specifications: Number of machine, 8 HS 9; capacity tubes, 5½ in., rods, 2½ in.; r.p.m of flywheel, 150; air pressure required, 90 lb.; hydraulic pressure, 125 lb.; size of motor, 40 hp.; speed of motor, 900 r.p.m.; size of machine base, 54½ x 88½ in.; floor space required for operation, 138½ x 118½ in.; height of machine, 78 in.; approximate net weight, 16 tons.

Langelier Manufacturing Co., Providence, R. I. It was designed especially to form a U-shaped joint uniting a pair of pipes, but is not limited to this one class of work, as it can be used to a decided advantage on many forms of straight work.

Combined Langelier Features

The design employs standard Langelier construction combined with a number of special features. The swaging dies are arranged to operate in the usual manner common to machines of this type. The operation may be readily understood by reference to Fig. 2, which shows the arrangement of the dies, rollers, etc., in the machine head. Briefly described, a pair of oppositely disposed swaging dies are carried in the spindle head and are caused to open and close rapidly as the spindle revolves. The dies are opened by centrifugal force and are closed or squeezed together, when passing between a pair of fixed rollers, located in the stationary head, it being understood that suitable hammer blocks are interposed between the dies and the rollers. There are six pairs of the fixed rollers that form a circle around the spindle head, consequently the dies are forced together six times during each revolution of the spindle. As the machine runs at a speed of 150 r.p.m., the dies deliver 900 blows per minute, and the work is thus swaged, or hammered into shape as it is fed into the dies. The work saddle, or carrier, arranged in front of the machine head, is provided with air operated clamping jaws for holding the work. The saddle is moved on its slide-ways by haudraulic pressure, the movement being controlled by a hand valve.

Swaging Operation

When two pipes are to be joined in the form of a U-shaped bend, as shown in Fig. 3, they are first welded together by hand, with the ends forming a single opening, as shown in Fig. 4. The pipes thus united by the incomplete bend are again heated to welding temperature and then properly located between the clamping jaws, one pipe above the other. The clamping jaws

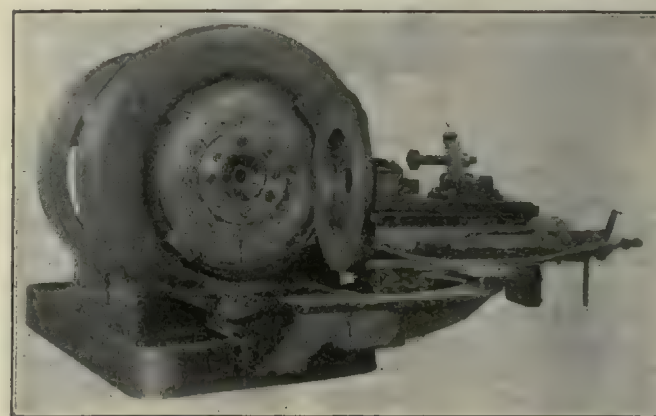


FIG. 2. SADDLE HEAD SWUNG ON ITS HINGES TO SHOW ARRANGEMENT OF DIES AND ROLLERS

have forwardly extending, reinforcing members which fit snugly into the curvature of the bend at each side, thus holding it rigidly in place during the swaging operation, and counteracting the twisting force exerted by the rapid rotation of the swaging dies. The jaws are closed initially with a moderate clamping effect by a manually operated handle, but as the work saddle moves slowly forward forcing the incomplete bend between the swaging dies, the jaws are automatically brought closer together, gripping the pipes with great pressure. This is accomplished by means of the pneumatic device, which is shown in Fig. 5. The controlling valve is governed by movement of the work saddle and is operated by a lever and cam arrangement located at the opposite side and shown in Fig. 1. As the

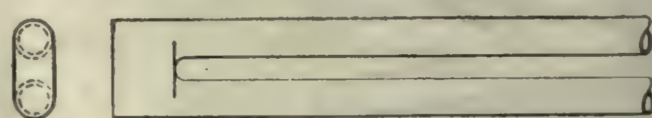


FIG. 3

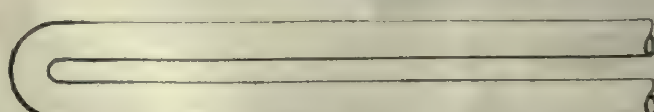


FIG. 4

FIG. 3. THE INCOMPLETE JOINT BEFORE SWAGING
FIG. 4. THE COMPLETED U-JOINT AFTER SWAGING

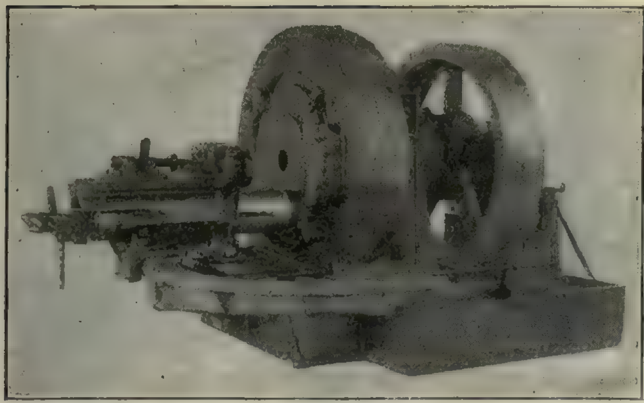


FIG. 5. SHOWING ARRANGEMENT OF AIR OPERATED CLAMPING JAWS

unfinished joint is forced into the vibrating dies its opening is closed and the metal consolidated in the form of a U-shaped bend. The joint being complete, the projecting tit is cut off and its root smoothed down by land with the aid of a swaging hammer. The bulge in the bend, caused by the swaging operation, is straightened or flattened out in a suitable press. A structurally defective or deformed bend is prevented by the manner in which the work is first securely seated in place and then gripped and supported by the clamping jaws.

Other Work of Machine

In addition to forming U-joints as above described, the machine is capable of turning out a large variety of straight work such as shown in the line cut, Fig. 6. The tubes shown were each heated and swaged at one pass and turned out at the rate of two tubes per minute, the machine being equipped with the automatic clamping jaws and running at a speed of 150 r.p.m. On work of this character the machine has a capacity for tubes as large as 5½ in. in diameter and rods as large as 2½ in. in diameter.

Owing to the great size of the machine and heavy weight of the parts, a curved base support, shown plainly in Fig. 2 and Fig. 5, is provided to support the outer end of the work-saddle mechanism. A special foot attached to this rests upon the base support and relieves the hinges of weight when the saddle arrangement is swung to one side, as shown in Fig. 2. The entire machine is solidly constructed and all details have been taken care of so as to produce a unit of great strength and endurance. The machine head is provided at the back with a cored and webbed chamber, having wide ports through which a continuous flow of water is maintained either by city pressure or by means of a small pump. This cooling provision permits the machine to be continuously operated on hot stock and greatly increases its efficiency. The machine spindle is exceptionally large and heavy, of hammered steel turned and ground, bored throughout its entire length and slotted diametrically across the enlarged head. A circular steel ring, tongued and screwed in, greatly strengthens this open end. The sides of the slot are lined with hardened steel plates riveted in place. The spindle runs in loose cast-iron, perforated, sectional bushings that are turned and ground. These slowly creep around as the spindle revolves, giving about 50 per cent more bearing surface, and making it possible and inexpensive to replace them when worn out, without requiring that the entire head of the machine be sent back to the factory for repairs, as would be the case if the spindle revolved directly in a solid head, or a solidly bushed head. The full power of the flywheel, exerted on the dies, explains the ease and rapidity with which the machine produces the great reductions of different pieces accurately to size without chatter marks, and at a speed not possible by any other process. The 40-hp. motor handles the work readily and with ample reserve power as full-load requirements seldom exceed one-half that amount.

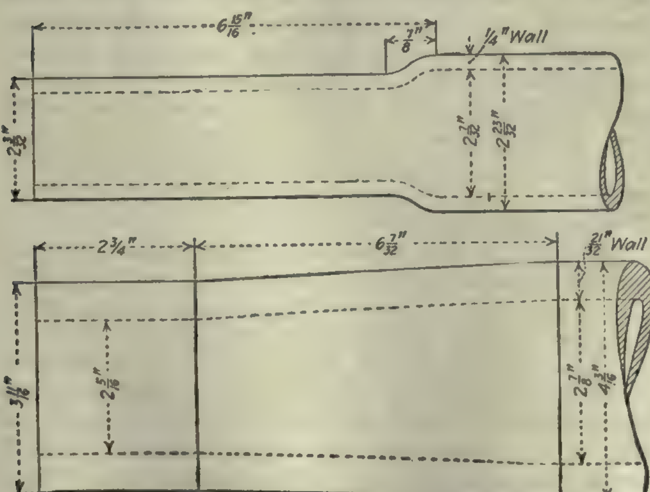


FIG. 6. SAMPLES OF TUBE SWAGING

An Oxy-Acetylene Welding Job

By A. F. Morton

The illustrations show two breaks in a press frame that were successfully welded by the oxy-acetylene process.

The first break occurred at *A*, Fig. 1. This was welded and the press was back in service in 18 hr. No reinforcing metal was added to the surface of the casting and the bearing was in such good alignment that no work on it was necessary.

After about six months' service the frame cracked on the opposite side and lower down, as shown at *B*, Fig. 2. The crack appears larger than it actually was, as considerable metal had been cut away to make a good weld.

The location of the crack made preheating necessary. The job was completed and returned to the owners in 48 hr. and the press is again giving good service.

Fig. 3 shows the first break at *A*, while the last one, after the weld was completed, is shown at *B*.

THE PRESS FRAME SHOWING THE WELDS
Fig. 1—The first break after welding. Fig. 2—The second break (ready for welding). Fig. 3—Both breaks after welding.

Firing Orders of Internal Combustion Engines

By K. H. CONDIT
Managing Editor, *American Machinist*

This discussion of the firing orders of gas engines in everyday use is presented for the benefit of the man who likes to play with experimental engines but who has never had time to go very far into the reasons why. Much of the difficulty caused by the unfortunate lack of uniformity in the method of designating cylinders can be overcome if the method described here is followed. The method is not new but does not seem to have been adopted universally by any means.

SO MANY people have trouble in figuring out what the firing order of an automobile or airplane engine is or ought to be that it has seemed worth while to work out this little system to show how easy the whole thing is. It must be understood that this scheme is based on the usages of common practice and may not cover all the freak engines that have been built and made to run. There are also a few exceptions to the general practice which only go to prove the rule.

The simplest multi-cylinder engine in general use at the present time is, of course, the four-cylinder type. Experience has proved that a crankshaft with the outer crankpins, No. 1 and No. 4, in line with each other, and with the inner ones, Nos. 2 and 3, in line with each other, but 180 deg. away from the outer ones, gives the best results. Fig. 1 shows such a shaft. With this arrangement it is evident that a four-cylinder, four-cycle engine can only fire two ways, either 1-2-4-3 or 1-3-4-2, for the impulses occur at intervals of 180 deg. of crankshaft revolution. The duration of the four-stroke cycle is 720 deg. and the interval for even spacing will be 720 deg. divided by the number of cylinders.

A Chronological Experiment

There is a story that in the early days of automobile construction there was a manufacturer with a very orderly brain who conceived the notion that 1-2-3-4 would be much more logical or perhaps chronological than the ordinary way. He built an engine with a special crankshaft to give this firing order and even got so far as putting it in a chassis and starting it. It ran all right, but showed a marked disinclination to stay with the rest of the car. The rocking motion set up by the wave of impulses soon broke every holding-down arrangement that could be devised. They finally gave it up, put in a conventional crankshaft and camshaft and the motor ran beautifully without the slightest tendency to rock. That settled the chronological idea.

The eight-cylinder, V-type firing order naturally comes next as it is based on either one of the four-cylinder orders just mentioned and because the eight uses the same shaft as the four, two connecting-rods being attached to each crankpin instead of one.

Here we strike a snag in the various methods of designating cylinders. In the four this does not make so much difference, for the same result is arrived at no matter which end you start from. There is little doubt that the best and most logical method to follow is to number the cylinders from 1 to 4 right and from 1 to 4 left, commencing from the starting crank end of an automobile engine and from the end opposite the propeller end of an airplane engine. This makes the output end of each engine the one with the highest-numbered cylinder nearest to it. Fig. 2 shows diagrammatically this system of numbering applied to eight-cylinder engines.

Firing Orders of an Eight

Assuming that our cylinders are numbered this way, and that our cylinder blocks are inclined at 90 deg., which is customary, we can evolve two firing orders from each four-cylinder firing order. The firing interval will be 90 deg. and the firing order will alternate between the two blocks. The easiest order to work out will be obtained when opposite cylinders, that is, the ones whose connecting-rods are fastened to the same crankpin, fire consecutively. Application of this principle gives two firing orders, 1L-1R-2L-2R-4L-4R-3L-3R and 1L-1R-3L-3R-4L-4R-2L-2R.

Reference to Fig. 2 will show that instead of firing opposite cylinders such as 1L and 1R we could fire cylinders whose rods come to different pins which are in line, for example, 1L and 4R or 2L and 3R. The only changes necessary in the engine would be in the camshaft and wiring. The other two firing orders are then 1L-4R-2L-3R-4L-1R-3L-2R and 1L-4R-3L-2R-4L-1R-2L-3R. It is probable that the engine balance is slightly better with either of these arrangements than with the first two mentioned.

So far nothing has been said about the direction of

rotation of the crankshaft. In automobiles the rotation is clockwise when the observer stands in front of the car, except in a very few cases, notably an old Stearns model. With an electric starter fitted to the engine it

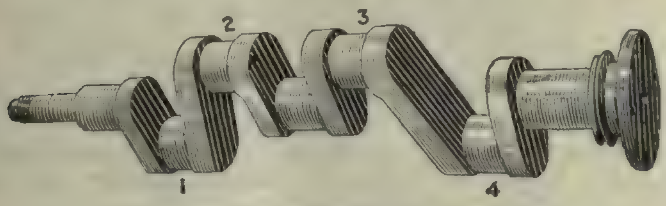


FIG. 1. FOUR-CYLINDER CRANKSHAFT

really makes very little difference to the operator which way the crankshaft turns, but before the days of starters when "tail-twisting" was in vogue, the natural right-handedness of the big majority of the population dictated the direction of rotation.

Direction of Rotation of an Airplane Engine

When it comes to airplane engines all sorts of contradictory ideas are encountered. With a direct-drive tractor the usual way is to call the motor a clockwise motor if the pilot, as he sits in his seat looking forward along the cylinders, sees the propeller describing clockwise circles. If the propeller is driven through reduction gearing the question arises as to whether to judge by the rotation of the propeller or of the crankshaft. It would seem better to judge by the crankshaft, although this is not the usual practice, because the type of reduction gearing used on the Rolls-Royce drives the propeller in the same direction as the crankshaft rotation, while in the Sturtevant the directions are opposite.

Still further confusion results when we take the rotating cylinder type into account. Here the observer stands out in front of the airplane and determines the direction of rotation from that position. Consequently, a counter-clockwise Gnome or Le Rhone engine will rotate a propeller in the same direction as a clockwise Curtiss or Liberty engine.

To simplify this discussion we will decide the direction of rotation from the crankshaft, the observer standing in front of the engine; that is, at the end opposite the output end. This will help in the consideration of six-, twelve-, and eighteen-cylinder engines, all of which use the same type of crankshaft.

The six-cylinder shaft is built in two ways which are arbitrarily called right-hand and left-hand, this distinction having nothing whatever to do with the direction of rotation. Fig. 3 shows views of both arrangements of crankpins. When the observer stands in front of a

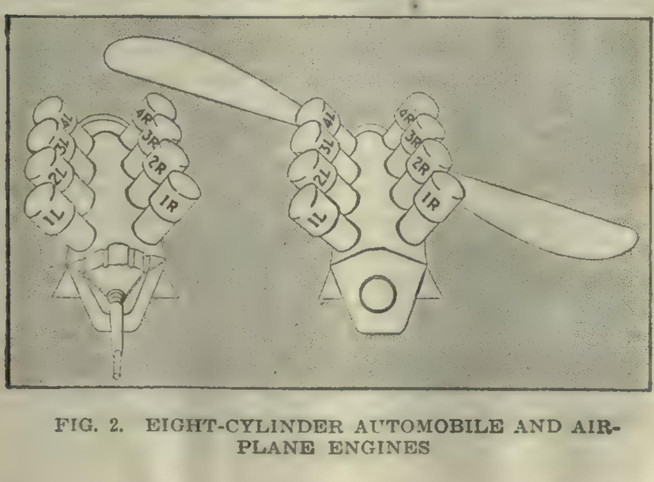


FIG. 2. EIGHT-CYLINDER AUTOMOBILE AND AIRPLANE ENGINES

right-hand crankshaft which has been rotated so that crankpins 1 and 6 are vertically upward he will see the center crankpins, 3 and 4, to the right of the center line and 2 and 5 to the left. This is reversed for the left-hand shaft.

The crank arms are at 120 deg. to each other to give even firing angles of 120 deg. This value is determined as before by dividing the total duration of the cycle, 720 deg., by the number of cylinders. A glance at Fig. 3 will show that the number of possibilities in the firing order of the cylinders is greater than with the simpler crankshaft. If we rotate the right-hand shaft clockwise, we could fire the cylinders in the two orders 1-2-3-6-5-4 and 1-5-3-6-2-4. Experience has shown, however, that it is not advisable to fire adjacent cylinders consecutively, and, consequently, we can eliminate the first arrangement as unsatisfactory. The second arrangement is then the one to be expected when the shaft under consideration is a right-hand shaft and rotates

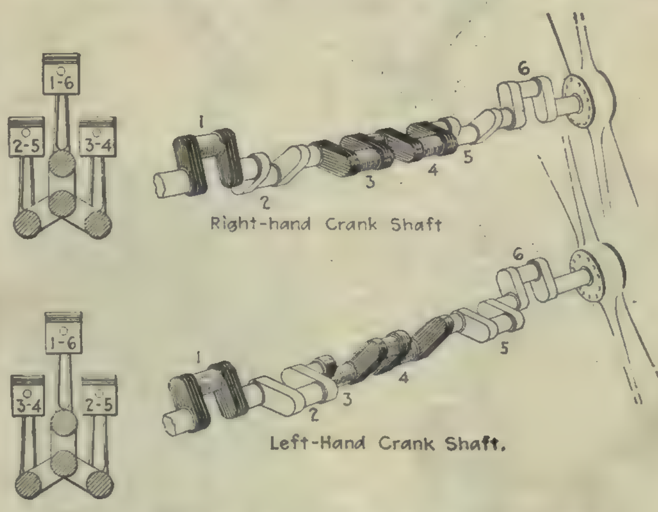


FIG. 3. RIGHT- AND LEFT-HAND SIX-CYLINDER CRANKSHAFTS

clockwise. A little study will show that it is also the firing order of the left-hand shaft turning counter-clockwise.

It might be well to mention at this point the ways of determining the direction of rotation of the crankshaft. If the engine is assembled it is only necessary to turn the shaft slowly by hand, watching the valves on any one cylinder during the process. If the inlet valve is seen to open immediately after the closure of the exhaust valve, the direction of rotation is correct.

With the engine disassembled, an inspection of the camshaft to determine the relative positions of the cams which open the valves of any one cylinder will answer the question. The relative directions of rotation of the camshaft and crankshaft due to the type of gearing used must be taken into consideration, as in the average L-head motor the directions are opposite, while in some overhead-valve types they are the same.

Returning now to our right-hand crankshaft—if we rotate it counter-clockwise we get the firing orders 1-3-5-6-4-2 and 1-4-2-6-3-5. The first is bad because 2 and 1 and 5 and 6 are together, but is in use on at least one six-cylinder engine, that installed in the 120-hp. Holt tractor. The other is the conventional one and will also apply to the left-hand shaft when rotating clockwise. This exhausts the reasonable possibilities and leaves us with practical firing orders, 1-5-3-6-2-4 and 1-4-2-6-3-5.

Just as tne V-type eight is a double four so the V-type twelve is a double six or twin six, as it is sometimes called, and uses a six-cylinder crankshaft, either right- or left-handed. The direction of rotation is ordinarily clockwise, although some airplane engines for multi-engined machines turn counter-clockwise to equalize the torque.

The normal firing angle of the V-type twelve is, of course, 60 deg., but in some airplane engines, the Liberty, Renault and Lancia, for example, this angle has been reduced to cut down the width and consequently the head resistance of the engine. This sacrifices the even firing angle, but apparently has no particularly detrimental effect on the running of the engine. The change, however, has nothing to do with the firing order.

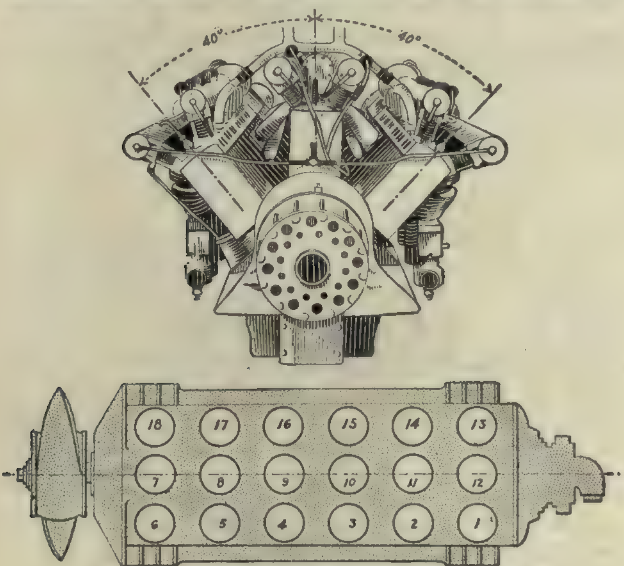


FIG. 4. THE 18-CYLINDER W-TYPE AIRPLANE ENGINE

If we number our cylinders as we did those of the eight, from 1 to 6 right and 1 to 6 left, we can, by applying the same reasoning, obtain four twelve-cylinder firing orders, as follows: 1L-1R-5L-5R-3L-3R-6L-6R-2L-2R-4L-4R, 1L-1R-4L-4R-2L-2R-6L-6R-3L-3R-5L-5R, 1L-6R-5L-2R-3L-4R-6L-1R-2L-5R-4L-3R, 1L-6R-4L-3R-2L-5R-6L-1R-3L-4R-5L-2R.

The third one is in most common use, as most twelve-cylinder engines use right-hand shafts turning clockwise.

We can go one step further with this development and take in the 18-cylinder W or broad-arrow type exemplified by the 18-cylinder Sunbeam, which is essentially a V-type twelve with an extra row of six cylinders down the middle. Assuming that a right-hand, clockwise crankshaft is used, we can readily work out the firing order of this type if we know one other fact about it, that the cylinders opposite each other on the outside banks fire in the same group with the center cylinder whose rod comes to the other crankpin in line; that is, 1L and 1R, whose connecting-rods come to No. 1 crankpin fire in the same group with 6C, whose rod comes to No. 6 crankpin. The firing angle is 720 deg., divided by 18 or 40 deg., and the angles between the cylinder blocks are 40 deg. as shown in Fig. 4.

If we follow through the scheme just outlined, we can obtain the firing order which follows: 1L-6C-1R-5L-2C-5R-3L-4C-3R-6L-1C-6R-2L-5C-2R-4L-3C-4R. This makes use of our standard method of cylinder numbering and is comparatively easy to remember or work out. The maker numbers the cylinders in tne manner shown at *A*, Fig. 4, and his method of numbering makes the firing order read 1-7-13-5-11-17-3-9-15-6-12-18-2-8-14-4-10-16. There is apparently no rhyme or reason to this, although it is just the same as the other one and it would take a memory expert to figure out a scheme by which to remember it without chance of mistake. The same applies to twelves and eights, which are numbered to suit the fancy of the designer, with the exception of the little Curtiss airplane engine, which has a firing order, using the maker's numbers, that almost repeats itself—1-2-3-4-7-8-5-6.

Nothing has been said about the eight-cylinder-in-line, 12-cylinder W-type or 16-cylinder twin engines because they are not in common use and have hardly emerged from the experimental stage.

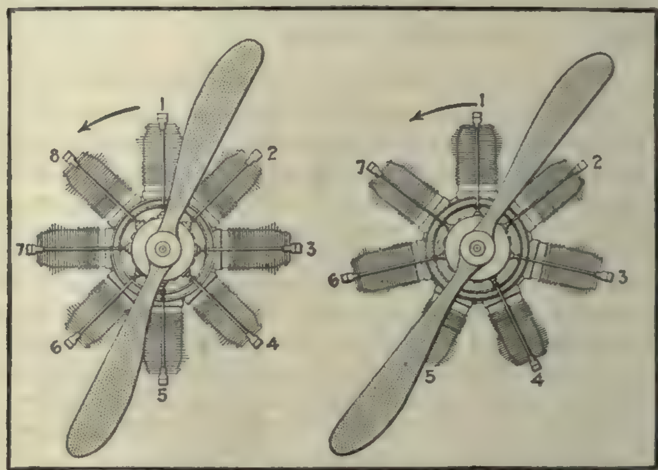
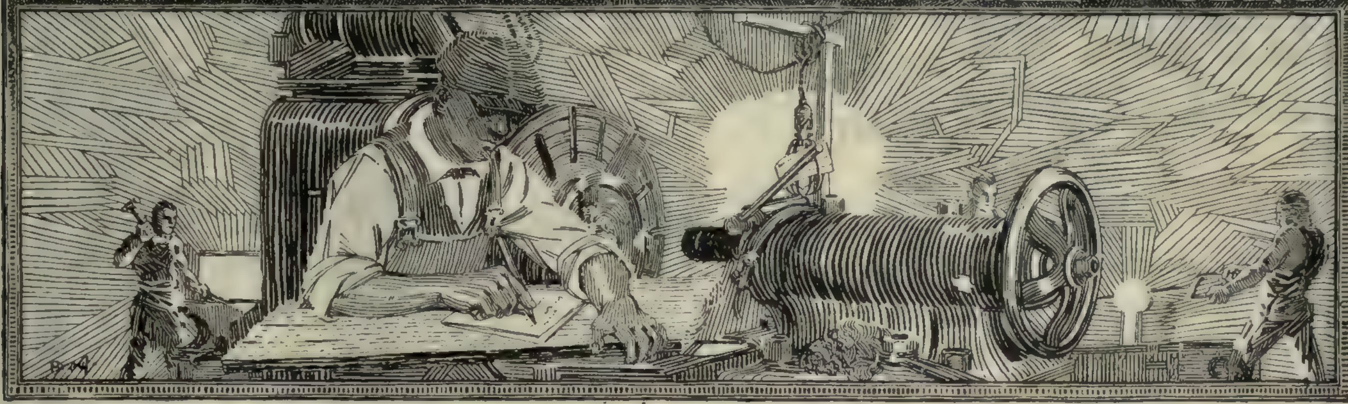


FIG. 5. DIAGRAM OF ROTARY-ENGINE CYLINDER ARRANGEMENTS

To close the discussion, a word about the rotary or revolving-cylinder engines should not be out of place. Engines of this type such as the Gnome, Le Rhone and Clerget, generally have the cylinders arranged radially in one plane about a drum-shaped crank case, all the parts being made of steel to secure the requisite strength. A brief study of Fig. 5 will show why they invariably have an odd number of cylinders, 5, 7, 9 or 11. The engines mentioned are all of the four-cycle type and turn counter-clockwise as viewed from the propeller side. The engine must make two complete revolutions to complete one cycle during which each cylinder fires once. If we try to work out the firing order for an even-cylindered engine, such as the eight shown diagrammatically in Fig. 5, we find that we must either fire all the cylinders during the first revolution and have them all dead during the second one, a manifest absurdity, or else fire them alternately, in which case there will be a break where the two series join. For example, if we fire 1-3-5-7-2-4-6-8-1- etc., we have 90-deg. firing angles between 1, 3, 5 and 7 and 2, 4, 6 and 8, but a 135-deg. angle between 7 and 2 and a 45-deg. angle between 8 and 1. There is no way out of the difficulty except to add or remove a cylinder, in which case we get a firing order of 1-3-5-7-9-2-4-6-8 all the intervals being the same, 80 deg. In the airplane engines in use, the cylinders are numbered as shown in Fig. 5, so that as the engine turns they pass top center in numerical order. This arrangement is the same on all engines of this type and gives a much easier firing order to remember and handle than any of the others.

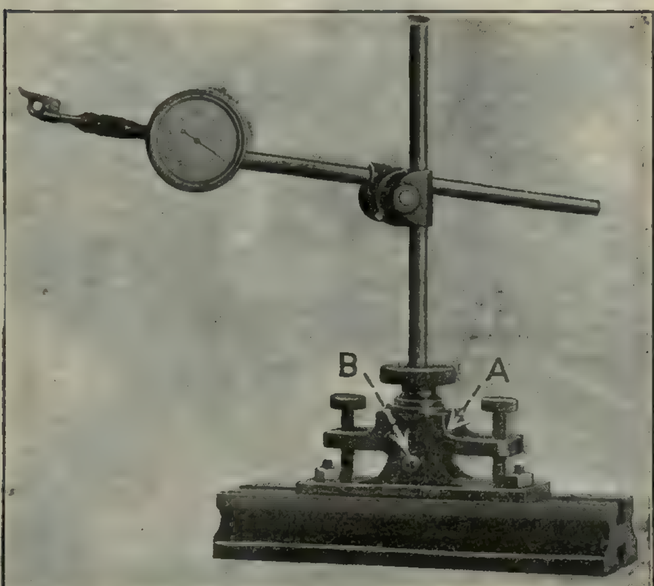
IDEAS · FROM · PRACTICAL · MEN



A Home-Made Surface Gage

By Joseph Hagstrom

The illustration herewith shows a surface gage which I made to be used in connection with a dial indicator. The idea is not new but the tool embodies features which may be of interest to others because of its adaptability for use in positions where the regular form of gage might be inconvenient. A rocking plate *A* tilting upon the fulcrum *B* provides the movement and it is adjustable by means of the two fine-pitch, knurled-head screws near its ends. Other movements of the dial arm are common to all surfage gages.



HOME-MADE SURFACE GAGE

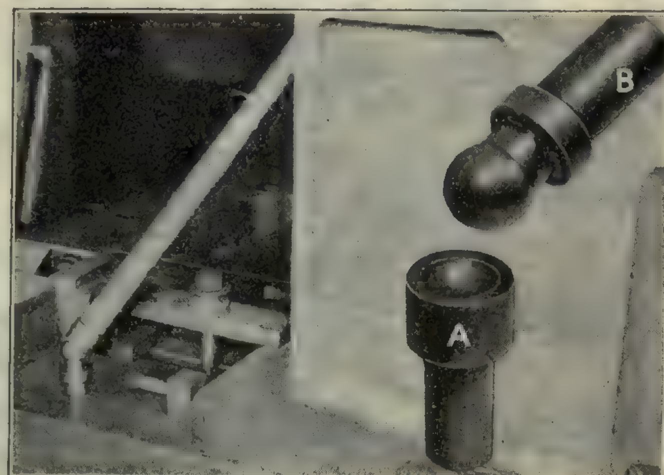
Bunters for High Work on the Planing Machine

By E. A. Dixie

Bunters for high work on the planing machine are often difficult to adjust properly because on long ones the operator cannot be at both ends at the same time. In the illustration is shown one of the most sensible ones that I have seen.

The ball member *A* has a stem that fits the reamed holes in the planing machine table. The socket *B* has a stem that fits the hole in ordinary wrought-iron pipe—in this case 1 in. When there is any high work to be supported against the force of the cut, the ball member is inserted in the table, a piece of pipe the correct length is cut off and the socket inserted in the one end of it. The other end is provided with a capscrew and nut to act as a jack. The ball and socket allows the strut to find its own location without constraint.

The device is shown at the left of the picture as it appears in place on a job. In this case the stem of the ball-ended member has been purposely allowed to project above the table so that it would show. When properly placed the flange comes in contact with the table.



BUNTER WITH BALL AND SOCKET

Enlarging an Automobile Piston

By John P. Wheeler

I have read with great interest C. M. Starr's description on page 548 of the *American Machinist* of how he enlarged an automobile piston, but why did he pound it with a sledge? If he had heated it just as he describes and then cooled it off without any hammering he would have found that it had enlarged or "grown" more than enough to make up for the 0.004 in. undersize. I once helped an old mechanic increase the size of a gas-engine piston, way back in 1892, which was a great deal more than 0.004 in. (or 0.04 in. for that matter) undersize. We heated and cooled it off three times, and then had to take nearly $\frac{1}{16}$ in. of a cut off it before it would enter the cylinder.

Of course we had to dress the ring grooves and make new rings, but that was quicker than getting out a new casting and machining a whole new piston.


STEALING JUICY TRADE-MARK PEACHES
YES BUT I GOT 'EM NOW WHAT WILL YOU GIVE ME
HEY ! THOSE BELONG TO ME
STERLING
ROYAL
WHITE
BLOCK
WOLF
ACME
STANDARD
WHITNEY
RED LEAD
INLAND
KELLOGG
OXFORD
HEINZE
American Machinist
Brow

What Have You Done to Protect Your Trade-Mark Abroad?

WE have several times called the attention of our readers to the fact that unless properly safeguarded, their trade-marks were liable to be stolen by unscrupulous persons in foreign fields.

A specific instance of the pirating of American trade-marks comes in a report furnished by the American Chamber of Commerce of Brazil, S. A. A single firm in Rio Janeiro has registered under its own name more than forty well known American trade-marks, the object being to make the real owner pay an exorbitant price for the use of what is actually his own property.

Out of the trade-marks, listed in the Diario Official, we give only a few that seem to be close to our field. These are "Kellogg" air pumps, Kellogg Mfg. Co., Rochester, N. Y.; "Heinze" dynamo and electric motors, J. O. Heinze, Springfield, Ohio; "Whitney" chains, Whitney Mfg. Co., Hartford, Conn.; "Hoyt" anti-friction metal, Hoyt Metal Co., St. Louis, Mo.; "Card" taps and dies, S. W. Card Manufacturing Co., Mansfield, Mass.; "Barnes" lathes, W. F. & John Barnes, Rockford, Ill.; "South Bend" lathes, South Bend Lathe Works, South Bend, Ind.; 'Edison" storage batteries, Edison Manufacturing Co., Orange, N. J.; "Evinrude" motors, Evinrude Motor Co., Milwaukee, Wis.

Apparently many exporters do not suspect the trouble in store for them, but once registered for the period required by law, a Latin-American trade-mark becomes the absolute property right of the registrant, and *infringement is punishable by fine, imprisonment and confiscation of goods.*

In Brazil, six months are allowed for protest dating from the time the notice is first published in the Diario Official.

From this it will be seen that prompt action is necessary if a manufacturer cares to protect his trade-mark in Brazil—but while he attends to this he should also attend to the proper protection of his trade-mark in other countries. In most cases the charge is small in comparison with the benefits derived.

Ethan Viall

Needed Improvements in Our Patent Office and System

BY GLENN B. HARRIS
President, E. R. G. Company, Inc., New York

There is now before the Committee on Patents of the United States Senate, bill No. 11,984, which was referred to editorially on page 638. This bill vitally concerns our patent system and it deserves consideration and attention not only of every manufacturer of machine tools, but that of all manufacturers in this country as well. Here are the facts in the case.

IN 1848, the Patent Office was organized as a going body and in that year the position of Principal Examiner was considered of such importance that so far as his salary of $2,500 per annum was concerned, it was equal to that of a United States District Judge, and a Member of Congress. Except for a slight increase of $200, per annum, the salary remains as it was placed more than seventy years ago. The qualifications and duties of the Principal Examiner and his assistants will be referred to later.

The bill now before Congress bearing on the efficiency of our patent system, and the organization of our Patent Office, so far as this pertains to the effective handling of the work, is briefly, to increase the force and salaries in the Patent Office. There is also a provision which is intended to extend means for arriving at or compensating damages in infringement suits where the plaintiff is successful. What, however, concerns the machine tool industry most vitally is the obtaining of and retention in the patent office of a competent examining corps. This is absolutely essential to the safeguarding of the best interests of the machine tool industry, and can only be obtained by paying this corps salaries adequate with the services which they render.

> In our editorial on page 638 we advised our readers that Patent bill No. 11,984 had passed the House and was before the Senate. This bill should not be delayed as the situation regarding competent help in the Patent Office is critical. Mr. Harris has personally gone over the conditions in Washington within the last few weeks, and knows what he is talking about.

The duties of an examiner are of an extremely technical or scientific nature, in addition to which a knowledge of law is most essential, particularly patent law in order that the rulings of the Commissioner of Patents, the Examiners in Chief and the Examiners of Interference may be intelligently interpreted as to procedure. The decisions of the Courts as to what constitutes patentable subject matter must also be properly interpreted. On an application for patent reaching the Examiner's hands it must be carefully gone over for the detection of any language errors. The specification must then be checked with the drawings to determine that the references thereto by letter or numeral are correct and also that the drawings illustrate an operative device or mechanism, and are in thorough accord with the specification or description. Even this apparently simple procedure requires more than ordinary ability. When this examination of the invention as covered by the specifications is completed and claims of the application for patent has been made, the examination as to the patentability of the invention and the scope of the claims is taken into consideration. This examination, if thoroughly carried out, is one requiring an ability to read mechanical drawings almost at sight, and also a keen sense of discrimination as to whether an apparently pertinent reference, that is a previously granted patent or publication, is applicable to the subject matter under examination or any part thereof, or the claims thereunder, which may be involved in the application. It also calls for a thorough search through arts analagous to that of the applied-for patent.

The duties of the position are of a trying and exacting character, and such as merit very material increases in salaries. At the present time there are many vacancies in the Examing Corps of the Patent Office due to the fact that the salary at entrance, fifteen hundred dollars, is not sufficiently large to attract the character and quality of men who are able to pass the rigid examinations laid down by the Civil Service as a prerequisite to appointment to Examiners' positions. In consequence temporary appointments and transfers of clerical help are necessitated by existing conditions, and the character of work rendered is of a decidedly inferior character. Even though this temporary help may gain knowledge during its incumbency, there is no way at present by which their services may be permanently retained as they are not sufficiently educated to pass the examinations.

The Commissioner of Patents is authority for the statement that the work of the Patent Office was never in such a poor condition, that he has eighty-five fourth assistant examiners' positions, and that men will not take them even without examination at the present alary.

Before the war it was possible to obtain good men through the Civil Service notwithstanding the low salaries and rigid requirements, but this is now a thing of the past and to add to the difficulties which the Patent Office is encountering it is losing approximately twenty-five per cent of its entire examining

force each year through resignation. There is a tremendous demand for scientifically trained men just at the present time and the examiners will not remain in the office at the salaries which are now being paid.

To give any idea as to the exacting requirements, reference is made to a circular issued by the Civil Service Commission on which it is stated that an examination to fill vacancies in the examining corps of the United States Patent Office will be held on a given date, and that competitors will be examined on subjects which will have the relative weights indicated.

Difficult Examinations

1. French or German 20
2. Mechanical drawing 20
3. Technics covering the field of mechanics, mechanical arts, industrial arts and processes and applied chemistry...... 20

The above examination extends over a period of two days, and on the third day the applicant must select two subjects from Chemistry, Civil Engineering, Electrical Engineering, Mathematics, Mechanical Engineering, Physics and Experience, and to each of these subjects a rating of 20 is given.

The percentage required for a passage of the examination is relatively small, seventy per cent, but when its exacting character is taken into consideration even this percentage is high. If the applicant is a young man fresh from college he is naturally lacking in experience, and would fail on this phase of the examination. Should the applicant possess experience it would have been gained by hard work in some manufacturing industry, and the position offered would not be an appealing one, for with the educational requirements necessary plus experience there would be literally thousands of positions open at salaries much more than double those offered.

The manufacturing industries of the country are constantly on the look out at graduating time for the product of our colleges and our technical schools which turn out young men with technical or scientific educations, and offer them salaries and inducements far beyond the possibilities offered in the examining corps of the Patent Office. Salaries of $2,000 to $2,400 and upward are the initial offering. How then is the government in a position to secure the high grade services required at the rates offered?

To return to the examination which an applicant for the position of Assistant Examiner is compelled to pass, reference is made to some of the questions submitted in a typical examination.

Technics

Manufacture of porcelain, steps in process.

Production of zinc oxide (a) American process, (b) French process, (c) in manufacture of vulcanized rubber.

What are the uses of tungsten, chronium, nickel, ferro-silicon, and ferro-manganese in metallurgy? Give chemical and physical effects of each.

Describe a shrapnel shell ready for use.

Describe a 5 Kilowatt Radio set ready for use.

Give methods, sketch, and diagram electrical production of nitrates from the atmosphere.

These are a few of the questions propounded under the head of Technics, but wait—under the head of physics we have such very simple little queries as:

"Cubic sheet of metal 100 sq.cm., 6 mm. thick is exposed to a temperature of 100° C, on one side and 0°C on the other. Find the time traversing the plate. —Sp. cond. of Cu. 713.

$$\frac{713 \times 100 \times 1 \times 100}{0.06}$$

State five types of simple machines, define mechanical advantage, define efficiency of machine.

Describe fully the principles of the gyroscope, explain its precision, give two distinct examples of gyroscopic action. Explain radio activity, also the X-Ray.

Under the head of Chemistry we have the following:

Describe the preparation of chloroform, giving the chemical reactions by formulas.

Describe the manufacture of glucose (by formulas).

Give complete description of the manufacture of Fe.

Where are the principal deposits of sodium nitrate found, for what is it used and what is its commercial industrial value in the arts?

In addition to what has been outlined there is an examination on the ability of the applicant to read understandingly various sheets of mechanical drawings and he is required to thoroughly dissect the same, describing the views, the construction of the machines and their operation.

The requirements as before set forth are examples of the comparatively simple ones in which the applicant for the lowest position in the Patent Office Examining Corps must prove himself competent.

Other Examinations Compared

Having touched only a few of the high spots in the examination of a prospective fourth assistant examiner in the Patent Office it might be well to give briefly a synopsis of other examinations for admittance to the government service.

The position of Special Agent, Bureau of Foreign and Domestic Commerce, pays $3,650 per annum, or $950 more per year than is given a Principal Examiner in the Patent Office.

Education and experience	40
Language, say Spanish	20
Practical questions aiming to bring out the candidate's knowledge of the subject in connection with which he is an applicant	40

Then we have an examination for the position of Chief of Division of District Offices, Bureau of Foreign and Domestic Commerce. The entrance salary is $2,500, and the examination is only briefly referred to as:

Education (the equivalent of a four-year high school course)	20
Experience	50
Thesis	30

A principal examiner receiving $2,700 per year, and reaching this position by showing himself to be a star in the four successive grades of assistant examiner, is in charge of a number of assistant examiners and a very considerable office and only reaches this position through years of untiring devotion to duty and proven ability. He must have an intimate knowledge of mechanics, the sciences and the arts, and must also not only be well grounded in the law, but must keep absolutely abreast the times regarding decisions of

the different tribunals which have the deciding of patent questions.

It is thought that a large majority of our readers will reach the immediate decision that there is no comparison between the exacting requirements placed on a Principal Examiner and those to which brief reference has been made, but that there will be a practical unanminity of opinion that the Patent Office Examiner is a laborer worthy of his hire, and that he does not get it.

There is one little feature in an examiner's work to which attention is asked, and that is a dissection of the following equation from a dye patent. The reaction is set out in the following equation:

$$C_6H_4 \left\langle \begin{matrix} N(CH_3)_3X \\ N = N \end{matrix} \right. - C_6H_z \left\langle \begin{matrix} CH_3 \\ N = NCl \end{matrix} \right. + \underset{\text{Phenylmethylpyrazolon}}{C_{10}H_{10}N_2O} =$$

$$C_6H_4 \left\langle \begin{matrix} N(CH_3)_3X \\ N = N \end{matrix} \right. - C_6H_3 \left\langle \begin{matrix} CH_3 \\ N = N \end{matrix} \right. - C_{10}H_9N_2O + HCl$$

X in this equation means chlorin or an equivalent radical of an acid.

The claim in the dye patent reads as follows: "As a new product, the yellow dyestuff obtained from diazotized metatrimethyl ammonium phenyl-azometa-toluidin and 1 phenyl 3 methyl 5 pyrazolon, being an orange-yellow powder, soluble in water, alcohol, ether and benzene; insoluble in petroleum ether, dyeing tanned and untanned cotton as well as half wool yellow in an acid bath, substantially as set forth."

It will undoubtedly be appreciated that it requires a scientist who must also have a thorough legal training to interpret and construe this patent.

Office Staff Depleted

The Commissioner of Patents has stated that he is losing about twenty-five per cent of his examiners yearly. There is no business concern that can survive under such a turn-over and this holds good particularly with the Examining Corps of the Patent Office where, notwithstanding the high grade of men obtained, a period of training of at least two years in the office is essential to make the new man at all proficient, and this proficiency is attained at the expense of time on the part of his superiors in giving instructions, advice and in thoroughly checking up the work of the novice.

The reason for the wholesale resignations from the Patent Office is not hard to locate. Large industrial concerns maintain their own patent staffs and are ever on the lookout to secure the services of the cream of the Patent Office force.

In addition the Patent Lawyers are continually depleting the office by offering partnerships or positions in their offices and the inducements are such that the Examiners cannot consistently refrain from accepting the proffers made them.

As an instance of the earnings of Examiners in and out of the Office reference is had to resignations occuring during a period of two months of 1919. There were resignations of three principal examiners in the time mentioned. These examiners were drawing $2,700 per annum. In their new positions the average earning was $4,500. Five second assistant examiners resigned positions paying $2,100 per annum, to accept outside positions bringing an average income of $2,920 per year, while two third assistant examiners left government service at $1,800 to accept incomes of $2,500 per annum.

In the British Patent Office where the requirements are not in the least comparable with those of our own office, the salary of the official corresponding with our Commissoiner of Patents, is $7,305 compared with our $5,000; our chief clerk receives $3,000, in Great Britain $4,866. Supervising examiners receive in Great Britain, $3,896, here the corresponding positions are recompensed $2,700. The first grade examiners receive from the English Patent Office $3,409, here $2,400 and in the next lower grade $3,287, as against our $2,100. A noted inventor in hearings held by the Committee on Patents testified that in *one* of his cases the fees paid his patent lawyers amounted to approximately $10,000, while the examiner who made the search under his application, passed on its form, correctness of statement and the patentability of the subject matter submitted, received but $2,700 per year and the application for the patent referred to was only one of hundreds that came to him for consideration and decision during the year.

Salaries in Other Departments

The Patent Office is to the manufacturing industries of the country what the Agricultural Department is to the agricultural interests. In this latter department of the government there are in the neighborhood of forty skilled employees who obtain salaries of from four to six thousand dollars per year, the latter salary greater than that of the Commissioner of Patents and the lower figure nearly equal to that of the Assistant Commissioner of Patents and greatly in excess of that of other officials in a lower capacity. In other words there are but two more than $4,000 per annum, and yet the requisite qualifications of these most estimable and learned men in the Agricultural Department are not nearly as exacting as are those for the position of Assistant Patent Examiner.

The Agricultural Department receives from the government more than $30,000,000 per year and this amount is practically all expenditures with no monetary return.

The Bureau of Standards which was established about twelve years ago, and which is an admirable, helpful, and it might be said necessary institution, but which is not to be compared in importance to the Patent Office, receives practically as much for its maintenance as does the latter and with this Bureau it is practically all expenses and no income.

Assistant physicists in this branch of the government receive $2,800 per year and more, while the heads of sections receive considerably larger sums, all greatly in advance of the salaries paid Patent Office Examiners. The importance of the duties, their responsibilities and their exactions in the two different offices are not comparable, but were they, the advantage would strongly resolve itself in favor of the Patent Examiner.

The War Department has announced that it has been successful in obtaining the sum of $2,000,000 for army schools. There is no one who will criticise this appropriation, but why should not the Patent Office be as generously treated.

The Patent Office is much more than self sustain-

ing and now has accumulated in the U. S. Treasury more than $8,000,000. This surplus is yearly increasing, and yet no part of it can be utilized for the betterment of Patent Office conditions.

The inventors of the country and the manufacturers who aid them, pay for a service which is but inadequately rendered, and there is no substantial reason why this branch of the service should not give a prompt and efficient return for that for which it has been paid. It is absolutely beyond the pale of excuse.

Applications for letters-patent are increasing in large number, and even with the force maintained at its present level, that is to say were there no resignations, the present complement of examiners, clerks and others would be entirely incapable of contending with the present, not taking into consideration the ever increasing volume of work. At the present time there are applications for patents on file which have been pending nearly eleven months and yet have not been reached for preliminary action. The division which is nearest up-to-date in examination is two months behind in its work. Fifty per cent of the divisions are eight months or more in reaching their work.

This, however, is not all. A case when examined is probably in nine cases out of ten (this is extremely conservative) found anticipated in whole or in part by something that has gone before. This necessitates a rejection of the application in its presented form and requires amendment on the part of the applicant's attorney. This procedure takes place by correspondence and is not at all similar to cases in court where the evidence of the plaintiff is heard and then that of the defendant and a decision reached.

The delays in the prosecution of a case through the Patent Office are not only disheartening, but to many of incalculable detriment and injury. As the time consumed in obtaining a patent requires from two to three years in cases that are not at all unusual. It needs no argument to convince those at present interested in patents or who are likely to be at some future time, and all of the readers of the *American Machinist*, of the imperative necessity of doing all within their their power to aid in securing an adequate force in the Patent Office to care for as promptly as possible the applications for patents which are presented, and to retain an efficient personnel that this may be an accomplished fact.

The filing of an application for patent affords no protection whatever. Protection can only come when the patent is issued, when it is an assured fact. It is true that should a conflicting application be filed, that is an application on substantially the same device, the two or more parties claiming the invention must pass through interference proceedings which are initiated to decide which of two or more inventors is rightfully entitled to the invention in question. These proceedings are not only long drawn out but are expensive beyond the means of the average inventor.

The delay in reaching applications for patent and examination as to patentability is very apt to plunge the rightful applicant into these interference proceedings. If the subject matter of the invention is placed on the market, chances are taken and must necessarily be taken that the unscrupulous will take advantage of the fact that the patent has not been granted thereon, and will begin manufacture of the invention. The owner has no recourse whatever until the patent issues. In numerous instances a conflicting application for patent is filed covering a meritorious invention with the sole purpose in view of delaying the issuance of a patent. The party filing this illegitimate application does so for the sole purpose of delaying the grant to another of that which rightfully belongs to him and thereby enabling the usurper if only for a few years to obtain gains to which he is not rightfully entitled.

It would therefore seem that for the proper performance of the legal and technical duties incident to the investigation and determination of the problems and questions involved in the work of patent examiners it is essential that such officials be long trained in not only the metaphysical but the judicial consideration of the scientific, technical and legal questions presented, and yet none of the interests so vitally concerned in the patent situation have sought to furnish means to provide for the retention of competent patent examiners by improving working conditions, or seeking to raise grossly inadequate salaries. As a result it is practically impossible to retain the valuable services of experienced examiners or to obtain the services of efficient new examiners, so that the interests of inventors, manufacturers and investors in patent property have been most seriously impaired.

It is a fact that a serious industrial condition exists in the Patent Office. A condition calling for aid rather than for criticism or reflection, and this condition must be met and remedied if inventors are to be expected to continue to produce new forms of industrial property in the public interest, if capital is to be expected to invest in industrial enterprises and if the ever increasing demands which it is continually making for increased conveniences, and everyday necessities, are to be met.

It is urged that the serious condition in the Patent Office can only be counteracted by enlarging and modernizing it, by giving it the required personnel, and proper facilities and equipment.

Who's Next?

At Chicago, on March 16, the American Railway Engineering Association adopted the following resolution which was introduced by W. H. Courtenay of the L. & N. R.R.:

"The American Railway Engineering Association, in convention assembled, expresses its opposition to the adoption of the metric system of weights and measures to the exclusion of the English system or the American system at present in general use."

It may be stated without fear of contradiction that since the inauguration of the patent system, the Patent Office has constituted the greatest primary governmental medium in producing the industrial wealth of the nation. It is not a question of whether the patent system, or the Patent Office, will be self sustaining under the proposed increase, and yet it is positively assured that it will be and with a surplus of from two to three hundred thousand dollars annually. But the question of self-support should not be the controlling factor.

If funds can be appropriated to the extent of thirty million dollars or more to promote the Department of Agriculture which is engaged in promoting agricultural interests alone, and which is not in any way self sustaining, certainly two or three million dollars may be readily appropriated to maintain a modernized and self supporting Patent Office which will be engaged in promoting all lines of industry, including the agricultural interests

Salient Features of the Bill

In the patent bill H. R. 11,984, before referred to, and which passed the House of Representatives by a vote of 272 to 6, there is also embodied a section which deals with the question of damages in infringment suits and in order that this feature of the bill may be understood by manufacturers and others interested in patents, its salient features are given as follows:

"The several courts vested with jurisdiction of cases arising under the patent laws shall have power to grant injunctions according to the course and principles of courts of Equity, to prevent the violation of any right secured by patent, on such terms as the court may deem reasonable; and upon a decree being rendered in any such case for an infringement the complainant shall be entitled to recover, in addition to the profits to be accounted for by the defendant, the damages the complainant has sustained thereby, and the court shall assess the same or cause the same to be assessed under its direction. If on the proofs it shall appear that the complainant has suffered damage from the infringement or that the defendant has realized profits therefrom to which the complainant is justly entitled but that such damages and profits are not susceptible of exact calculation and determination, the court may on evidence tending to establish the same, in its discretion, receive opinion or expert testinmony, which is hereby declared to be competent and admissible, subject to the general rules of evidence and all other evidence applicable to this character of testimony and upon such evidence and all other evidence in the records, the court may adjudge and decree the payment by the defendant to the complainant of a reasonable sum as a royalty or general damages for the infringement, and the court shall have the same power to increase such damages in its discretion as is given to increase the damages found by verdicts in actions in the nature of actions of tresspass upon the case; but in any suit or action brought for the infringement of any patent there shall be no recovery for profits or damages for any infringement committed more than six years before the filing of the bill of complaint or the issuing of the writ in such action, and this provision shall apply to existing causes of action."

With regard to this proposed change in the statutes governing compensation for the infringement of patents the following will undoubtedly prove of interest to the manufacturer:

While an injunction can ordinarily be obtained against an infringer in a case where a patent is adjudged valid, except where it would interfere with Government work, a monetary recovery has not heretofore been generally possible except under most favorable circumstances. In a case where it cannot be said that the entire salibility of the article depends upon the invention it has been necessary to show just how much of the price of the article is attributable to the invention, and as it is ordinarily impossible to make such a separation, and as most patent cases are ones in which it cannot be said that the whole salability of the article depended upon the invention, it has resulted that recovery of money is seldom obtained in a patent suit.

Courts Take Liberal Attitude

Recently there have been two or three decisions in which the courts have taken a more liberal attitude, holding in effect that where an invention has been used by the infringer a reasonable royalty may be awarded to the patentee based on a mere estimation or on opinion evidence, even though no exact computatation can be made. This is analogous to the attitude of the courts in personal-injury cases and is entirely just and reasonable. While, as stated, there have been two or three decisions to this effect, it may take a generation to induce United States courts generally to adopt this position, if at all, and the committee therefore proposes that the law be amended to provide, that as damages to the complainant, the court, on due proceedings had, may adjudge and decree to the owner payment of a reasonable royalty or other form of general damages. Such an amendment has been provided in the attached bill amending section 4,921, the Revised Statutes of the United States, and reading as follows:

"If proof is not offered or, in the absence of adequate proof of the amount that should be awarded as damages or profits, the court on due proceedings had, may adjudge and decree to the owner payment of a reasonable royalty or other form of general damages."

This proposed amendment would enable the patentee in all suits where the patent has been found valid and infringed to recover at least a reasonable royalty, and would provide a money recovery in the great majority of patent suits where no recovery would otherwise be possible. It is believed that the comparative certainty of financial return would answer one of the most common and strongest reproaches against the patent system, namely—that a patent does not ordinarily pay the inventor any money, and it believes that the incentive to invent would accordingly be greatly increased. There are some cases in which it seems to many who are familiar with such matters as though the courts were inclined to go to the other extreme and award damages out of all proportion. Where a complainant has shown that profits have been made by the use of an article patented as an entirety, the infringer is liable for all the profits unless he can show—and the burden of proof is on him to show—that a portion of them is a result of some other invention used by him. If the infringer can not show what proportion of the profits is due to such other invention, then all

his profits must go to the complainant. Any rule by which the entire profits are given to a patentee in the absence of proof that they are all due to the invention of the patent sued upon is unfortunate and sometimes very unjust. The proposed amendment to the statute would permit a court under these circumstances to do substanial justice, even though it could not be mathematically exact.

Use of Photostats in Plant Layouts

By Thos. H. Westphal

For placing machinery in a new or remodeled shop or for rearrangement in an existing one, the use of cut-out scale plans of the machines is common, but it is sometimes rather tedious work to make these plans to the required scale with the necessary amount of detail. For this purpose photostatic reductions from the manufacturer's drawings of the machines may be quickly made to any desired scale and cut out in outline as at *B* in Fig. 1, which represents the silhouette plan of the air compressor of which the locating dimensions are given in the maker's blueprint *A*.

In Fig. 2 the floor plan of the shop appears with the available space marked roughly in crayon. In Fig. 3 the two cut-outs are shown in position on the floor plan.

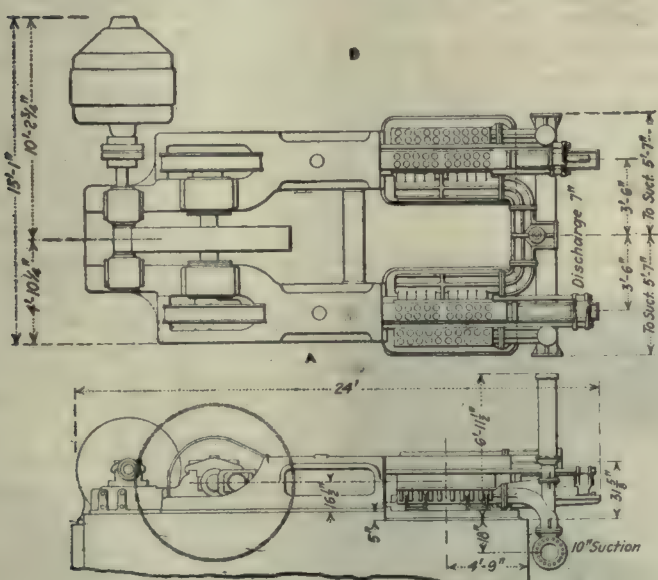


FIG. 1. PLAN OF COMPRESSOR

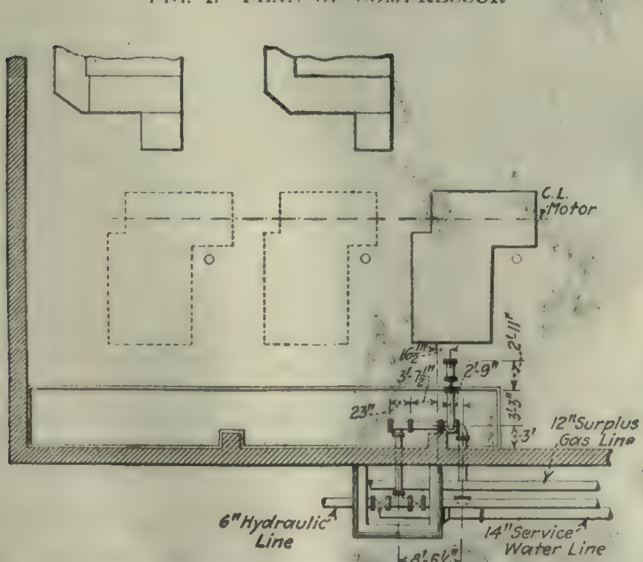


FIG. 2. FLOOR PLAN OF SECTION OF SHOP

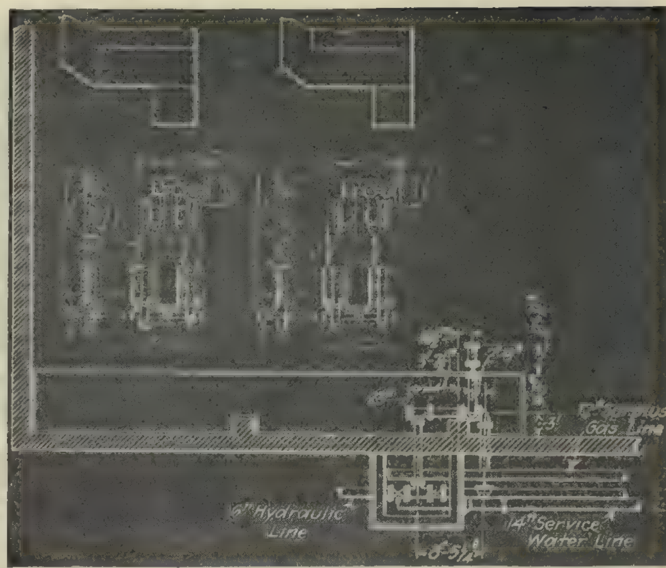


FIG. 3. PHOTOSTAT PLAN IN POSITION ON FLOOR

A Home-Made Boring-Tool Holder

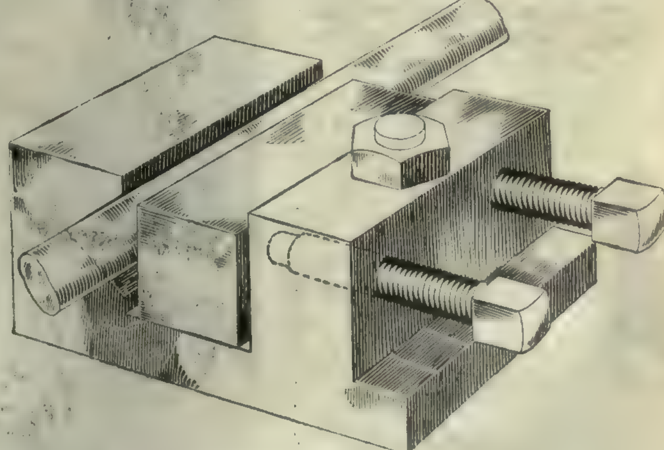
By J. A. Nightingale

The illustration shows a boring-tool holder that may be of interest. It is rigid and at the same time adaptable. It is preferred by lathe men here to the commercial article or to other home-made devices.

The holder is of cast iron, machined flat on the bottom, and has a V-shaped groove in the raised portion, with the apex of the V on the center line of the lathe. It is held to the cross-slide by a single heavy bolt with a head made to fit the T-slot, and a nut that fits the tailstock wrench.

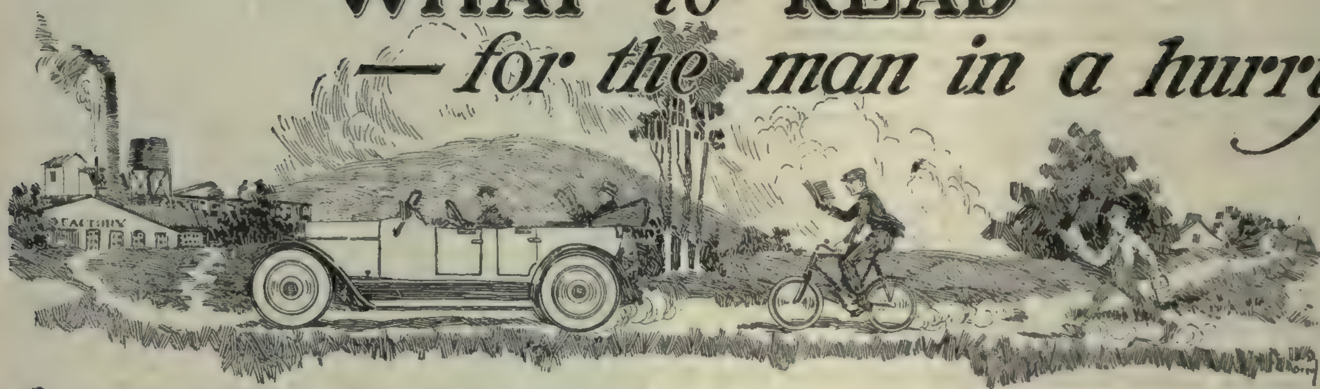
The boring bars are clamped into the V with two hardened screws having heads to fit the toolpost wrench. These screws bear directly on the largest boring bars, while in using the smaller ones a piece of square bar stock is dropped in between the screws and the bar.

This saves time, as by loosening the clamping screws the block can be lifted out and the bar removed instead of backing the screws out far enough to clear the bar. This device holds, both firmly and on center, anything from a big bar for boring engine cylinders to a tiny bar the size of a match.



BORING-TOOL HOLDER

WHAT *to* READ — *for the man in a hurry*



Suggested by the Managing Editor

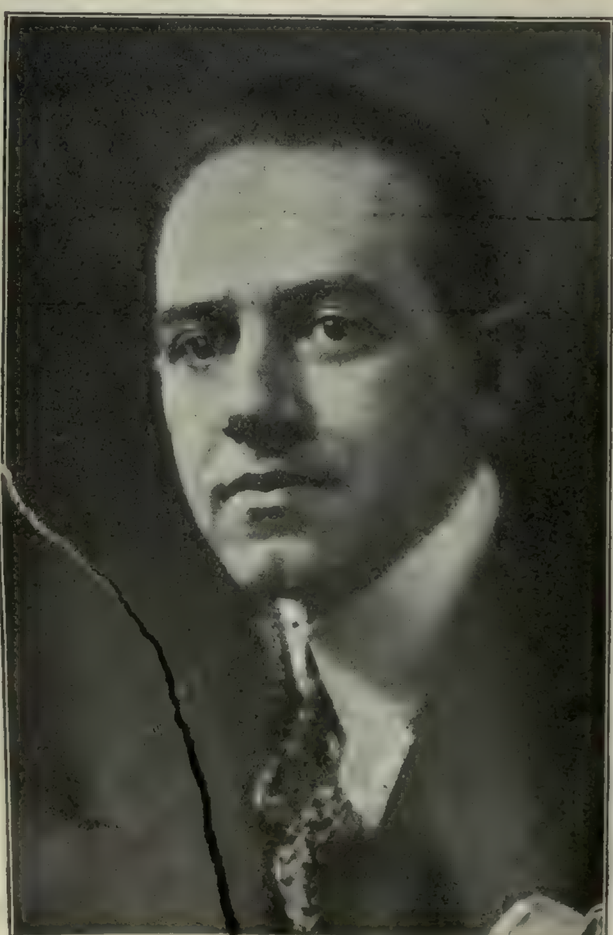
> *Nobody who is holding down a man's job has time to read all of the American Machinist. On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials—they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.*

MASON Britton told us just as we were about to start this week's page, that nearly one-quarter of several hundred print shops were losing money. And they were losing it simply because they had no notion of proper cost keeping. He went on to say that it had set him to wondering how many machine shops were in the same fix.

We want to say right here that it is against our principles to let any member of the business management get his name into the editorial section, but this is an exceptional case. For, this time, we were able to stick our thumbs in our vest, tilt back our chair, and say with a condescending smile, "Look at the leader in the April 8 issue."

This leader is the first installment of a long series we have been working on for several months. The idea was to present to machine-shop owners and operators a series of articles by an acknowledged authority that would be equally useful to all sorts of shops and that could be filed as a reference book on the subject of factory management.

We have called it "Modern Production Methods" for want of a better title. It covers so much ground that it is hard to be more specific. The author, whose photograph appears in the middle of this page, is W. R. Bassett, president of the firm of Miller, Franklin, Basset and Co., of New York City. This organization tackles problems of any sort that may come up in any manufacturing plant, from the design of the plant to marketing the product. Mr. Basset does not believe in the use of formulas but in judging each case on its merits, and prescribing a remedy on that basis. He writes this series for the machine shop as a result of his experience of eighteen years in more than 1,500 factories.



For the designers and draftsmen we have two articles worth noting. Professor Furman's tenth article on Cam Design begins on page 777 and takes up the details of the effect of variable angular velocity of the drive shaft on the design of the toe and wiper cam and also goes into the matter of friction in this combination. Then there is an article on page 773 dealing with the proper treatment of studs in machine parts. We also have a good one for the toolmakers. It is by Pusep, one of our older contributors, and deals with the lapping of small cylindrical plugs and the measurement and gaging of the completed work.

If you don't like to laugh don't read Glenn Quharity's latest "Pipe Dream," page 775. It hasn't very much connection with machine shops or machine tools, but that doesn't make it any the less funny.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and · equipment ·

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs · and equipment ·

Cutler-Hammer Self-Starter for Slip-Ring Motors

The Cutler-Hammer Manufacturing Co., of Milwaukee, Wis., has developed an automatic starter with a speed regulating handle for use with slip-ring motors engaged in driving printing, folding and paper box making machines, etc., where a high torque is frequently required for starting and some speed changes are desired.

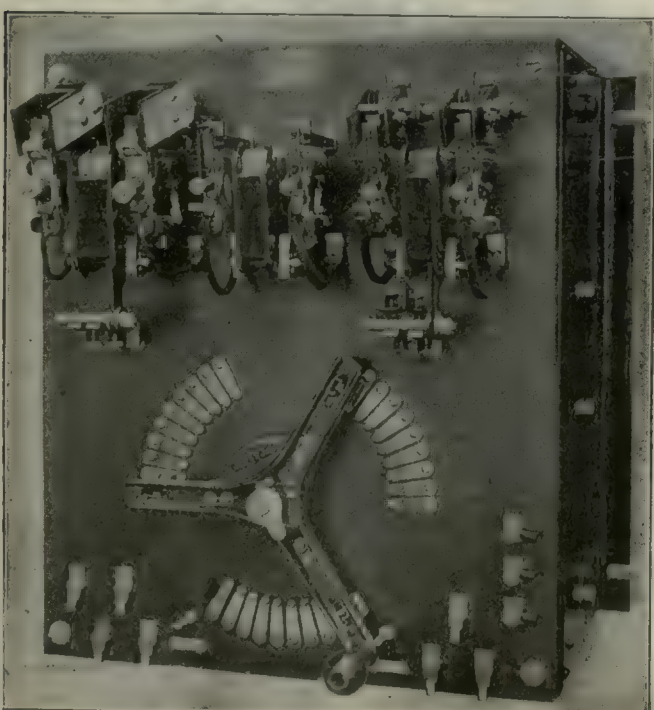
The starting panel consists of a primary and two secondary double-pole-magnet switches, below which is mounted a rheostat consisting of the resistance segments and sliding contact arms for regulating the resistance in the secondary circuit. As the handle of the rheostat is moved, resistance is cut in or cut out of each of the three phases.

The starter is operated from one or more push button stations with three-wire control. A special type of reversing push-button master switch can be provided with the controller for use with cylinder presses. Upon pressing the "run" button the main contactor closes, and the torque resistance is automatically inserted by one of the secondary contactors. When the motor has attained its speed the other contactor closes and cuts out the starting resistor and inserts the speed-regulating resistor. The motor automatically comes to the speed for which the regulating resistor is set. Speed regulation may be made while the motor is running by manually operating the regulating rheostat, which is of sufficient ohmic capacity to allow approximately 50 per cent speed reduction at one-half the rated load of the motor. Low voltage protection is an inherent feature of the equipment.

Both the starting and regulating resistors are mounted to the rear of the panel in a sheet iron frame which is arranged to be mounted on a wall or switchboard by means of four bolts.

When the panel is installed in an exposed position so as to be dangerous to workmen, it may be provided with a sheet metal enclosing case, with the speed reglulating lever outside.

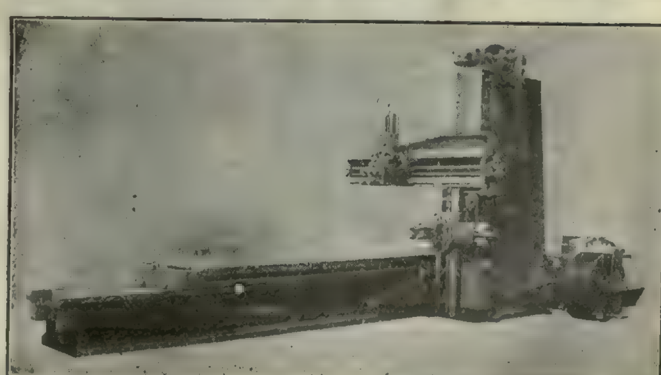
This new controller is made in various capacities up to 15 hp. for use on the several commercial voltages not exceeding 550.



CUTLER-HAMMER SELF-STARTER FOR SLIP-RING MOTORS

Simmons Openside Planer

The Simmons Machine Co., Inc., Albany, N. Y., is manufacturing openside planing machines of the design illustrated. The model shown will plane work 42 in. wide, 48 in. high under cross-rail, and 12 ft. long. The machine is heavily built, the bed being of box section with a solid top and provided with full depth inside ribs. The table is of the double-deck pattern and has three planed T-slots, the center one extending to the extreme ends of the table. The heavy, box-type column is reinforced with inside ribs, is tongued and grooved to a cheek piece on this bed to which it is securely bolted with turned bolts fitted to reamed holes. The L-shaped cross-rail is reinforced to resist strains and has a long bearing on the column. It is amply braced

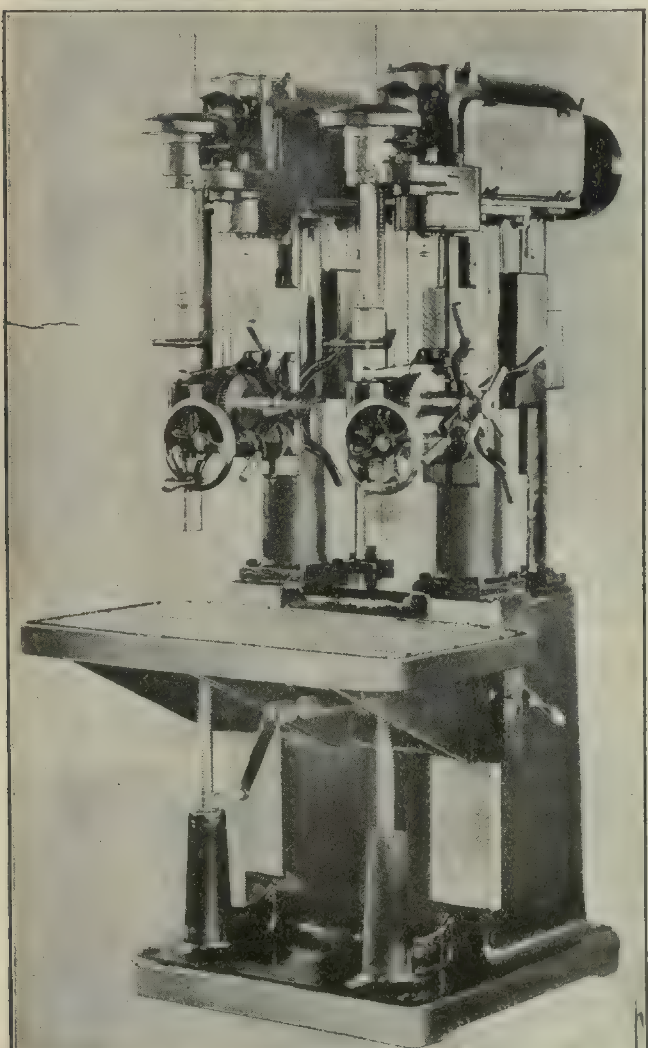


SIMMONS OPENSIDE PLANER

at the back and is raised and lowered by power. The cross-rail head has horizontal, vertical and angular feeds which are positive in action and may be adjusted without stopping the machine. A spiral-gear drive is used, the cast-iron rack and steel pinion being cut from the solid. The drive-shaft bearings are bronze bushed and provided with oil cups; the end thrust may be taken up by a key located at the outside of the bed. The belt shifter can be operated from either side of the machine and may be locked in the off position to prevent accidental starting. The rocker arm is provided with a trip lever, which allows the table to be run past the shipper dogs for the purpose of inspecting the work.

Dauber-Kratsch "Wisconsin" Gang Drilling Machine

The Dauber-Kratsch Co., Oshkosh, Wis., has added the all-geared gang-drilling machine, shown in the illustration, to their line of "Wisconsin" drilling machines. The upper structure of these is similar to their gear-driven 20-in. drilling machines, but the base is designed so that they can be built up in units of two or more spindles. At the present time these are made up as two-, three- and four-spindle machines.



DAUBER-KRATSCH "WISCONSIN" GANG DRILLING MACHINE

Specifications: Drills to center of circle, 20¾ in.; spindle movement, 8 in.; movement of sliding head, 7 in.; diameter of spindle, 1¾ in.; Morse-taper hole in spindle, No. 4.

A wide work table is provided and this rests on broad-faced planed and scraped ways. The table may be locked in position by a lever-operated gib. There is an elevating screw directly beneath each spindle, and these are operated simultaneously by a single crank.

A heavy column construction is employed which is reinforced by a straight back-strut which both supports the rear end of the gear box and relieves the column of bending stresses induced by drilling pressure.

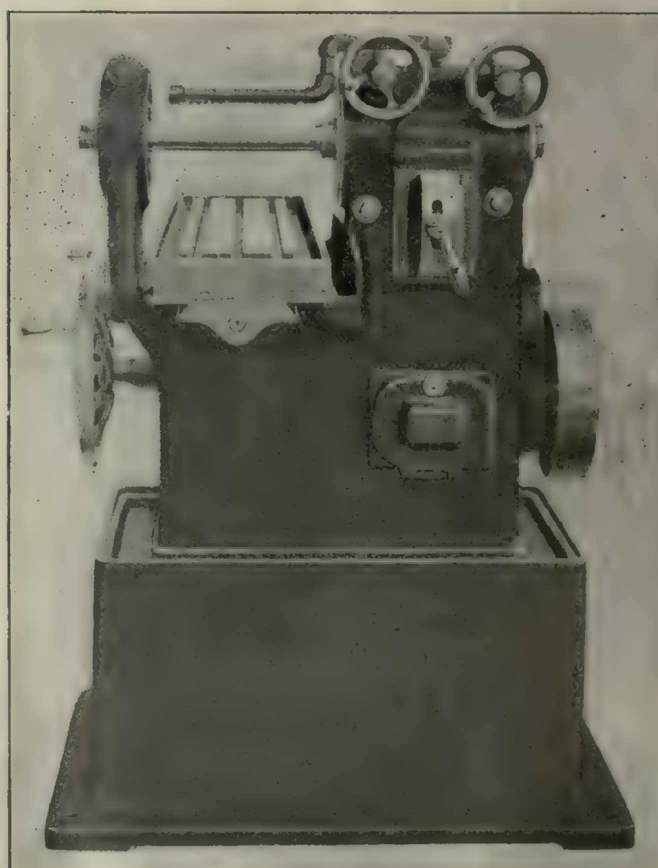
A single-pulley drive is used, and by suitable gearing the power is transmitted from one spindle-gear box to the next. The drive consists of semi-steel and rawhide gears which are engaged or disengaged through friction clutches by means of a single operating lever.

The machine is equipped with a sliding head and geared power feed. It has a hand feed and a large pilot wheel for quick return of the spindle and for sensitive drilling with small drills. There are four changes of feed for each spindle speed. If desired, a two-speed friction countershaft may be furnished, thus giving eight spindle speeds. The machine may be equipped with a tapping attachment if desired.

The Gabrielson Milling Machine

The Gabrielson Manufacturing Corporation, Syracuse, N. Y., has brought out the milling machine illustrated herewith.

This machine was designed solely for manufacturing operations. The arbor support is an integral part of the frame, avoiding the necessity for an overarm. The frame, which houses all the gears and working parts



GABRIELSON MILLING MACHINE

Specifications: Taper hole in spindle, No. 11 B. & S. Spindle adjustment: vertical, 1 in.; endwise, ½-in. Drive pulley: size, 14 in. in diameter for 3½-in. belt; speed, 320 r.p.m. Table: working surface, 34 x 7 in.; travel, 31 in.

is cast in one piece and is bolted to a base containing a reservoir for cutting compound. The base is larger than the frame and has a raised edge to catch all drip.

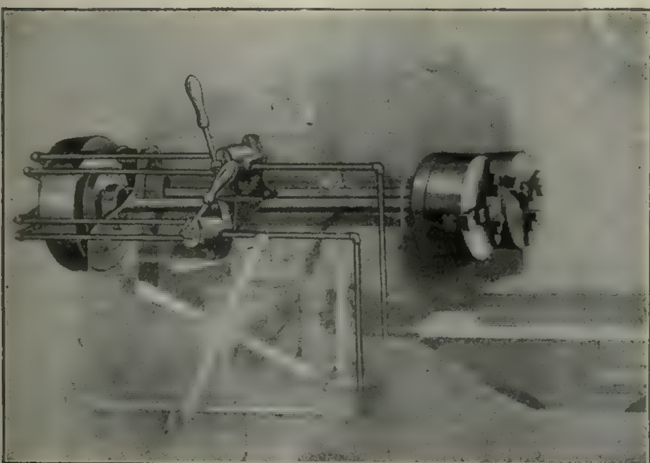
The spindle is hardened, ground and lapped and runs in bronze bearings, having means of adjustment for wear. Both spindle and bearings are carried in an eccentric sleeve which provides for vertical and endwise adjustment.

The constant speed drive is through a pulley and gears mounted on ball bearings. Changes in speeds and feeds are effected by change gears.

This machine is built in three sizes having distances between spindle and table of 6, 9 and 12 in. respectively.

Logan Air Chucks for J. & L. Double-Spindle Turret Lathes

The Frank G. Payson Co., 9 South Clinton St., Chicago, Ill., has developed a special line of air-operated chucking equipment for service on Jones & Lamson double-spindle flat-turret lathes. The illustration shows the method of installing this equipment,



LOGAN AIR CHUCKS IN J. & L. DOUBLE-SPINDLE TURRET LATHE

the chuck and air cylinder being connected by means of a rod run through the hollow spindle. The one-piece body of the chuck is threaded and does not require the use of adapters to attach it to the spindle nose.

Superior Collet Chuck

The Superior Collet Chuck Co., Grand Rapids, Mich., has placed on the market the collet type chuck illustrated herewith.

The driving pins are pushed into driving position by the inclined interior wall of the collar. When the collar is raised so that the enlarged bore below the incline is opposite the driving pins they are free to move outward and away from engagement with the

SUPERIOR COLLET CHUCK

collet. In this position the weight of the collet will force the pins outward and the collet will then drop from the chuck. Raising the collar and allowing it to drop after the collet has been inserted will push the driving pins into engagement.

A stop ring on the chuck body limits the motion of the collar.

It is claimed that the drive is positive and that all collets having a concave driving surface can be used.

Toledo Vertical Milling Machines

The machine here illustrated and described is an addition to the line of the Toledo Milling Machine Co., Toledo, Ohio.

In the design of this machine the unit method of construction has been carefully thought out. The table, saddle and knee are quickly removable and the feed-gear case with gears intact may be taken off by removing six screws. Similarly the speed gears and case may be removed.

The knee is held to the column by the usual dove-

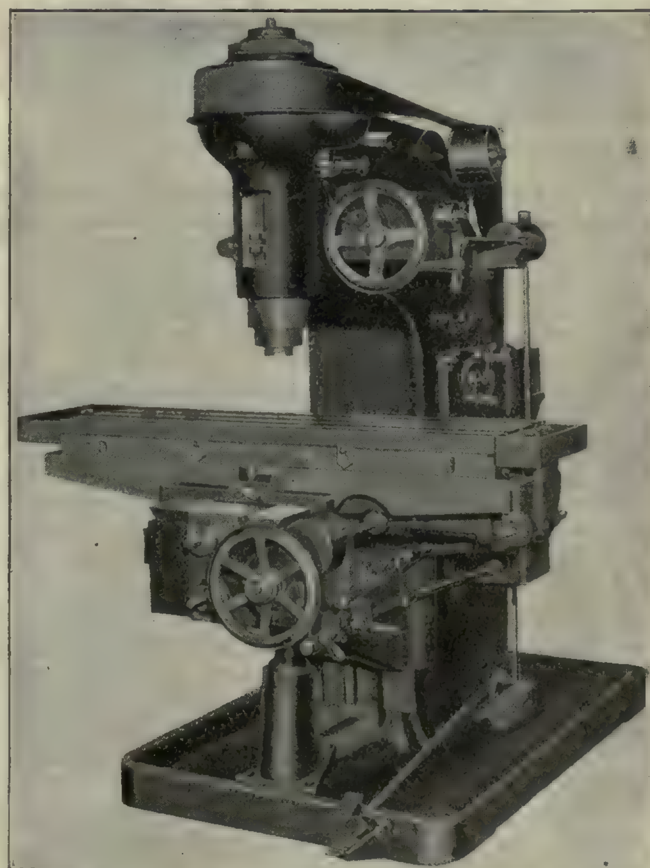


FIG. 1. TOLEDO VERTICAL MILLING MACHINE, FRONT

Specifications: Taper hole in spindle, No. 13 B. & S. Speeds: with open belt (8), from 97 to 411 r.p.m.; with back gears (8), from 18 to 76 r.p.m. Feeds: (16) from 0.004 to 0.710 per rev. of spindle. Table movement: longitudinal, 46 in.; traverse, 14 in. Vertical knee-movement, 14 in. Spindle movement, 6½ in. Table surface, 56 x 14 in. Weight, 7,000 lb.

tailed slide and in addition is guided by a central taper gib.

The saddle is 4 in. longer than the table, thus providing more than ordinary support for the table at extreme ends of travel.

The movements of the knee, saddle and table are all controlled from one operating position and, by means of an engaging lever, the control of any of these move-

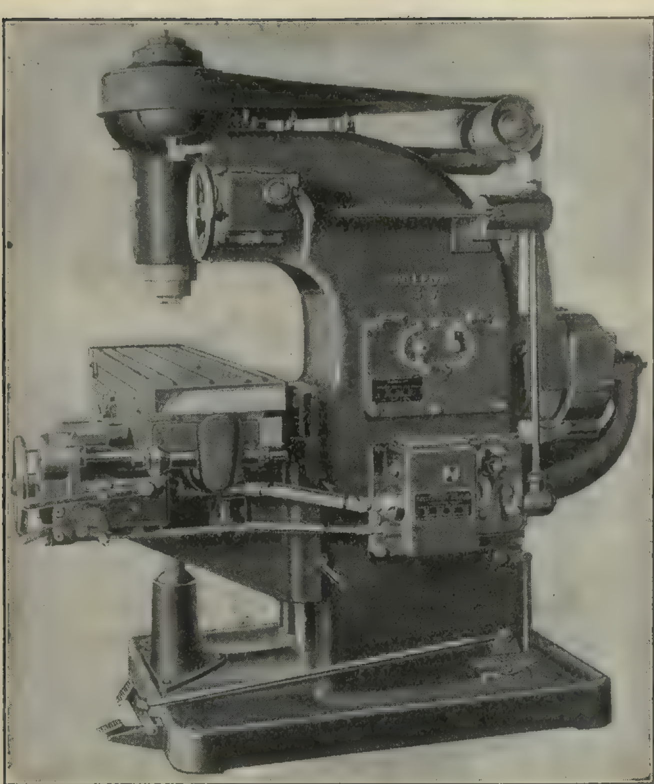


FIG. 2. TOLEDO VERTICAL MILLING MACHINE, SIDE

ments can be transferred to the centrally located handwheel on the knee. The feed mechanism is so designed that it is impossible to engage more than one feed at a time.

Rapid traverse is provided for the knee, saddle and table and when in use the regular feeds are disengaged automatically and vice versa.

Provision is also made for table control from the rear.

The main spindle bearing is 3¼ in. in diameter and runs in two phosphor-bronze bushings each 4½ in. long and spaced 3 in. apart. An adjustment for wear is provided. End thrust of the spindle is taken by ball bearings at each end of the main bearing. The pull of the belt is taken by a large auxiliary bearing at the top of the machine so that the spindle is not affected in any way. This auxiliary bearing is adjustable and is provided with two specially designed ball bearings to take care of the belt pull.

Ample provision is made for lubricating all bearings.

All speeds and feeds are arranged in geometrical progression.

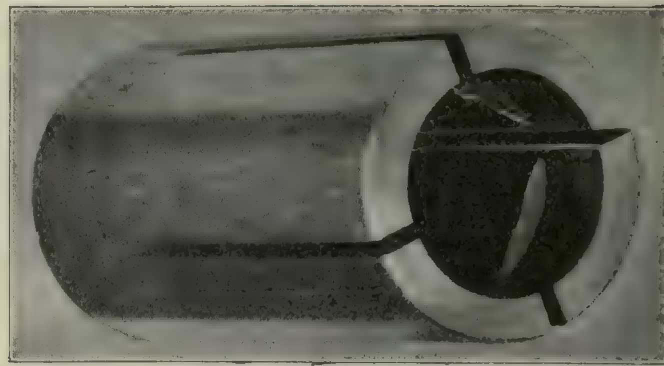
Cutters are attached to the spindle by a straight fit at the nose and are held in place by a draw-in-rod. Also there are two hardened-steel keys secured in two slots at the spindle nose. These keys engage similar slots in the cutter and furnish provision for driving.

All gears throughout the machine are of steel, heat-treated. The gears in the speed and feed cases run continuously in grease.

A rotary attachment having all regular and quick traverse feeds can be furnished.

Scully-Jones "Wear Ever" Turret Chuck

The Scully-Jones Co., Railway Exchange Bldg., Chicago, Ill., has added the "Wear Ever" turret chuck, shown in the illustration, to its line. This turret chuck



"WEAR EVER" TURRET CHUCK

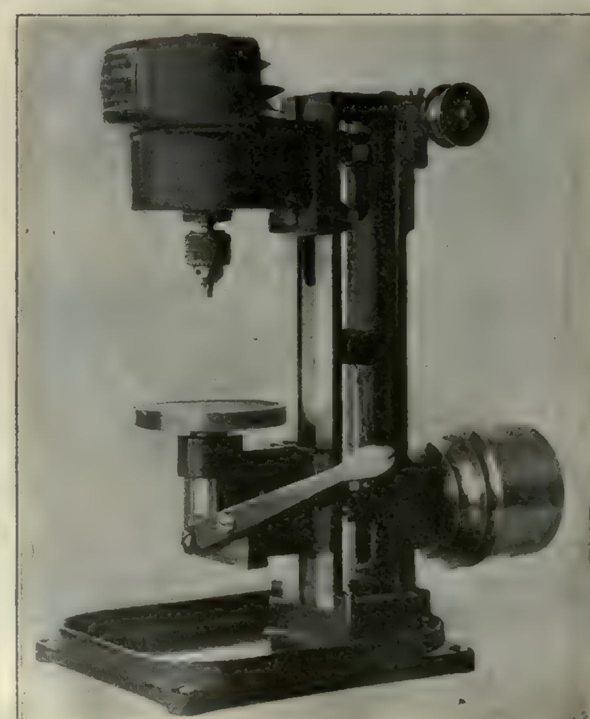
is similar in general construction to the other chucks of this line, but is designed to hold square-end tap shanks or other square-end shank tools in the tool holes of the turret. It is made in a variety of sizes to fit different diameters of tap shanks and can be fitted with standard bushings to fit larger turret holes.

Bicknell-Thomas Vertical Tapping Machine

The Bicknell-Thomas Co., Greenfield, Mass., has added to its line a vertical tapping machine for bench use having a capacity from 0 to $\frac{3}{16}$ in. taps.

This machine is made with an especially sensitive friction driving mechanism which, it is claimed, enables the operator to tap to the bottom of a hole without danger of breaking the tap. It is equipped with a two-step cone pulley for $\frac{3}{8}$-in. round belt, also tight and loose pulleys so that no countershaft is required.

The spindle has a reverse speed of twice the tapping speed, and the work table is easily operated by the lever shown. If desired, the work table can be removed and a special work-holding fixture used in its place. The machine stands 15 in. high and weighs 48 lb., complete.



BICKNELL-THOMAS VERTICAL TAPPING MACHINE

Business Conditions in England

BY OUR LONDON CORRESPONDENT

LONDON, March 2, 1920.

THE general conditions here are of the same order as reported heretofore. Prices of materials of nearly all kinds, manufactured or otherwise, are high, costs are increasing, wages are rising, and so, too, it may be added, are profits. Everybody seems dissatisfied, especially those who have acquired capital during the war and who are now seriously threatened with a levy, which, whatever the intention, can hardly be based entirely on war profits, as some, of course, have been spent. Demands for higher wages seem to be continuous. The Industrial Court heard a day or two ago in London a claim by the engineering and foundry workers for an increase of 15s. a week. A review of wages of this kind may be made every four months. Representatives of the workpeople required not only that wages shall be increased with increase in cost of living, but also that the standard shall be further raised. We may recall that in December last a rise of 5s. was granted, this in anticipation of increases in living costs which were expected to take place during the ensuing months. The award is expected daily. London engineering workmen are to press for a basic rate of 3s. an hour, and some urge "taking over and controlling the whole of the engineering industry by the operative engineers themselves."

FINANCIAL OUTLOOK

As to the other side of the table, it is no uncommon complaint that persons engaged in the conduct of engineering and industrial firms have lately been occupying themselves not so much with organization for output as with various favorable financial arrangements. Speculation has been so prevalent and excessive that pressure has been brought to bear, apparently with success, on the banks to prevent their help being given to anything but safe and legitimate enterprises. Capitalized on the basis of war profits, new public companies have been floated and placed on the money market at an astonishing rate. Reserves, too, have for a considerable time been steadily capitalized. In many of the new industrial companies the future has been burdened with cumulative preference shares at 7½, 8 and even 8½ per cent. It may be that the high rates at which the government has been appealing to the public for money are the reason. Certainly 5¾ per cent has been offered, although to the plain man it seemed to be quite definitely promised when the 5 per cent war loan was urged on the nation, that no government issue at a better rate would later be available. A recent marked fall in government securities has had as one explanation the suggestion that, in order to secure the immediate financial support not now being accorded by the banks, firms have been selling out.

THE METAL INDUSTRY

The metal market shows little in the way of decline, and almost the whole world has been inquiring of late for iron and steel, America, in particular, for sheets. In a large number of instances high prices are of no importance if delivery can be promised, but as regards the East in particular it has been said that the safeguards now placed in contracts on behalf of the seller are not without their effect in stopping orders. The truth is, however, that the home market could take almost the whole of the production of iron and steel, and also of coal. The shortage of coal in Great Britain for household purposes has lately become more marked, especially in some parts of London. In certain towns restrictions are imposed on the use of electricity for industrial purposes. At Hull, for example, a number of the engineering firms have been asked to reduce their load by 50 per cent, this being partly due to the lighting demand arising from dull weather and also to the poor quality of the fuel used for steam-raising purposes.

Aluminum manufacturers are in some instances endeavoring to meet the difficulties of the future by basing prices on those prevalent at the time of delivery. Of course this may mean a fall, though at present it looks very unlikely. But if it should mean a rise in price it is stipulated that this shall not exceed 10 per cent. An advantage that firms using aluminum as their raw material have over others is that they can immediately cover their requirements.

As to iron and steel, the Profiteering Department of the Board of Trade requested manufacturers to send in statements of costs, and this, according to report, included the pig-iron branches and several connected with finished steel and tin plate.

Much comment has been made on the finance of the cotton industry and warnings have been issued. Opening the newspaper at random one finds, for example, £32 offered for each £5 share (£2 10s. paid) in a Lancashire cotton mill, its latest dividend being at the rate of 240 per cent per annum. The fact is that new textile machinery cannot be had for periods that run literally into years, and this is particularly true of jute machinery. All textile fabrics are sold at increasing prices. In fact, distributors themselves have become alarmed at the profits being made, but there is scant sign of lowering of retail prices.

To judge by a reply given in the House of Commons recently, the total value of the works and plant, set up by firms engaged on munition production during the war and partly or completely paid for out of public funds, was about £85,000,000. Of this the government itself agreed to supply the sum of about £11,000,000 as a non-repayable contribution, the assets remaining with the contractors. Similarly the sum of £2,000,000 was expended as repayable contributions, while about £19,000,000 was spent by the government to meet the whole expenditure of the work, the assets remaining government property.

Summer time is to commence on March 28 and to end on Sept. 27 next. Despite rather feeble complaints from the farmers, and some reference to the ill effects on children who cannot be put to bed at the usual time, there is every probability that the change will be made from year to year; indeed an international basis is being proposed.

TO EDUCATE EX-SERVICE MEN

A national roll is to be issued, to contain the names of firms who undertake to employ disabled ex-sailors and soldiers on a definite percentage basis. The first issue, shortly to be made, shows up to the end of last year the names of about 9,500 firms, employing between them 1,482,130 workpeople, of whom 86,000 are disabled men. Apparently some 33,000 such men are still registered as unemployed, and a note of disappointment may be detected by some in the statement officially issued.

The Ministry of Labor expects through its training department to spend at least £22,000,000 during the next two or three years in the training of some 60,000 to 80,000 men. The schemes, both of bodies of employees and of employers, generally include a preliminary period of from six to eighteen months in a technical school or instructional factory, with a further period of eighteen months as a works improver, the man then becoming a member of an appropriate trade union. At least that was the suggestion of Mr. James Currie, head of the department, expressed in a paper he read recently before the Society of Arts. The men, discharged and disabled soldiers, are trained definitely for a trade, and an example is given of a man to be engaged subsequently as a turner on an ordinary engine lathe. Such a man, it is suggested, would be given preliminary lessons in measuring instruments, machine drawing and elementary mathematics. The man would be taught what the job is for and how to do it under the conditions of a modern factory. For men disabled by the war the scheme, it is suggested, will be in existence possibly till 1924. As in France, it may also be employed to train men, crippled as the result of accidents, in ordinary working, and there seems a pos-

sibility that it may later develop for general application to industry.

It has arisen out of the scheme inaugurated in 1915 by the Ministry of Munitions, and greatly extended in 1916, for producing single-operation workers for the intensive production of war material. Special recognition was given by Mr. Currie to the efforts of Sir Alfred Herbert and Mr. Oscar Harmer of the Coventry firm, Mr. Schofield of Loughborough Technical College, J. L. Hall, also of a well-known Coventry firm; Mr. Binns, a local official of the Amalgamated Society of Engineers, and H. Purdy and W. E. Buskard.

It is well known that in all probability a number of the leading engineering trade unions will amalgamate into one common union. Certain of the foundry unions are, however, definitely holding aloof for the purpose of forming their own amalgamation.

As applied to trade unions, an entirely new experiment is being made at the Birmingham University. Here systematic instruction in history, science, and government, together with a course of lectures on Shakespeare, will be provided for a number of men and women selected by the trade unions themselves, who will have to make arrangements regarding wages for the time thus occupied. The course is for two days a week. The men and women selected can be taken from the shops or may be officials of the trade unions, entirely at the discretion of the latter. The vice principal, Sir William Ashley, when making the announcement, requested publicity for the proposals which, he stated, had the support of labor leaders themselves.

Great Success of Industrial Fairs

Reference has been made in these columns to the British Industries Fairs organized by the Board of Trade and being held in London, Glasgow and Birmingham. The engineering and hardware exhibits are pretty well confined to the two latter cities. Very little of a novel nature has been exhibited, but, of course, this is not the purpose. Continental visitors, particularly from Scandinavia and from France, have been numerous, and merchants from Egypt, Nigeria, Japan, Brazil and the Argentine, as well as from Italy and Holland, have received especial mention. Admission to these fairs is by invitation, which is extended to business men only.

Official returns suggest that unemployment is diminishing more quickly for skilled workers than for unskilled. The demand for really skilled labor can hardly be satisfied while, on the other hand, unskilled or semi-skilled workmen have a much harder task to find employment. The resumption of work by the moulders naturally meant the almost immediate re-engagement of the skilled and other engineering workers who were put out of employment as a result of this very unwise strike.

High Cost of Petrol

Looming up as a handicap to motoring, whether for pleasure or profit, and therefore to the motor industry, is the rapidly rising price of petrol. At 9d. in 1896 and 1s. 4d. in 1906, the price in Great Britain is now 3s. 8½d. per gallon. The Automobile Association is promoting a petition to the head of the government, and states that "the exorbitant price exacted from the British public by the petrol interests is directly increasing your cost of living and bids fair to strangle road transportation and the motor industry." The action of combines is suggested, and it may be noted that benzol, the British competitor of petrol, though having certain advantages as to duties, is yet sold at the same price. The petitioners have, possibly not unexpectedly, received support in a report issued today by the Board of Trade, which appointed a subcommittee to investigate this subject. Figures are given and it is suggested that No. 1 petrol shall be sold at 2s. 10½d. and benzol at 2s. 8d. per gallon. Reference is made to the risk of a future famine and the danger arising from the fact that both supply source and machinery for transport and distribution "are mainly controlled by the same interests. The two main groups concerned are the Standard Oil Co. and the Royal Dutch Shell, whose great resources and wealth are indicated by the large number of companies they control." It is pointed out that "power alcohol is the only potentially unlimited source of supply."

London, March 12, 1920.

Two most important decisions bearing on the industrial future of Great Britain were made yesterday. On the one hand the special trade-union congress in London rejected direct action—that is, a general strike to force the nationalization of the mines on the government—declaring instead in favor of political action. Thus Great Britain, which since the armistice has lived from one strike or strike threat to another, escapes a general upheaval. The other decision is that of the Industrial Court considering claims for increases of wages in mechanical and other trades. It is now held to be necessary that the value of work done should govern the remuneration of workpeople, this value depending on the state of the market.

The Industrial Court, in fact, rejected a claim made on the ground of increased cost of living, but nevertheless awarded an advance on time rates and on piece rates. The engineering industry was reported as in an abnormal condition—owing to the great demand for engineering products in the devastated areas of Europe, and in the home and foreign markets generally, due to the necessary rehabilitation of the industrial world which has been deprived in a large measure of engineering products during the greater part of the war period. Reference was also made to the fact that, apart from advances to meet increased cost of living, wages in the engineering industry had remained unchanged for a number of years, and a comparison was made with wages of other industries and consideration given to the need for stabilizing the industry for a considerable period. On these grounds the advance was given.

The Shipbuilding Industry

The condition of the British shipbuilding industry may be gathered from the report published that Palmer's, of Jarrow and Hebburn, are in receipt of orders valued at between £15,000,000 and £20,000,000. The shipbuilding industries of the English northeast coast have work in hand for two or three years. The Clyde area is not behind and the Johnstone and other Scottish machine-tool firms that cater to them can be described as "full-up."

Inquiry at a well-known English ball-bearing works showed that at present the individual worker's output is at about two-thirds the pre-war rate.

The London market was somewhat astonished at the last meeting by the fact that quantities of steel amounting to several thousand tons have been bought by British firms from Germany at prices lower than those ruling in Great Britain. In fact it is said that further material is under offer at from £3 to £5 a ton below home prices. Sheffield, however, has refused to be perturbed, except perhaps on the ground that Germany could actually give delivery.

Reference was made recently in these columns to the census of production to be made in Great Britain in 1921. This is to deal only with essential trades. A complete census to cover all industries will probably be taken in 1922.

Welfare work was a pronounced feature of the war-time period, and much remains. An unusual extension has been announced in connection with a Rochdale firm. They have placed a firm of accountants at the disposal of workpeople, to give any information and advice on income-tax matters, the Rochdale firm being responsible for the expenses and supplying the necessary letters of introduction through their welfare department.

The Motor Boat, Marine and Stationary Engine Exhibition which opened today at Oylmpia, London, W., and which will remain open until March 20, contains about 150 exhibits, including one or two of machinery and small tools. Little of an outstanding character is shown. The Thorneycroft stand, however, showed the coastal motor boat No. 4 which ran the blockade in Petrograd Bay and destroyed a Russian cruiser. She is a skimmer with a single step and is 40 ft. on the water-line by 8 ft. 6 in. beam, the V-form 12-cylinder engines being of about 225 hp. With full load, 40 knots has been attained.

What Other Editors Think

The "Impossible" Has Happened

From *Railway Age*

IT IS AMUSING now to recall many things that were said about two years ago regarding the future of the railways. Director General McAdoo was engaged in trying to revolutionize not only the organizations, but also the operation and the physical properties of the railways, in the interest of unification. He seemed to be making such progress that it became a commonplace of conversation for people to predict that the railways would never be returned to private operation. Many of them based their prediction, not upon the ground that this would be undesirable, but that it would be "impossible." Everything would be so changed that the railroads not only would not, but could not, be returned. Nevertheless, they have been returned. . . . The transfer took place with so little trouble as to have a tendency to deepen the impression in the minds of many persons that the railroad problem has been solved and easily solved. *Unfortunately, that impression is erroneous. The passage of the new railroad legislation and the return of the railways to their owners is but a commencement of the solution of the problem. The railways are still just as short of facilities as they were when the Government turned them back, and it will take years of work and billions of new capital to make their facilities adequate. Former Director General Hines has stated that the properties have been returned to the companies in as good condition as they were received by the Government. This is certainly not correct as to passenger equipment, because the Government never, in more than two years of Government operation, bought a single passenger car. It can hardly be true as to locomotives and freight cars, because in two years of Government operation the Government bought only as many locomotives and freight cars as were required to replace the number ordinarily retired in one year. The equipment may be in as good condition in so far as repairs can make it so, as it was two years ago, but the amount of it is much more inadequate than it was then, and no repairs can make an old car as good as a new one. With regard to track, the Government has not laid anywhere near as many new rails and ties as the companies normally did under private operation.*

Government operation has caused numerous changes in the official personnel of the railways. It will be a long time before the roads will recover from the effects of the ruthless disruption of their official organizations which occurred under Government control. . . . Mr. Hines, in a recent statement, maintained that Government operation had been as economical as private management would have been. That is a matter of opinion. Under Government operation, railway expenses increased $1,600,000,000 a year. The *Railway Age* does not believe that an equal increase in expenses would have occurred under private operation. . . . At any rate, both Government operation and the new railroad legislation together will not solve the railroad problem. Under the new legislation the Interstate Commerce Commission and the railway managements may solve it, but they will not solve it unless there is the closest and most intelligent and friendly co-operation between the commission, the railroad managements, and the shipping and traveling public. Some people are disposed to say that the railroads have been returned, not to their owners, but to the Interstate Commerce Commission. We do not believe that is true in the sense in which it is meant. The commission has been given greatly increased power, but we believe that the future attitude of the commission, railway employees and the public toward the railways can be and will be determined chiefly by the railroad managements themselves. We believe that the railroad managements can cause private management to fail. We also believe that they can cause private management to succeed, and that by the exercise of diplomacy, public spirit and efficiency they will make it succeed.

Trading Conditions With Germany

From *Mechanical World, England*

THE ratification of the Peace Treaty has led the government to put into effect immediately the arrangements we have already outlined for dealing with enemy debts. All persons owing money to Germany or owed money from that quarter are therefore requested, if they have not already received a notification as a result of having registered themselves with the public trustee, to put themselves into communication with the comptroller of the clearing house, Cornwall House, Stamford Street, S.E. 1. In the case of other countries, debts will be collected directly between the concerned, but in the case of Germany collection of debts can only take place through the clearing houses which have been established in London and Berlin. Another and even more important announcement, which is the direct sequel of the ratification of the Peace Treaty, is the government giving notes as to the conditions under which trading may take place with Central Europe. Although the war with Germany is officially over, this by no means implies that there is an immediate return to pre-war conditions. Traders will find that there are still a few restrictions which must be complied with. . . . The position created by the judgment of Justice Sankey in regard to the right of the Government to prohibit importation under the customs consolidation act has left the position in such doubt that for the moment the goods dealt with in that way are presumably freed of restrictions, but steps will no doubt be taken to insure that the Government view shall be given effect through the medium of legislation. For this reason traders are warned that although they may make arrangements for imports during the interregnum, goods not actually delivered by the time new legislation is passed will not necessarily be admitted because they are ordered now. The necessities of the country will be the deciding factor.

SPARKS FROM THE WOR

Valentine Francis

British Trade-Mark Law Amended

A new trade-mark amendment act has just been put into effect in Great Britain. Under the provisions of this act, any trade mark which has been actually in use in trading operations for a period of two years can be registered by the user thereof.

In this way many marks which could not have been registered under the old law, such as geographical terms, surnames and descriptive words, may now be registered.

Many foreign countries require the filing of a certified copy of home registration as a prerequisite of registration in the foreign country. This regulation has prevented the owners of many valuable but unregistered trade marks from obtaining protection in foreign countries.

The National Foreign Trade Council points out that similar legislation is greatly needed in the United States. A large number of trade marks are used by American manufacturers which are incapable of registration under the provisions of the present trade-mark law; usually because they are either geographical, the mere name of a person or persons not used in a particular or distinctive manner, or words or devices which are descriptive of the goods or of the character or quality of such goods. Many of these marks have, through extensive use and advertising, become extremely valuable. Yet, because they cannot be registered in this country, their owners are not able to register them in countries which require the certified copy of the home registration and are, therefore, open to piratical attacks by dishonest foreign traders.

Recently an attempt was made in Portugal to steal over forty American automobile trade marks. Similar attempts are of frequent occurrence, and can be prevented only by a revision of the U. S. trade-mark statutes.

Summer Meeting of the S. A. E.

The usual summer meeting of the Society of Automotive Engineers will be held at the usual place—Ottawa Beach on the eastern shore of Lake Michigan. The meeting is set for June 21-25 inclusive.

The program for recreation and sport is one to look forward to, and over two hundred prizes will be awarded. Tennis, baseball, golf, trapshooting, races, water sports and special sports will be staged, with expert amateurs in charge. There will be dancing every evening (Monday excepted), and the ladies especially are promised an excellent time.

One professional session will be held each day. These will be as follows: Monday, June 21, Standards and Business Sessions; Tuesday, Fuel Session; Wednesday, Transportation Session; Thursday, Farm Power Session; Friday, June 25, Production Session.

The meeting committee has arranged for excellent hotel accommodations.

Chicago Pneumatic General Offices Removed from Chicago to New York

The general offices of the Chicago Pneumatic Tool Co. were transferred to the Chicago Pneumatic Building, a new ten-story structure erected for the exclusive use of the company at 6 East 44th St., New York.

The move was accomplished without appreciable interruption to business over the week end. Arrangements, carefully made in advance, made possible the jump of this large organization across half of the continent without interference to the normal routine of business except for a brief period.

The Chicago district sales branch, previously in the Fisher Building, was moved at the same time to new quarters in Chicago, at 300 North Michigan Boulevard. The Chicago service branch, formerly at 521 South Dearborn St., has been consolidated with the sales branch at the new address. J. L. Canby, district manager, will continue to serve the company's customers in the Chicago and Milwaukee territories.

Production of Trahern Pumps Increased

The George D. Roper Corporation, Rockford, Ill., manufacturer of the Trahern pump, announces that its recent amalgamation will enable it to increase production of its pumps more than 50 per cent. This amalgamation was formed by the merging of the Trahern Pump Co., Eclipse Gas Stove Co., American Foundry Co. and the Rockford Vitreous Enamel Manufacturing Co. into the George D. Roper Corporation. The new firm will soon be housed in a new model plant, costing $1,500,000.

The "Trahern" pump will still retain its trade mark. The type of Trahern pump best known to the machinery trade is the rotary geared circulating pump, suitable for use on metal working machines for delivering coolant to the cutting tools.

Bartlett-Hayward Plant Offered For Sale

The War Department authorizes publication of the following statement from the office of the Director of Sales:

The Director of Sales announces that the Ordnance Salvage Board, War Department, is offering for sale by informal bids, the site, buildings and plant equipment of the Park Plant of the Bartlett-Hayward Co., situated at the corner of Columbia Ave. and Putnam St., Baltimore, Md., bids for which will be received until 12 o'clock, noon, April 15, 1920, by the Ordnance Salvage Board, Munitions Building, Washington, D. C.

This plant was erected and designed for the manufacture and assembling of 155-mm. shrapnel projectiles and is particularly adapted for the manufacture or assembling of automobiles or motor trucks. It is located on the Baltimore & Ohio Railroad which has two spur tracks entering the property, is near the heart of the manufacturing district of Baltimore, and is in proximity to that city's docks and wharves. The buildings are of substantial construction, and provide an aggregate floor space of approximately 450,000 sq.ft.

Included in the structures are five machine shops, tool shops, office buildings, assembling building, lunchrooms, a storage building, hospital, oil house and smaller buildings, all of which are of mill construction. The machine shops are sided with steel sash. The boiler house and addition, two heat-treating buildings and three transformer houses are built of brick. The forge shop, pump house and four cooling sheds are steel frame, brick and galvanized-iron structures with steel louvre sash.

The equipment includes a 500,000-gal. and a 60,000-gal. steel oil tank, two pressure oil tanks, one cooling tower, one 50,000-gal. water tank and such plant facilities as concrete roads and walks, railway trackage, coal trestle, truck scales, wood and wire fencing, electric light poles and feeders, four electric cranes, one motor generator set, heating, plumbing and lighting fixtures, gas, sewer, water and oil piping, transformers, fire plugs, etc.

No bid forms are necessary in submitting offers for this property and any offer in writing will be considered. The plant is in shape for the immediate resumption of activities and may be inspected by applying to the chairman, Baltimore District Ordnance Salvage Board, Columbia Ave. and Baltimore & Ohio Railroad, Baltimore, Md.

LD'S INDUSTRIAL FORGE

News Editor

War Department Offers Surplus Stocks to Tornado-Swept Areas

The War Department authorizes publication of the following from the Office of the Director of Sales:

Following is a copy of a telegram sent out recently by the Director of Sales, War Department, to the mayors, postmasters, and similar officials in those areas which were swept by tornadoes, calling to their attention the fact that the War Department is ready to place at their disposal large quantities of equipment and materials adaptable in the rehabilitation of industrial institutions and agricultural communities:

It is with deep regret that I have read of the calamity suffered by your community. The War Department has large surplus stocks of plant equipment, contractors' equipment, building supplies, other than nails, other equipment and materials adaptable in the rehabilitation of industrial institutions, and a limited quantity of telephone wire and cable. Deliveries of this equipment can be effected promptly; prices are reasonable.

It may be to the mutual advantage of the Government and your stricken industries to get into direct communication. We will give inquiries and orders from your community emergency consideration. Please bring this suggestion personally to the attention of those industries in your community which may be in the market for surplus stocks held by the War Department, and give it as wide publicity as possible through the newspapers of your city and section. Inquiries by telegram or letter, outlining the character of the equipment or supplies desired, should be directed to Director of Sales, Munitions Building, Washington, D. C. We will have a representative of the War Department ascertain the actual needs of all prospective purchasers and advise each promptly of what part of his needs the War Department can supply.

The War Department has expedited the rehabilitation of several large industrial plants destroyed by fire by supplying promptly machinery and other plant facilities needed.

E. C. MORSE,
Director of Sales, War Department.

Twist Drill and Drop Forge Concerns to Vote on Merger

Special meetings of the stockholders of J. H. Williams & Co., at Brooklyn, N. Y., and of the Whitman & Barnes Manufacturing Co., at Akron, Ohio, have been called for April 2, for the purpose of ratifying an agreement entered into by their respective presidents, for the merging of the Chicago, Ill., and St. Catherines, Ont., plants of the Whitman & Barnes Manufacturing Co. with J. H. Williams & Co.

When ratified, this plan will contemplate the operation by J. H. Williams & Co. of drop forging and drop-forged tool plants at Brooklyn, N. Y.; Buffalo, N. Y., and West Pullman, Chicago, Ill., and at St. Catherines, Ont., Canada.

The plans of J. H. Williams & Co., under this arrangement, call for a considerably extended business and for service to its customers in the location most convenient for them. The Whitman & Barnes Manufacturing Co. will continue its business of making twist drills, reamers, etc.

Baker R. & L. Co. Changes Business

The Baker R. & L. Co., Cleveland, Ohio, announces an expansion of its business which will allow for greater production of Baker industrial trucks and Raulang bodies. The change includes the sale of the electric passenger-car business to Rauch & Lang, Inc., Chicopee Falls, Mass.

The manufacturing space made available will result this year in tripling the industrial truck output and doubling the body production. E. J. Bartlett is general manager.

The Baker R. & L. Co. started business over sixty years ago building coaches and later has been prominently identified with the electric vehicle industry.

The first electric road vehicles offered for sale on the American market were built by this company and fifteen years ago attracted much attention with the Baker Torpedo Kid, an electric racing car that established the world's kilometer record and attained a speed of 128 miles per hour at Ormond Beach, Fla.

All Express Charges to Canada Must Be Prepaid

Announcement has been made that on and after April 15, the American Railway Express Co. will require prepayment of express charges on all shipments which are destined to points in Canada.

This action, which is in line with that taken by the railroads some time ago, has been made necessary because of the heavy rates of exchange, which make the Canadian dollar worth only eighty-six cents in United States money.

The tariff rates from express offices in the United States to those in Canada have always been calculated in the currency of this country. The express company has found that it thus loses fourteen cents on every dollar of express charges when collection is made in Canadian funds.

The date of the enforcement of this new rule, according to express officials has been placed in advance so as to give shippers in the 'States an opportunity to make necessary arrangements with customers in Canada.

Trade Currents from New York and Chicago

New York Letter

Little change has been apparent in the local machine-tool situation during the past week. Sales have decreased slightly, but dealers report business in general to be satisfactory.

The General Electric Co. supplemented its Bridgeport list of the week previous with inquiries for new equipment for its Pittsfield, Mass., and Schenectady, N. Y., factories.

The Spalding Chain Corporation, of Bloomfield, N. J., has inquiries out for a substantial list, and it is reported that the Submarine Boat Corporation will shortly enter the market for plate-making and pneumatic equipment.

The Fairbanks Co., through E. R. Seiter, sold a 14-ft. boring mill weighing 50 tons to Theo. A. Crane & Co., of Brooklyn. This is said to be the largest mill in this section.

The New York representatives of several Cincinnati machine-tool factories report that deliveries by their firms will be uncertain due to a foundry fire in which large numbers of patterns were destroyed. In the pattern room at the time were patterns belonging to a number of different machine-tool makers who depended on the foundry destroyed for their castings.

The Lehigh Valley has completed its recent list, and is said to be temporarily out of the market.

The American Manufacturers' Export Association reports a constantly increasing demand for machine tools for export to countries where the exchange rate is favorable. The Belgian Commission was a recent inquirer through this organization.

The used-tool market is steady with all lines active. Floor stocks are more complete at this writing than has been the case for some time, and a greater variety of tools is noticeable.

Chicago Letter

For the first time since just a year ago, shipments of goods on order this month by machine-tool dealers equal or exceed the amount of new business. However, the swollen pile of back orders has been but slightly reduced. For twelve long months nearly every dealer received from 50 to 100 per cent more orders than he made shipments, but for March the average report is that orders are 70 per cent of shipments.

Delivery dates on new business are no better than in the past, for it will take several months of steady production to bring things back to a reason-

able basis. February, on account of transportation difficulties, was about the worst month for deliveries in a year, but March has made up for it, and the change is welcome.

Trade conditions show no material change since last week's report. Business continues good and regular, but on a scale materially reduced from the abnormal standard set in the past several months. The reduction is attributed to various causes by different dealers and manufacturers. Some think that slow deliveries are the cause, there being no reason for ordering machines that will not be delivered for six or nine months.

The railroads remain largely an unknown quantity. The Great Northern is out with an inquiry for a comparatively small line, and it is understood that appropriations for machine replacements have been approved by the governing bodies of many roads. Among those mentioned in this class are the Rock Island, Northwestern and St. Paul. The volume of these authorizations remains problematical, and will be so until requests for bids are made.

In connection with the fall-off in new business, some speculation is being indulged in as to the amount of possible cancellations which may be laying dormant in the back-order files. Many cancellations are claimed to be the result of a user ordering the same article from more than one source, and then, upon receipt of shipment from the concern first producing the goods, cancelling the order on the other dealer. Now that a breathing spell is being granted, a check-up process is starting with a view to eliminating this class of fictitious ordering as much as possible. It is not felt that any appreciable amount of this duplication will be found, as the total number of cancellations received during the past twelve months runs lower than 1 per cent.

Little Things

He rang in a little sooner
  Than the fellows in his shop;
And he stayed a little longer
  When the whistle ordered "Stop".
He worked a little harder
  And he talked a little less;
He seemed but little hurried
  And he showed but little stress,
For every little movement
  His efficiency expressed.
Thus his envelope grew just
  A little thicker than the rest.
He saved a little money
  In a hundred little ways;
He banked a little extra
  When he got a little raise.
A little "working model"
  Took his little "leisure" time;
He wrought each little part of it
  With patience most sublime.
Now it's a very little wonder
  That he murmurs with a smile,
As he clips his little coupons:
  "Are the little things worth while?"

Arthur L. Ormay

ARTHUR L. ORMAY, illustrator-in-chief of the McGraw-Hill Co., died at his home in Brooklyn, March 23.

Mr. Ormay was born in Kassa, Hungary, May 25, 1881. After the usual preliminary education he entered the Polytechnic of Budapest, from which he graduated in June, 1905, with the degree of M. E. He came to the United States the following year and shortly afterward joined the staff of the *Engineering News* as draftsman and letterer. He stayed with this paper for about three years. He then went to John Hill with a proposal to establish a drafting department to do

ARTHUR L. ORMAY

the work of the papers of the Hill group, which at that time consisted of the *American Machinist*, *Power*, and *Engineering and Mining Journal*. Mr. Hill considered the proposition favorably and one of Mr. Ormay's first jobs was the making of a difficult boiler chart for *Power*. This piece of work at once stamped him as just the man for technical work. In the establishment of a separate illustrating department he had not only charge of the drafting, but of layout and retouching work.

Mr. Hill started *Coal Age* in October, 1911, and in December of the same year bought the *Engineering News*. The work for the two additional papers was also successfully handled under Mr. Ormay's supervision. It was during this period that he developed what is known as the Ormay Process of Illustration, patented in 1915.

The consolidation of the McGraw and the Hill companies in 1917 after Mr. Hill's death broadened Mr. Ormay's duties and responsibilities, as he then had ten technical papers to serve. He was given the title of Illustrator-in-Chief, which he held at the time of his death.

In addition to his other talents, Mr. Ormay was noted for his pen-and-ink sketches of people. One of his best was a large likeness of Mr. Hill, which was finished shortly before Mr. Hill's death. This portrait displays an execution and artistic talent of a very unusual quality.

Stanley Rule and Level Co. Votes To Sell Out

At a meeting of the stockholders of the Stanley Rule and Level Co., New Britain, Conn., held at the offices of the corporation recently it was voted to accept the previous recommendation of the directors in advising selling the effects of the concern to the Stanley Works. The price paid will be $6,000,000 as suggested and the Stanley Rule and Level Co. will protect the minority stockholders on its holdings to the extent of guaranteeing par on the preferred issue, as suggested by the Stanley Works, until June 1, 1920.

Detroit Gear and Machine Co. Is Building a New Plant

The Detroit Gear and Machine Co., Detroit, Mich., is constructing an entirely new fireproof building which will be ready for occupancy in about six weeks.

When the building is completed the firm will consolidate its three separate plants which it now operates. It is buying new machinery for equipping this plant and is still in the market for more. It is producing gears and complete transmissions for automobiles, and machines along this line will interest them.

Cornell's Engineering Graduates Meet to Form Society

A meeting of graduates in engineering at Cornell University will be held on the evening of April 9, in the Engineering Societies Building, New York. The meeting is called by the Cornell Society of Civil Engineers, partly with the idea of forming a general Cornell engineering society, now that the different engineering schools at Cornell are to be combined into one general engineering college. The new dean of the combined college, Prof. Dexter S. Kimball, will be one of the speakers.

Drake Lock-Nut Co. Has Foreign-Trade Improvement

An idea conceived by George F. Drake, vice president of the Drake Lock-Nut Co., of San Francisco, Cal., has been a big factor in smoothing out foreign-trade relations, and a great help to foreign buyers.

This plan enables the company to quote C.I.F. to any usual seaport in the world. A buyer in Johannesburg, Buenos Aires or Singapore, seeking an American product which is advertised and which he may want to try, has first-hand information as to the cost of the merchandise landed at his sea port.

New Radio Trucks Will Soon Be Given Trials

The Radio operating truck, mounted upon a White chassis and being manufactured by the Mulholland Co., of Dunkirk, N. Y., is well on toward completion. The body is totally inclosed and is 120 in. long, 64 in. wide and 64 in. high with a door on the right-hand side and two glass windows provided with canvas flaps. Room is provided for three operators and one squadron radio officer. One bench supports a ground radio telephone set, one crystal detector receiving set and one low frequency amplifier. Storage batteries are held in clamps underneath the bench. A continuous-wave radio telegraph transmitting and receiving set is installed on another bench. A 6-volt circuit, comprising two lamps, is connected to storage batteries while a 110-volt 2-lamp circuit may be used when a suitable external supply is available.

External brackets are provided for carrying antenna masts. Each set is provided with its own antenna.

The ground radio telephone set will in the future be replaced with a higher-powered telephone set which will increase two-way telephone communication to a distance of approximately fifty miles. These higher powered sets are not available at the present time.

The radio telephone set will have a transmitting range of approximately fifteen miles under ordinary conditions for work from ground to plane and vice versa. The transmitting range of the continuous wave set is in the neighborhood of fifty miles. The receiving ranges of these sets will depend upon the local conditions and mainly upon the power of the transmitting set whose signals are being received.

Engineering Advertisers' Association Elects Officers

The first milestone of the Engineering Advertisers' Association of Chicago was passed on March 9 at the Auditorium Hotel, at which time the following officers were elected for the ensuing year: President, A. H. Hopkins, advertising manager, C. F. Pease Co.; vice president, J. J. Arnsfield, advertising manager, Fairbanks-Morse Co.; secretary, G. S. Hamilton, advertising manager, American Steam Conveyor Corporation; treasurer, E. I. Pratt, advertising manager, Kellogg Switchboard and Supply Co.

According to a clipping from the Sheffield (England) *Telegraph*, transmitted by Consul William J. Grace, so many second-hand lathes have been thrown on the British market recently, through the dismantling of munition plants and other war activities, that there is now no call for them. Purchasers have found difficulty, the clipping states, in converting the lathes from the special purpose for which they had been used, to general utility machines.

Obituary

John Clinton Scott, 70 years old and for nearly 35 years head of the tool-steel department of the Bourne-Fuller Co., Cleveland, Ohio, died on March 21. The news of his death came as a shock and surprise to his host of friends in the steel, machinery and manufacturing trades. Mr. Scott originated many of the tool-steel analyses used today and was the author of a book, "Tool Steel and Its Uses." He was looked upon as a national authority on all phases of tool steel and Scott's tool steel was named for him.

J. N. Derby, vice president of Manning, Maxwell & Moore, Inc., New York, died at his Greenwood, Conn., home on March 28 from heart disease.

George H. Webb, treasurer and general manager of the Pawtucket Manufacturing Co., Pawtucket, R. I., died on March 6.

N. Howard Easton, president of the Pawtucket Manufacturing Co., Pawtucket, R. I., died on March 14.

Business Items

The Cincinnati Shaper Co., Cincinnati, Ohio, has just completed its new addition which, it is expected, will double its production.

The export department of the Canton Foundry and Machine Co., Canton, Ohio, is now at the International Machinery Exposition, Grand Central Palace, New York City.

Domestic Exports of Metal-Working Machinery from the United States by Countries During January, 1920

Countries	491 Lathes	492 Other Machine Tools	493 Sharpening and Grinding	495 All Other
Austria	$4,875	....	....	....
Belgium	34,275	$20,299	$29,081	$66,258
Denmark	4,098	4,570	2,250	4,733
Finland	....	2,563	....	....
France	101,691	151,456	79,809	385,171
Germany	....	....	....	60,100
Greece	....	1,103	....	....
Italy	9,637	16,605	....	36,641
Malta, Gozo and Cyprus Is.	....	....	125	....
Netherlands	17	1,459	1,223	8,013
Norway	3,524	7,337	6,209	16,937
Poland and Danzig	5,519	1,307	154	5,700
Portugal	2,559	136	832	1,821
Roumania	....	....	....	1,155
Russia in Europe	....	....	....	85,642
Spain	22,104	10,319	5,158	25,857
Sweden	18,551	17,343	9,422	51,313
Switzerland	112	2,831	1,405	7,006
Turkey in Europe	....	....	210	....
England	137,507	174,093	124,291	306,417
Scotland	....	....	1,315	5,620
Bermuda	....	45	....	....
Canada	126,202	220,564	66,693	198,979
Costa Rica	....	342	....	245
Guatemala	....	52	....	....
Hondruas	1,433	509	....	2,771
Nicaragua	....	102	....	....
Panama	....	536	....	489
Salvador	....	89	27	....
Mexico	2,241	3,464	2,479	4,617
Newfoundland and Labrador	....	60	1,060	....
Jamaica	....	126	....	350
Trinidad and Tobago	145	203	5	....
Cuba	9,250	54,431	7,709	29,805
Danish West Indies	....	51	....	....
French West Indies	....	14	....	875
Haiti	....	113	....	....
Dominican Republic	1,250	913	....	1,291
Argentina	3,638	11,909	887	5,321
Brazil	14,328	6,196	348	2,867
Chile	7,581	3,537	215	863
Colombia	....	596	137	866
Ecuador	....	199	....	189
Peru	4,777	9,109	876	1,893
Uruguay	3,103	403	88	133
Venezuela	106	116	65	95
China	11,993	26,193	1,764	18,795
Kwantung	42	....	....	....
Chosen	530	....	....	34
British India	21,697	133	254	7,086
Straits Settlements	1,039	322	....	....
Other British East Indies	....	221	....	....
Dutch East Indies	8,415	3,360	9,269	2,741
Hongkong	362	234	....	35
Japan	45,461	41,646	31,787	225,852
Siam	....	292	....	250
Australia	4,759	9,959	6,283	20,188
New Zealand	1,192	2,238	358	1,769
French Oceania	....	....	15	....
Philippine Islands	4,904	5,795	358	11,571
British South Africa	12,354	664	524	2,132
French Africa	....	235	....	....
Madagascar	....	....	....	150
Morocco	....	381	....	892
Egypt	....	....	1,689	....
Total	$631,271	$816,773	$394,374	$1,611,528

J. C. Dillenbeck and George L. Bassler have formed the D & B Sales Co., with Chicago office at 549 Washington Boulevard. This company will specialize in the sale of abrasive grinding wheels, etc. They are manufacturers' agents for the American Emery Wheel Works of Providence, R. I. Both members of this company were formerly with the Abrasive Co., of Chicago, Ill.

The Philadelphia Textile Machinery Co., Philadelphia, Pa., has started the erection of an addition to its plant at Sixth St. and Tabor Rd. The new building will be four-story, reinforced concrete, 146 x 77 ft.

Carl F. Gerlinger, W. G. Vassall and R. L. Chapman of Dallas, Ore., have incorporated the Dallas Machine and Locomotive Works and plan to engage in construction, erection and repair of motors, locomotives, machinery, engines and foundry products.

The Progressive Die and Tool Co., Columbus, Ohio, has been incorporated by H. F. Gray, M. Voltz, G. Snashall, H. E. Brennan and J. P. Michael. The company is a reorganization of an individual concern which has been in operation for about five years. H. F. Gray is head of this company.

Manning, Maxwell and Moore, Inc., New York City, has announced that its branch office in San Francisco has moved to 40-42 Fremont St.

The Hooven Radiator Co., has moved into its new factory and office at 410-420 North Western Ave., Chicago.

The Cleveland office of the Chase Metal Works and Chase Rolling Mill Co., Waterbury, Conn., is now located at 310 Engineers Building, and is conducted by W. B. Fairfield and C. K. Lenz.

The Lafayette Tool and Equipment Co., Lafayette, Ind., has appointed Societe Anonima Italiana Alfred Herbert, 42 Via Cajazzo, Milan, Italy, as its sole agent for the sale of the Lafayette universal grinding machine.

Prominent business men of Lynch and Harlan, Tenn., have organized the Harlan Electric and Machine Works, and announcement has been made that a $75,000 machine shop will be immediately established at Harlan. W. H. Rogers heads the new company. The size of the building to be constructed will be 80 x 100 ft.

The Plant Engineering and Equipment Co., Inc., of New York City, manufacturer of Corliss valve steam traps, Mason condensation meters and other power and heating specialties, announces the opening of an office in Newark, N. J. M. Wm. Ehrlich will be the New Jersey manager in charge with headquarters at Newark, N. J., and a sub-office at Lyndhurst, N. J.

The Hyatt Roller Bearing Co. has moved its New York office to 6th Ave. at 41st St. and invites its friends to drop in whenever they are in New York.

Personals

PROF. ARTHUR D. BUTTERFIELD has been appointed educational director of the entire plant of the Norton Co., of Worcester, Mass. Professor Butterfield was formerly in the mathematics department at the Worcester Polytechnic Institute and is also secretary of the Technical Alumni Association.

R. G. PROUTY, formerly with the American Saw and Manufacturing Co., has resigned to take charge of the sales of the Moore-Stillson wrenches for the Moore Drop Forging Co., Springfield, Mass.

D. J. FLYNN, openhearth superintendent of the Tacony Steel Co., Philadelphia, Pa., has been transferred to the New Castle plant of the Penn Seaboard Steel Corporation, with which the Tacony Steel Co. recently merged.

EDWARD F. BUIE has been appointed by the Victor Saw Works, Inc., Springfield, Mass., as its Pacific Coast representative, to succeed Victor Pezzini, who has resigned from its employ. Mr. Buie was formerly connected with the Union Hardware and Metal Co., Los Angeles, Cal.

E. E. YAKE has resigned his position as engineer in charge of the inspection and maintenance department of Gilbert and Barker Manufacturing Co., Springfield, Mass. Mr. Yake is going with the Walworth Manufacturing Co. to do similar work.

H. C. FOSBERG, head of the experimental division in the engineering department of the Art Metal Construction Co., Jamestown, N. Y., has resigned his position and will be succeeded by J. R. Turner, acting head of the department.

RAY T. MIDDLETON has resigned as general sales manager of the Standard Steel Castings Co., Cleveland, Ohio, to become vice president and director of sales and advertising for the Kelly Metals Co., of Chicago, Detroit and Los Angeles. Mr. Middleton will have his headquarters in Chicago.

R. R. KNAPP, formerly connected with the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has become sales manager of the Reliance Spring and Manufacturing Co., Brooklyn, N. Y.

H. DEVERELL, sales engineer, has severed his connections with the Deverell, Spencer & Co., Baltimore, Md., and has opened an office at 1401 Lexington Building, Baltimore, Md. Mr. Deverell will be engaged in the elevating, conveying and transmission machinery business.

WILLIAM E. STEVENS, head of the New England sales force of the Stanley Works, has been employed by the company for fifty years. Mr. Stevens entered the factory at nineteen and held various positions up to his present one.

P. J. F. BATENBURG, for ten years identified with the automotive engineering field, has been appointed chief engineer of the Mitchell Motors Co., Racine, Wis. At one time he was chief engineer of the Four Wheel Drive Auto Co., Clintonville, Wis.

WILLIAM TAYLOR has been appointed chief engineer of the Scripps Motor Co., Detroit, Mich. Formerly, he was motor engineer of the Liberty Motor Car Co. He also designed the Militor motorcycle engine.

CHARLES S. AMADON has resigned his position as general manager of the J. N. Lapointe Co., New London, Conn., to become president of the Euclid Broach and Machine Co., Cleveland Ohio.

LOUIS E. PECK has resigned his position with the J. N. Lapointe Co., New London, Conn., to become treasurer of the Euclid Broach and Machine Co., Cleveland, Ohio.

C. L. GOODRICH, assistant superintendent of equipment, Pratt & Whitney Co., Hartford, Conn., has returned to this country after a several months' business trip in Chile.

Forthcoming Meetings

The Electric Hoist Manufacturers' Association will hold a meeting at 9 East 40th St., New York, on April 15.

The National Metal Trades Association will hold a convention at the Hotel Astor, New York City, on April 19 to 22, 1920. H. D. Sayre is the secretary.

The American Welding Society will hold its annual meeting at the Engineering Societies Building, 33 West 39th St., New York City, on Apr. 22, 1920, at 10:30 a.m. Howard C. Forbes is the secretary.

The National Chamber of Commerce will meet in Atlantic City, N. J., on April 26, 27 and 28.

The American Gear Manufacturers' Association wil hold a meeting at the Hotel Statler, Detroit, Mich., on April 29, 30 and May 1.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21 at the Hotel Traymore, Atlantic City, N. J.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The American Drop Forge Association will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

April 15, 1920 American Machinist Vol. 52, No. 16

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Greenlee Double-End Center-Drive Lathe

BY J. V. HUNTER
Western Editor, *American Machin*

The machine described in this article has been developed for rapid production work and to a certain extent is a single-purpose machine. The special features of design which enable it to turn both ends of a shaft semi-automatically are clearly shown in the illustrations.

THE double-end center-drive lathe shown in Fig. 1, was developed by Greenlee Brothers Co., Rockford, Ill., and was originally designed for turning both ends of an automobile axle at the same time. It is now being applied with equal success to bar and shaft work requiring turning only on the ends.

In this machine the work passes through a drive head which may be located somewhere near the center. The tooling is varied to suit the character of the work, and in this respect the lathe may be classed as a single-purpose machine because special tooling must be built up to suit each particular piece of work. However, this is not a definitely limiting feature since several tooling sets can be furnished and these, in most cases, can be as readily applied to set up any other type of quantity production machine.

The bed of the machine is of heavy box section, closed at both ends. It has two sets of ways, one consisting of a pair of Vs 15 in. from center to center for the carriages, and the other having one flat and one V for the tailstocks and center drive head. Beneath the bed is a steel chip pan draining to a cast-iron coolant reservoir below.

A main drive shaft extends lengthwise through the center of the bed and is driven through suitable reducing gears by either a motor, or belt drive. With belt drive a clutch is provided between the pulley and the gear-drive shaft. Where motor drive is used no such clutch is furnished as suitable push-button electric control is provided for starting and stopping the motor. To aid in quick stopping a lever-operated brake is provided for the motor-driven machine.

For single-purpose production work no speed changes are provided for the main-drive shaft, but these can be

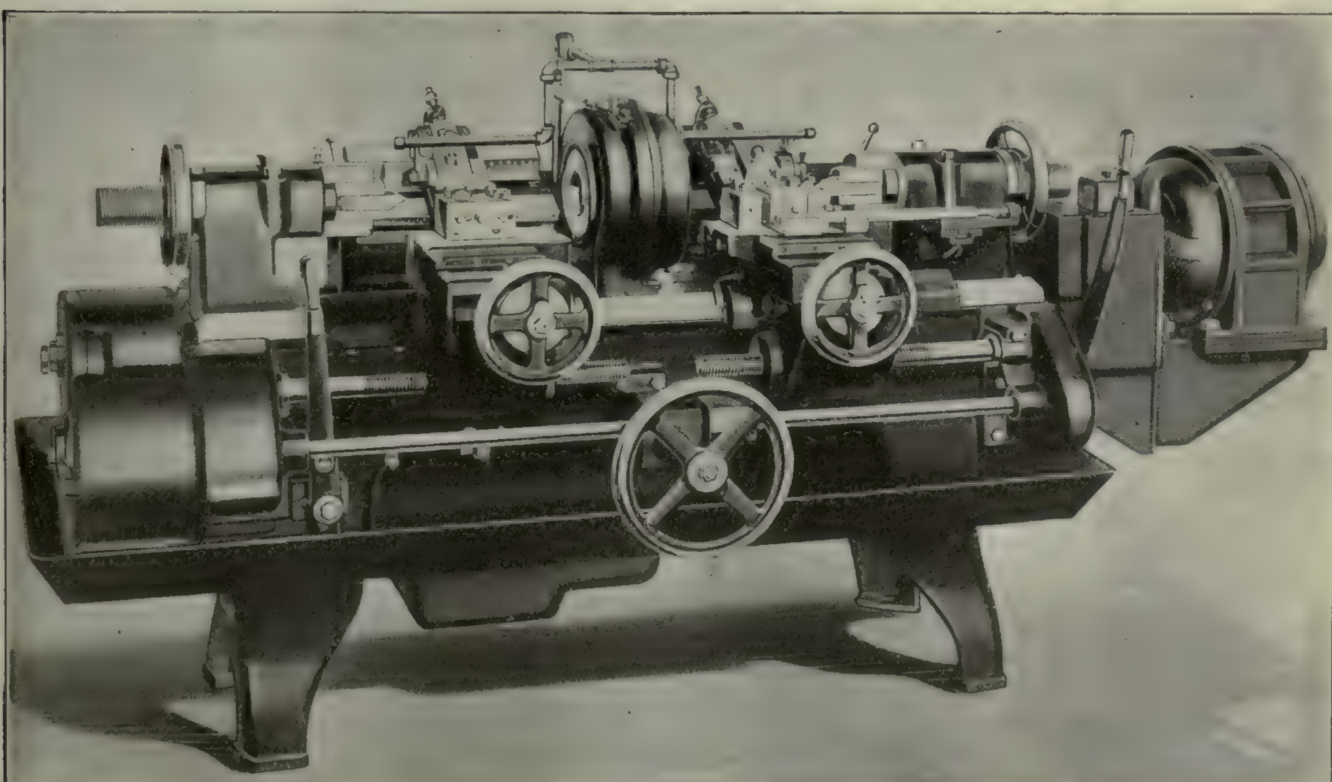


FIG. 1. GREENLEE 36-IN. DOUBLE-END, CENTER-DRIVE SHAFT LATHE

Specifications: Two sizes, 36 in. and 60 in.; maximum diameter to be turned, $2\frac{3}{4}$ in.; hole through center of drive head, $3\frac{1}{4}$ in.; floor space, 36-in. machine, 44 in. x 10 ft., 60-in. machine, 44 in. x 12 ft.; height overall, 64 in.; motor required, 5 hp., 1,200 r.p.m., constant speed; belt drive, 16 x $5\frac{1}{2}$-in. pulley, 5-in. belt; weight, 36-in. machine, 4,950 lb., 60-in., 5,400 lb.

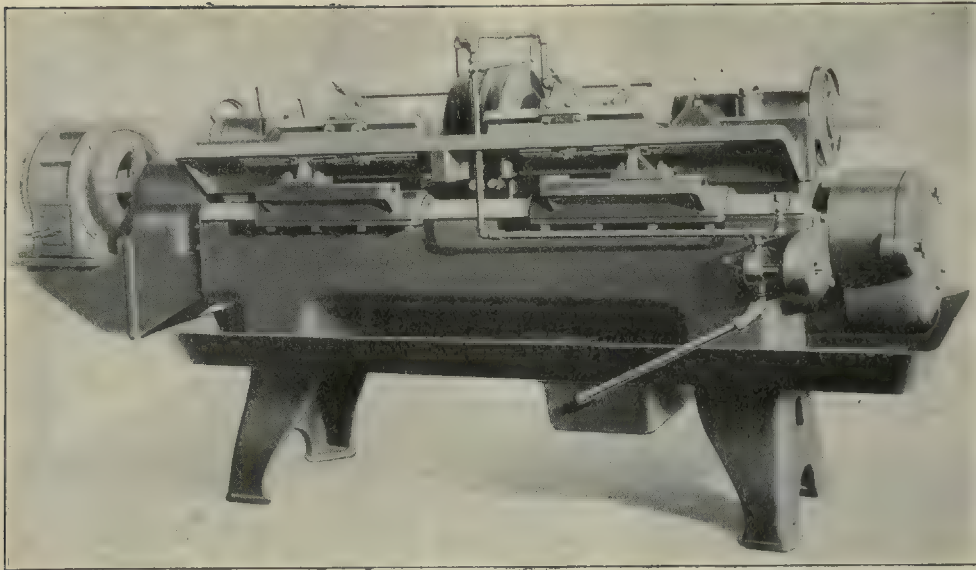


FIG. 2. REAR OF MACHINE SHOWING BACK TOOL SLIDES

furnished for special cases. The drive gears are located in a box at the right of the machine bed, this box being so constructed that it may be opened in order to change the gear ratios if it is necessary to alter the speed.

Center Drive

A key running the length of the main-drive shaft serves to drive the pinion of the center-drive head in all positions of the latter along the bed. The pinion transmits power to the large gear of the drive head through an idler. Steel helical gears are used to obtain smooth silent running, and the reduction from the pinion is 3 to 1. The drive-head gear is mounted on two ball bearings 7⅞ in. in diameter carrying 1-in. balls, and these take up all thrusts. The parts are inclosed to make the center-drive head housing dust-proof. Suitable oil and grease reservoirs are provided for lubricating the mechanism.

The clutch for the drive head is of the full-floating type made of two plates, each of which is centralized by two springs. Three self-centering and clamping jaws are used to grip the work, these jaws being operated for the insertion or removal of work by means of a hand lever. The tailstock spindles are 3½ in. in diameter and are bored to No. 5 Morse taper. The spindles are run out or in by means of handwheels. The noses of the spindles are cut away on one side, as shown, to clear the tools when turning work of small diameter. Each end of the lathe has a tool carriage, with a bearing 21 in. long, sliding on two V-ways. These carriages are securely gibbed and are provided with separate feed screws and oil wipers. On the 36-in. machine each carriage has a traverse movement of 8 in. when the drive head is in the center of the bed. The large handwheel shown in the center of the machine can be used to operate the feed screws through the feed-drive shaft (with the feed clutch control lever in neutral position) when it is desired to do so for setting up the tooling. The tool carriage is semi-automatic in its action and is controlled by a feed lever at the left end of the machine. This lever operates a positive clutch which engages the feed shaft that drives the change-gear mechanism for the feed screws at each end of the machine. Throwing the lever to the left causes the carriage cross slides to feed in 1 in. which enters the tools to the full depth of cut, thereupon the cross-slide motion is cut off and the carriages travel toward the center-drive head. At a predetermined point a dog on the left carriage reaches an adjustable stop on the stop rod which throws the feed mechanism into reverse. The tools are instantly withdrawn 1 in. for clearance, and the tool carriages return rapidly to their starting point. All of the feed mechanism is then automatically stopped. Taper turning is done by means of a taper slide bar.

The feed gears are located in the housing at the left end of the bed and are driven from the main-drive shaft through pick-off gears. The feed and rapid traverse motions are controlled through a system of planetary gearing. In cases where different rates of feed are required on the two feed screws the arrangement is made by changing the ratio of the pick-off gears on the opposite ends of the feed-drive shaft.

Feed Rates Must Be Properly Proportioned

Both carriages must finish their feed and be ready for reversal at the same instant, and this requires that either the respective feed rates must be properly proportioned for this result or that one tool carriage must be in a position to start its cut the necessary period before the other tools get into the work. The latter result can be accomplished by placing the carriage with the shorter cut, closer to the tailstock so that it is slower in reaching the work.

A feature of the machine is the back tooling which is carried on inclined ways so that the tool cross-slides stand at an angle of 30 deg. from the horizontal. The back-tool slide bases are stationary and are carried on

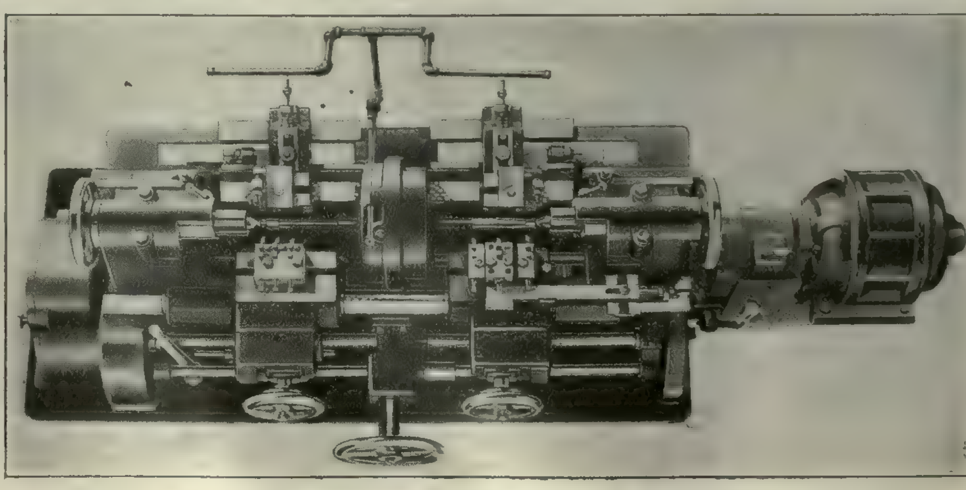


FIG. 3. TOP VIEW WITH TOOLING AND WORK IN POSITION

brackets which are bolted to the center-drive head casting and to the tailstocks as shown in Fig. 2. The tailstocks have flat planed ways to which the brackets are clamped by bolts fitting in T-slots so that both the center-drive head and the tailstocks can be shifted as necessary for different jobs.

Looking down on the machine as in Fig. 3, gives a good idea of the arrangement of one tooling set-up. The back tools serve for facing off ends or shoulders and

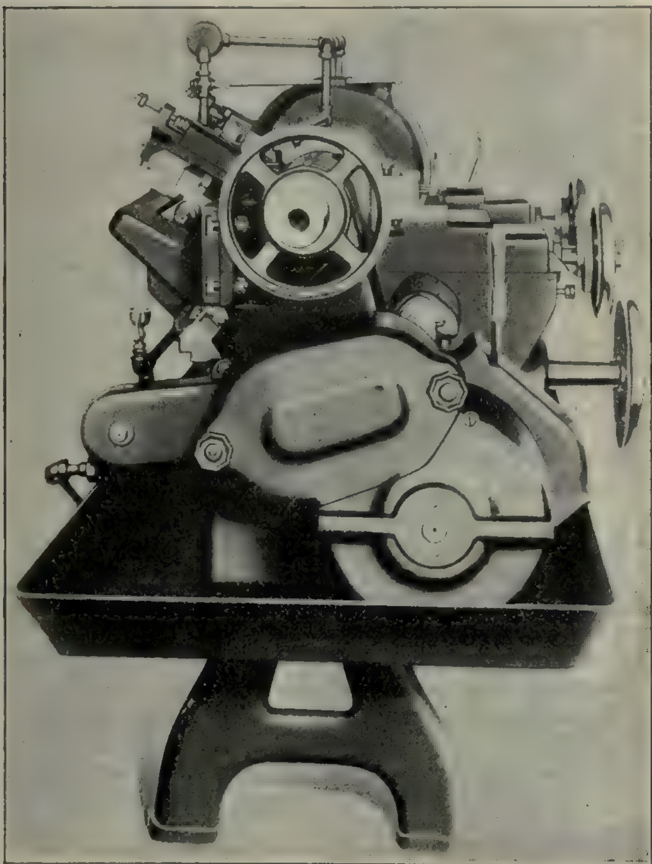


FIG. 4. END VIEW OF THE LATHE SHOWING FEED-GEAR BOXES

necking down preparatory to grinding a finish. Circular form tools are often used on the back slides, since these can be removed for sharpening and replaced without changing their longitudinal position. The back tools have no traverse movement and can be fed only straight in or out.

These tools are operated by means of a rod on the bottom of the cross-slide which sets down into a slotted cam slide working crosswise of the tool travel as can be seen at the left in Fig. 4. The cam slide derives its movement from that of the main carriage to which it is connected by an adjustable bracket. More than one back-tool slide can be used when required on the same end of the work.

A Chain-Drive Coolant Pump

A liberal supply of coolant is furnished to the tool by a geared pump located on the back of the machine and is driven from the main-drive shaft by a chain drive. The coolant piping is provided with a swivel joint so that the operator may swing it out of the way while replacing and removing work. The coolant flow is regulated by a valve operated by a rod extending through the center-drive housing to the front of the machine.

Review of Alloy-Steel Development

By J. W. Marshall

In looking back over the past two decades we must admit that they have been periods of great industrial development. During this time we have seen the Diesel engine developed, the steam turbine jump into prominence, the gas engine and the automobile perfected, and even the old-fashioned steam engine redesigned and greatly improved.

The steel of which many parts of these engines are formed, while still looking the same to the naked eye, has undergone a truly remarkable change. This change has been brought about by a demand for a steel, particularly by automobile manufacturers, for purposes of construction that would exhibit great strength, a high elastic limit and great fatigue-resisting qualities.

An Accidental Discovery

Perhaps the greatest discovery of the period was an accident. I refer to the discovery by Taylor and White; while engaged in a work of an entirely different character—namely, that of standardizing the tools of the Bethlehem Steel Co.—they stumbled as it were, on the remarkable qualities (particularly the property of red-hardness) of steel alloyed with tungsten, or molybdenum, and manganese or chromium. Truly, they astonished the world when, in 1900, they exhibited the results of their discovery at the Paris exposition. The great depth of cut, the thick chip and the high cutting speed of tools made from this steel had never before been shown. Like all great discoveries, there was an aftermath involving the redesign of the shop equipment on which high-speed steel was used, for it was soon found that machine tools and belting were not strong enough to stand the strains or do the work imposed upon them. Thus, the new steel, which became known as high-speed steel, began to revolutionize the existing practice of manufacturing.

High-Speed Steel

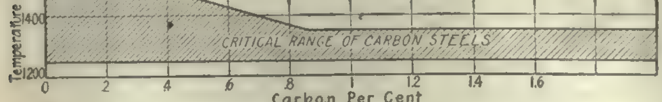
High-speed steel is essentially an alloy of carbon steel and tungsten, or molybdenum and chromium. In order to attain its red-hard property, it must first be put through a heat treatment, involving heating the steel to the melting point and cooling quickly. Iron and steel, as is well known, have different properties depending on the heat treatment received, being pearlitic, or soft, when annealed, and martensitic in structure when hardened. This martensitic or hardened form is obtained by heating the steel to a point above what is known as the critical temperature, or the temperature at which the carbon in the steel goes into solution in the iron, forming austenite or a solid solution of carbon in iron. Now, in the case of ordinary carbon tool steel, this critical temperature is about 1,400 deg. F., while in the case of high-speed steels, the critical temperature is about 2,000 deg. F. This explains why it is necessary to heat high-speed steels to the melting point, a process that would be ruinous to carbon tool steel. Again, when steel has been hardened, or put through a heat treatment that gives it a martensitic structure it may be tempered, which consists of gradually breaking down the martensitic structure into a pearlitic structure—the steel first being changed into troostite, then sorbite, and finally into pearlite. In the case of carbon tool steel, the martensitic structure breaks down into troostite at comparatively low temperatures, say 500 deg. F. In

this form, the steel is too soft to stand up as a cutting tool. With high-speed steel, however, the martensitic structure is very stable and does not break down into the troostitic form until heated to 1,100 deg. F.—a dull-red heat. For this reason, high-speed steel is said to have the property of red-hardness, which for a long time was thought to be an entirely new and distinct property. In reality, however, red-hardness is not a new property, the breaking down of the martensite into troostite merely being retarded by the presence of tungsten and chromium.

The demand for a more efficient cutting tool was met by introducing other metals into the steel and by giving the steel an appropriate heat treatment. It seems reasonable to suppose, then, that by a proper combination of alloys and heat treatments, steels could be developed that would meet the needs of structural parts. This did in fact happen. Unlike high-speed steel, however, the work was not done in a day but by a gradual process of experiment and investigation. It was found that steel containing nickel, when properly heat treated, was an ideal metal for crankpins, piston and connecting rods for high-speed engines, gun barrels and similar parts; that steels containing both nickel and chromium, when properly heat treated, were especially valuable for parts to be hardened and tempered as the fine structure thus produced has great shock-resisting power; that steels containing chromium and vanadium have much the same properties as nickel-chromium steels with the additional advantage that they are easier to machine and forge; and, only recently, that a high chromium steel, containing from 11 to 14 per cent of chromium, has special advantages for use in exhaust valves of airplane engines, owing to its resistance to scaling or oxidation at high temperatures.

Structural Alloy Steels and Heat-Treatment

Structural alloy steels are never used except in the heat-treated condition. The purposes of the heat-treating operations are twofold: To remove the internal stresses in the metal and secure the steel structure necessary for greatest strength, high elastic limit and fatigue-resisting properties. It is the function of the so-called double-quenching treatment to secure this result. The first treatment consists of heating the steel to just above the critical range and quenching. This puts the steel in the martensitic condition. The second treatment consists of heating the steel to just below the critical range and quenching. This is really a prolonged tempering operation and puts the steel in the sorbitic condition, hardened steels becoming sorbitic when heated to 1,100 deg. F. and quenched. Experiment has demonstrated that when in this sorbitic state, steels have the finest structure, greatest strength, high elastic limit and fatigue-resisting qualities. They further have a reasonable amount of ductility. The reheating operation also removes the internal stresses set up in the metal by working, sometimes so great as to negative the natural strength of the steel. The



CURVE OF CRITICAL RANGE OF CARBON STEELS

presence of vanadium has no effect on the critical range of the steel, and the effect of nickel and chromium on the critical range is so slight that for practical purposes it may be neglected. From this it follows that heat-treatment temperatures for alloy structural steels may be taken equal to those of carbon steels; that is, the variations of heat treatment will depend upon the percentages of carbon the steels contain. A curve similar to the one shown herewith may prove convenient for determining the upper and lower limits of the critical range.

The cross-hatched area indicates the critical range of carbon steels.

Experiences with the Metric System

By Thomas W. R. McCabe

My first introduction to the metric system was in 1887, when I was in business for myself making gages and other specialties to be used in manufacturing. Among the devices which were produced was one which had a series of holes varying by 64ths from ¼ to 1 inch.

From an advertisement in the *American Machinist*, we received an order from Russia for these parts, specifying metric sizes for the holes. None of us knew anything about this system of measurement but we got busy and learned, after some investigation, that there were 25.4 mm. in one English inch. Finally after a great deal of effort we converted the English sizes into the nearest metric equivalent and marked our standard device with the corresponding metric sizes. We shipped those tools to Russia, and later were much surprised to receive a duplicate order.

My second experience was as master mechanic in a factory that was starting up after being closed for three years. This factory under the old owners had adopted a beautiful system of metric diameters and English lengths.

We started with about three of the old toolmakers and some twenty or more new men, the latter knowing nothing about the metric system and, as I later found, caring less. In the tool crib we had taps, reamers, plug and ring gages, arbors, etc., which, with all the drill wire, were in metric sizes. The three old hands had been taught to reduce the millimeter into thousandths of an inch, so that when they wanted anything from the crib they would make their deductions accordingly.

Owing to the fact that the new owners were also owners of another factory in a different part of the country, and all our conversion tables were much the same as were used in their other plant, you may judge that it was some job to obtain a crib-tender who would stick long enough to become acquainted with our system. In employing a new man I always inquired if he knew anything about the metric system, and the answer always was "No! but I would like to learn."

After they got started I found that they only thought they wanted to learn.

After two very trying years, I threw up my hands and swore "Never again." I have been workman, foreman, superintendent, and factory manager for a number of years, and I try to keep in touch with current events, but I am commencing to believe that the hot-air artists are going too fast a pace and that I will, in common with the rest of the old mechanics, have to throw up the sponge.

Making 21,000 Pistons a Day

by
FRED·H·COLVIN
Editor American Machinist

This enormous output of pistons makes it possible to utilize practically any method that may be deemed desirable by the engineers, and it is extremely interesting to note those which have been chosen under these conditions. It should be understood, however, that it is the policy of the Ford engineers to make such changes from time to time as may be deemed best, and that it is highly probable that some of the methods here shown may have been recently replaced by others.

ON A BASIS of 3,000 cars to each 16-hr. day, and a repair schedule of over 9,000 pistons per day, the output of the piston department is scheduled to produce over 21,000 pistons per day, or more than 1,300 per hour. It should be further noted that extreme care is taken in the various operations, and that the pistons are very carefully inspected before being passed to the assembling department. Bronze bushings are used in the piston-pin holes instead of having the piston-pin bearing directly in the iron casting, this being done to make renewal easy after wear takes place. It will also be noted that the sides of the piston are relieved, but by a method which is entirely different from any yet illustrated. The main operations are shown by the transformation diagram in Fig. 1, the numbers corresponding to the figures showing how these operations are performed. The facing and boring of the open end of the piston skirt is done by two different methods, the one shown in Fig. 2 being done on a small three-station machine, and the other, shown in Fig. 3, on a heavy hand turret machine. The two machining heads of the first machine bore, face and ream the end of the piston skirt. The chuck jaws and the tools used are quite similar in both cases.

> The data on the machining of automobile pistons gathered on the following pages make up the first of two composite articles on the subject. In line with the announcement which appeared in our April 1 issue we have grouped the practices of several companies in one article so that comparison of methods will be as easy as possible. The companies whose methods are described here are Ford, Cadillac, Autocar and Chandler. Others to come include White, Packard, Franklin and Winton.

Figs. 4 and 5 show two methods of drilling the piston-pin hole, the first being done in the conventional double-headed machine of the New Britain type, and the next, a special Foote-Burt vertical-station-type machine. These two machines require almost no explanation, the first because most mechanics are familiar with it and the second because its operation is obvious from the photograph. The pistons are easily handled on both machines, and both drill and ream before releasing the work.

The machine shown in Fig. 5 drills and reams four pistons at the same time.

The pistons are turned on the vertical-spindle Foote-Burt machine shown in Fig. 6, the pistons fitting over the mandrel *A* while a short pin allows the eye *B* to pull them firmly in place. The turning tool is shown at *C*, the head-facing tool at *D*, and the chamfering and grooving tools are held in the block *E*.

The forcing of the bronze bushing into the piston-pin hole is done by a very ingenious punch press die, as shown in Fig. 7. This in reality carries a sub-press which guides the mandrel *A* over which a bronze bushing is slipped until it rests at the botom as at *B*. A piston is then slipped over the mandrel and a second bushing put on the mandrel on top of the piston. A single movement of the upper die *C* forces the piston down over the lower bushing and forces the upper bushing into the upper hole in the piston. This is performed more rapidly than it can be described. The usual cam-actuated lathe carriage was first used for relieving the sides of the pistons over the pin bosses as in Fig. 8. Grinding was also experimented with. These methods have, however, given way to a

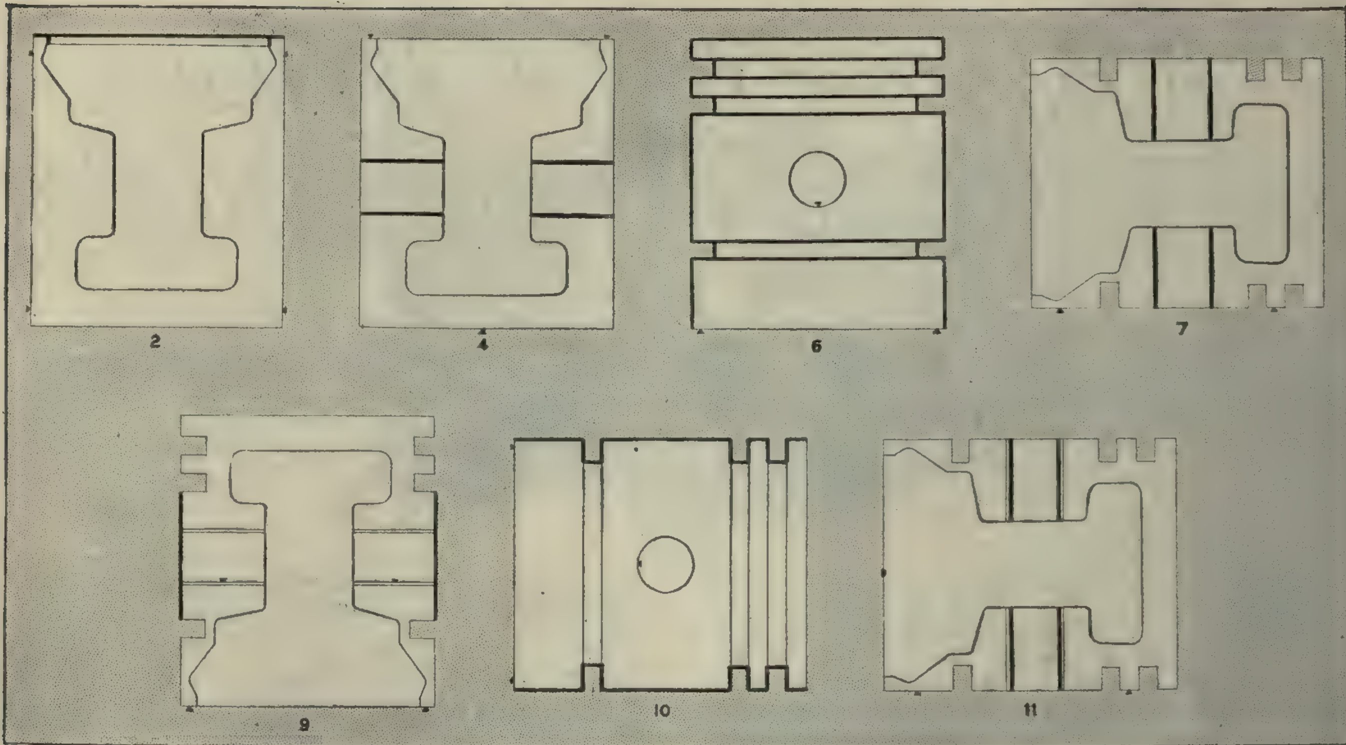


FIG. 1. TRANSFORMATION CHART OF FORD PISTONS

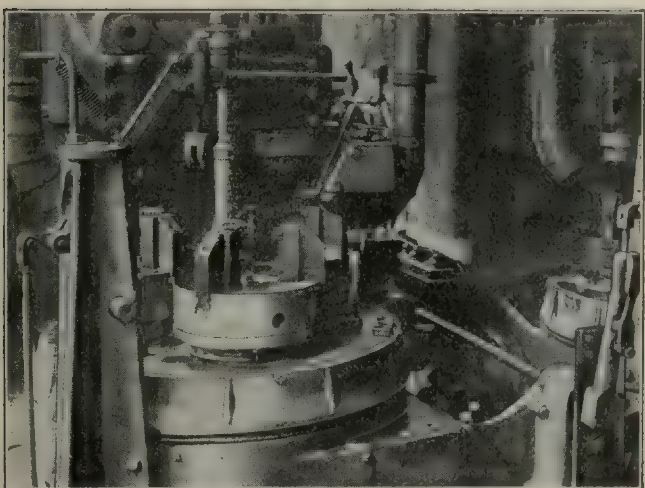


FIG. 2. BORING OPEN END ON SPECIAL MACHINE

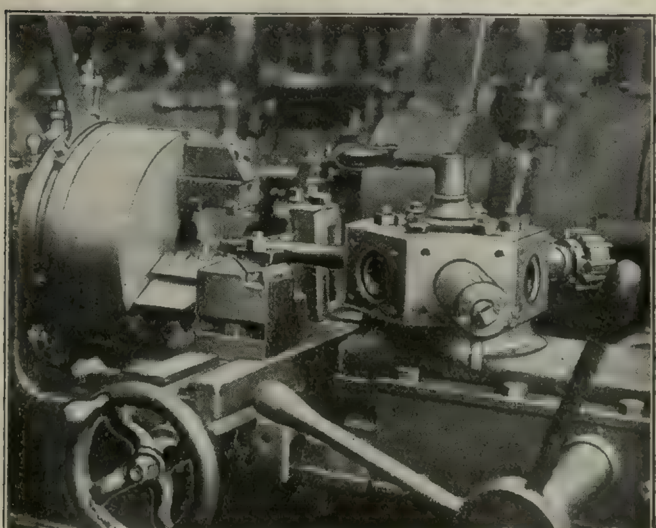


FIG. 3. BORING OPEN END ON TURRET LATHE

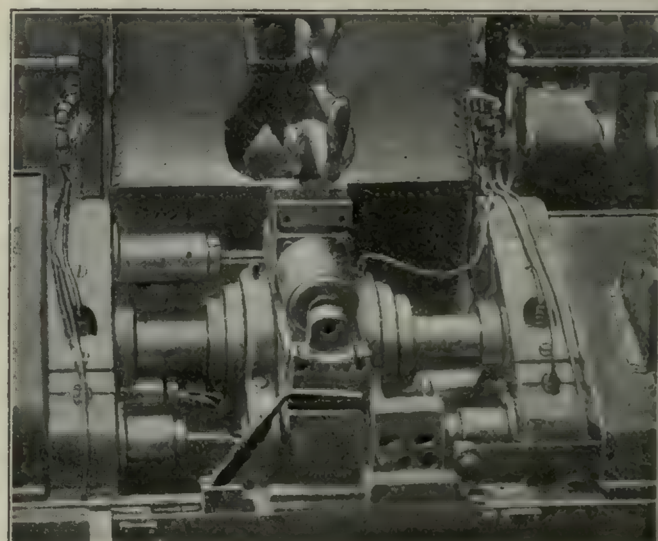


FIG. 4. DOUBLE-HEAD MACHINE FOR PISTON-PIN HOLE

very novel plan by which the sides are shaved or shaped in a punch press by means of a special tool head as shown in Fig. 9, and in detail in Fig. 10. The piston is placed on the slide *A* as shown, and pushed into position. The ram is then tripped and the special tools in each side of the head take 12 cuts over the piston from one ring groove to the next, as can be seen.

Shaving Piston Clearance

The main details of the construction of this fixture are shown in the two views in Fig. 10. The various parts are designated by the same letter in both views and in Fig. 9. After the piston has been placed on the slide A so that the piston-pin bosses center themselves in the V-blocks *B*, the slide is pushed back into position and the clamp *C* brought down on top of the piston by means of the rod *D*. The cam *E* and the handle *F* hold the piston firmly during the shaving operation.

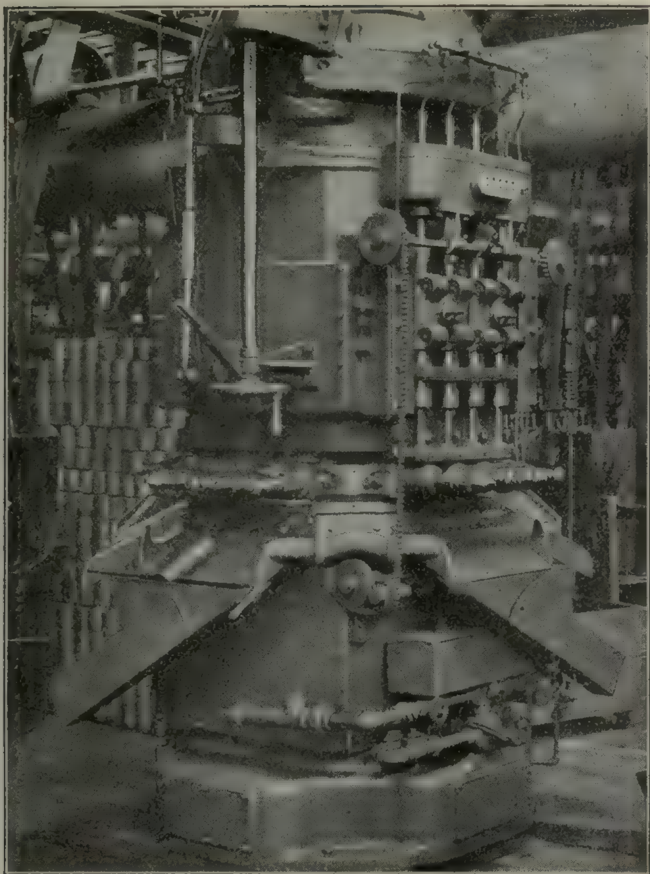


FIG. 5. SPECIAL MACHINE FOR PISTON-PIN HOLE

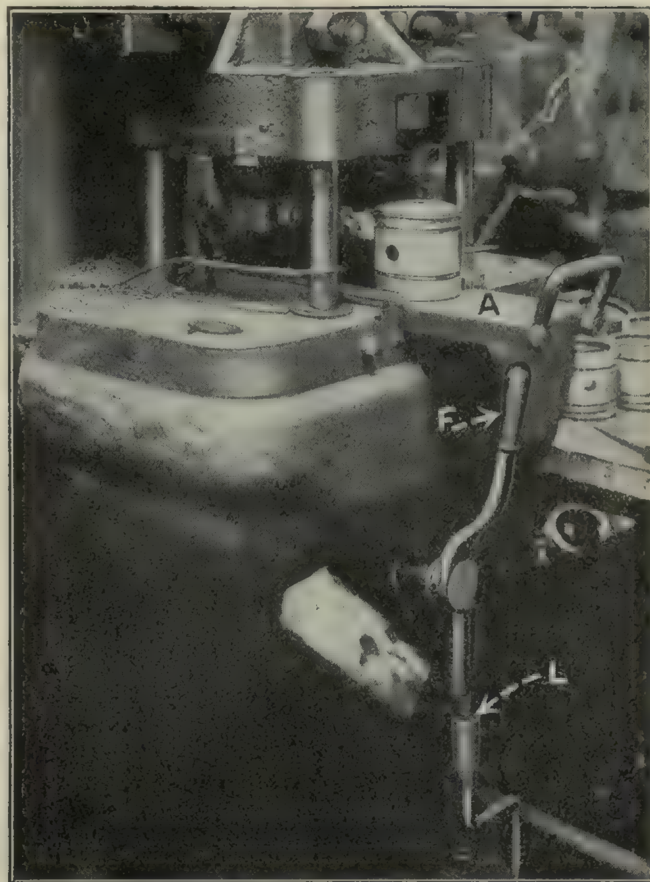


FIG. 9. SPECIAL METHOD OF CUTTING SIDE RELIEF

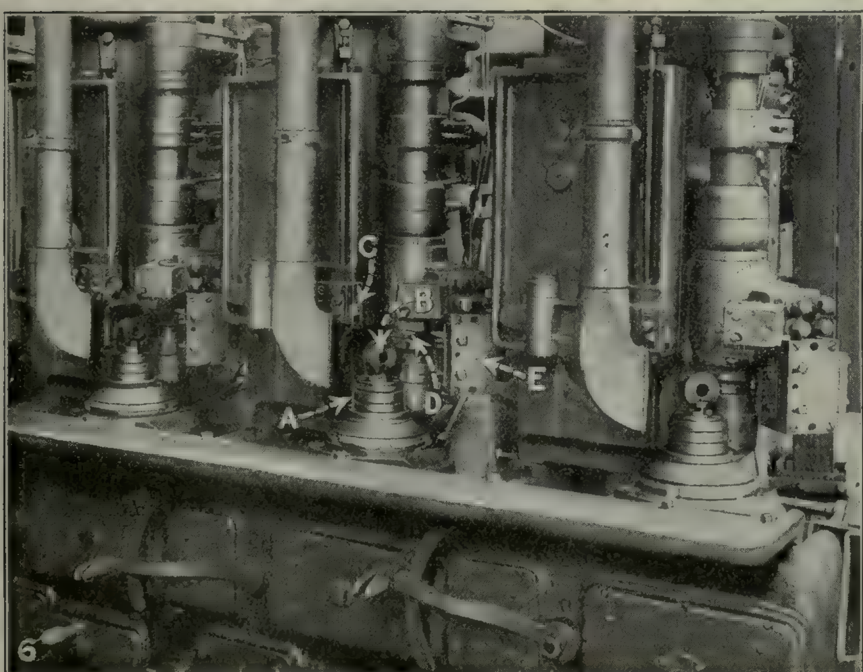


FIG. 6. MACHINE USED IN TURNING, FACING AND GROOVING

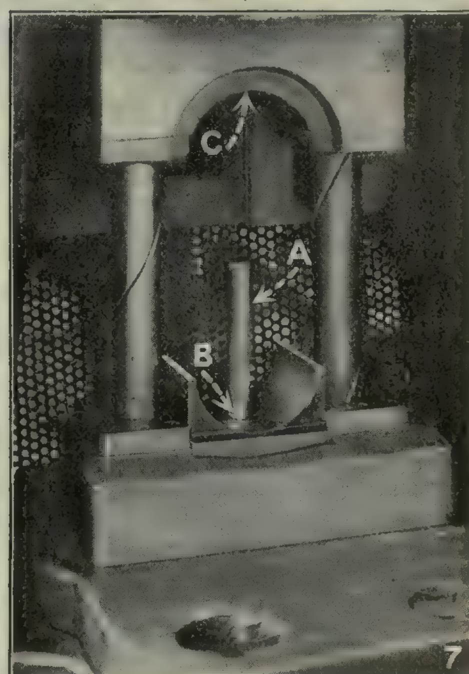


FIG. 7. PRESSING IN BRONZE BUSHINGS

The half-sectional view shows the piston in position on the centering blocks B and the position of the clamp C on the piston head. This view also shows the shaving tool G in section, this being shaped to the radius of the piston. This tool is held in the block H by means of the clamping wedge shown, the end being thoroughly backed up as can be seen. The block H has a regular clapper-box construction so as to relieve the tool on the upward stroke. It is carried in the plate above it, to which is fastened the rollers I, by which the whole slide is moved toward the center under control of the cam J. The springs K hold the rollers against the cam ring and force the tools back to the starting position after the twelfth stroke.

The cam J is rotated by means of a ratchet on the outside after each downward stroke of the ram carry-

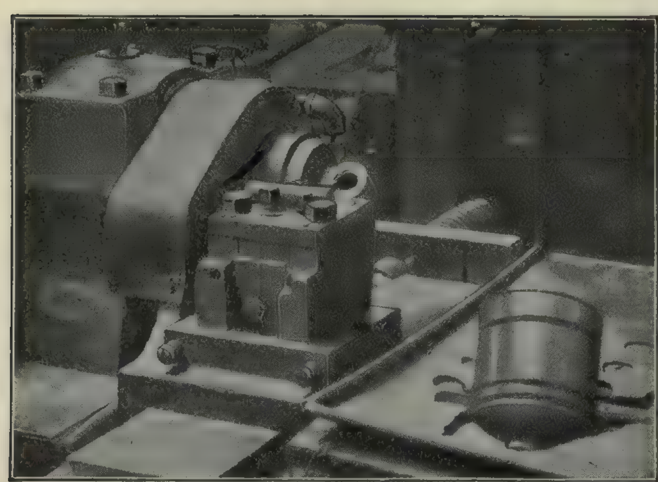


FIG. 8. CUTTING SIDE RELIEF IN LATHE

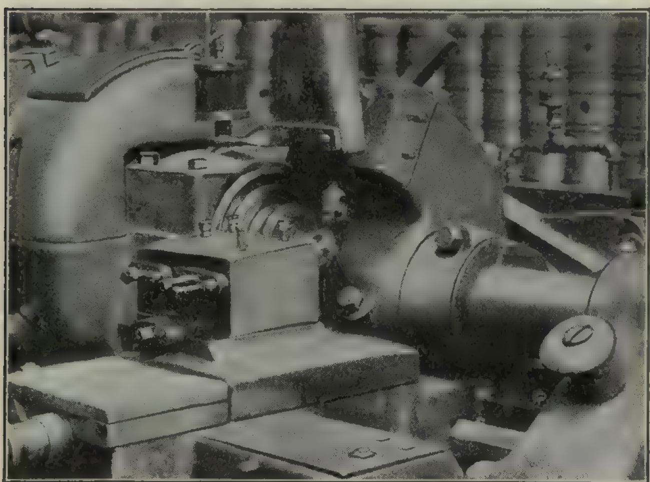


FIG. 11. FINISH-TURNING AND GROOVING OF PISTON

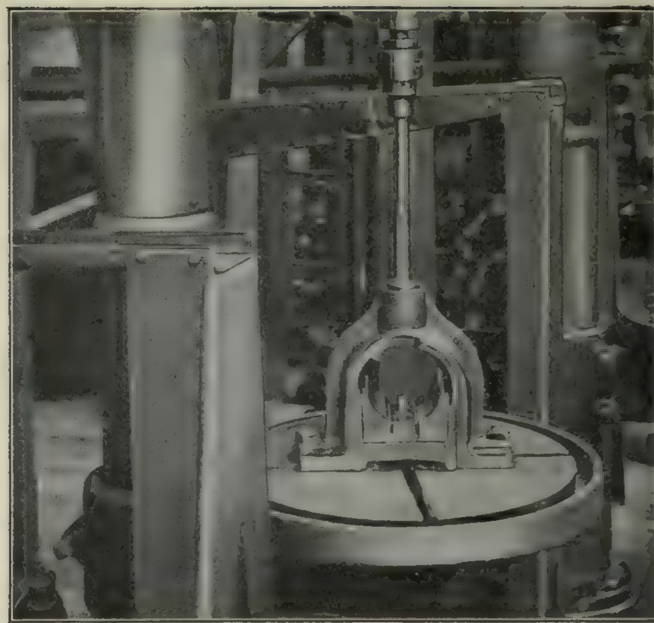


FIG. 12. REAMING THE BRONZE BUSHING

ing the shaving tool. Motion is imparted to the pawl, which turns the cam through the arm *L*, this being shown connected to the floor in Fig. 9, and broken in Fig. 10. Experience has shown that this shaving can be satisfactorily done in 12 strokes of the ram and the cam ratchet is so cut as to turn the cam the desired amount at each stroke of the press.

As the forcing in of the bushing and the shaving of the sides have a tendency to distort the piston, a finishing operation is necessary to keep them to the required standard. This is done in the machine shown in Fig. 11, the piston being held in position by an eye and pin through the pin holes as in all the machining operations. Especial care is taken to insure accuracy in this operation, after which the piston-pin bushings are finally reamed in the simple fixture shown in Fig. 12. The pistons are then ready to be forwarded to the inspection department.

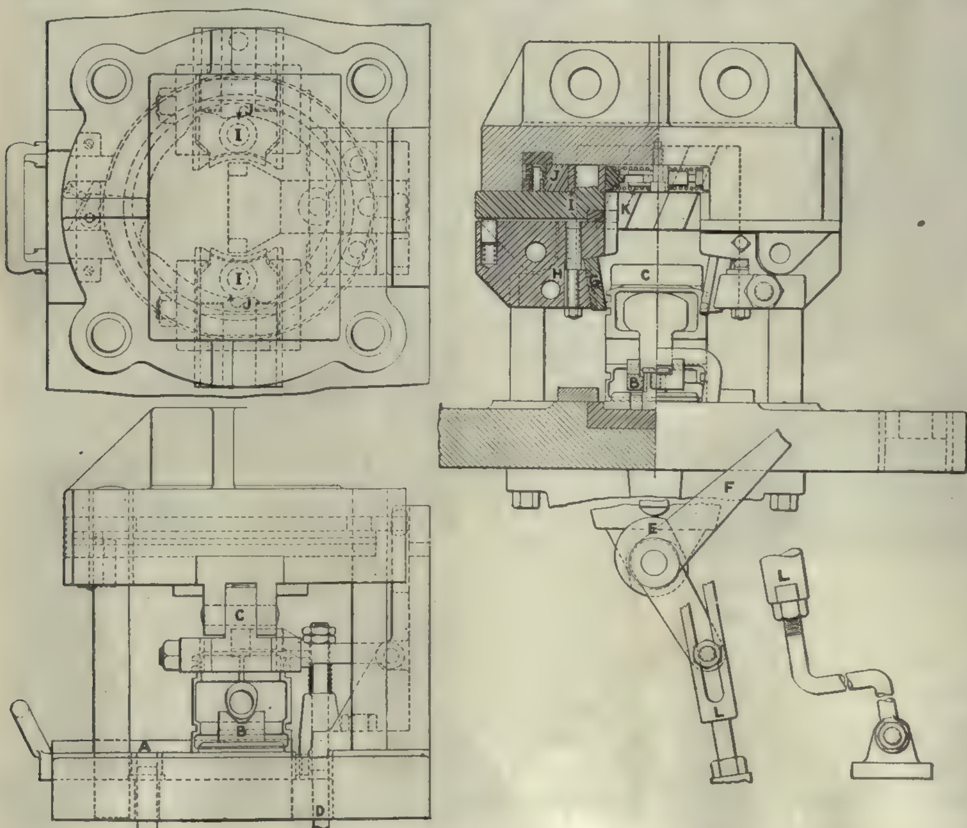


FIG. 10. DETAILS OF CUTTING HEAD

INSPECTION

The inspection bench is conveniently located and the pistons are carefully sorted as to diameter, the high limits being utilized in repair work as oversize pistons. These are, however, carefully gaged by methods which are both rapid and accurate, and which show great ingenuity on the part of the designers. These are a revelation to those not familiar with rapid gaging and will be shown in detail in a later article. The main objects are to reduce handling to a minimum and to secure accuracy as there must be no guesswork as to the actual diameter.

A Compact Piston-Making Department

The piston-making department of the Cadillac Motor Car Co. is perhaps one of the best examples of compactness in the arrangement of machines and the securing of a large product from a limited floor space. Whether this is entirely advantageous will be determined by the layout of its new plant, which is now under way.

THE making of pistons for the Cadillac car means the production of approximately 800 pistons per day, allowing for the usual number of spare parts and defects found at the final inspection. The necessity for this large output in a shop of limited size has developed an extremely compact arrangement of machinery which, while it secures the desired product, is probably more crowded than would be the case if the production engineers could have secured more floor space for it. It is an excellent example of what can be done under adverse circumstances, and the methods of handling the work, as well as machining it, are extremely interesting.

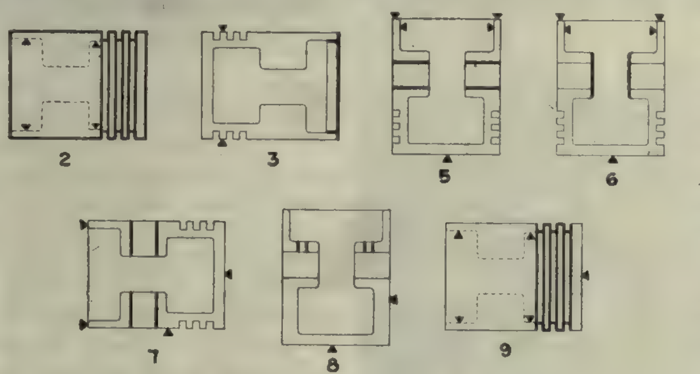


FIG. 1. TRANSFORMATION SHEET

The transformation sheet, Fig. 1, shows the sequence of the main operations, the heavy lines showing where each operation is performed, and the black triangles the points at which the piston is held in the various fixtures. The first operation is to rough-turn and rough-groove the piston as shown in Fig. 2.

This also shows the method of handling pistons from one operation to the next by means of the inclined runways placed between the two rows of machines. These runways enable the operator to pick out work as he needs it, and in some cases arrangements are made so that the auxiliary chute shown will be of assistance. The pistons roll by gravity from one machine to the next, the amount of incline being so proportioned as to carry them to the desired points.

The first inspection is made after the rough-turning, and the pistons go to the stockroom, from which they are issued to the piston department, with the assurance that after this they are annealed and sandblasted. The next machining operation is shown in Fig. 3, where the grooved end of the piston is held in a substantial two-jaw chuck and the open end bored and faced.

The mandrel which holds the piston in the machine shown in Fig. 2, can be seen in detail in Fig. 4. Recesses are provided for the piston-pin bosses and the expansion pieces *A* and *B*, controlled by a central spindle, grip the piston on the inside and hold it firmly.

Next comes the drilling of the piston-pin hole which is done on the special machine shown in Fig. 5. Here the piston is centered by the open end of the skirt and held in position by the screw clamp *A* operating in the arch yoke *B*. This yoke swings down out of the way while removing and replacing pistons, the stop *C* preventing it from being raised too far without undue attention on the part of the operator. This is only the rough-boring, the piston-pin holes being afterward finished by line-reaming, as shown. This illustration also shows the use of the inclined runways in saving room in the aisles for the usual tote boxes and the labor transportation, providing a constant stream of work to the machine.

After the holes are drilled, the inside faces of the piston-pin bosses are milled at the same setting and in the same fixture. In order to show this more clearly, the piston has been removed in Fig. 6, showing one of the milling cutters *D*, which is supported in the block *E*. This block is narrow enough to come between the

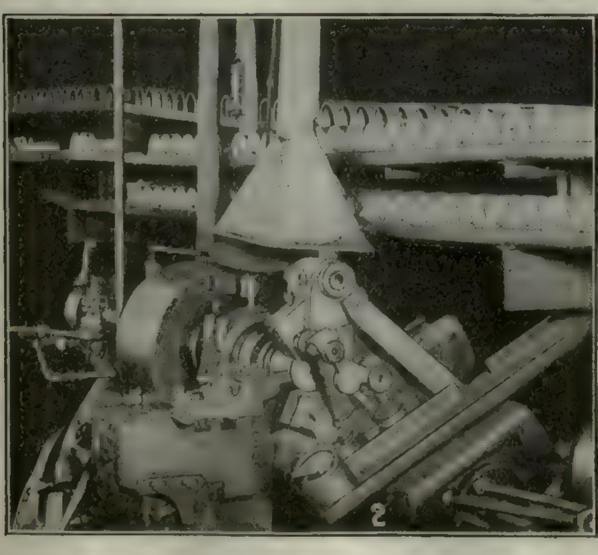


FIG. 2. ROUGH-TURNING AND GROOVING

FIG. 3. BORING OPEN END OF SKIRT

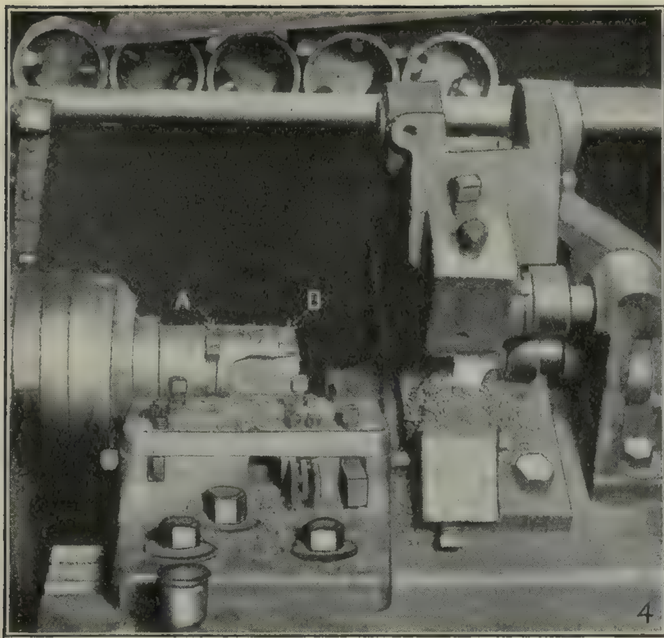


FIG. 4. MANDREL FOR HOLDING PISTONS

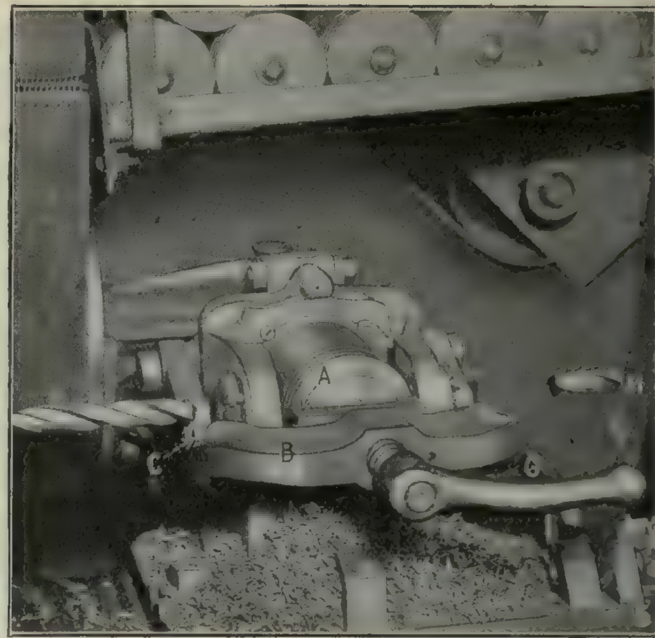


FIG. 5. DRILLING FOR PISTON PINS

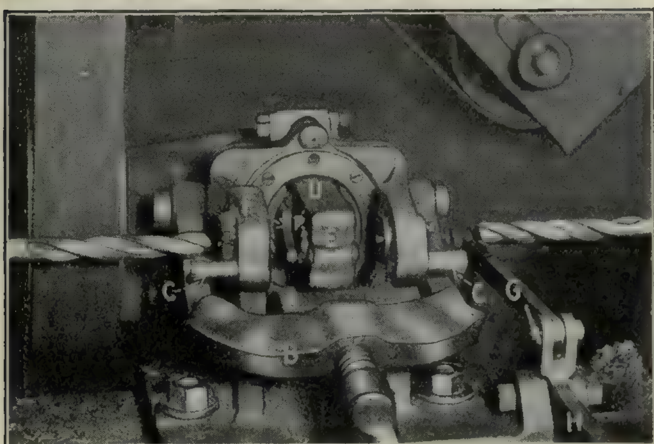


FIG. 6. FIXTURE FOR MILLING INSIDE OF BOSSES

piston-pin bosses, and also contains the gearing necessary to drive these milling cutters.

This illustration also shows the operation of the clamping device more clearly, the same reference letters being used as in Fig. 5. It also shows the centering incline *F* and the connecting link *G* by which the milling cutters are moved across the ends of the bosses, and back out of the way for the next drilling operation. The position of the handle *H* shows how this is operated.

After this comes the finish-turning of the outside diameter, hand-reaming of the open end, and rough-grinding of the piston surface. Then the piston-pin holes are reamed in the machine shown in Fig. 7. The pistons are centered in the usual way by the piston-pin bosses, tested by the pin *A*, which is pushed into the drilled holes, and then removed. The piston is next clamped in much the same way as in the first drilling operation. Then the reamers shown are used one after the other, the first being the through reamer at *B*. The other reamers, *C*, *D*, and *E*, ream first the lower boss and then the upper boss, as can be seen. The machine used is a special turntable machine, built for this purpose and indexed by means of the arm *F*.

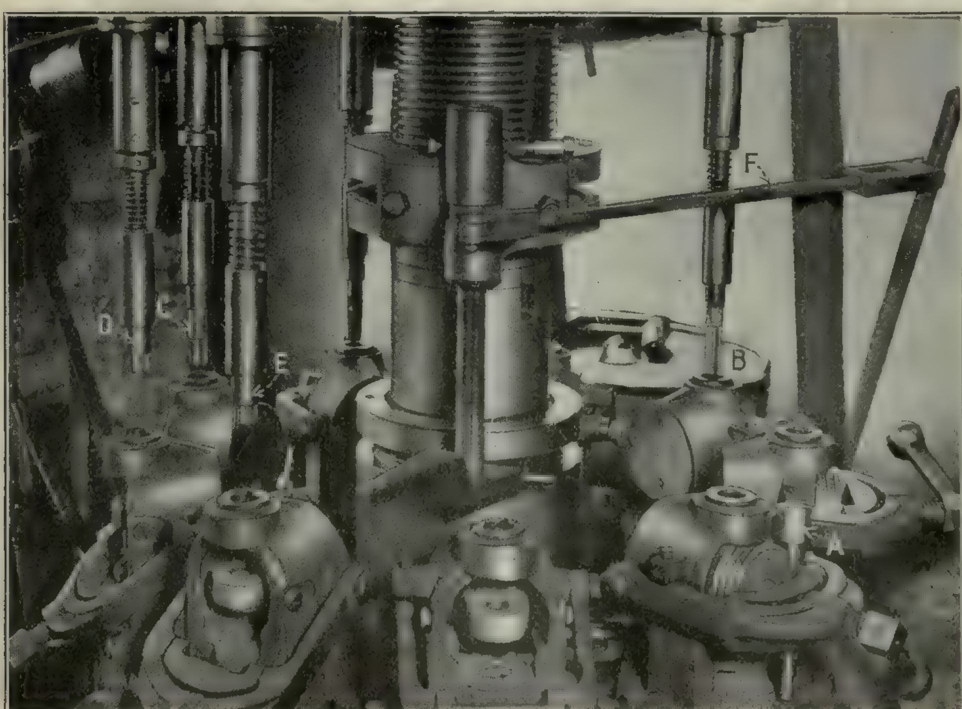


FIG. 7. SPECIAL MACHINE FOR REAMING

The holes for the piston-pin locking screws are next drilled, spot-faced and counterbored with the three spindles of the machine shown in Fig. 8. An interesting feature of the drilling operation is the sliding head *A* which carries the drilling bushing *B*, which is guided into its proper position by the rods *C* and held down by a spring behind the spindle. This spring is of the proper length to

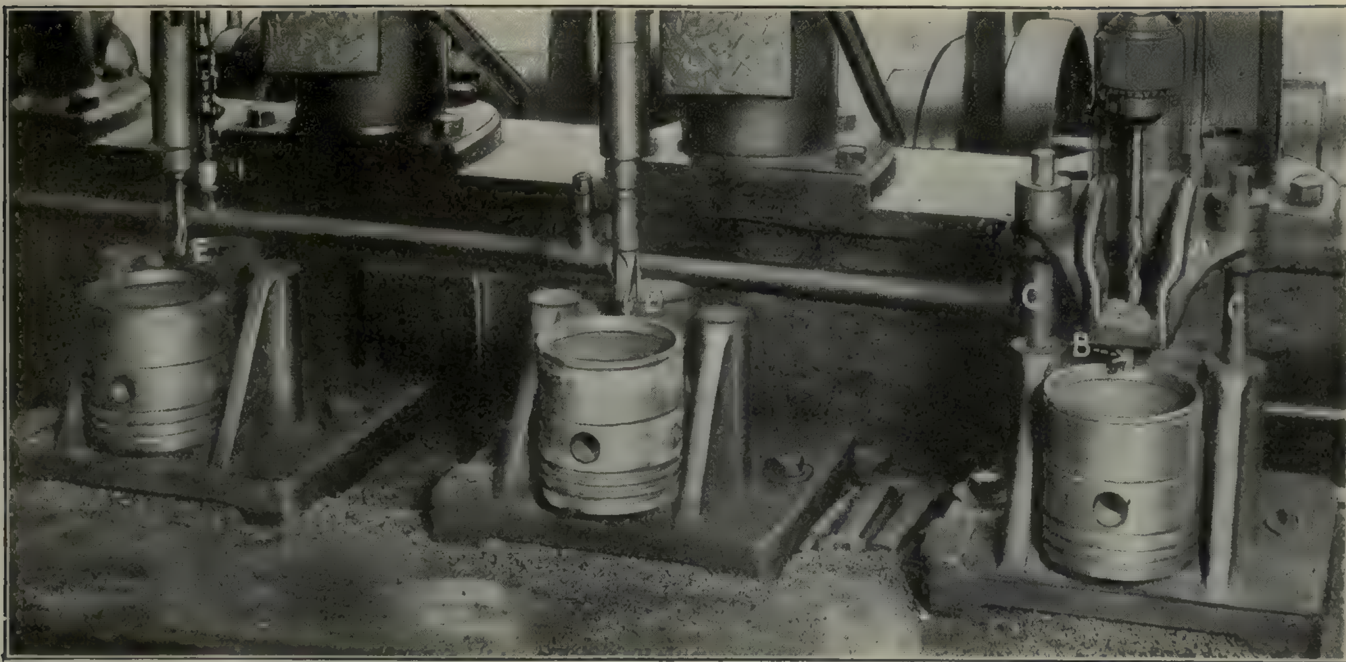


FIG. 8. DRILLING, SPOTTING AND COUNTERBORING FOR SETSCREW

raise the head, carrying the bushing up out of the piston when the drilling-machine spindle is raised. The spot-facing is done at D and the counter-boring at E, the pistons being located in each case by the hole fitting over a pin in the back of the fixture. This is a simple method of handling these pistons very rapidly, and one which has worked out very satisfactorily.

Sizing the Grooves With Rollers

Fig. 9 shows the next operation, which consists of rolling the piston-ring grooves to size by means of the three steel rolls A carried in the substantial supporting frame B. This has been found the most satisfactory method of sizing these grooves and has the additional advantage that it compresses the metal on the sides of the grooves, putting it in better condition to resist the wear of the rings.

This is the last operation illustrated, but is followed by the hand-reaming of the open end before the finish-grinding; a second rough-grinding; finish-grinding; grinding taper at the upper end of piston above the grooves; inspection; cutting off centers and facing the ends; grinding the top end; polishing; boring the oil holes; another inspection; followed by burring and testing for cracks; rough- and finish-reaming; finish-boring and reaming; after which it is ready for assembling with the connecting-rod.

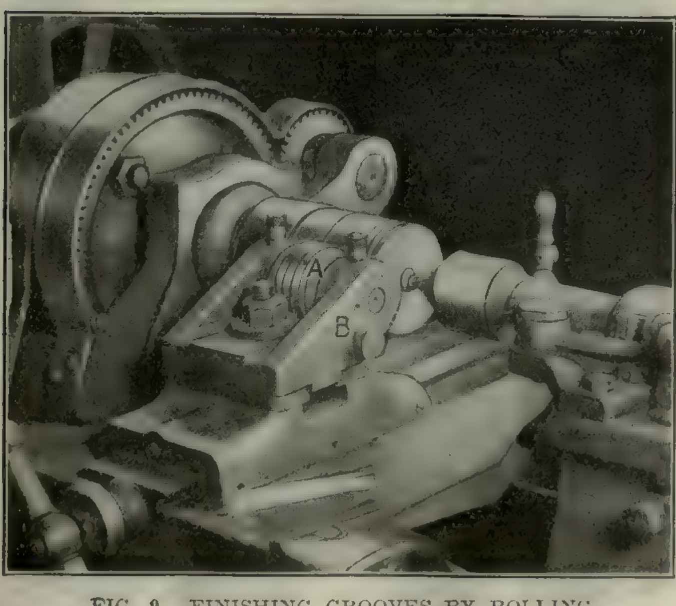


FIG. 9. FINISHING GROOVES BY ROLLING

To those who are only familiar with the manufacturing of larger pistons, some of these operations may seem like unnecessary refinements. It must be remembered, however, that, though these are comparatively small pistons, they are used in a fairly high-speed motor, and that balancing is of the utmost importance.

In spite of these numerous operations, however, which total up to 27, in addition to the various inspections, the manufacturing methods enable them to be produced at comparatively low cost.

Machining Chandler Pistons

While the methods used by the Chandler Motor Car Co. are somewhat similar to those used by other builders, the simplicity of the fixtures used makes them of interest at this time.

As only a few of the piston operations are shown, the transformation sheet has been omitted and only the halftone illustrations used. The open end of the skirt is first bored and faced as a working point for future operations, after which the piston goes to the simple drilling jig shown in Fig. 1. The piston is located with reference to the pin bosses by forked projections on the centering stud, and the simple latch and screw shown hold the piston firmly in position during the drilling operation.

The piston is next turned, faced, and grooved on the semi-automatic machine shown in Fig. 2, the piston-pin hole being used for drawing it back firmly against a special chuck.

The piston-pin hole is then reamed in the fixture shown in Fig. 3, the reamer having a long pilot which

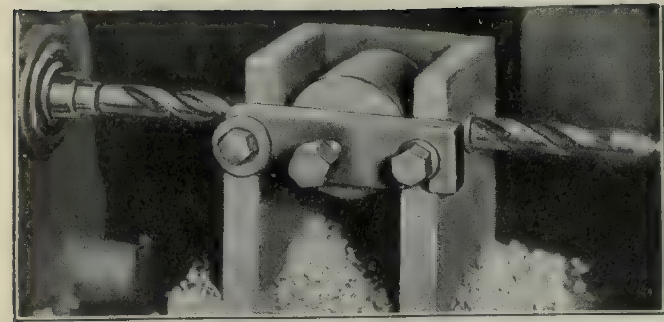


FIG. 1. CROSS-DRILLING THE PISTON-PIN HOLE

the eight holes very easily. The indexing is done by means of the latch *A*, while the work is turned by the knurled handle *B*. It will be noted that the oil holes are drilled in the lower ring groove, which in this case is below the piston-pin hole but not near the extreme end of the skirt.

Fig. 5 shows the racks in which the pistons are kept after they approach completion, each rack holding 224 pistons on each side. These racks are equipped with large casters having roller bearing tops and are easily handled from department to department in spite of their size and weight.

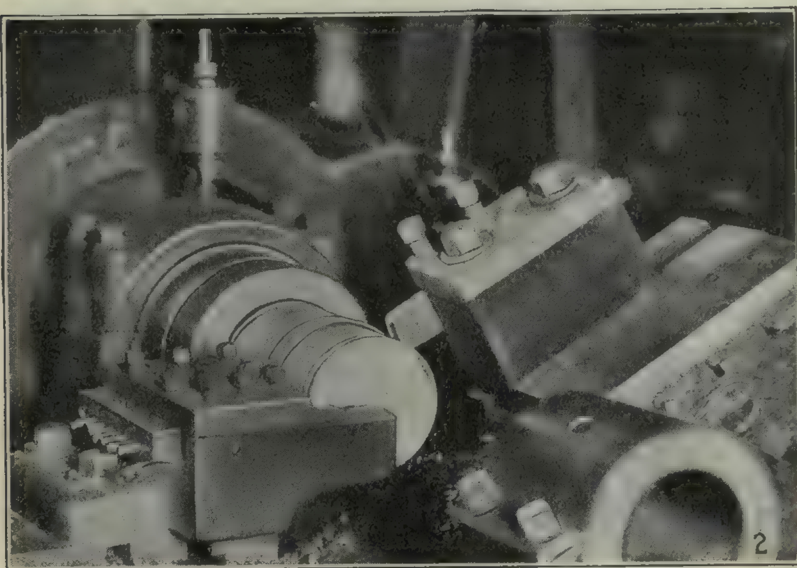


FIG. 2. TURNING PISTONS IN SEMI-AUTOMATIC MACHINE

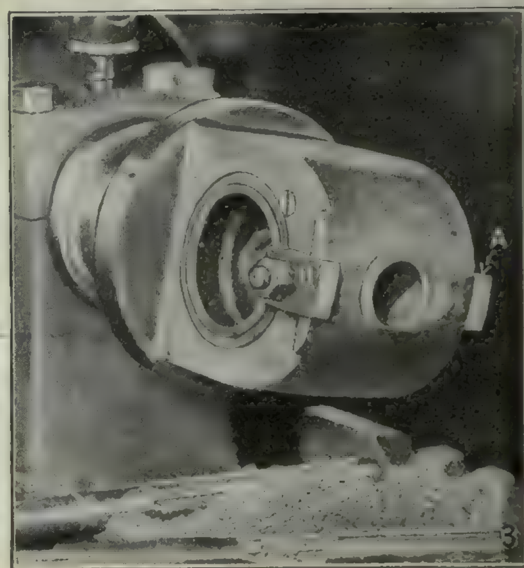


FIG. 3. REAMING THE PISTON-PIN HOLES

fits a hardened-steel bushing in the inner end of the chuck. The piston is located endwise by the permanent stop *A* and the adjustable clamp *B* holds it firmly in position. This chuck runs on the end of the spindle of an ordinary turret lathe, which allows several reamers to be used in rapid succession. The bosses are also back-faced by special cutters while held in this chuck.

The oil-drainage holes are drilled in the fixture shown in Fig. 4. This is a simple indexing fixture which drills

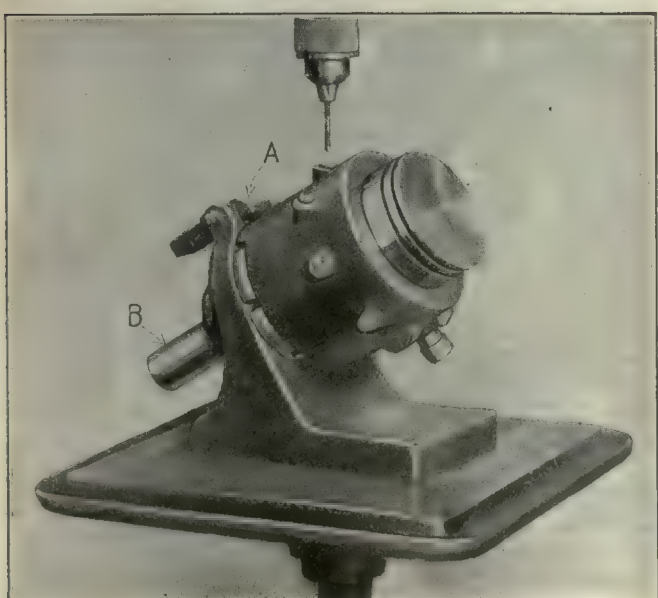


FIG. 4. DRILLING THE OIL HOLES


FIG. 5. STORAGE RACKS FOR PISTONS

Making Autocar Motor Pistons

This article shows the methods developed by one of the oldest builders of automobile and truck motors in this country. It may be said to represent the practice of a shop of moderate size, and as such will be of special interest to many.

THERE are 17 operations in the making of the piston for the Autocar motor, the first being to rough-turn the outside diameter and center the boss at the end. Fig. 1 shows the important operations. This is done on a Reed lathe, equipped as shown in Fig. 2.

The piston is centered from the inside by means of the two sets of three plungers each, shown at *A*, which are expanded against the inner surface of the casting by a cone operated through the hollow spindle. The end of the piston locates against the pins *B*, while the piston-pin boss slides into the recess *C*, which acts as a driver for the piston during the turning operation. While held in this position, a center is drilled and countersunk, as at *D*, on the end of a boss cast on the end of the piston to be used in future operating. The surface is turned with three tools so as to reduce the amount of travel necessary.

The next operation is to anneal the pistons by heating in a furnace to from 1100 to 1150 deg. F., after which they are cooled in air. After the annealing, the cylinders are held in the special chuck, shown in Fig. 3, where they are bored and faced at the outer end to the proper diameter. It will be noted that the pistons are held by means of a split bushing which is tapered on the outside so as to be readily contracted around the piston, holding it firmly and centering it accurately for this operation. The two tools in the cross-slide are used for facing the end of the piston skirt.

The head is then rough-faced, the piston being driven by a flattened mandrel, which centers the back end by the bore of the skirt. The solid end of the piston is supported by the center which has been previously made.

How the Pistons Are Driven

Following is the rough-turning of the ring groove as shown in Fig. 4. This shows the construction of the driver with its flattened end at *A* and the centering portion at *B*. It also shows the way in which the grooving tools are held in the tool block, being separated by distance pieces so as to make it easy to set up these tools after regrinding.

Then follows the finish-turning of the diameter to 4.477 in. to allow for grinding; finish-turning the head end; finish-turning the grooves to 0.3122 to 0.31227 in. for the rings; finishing sides and chamfering grooves, boring and reaming for the piston pin to 1.225 to 1.230 and 1.1557 to 1.1562 in., these being the two diameters on the piston pin. The drilling for the

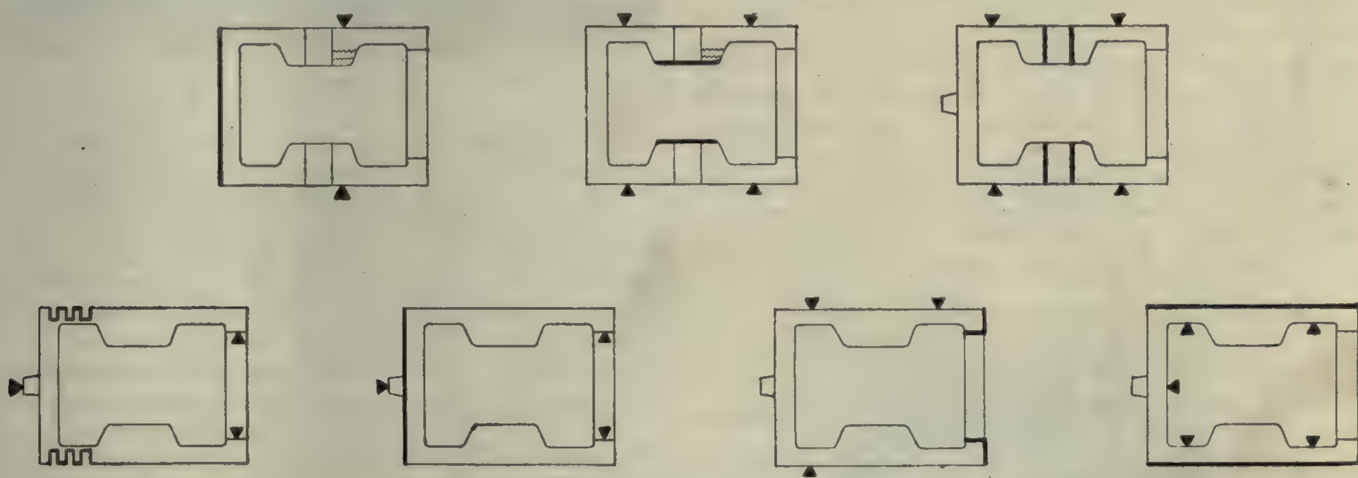


FIG. 1. TRANSFORMATION SHEET

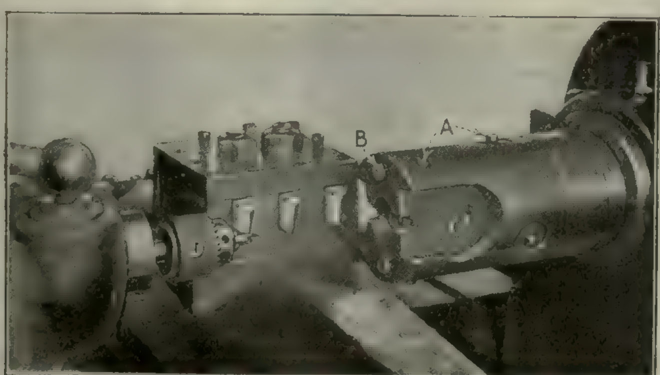


FIG. 2. DRIVER AND TOOLS FOR ROUGH-TURNING

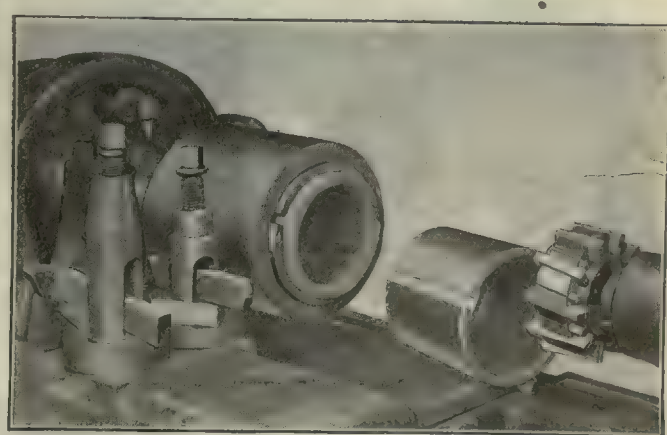


FIG. 3. HOLDING PISTON FOR BORING SKIRT

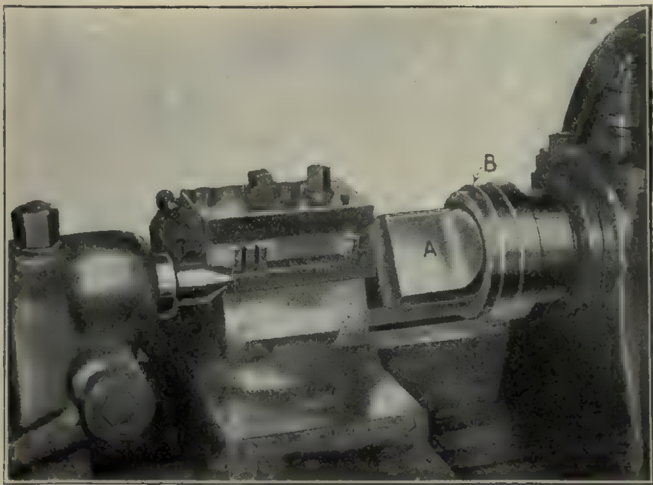


FIG. 4. GROOVING FOR PISTON RINGS

piston pin is done in a special chuck which holds the piston at right angles to its outside diameter and guides the drill and boring bar so as to obtain a piston-pin hole square with the piston itself.

Then the piston-pin boss is milled to $\frac{3}{4}$-in. diameter to assist in drilling and tapping for the piston-pin set-screw. Clearances of $2\frac{7}{16}$ in. are milled between the piston-pin bosses by a special milling head, after which the outside diameter is ground to 4.4746 in. and the head ground to its proper length from the skirt end.

The final inspection gage is shown in Fig. 5. It is a cast-iron stand of substantial dimensions and carries a hardened-steel bushing representing the cylinder, but of the proper diameter to give suitable piston clearance for oil.

FIG. 5. FINAL INSPECTION GAGE

Boats Driven by Airplane Propellers

By George F. Paul

The need for modern methods of navigation on the rivers of French colonies has spurred the French Ministry of Marine to make experiments with a view to using motor-driven aërial propellers as the motive

TEST OF MOTOR AND PROPELLER ON A CANAL BARGE

power. The first of these experiments was made at Joinville, near Paris. An automobile engine, fitted with an ordinary airplane propeller, was installed on board a canal barge as shown in the illustration. This engine developed from 20 to 25 hp., and with this unique apparatus was able to drive the barge, which was 130 ft. long, through the water at a speed of about three miles an hour.

The second series of trials was made at Toulouse, on the Garonne River, and at Carcassonne, on the Canal of the South, with a small air-propeller driven by a 3-hp. motor. This apparatus was installed on a barge 25 ft. long, and produced a speed of eight to nine miles an hour. This barge, when used as a tugboat, could pull eight small boats carrying a total of forty passengers. This same apparatus, when installed on a large barge used for lock-repair work, and weighing 40 tons, produced a speed of two miles an hour.

The third series of experiments was made with propellers having different types of blades and driven by a 15-hp. engine mounted on a small tugboat, 44 ft. long, 9 ft. wide and having a capacity of 12 tons. These trials took place at Juvisy. The greatest speed obtained was six and one-half miles an hour. With an airplane engine of 17 hp. mounted on a raft, 32 ft. long and 10 ft. wide, it has been a common occurrence with a dozen passengers aboard, to develop a speed of seven and one-half miles an hour on the Seine.

Experiments made under the direction of the Ministry of Marine showed that this unique device could be used to tow heavy loads. For instance, with an engine of 25 hp., a barge loaded with 300 tons of coal was driven at the rate of three miles an hour.

Those who are enthusiastic over the possibilities of the aëro-propeller, as they call it, point out that there are many conditions under which the propeller blades of a motor boat will not work well, whereas the effectiveness of the new device is not lessened by these varying conditions.

[We are somewhat skeptical in regard to the speeds said to have been attained. While we have no reason to doubt the veracity of the author, we trust some of our readers will correct any errors.—Editor.]

II. Types of Packages and Methods of Handling

BY HARRY N. KNOWLTON
Manager, Packing Service Department, Safepack Mills, Boston, Mass.

This installment includes definitions and descriptions of the different forms of packages used in shipping goods. Methods of handling and possibilities of damage to improperly packed commodities are also taken up in some detail.

(Part I was published in our Feb. 12 issue.)

THE more common types of packages are as follows: Box, crate, bale, bundle, barrel, drum, pail, tub, sack, bag and roll. Shippers generally are familiar with these different types, although in the case of some of them there is often difference of opinion as to just what they constitute. It is well, therefore, at the start to have a clear understanding of what each type is. A box is a rectangular closed container and is usually made of wood, fiber-board or metal. It is the most common type of package in use. Boxes are also sometimes called cases.

A crate is a container, usually although not necessarily rectangular in shape, consisting of a frame to which is fastened slats or braces. It may also be entirely closed or sheathed over so that it looks like a box, but, if so, it differs from a box in that it has an inside reinforcement of framework or bracing. Crates are generally made of wood although they are occasionally of metal. A completely closed or sheathed crate is frequently called a case.

A bale is a package generally covered with burlap or other textile material, matting or reinforced paper and securely bound with steel strapping, wire ties, rope or strong cord. Bales are often compressed, either by machines or by very compact packing. A bale differs from a wrapped bundle or package in that it is more firmly packed or more securely wrapped and bound.

The word bundle is used in two senses; referring both to a package generally paper wrapped and as a rule bound with cord, tape or string, and also to a package consisting of a number of articles bundled together and bound firmly at several places with wire, rope, cord or strapping. Shovels, handles, box shooks and similar articles are often shipped bundled in this manner.

A barrel is a closed cylindrical container with round flat parallel heads of equal diameter and with sides having a bulge or "bilge." Barrels are usually made of wood, metal or fiber.

A drum is a closed cylindrical container with round flat parallel heads of equal diameter and with straight sides without bilge. Drums are usually made of wood, metal or fiber. A tub is a cylindrical container with round flat bottom, usually tapering sides and round top. The diameter of the top is usually larger than the diameter of the bottom and for shipping purposes the top is fitted with a cover. Tubs are generally furnished with handles on the sides. They are made of wood, fiber or metal. A pail is very similar to a tub but is generally smaller and has a different type of handle.

A sack as a rule is a closed container made of burlap, cotton or other textile material or sometimes of paper. Sacks are generally made of a rectangular piece of material folded over and the edges stitched, sewed or pasted together, leaving the top open for filling. After filling the top is sewed or pasted together or the loose end gathered together and tied.

A bag is a closed container very similar to a sack and is generally made of textile material or paper. Bags, however, often have a square bottom or a round bottom which gives them greater carrying capacity than sacks.

A roll is a cylindrical package usually covered with burlap, other textile material or paper and either bound with cord, rope, wire or strapping, or sewed up, or pasted. Rugs, paper, and roofing are commodities which are often shipped in rolls.

Factors Governing the Selection of the Proper Method of Packing

There are many factors which have to be taken into consideration in deciding upon the proper method of packing, among them are: The character of the commodity to be shipped; the regulations of the transportation companies; the protection necessary from loss and damage; the cost of the package; in the case of foreign shipment, the customs' regulations; the climatic conditions; the port conditions, and the freight handling and transportation facilities of the country of destination.

The character of the commodity to be shipped is very often the determining factor in the choice of method of packing. Liquids, for instance, must of necessity be shipped in air-tight containers such as barrels, drums, cans or bottles. Small articles such as bolts, nuts, nails, rivets, etc., must also be shipped in completely closed containers to prevent loss during transportation. Machinery is sometimes shipped in an open crate, sometimes in a completely closed crate and sometimes simply on skids entirely unboxed and uncrated, the type of packing depending principally upon the article in question and its susceptibility to damage during transportation.

Before adopting a method of packing either in domestic or export shipment the packing regulations of the transportation companies should be carefully looked into to make sure that the package conforms to the regulations prescribed for the commodity in question. In domestic shipment the railroads, the Interstate Commerce Commission and the express companies have definite regulations concerning the accepted methods of packing, and commodities not packed according to these regulations are generally refused for shipment. In this connection it should be borne in mind that goods consigned for export from interior points are also subject to these regulations since they must first move to seaport by domestic shipment. In export shipment, the shipper should also be certain that the type of package which he selects conforms to the regulations of the steamship companies and the regulations of the foreign country of destination.

The protection necessary against loss and damage during shipment is one of the most vital factors in the choice of method of packing. The character of the article to be shipped largely determines the amount of protection necessary. Fragile articles must be shipped in closed containers carefully protected against impact and vibration. Stoves are exceedingly difficult to ship without breakage, especially for export, because unless very carefully packed they are easily broken. Some textile articles are shipped in bales while others are shipped in cases because of the ever-present danger of damage from bale hooks. Some articles can be shipped entirely unprotected by packing material without damage such as angle iron, bar steel, certain steel castings, etc. It very frequently happens that commodities are expensively and carefully packed which should not be packed at all. The shipper should determine just what protection from loss and damage is necessary for his product and then adopt the method of packing which will best provide this protection.

The cost of the package is a factor which is also of much importance in choosing the method of packing. Unfortunately, both in domestic and export shipment the item of cost has too frequently been the deciding factor in selecting the type of package without giving due consideration to the more important item of adequate protection from loss and damage. Naturally, the shipper wishes to keep his package cost down to a minimum because package costs are an expense. However, the use of a type of package which delivers the goods to a customer in a damaged condition is a false economy since it generally results in a damage claim and often in loss of that customer. In deciding upon the package type the shipper should select the package which is best suited to deliver his product safely at destination at minimum cost.

A very important factor in export shipment is the customs' regulations of the country to which shipment is made. Some countries levy import duty on the gross weight of the package. In this instance the weight of the container or packing materials is a matter of much importance as it enters into the duty along with the contents of the package. In shipment to countries where import duty is levied on gross weight, a type of package should be selected which is the lightest commensurate with safety from damage to the contents. Certain textile materials which are shipped to South American countries are universally packed in bales in place of cases, in order to reduce import duty. The importance of attention to this point can be appreciated when it is known that in some instances, principally owing to heavy containers, the duty on American goods has been nearly equal to the first cost of the goods in the United States. The subject of customers' regulations will be gone into in more detail in another chapter.

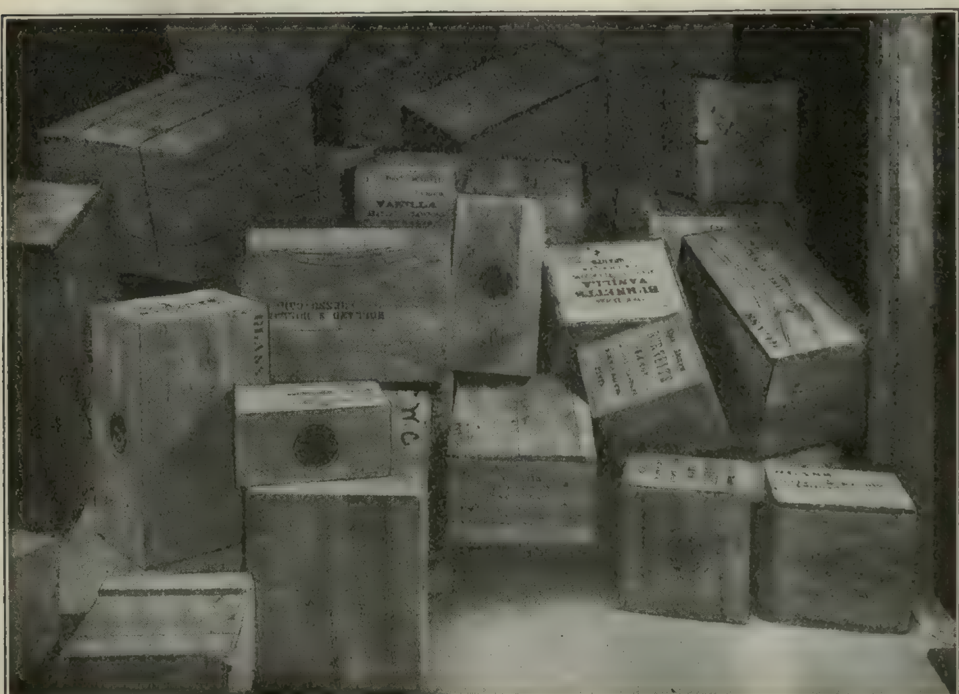


FIG. 1. CONDITION OF A POORLY PACKED CAR ON ARRIVAL

The climatic conditions of the country of destination and to a lesser extent of countries through which the shipment passes en route are an important factor in choosing the method of packing. Some countries have prolonged rainy seasons and excessive dampness, and goods destined for these countries must be shipped in waterproof, often hermetically sealed, packages to prevent ruin of the contents of the package from water and moisture.

Excessive heat and cold are other hazards which are of

FIG. 2. HANDLING CARGO IN A NET

FIG. 3. TRANSFERRING FREIGHT TO LIGHTER

great importance in some instances and have to be taken into consideration in the construction of packages for very hot or cold climates. The packer should be familiar with the shipping routes and also with the general climatic conditions of various countries through which the shipment passes to its ultimate destination.

The port conditions and the transportation facilities of the country of destination or of the countries through which the shipment passes, are vital factors in determining the method of packing in export shipment. Some countries have poor harbors and packages are discharged from the ship into lighters, often in rough weather. This method of unloading is very hard on packages due to the up and down movement of the lighter and if they are not strongly constructed they are very liable to damage. Some ports have inadequate storage facilities and packages may lie around in the open for a considerable time with no protection from rain, heat or cold. The transportation facilities in some countries are primitive, all freight being transported by carts, small boats or by animal back. Packages destined for such countries must be small and of light weight.

Methods of Handling Freight in Domestic and Export Shipment

To pack intelligently for any market a general knowledge should be had of the methods of handling packages during shipment.

In railroad shipment light packages are generally loaded into the car from a small truck by hand. Heavy packages are either handled by means of a crane or hoist or they are skidded into place on the car on rollers. The unloading operation is generally more severe than the loading operation owing to the tendency of letting the upper packages in the car, especially the heavy ones, fall down on the car floor by gravity, because this is an easier way than lifting them down. In railroad transportation the sudden starts and stops, especially in switching, cause the packages to drive against each other with great force in cars which are not loaded compactly. It is not an uncommon sight to see a car of package freight arrive in the condition shown in Fig. 1, due to poor loading and rough handling of the car. This latter also produces severe weaving strain tending to twist packages out of shape, especially those in the lower tiers in the car. This strain works the nails back and forth in the box or crate and greatly reduces their holding power.

In export shipment packages are usually submitted to rougher handling than in domestic shipment. They are handled a greater number of times as a rule, and each transfer gives additional opportunity for rough treatment and loss and damage. The methods of loading and unloading a ship's cargo are also conducive to damage unless packages are strongly constructed. The most common methods are the net, the sling and the tray method.

Small packages are generally handled with the net or tray. Fig. 2 shows a net full of small packages being discharged from a ship's hold. After the net has been lowered over the ship's side onto the pier two corners are released from the cable hook, and as the net flattens out it is hoisted up, causing the packages to tumble indiscriminately over one another. The loaded net, as it is being hoisted, also has a very severe crushing action on the packages in the center. Corners of boxes are crushed into sides and ends of other boxes; box strapping which is insecurely fastened is pushed off over the ends and much damage unavoidably occurs unless the packages are adequately constructed. The tray used for loading and discharging cargo consists of a heavy wooden platform with low sides and with a rope or cable attached to each corner meeting in noose or ring which is attached to the hoisting cable. The tray is not as hard on packages as the net because there is not the pressure from the sides which occurs in the net. The sling is used principally for larger packages such as heavy sacks, and large heavy boxes and crates. Like the net, the sling also exerts a severe crushing strain on the sides of the package and large packages should be designed to resist this strain. Small freight is sometimes discharged from lighters or barges directly into the ship's side, are shown in Fig. 3.

Packages are often unavoidably damaged because of the manner in which they are stowed away in the ship. Whereas in railroad transportation there is preferential loading of the lighter, weaker packages this practice cannot always be followed in ship loading. The aim, of course, is to stow freight away so that very heavy pieces will not rest on light pieces. Dunnage lumber is used to assist in supporting upper tiers of packages and to distribute the pressure evenly on the lower tiers. However, when ports are congested and ships must load quickly it is not always possible to stow freight away as carefully as it should be. Cargo must also be stowed with respect to its density so that the ship rides well

and preferential loading can be practiced only so far as it does not affect the ship's stability. The importance of stable loading can be appreciated when it is known that during the war several army supply ships had to be docked for repairs due to injuries received because of improper loading.

The shifting of a ship's cargo during rough weather also submits packages to many stresses during transportation. The weaving strains referred to in railroad shipment are especially severe and this constant weaving action may seriously weaken packages unless they are adequately constructed and well reinforced with steel strapping.

One of the worst sources of damage in handling both railroad and ship packages is the hook used by freight handlers and stevedores. These hooks are much used because they are a very convenient and efficient means of handling small packages and they save injury to the hands from splinters, nails and sharp ends of strapping. When used on boxes they often puncture thin boards, and rip off strapping and boards. When used on bales they very often puncture the burlap covering and lining and seriously injure the contents. The damage on bales by hooks is one of the principal reasons why bales have not been more universally adopted in place of boxes for shipping textile materials.

A Problem in Change Gearing

By J. Crommell

In looking over some old numbers of the *American Machinist* I came across a problem in lathe gearing by George B. Grant, published in the issue of April 8, 1891. The problem was to find the change gears to cut 47 threads in 12.37 in., the lead screw being 7 per inch and all the gears from 15 to 100 teeth being available.

Give this problem to a dozen lathe hands and the chances are that no two of them would select the same pair of gears. The boss may take it into the office and after a lot of calculation and explanation get the answer within a row of lampposts, or he may not.

Mr. Grant has the right gears (35 and 19) but he went a long way around to get them. For this and similar problems there is a shorter method.

According to Mr. Grant:

$$\begin{array}{r|l} 47 \div 12.37 = 3 & 79 + \\ & \;\;5 \\ \hline 15 & 3.95 = \text{nearly } 4 \\ 4 & \\ \hline 19 & = \text{Gear for lead screw} \end{array}$$

Lead screw $= 7 \times 5 = 35 =$ Gear for stud

Explanation: $47 \div 12.37 = 3.79 + =$ number of threads per inch.

Multiply the decimal 0.97+ by any number from 1 to 10 that will make it tenths or hundredths with the least remainder, thus: 0.79×5 equals 3.95, or nearly 4. The integer 3 multiplied by the same number (5) equals 15, and to this we add the 4 making 19 the gear to put on the lead screw.

Multiply the lead of the lead screw (7) by the same number (5) and we get 35 which is the gear to put on the stud. In dividing the number of threads by the length of the piece to get the number of threads to the inch, only two places are necessary.

This problem can be still further shortened. It is evident that the difference between 3.79+ and 3.8 would not materially change the result; therefore, multiplying 7 and 3.8 by 10 gives 70 and 38—the stud and screw gears respectively; the same proportioned gears.

When a machine is designed that must have an exact number of turns it is generally an after consideration and sometimes calls for expensive changes. The actual variation in Mr. Grant's problem is so small that it would trouble a precision lathe to show it.

Sidetrack the fractions and it is a kindergarten job to find the gears. It would be 47 turns in 12 in.; therefore we put a 47 gear on the screw and multiplying the lead screw by the length of the piece we get $7 \times 12 = 84$, the gear for the stud. This is the only pair of gears between 15 and 100 that will do this work without error.

Let us suppose we have to cut 6.83 turns to 1 in. with a 7 lead screw (a rather unusual lead, but as Mr. Grant selected it we will follow him); in this case there is no dividing to do.

$$\begin{array}{r|l} 6 & 83 \\ & \;\;6 \\ \hline 36 & 4.98 \text{ or nearly } 5 \\ 5 & \\ \hline 41 & = \text{the gear for the screw} \end{array}$$

$7 \times 6 = 42 =$ the Gear for the stud.

By this method the gears for fractional leads can be easily found.

Another problem: Required 22 turns in 5.12 in. with a five lead screw.

$$\begin{array}{r|l} 22 \div 5.12 = 4 & 29 \\ & \;\;7 \\ \hline 28 & 2.03 \text{ or nearly } 2 \\ 2 & \\ \hline 30 & = \text{gear for screw} \end{array}$$

$5 \times 7 = 35 =$ Gear for stud.

Most of these problems can be solved mentally. One such fixed in the mind or on a piece of paper is worth a dozen rules.

There is one rule that is worth while to remember, however, and that is that the gear calculated from the lead screw *always* goes on the stud; it makes no difference whether you multiply or reduce it.

Dimensioning Drawings for Factory Use

By Robert Coates

I have just been reading Mr. Armstrong's article captioned "Dimensioning Drawing for Factory Use."

There is no question in my mind as to the value and importance of paying more attention to this subject. The thought has often occurred to me (and it is recalled by the author's expression "scattering dimensions of a certain boss over all the drawings") why not go a step further in the drafting room than designing and dimensioning?

Why not tabulate corresponding parts in some convenient and systematic way? The illustration of the pillow block shown by Mr. Armstrong would hardly bring out the point, but take, for example, a complicated automatic machine with all its ramifications—it is designed and every detail provided for but, of necessity, scattered over a large number of sheets. Would it not save a lot of duplicate work if, at the time of detailing, a record was made and kept of the components of each sheet in such form that they could be used for ordering material, checking material delivered, estimating cost, etc.?

Testing Methods Employed at the Becker Milling Machine Co.'s Plant

BY E. L. DUNN
Associate Editor, *American Machinist*

The machine described in this article has been manufactured for thirty years or more and is so well known that the methods used to test the accuracy of its construction will prove of interest to many.

IN THE erecting of the Becker vertical milling machines, the testing starts with the first step of the assembly and continues step by step until the machine is complete. The working limits allowed are very close. The first two tests are to determine the correct relation of the knee and stand. The stand bearing *A*, Fig. 1, and the knee bearing *B* must be at perfect right angles to each other. This position is tested by using a full-length square and tissue-paper feelers.

The test shown in Fig. 2 is to determine the correctness of the knee bearing *B* with the angle bearing *C*. The knee angle *D* is scraped until the surface *B* is dead square with the angle of the stand. The gibs are now fitted into place and the next test, Fig. 3, is

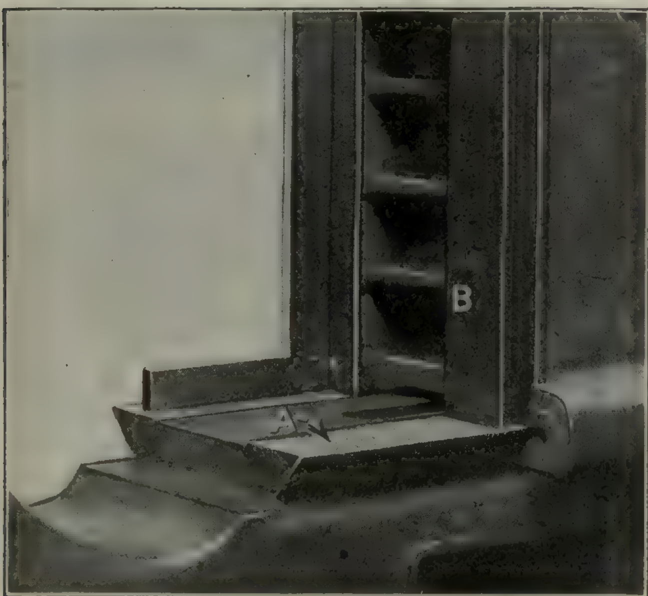


FIG. 1. TESTING SQUARENESS OF KNEE WITH COLUMN

FIG. 2. TESTING SQUARENESS OF DOVETAIL ON COLUMN WITH FACE OF KNEE

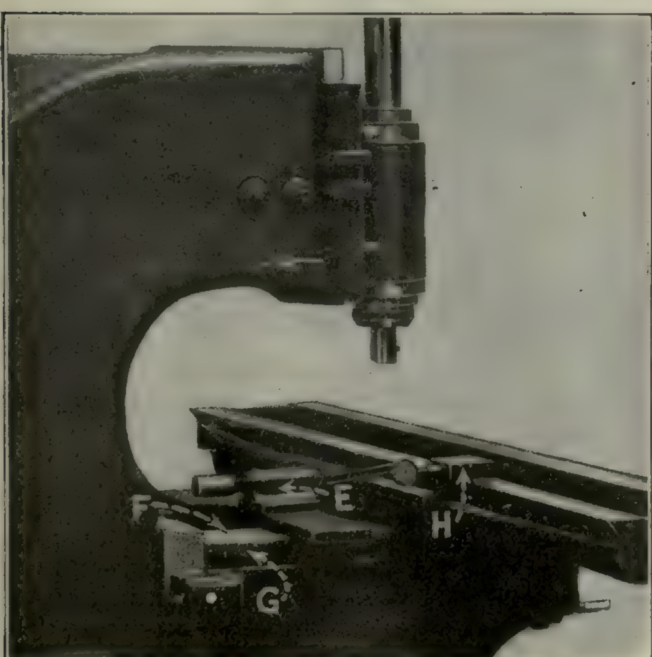


FIG. 3. TESTING ACCURACY OF KNEE AND SADDLE BEARINGS

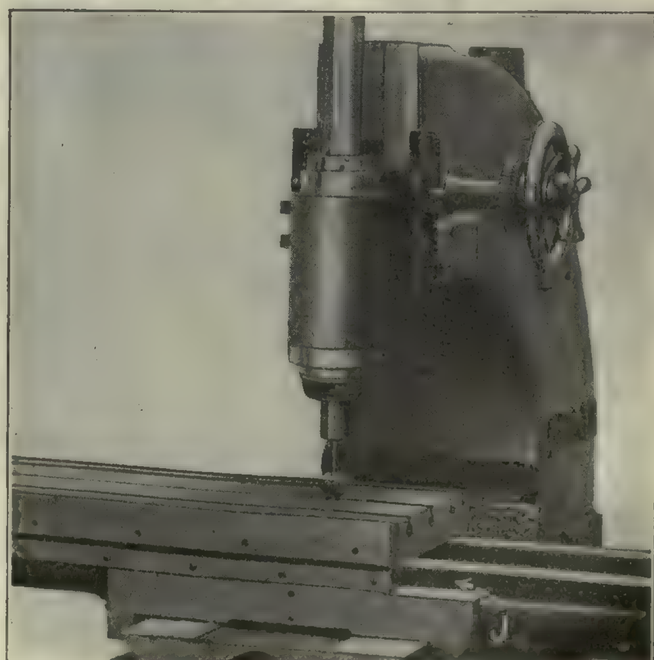


FIG. 4. TESTING PARALLELISM OF TABLE SLOTS WITH WAYS

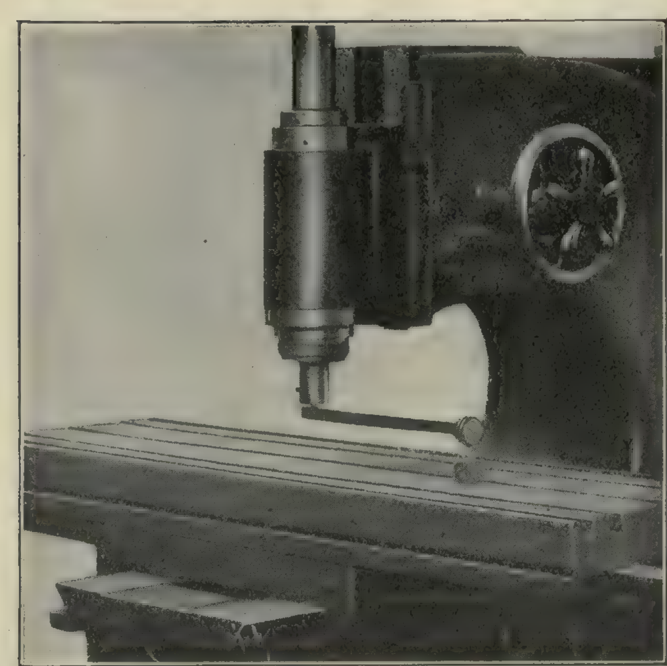


FIG. 5. TESTING SQUARENESS OF SPINDLE WITH TABLE

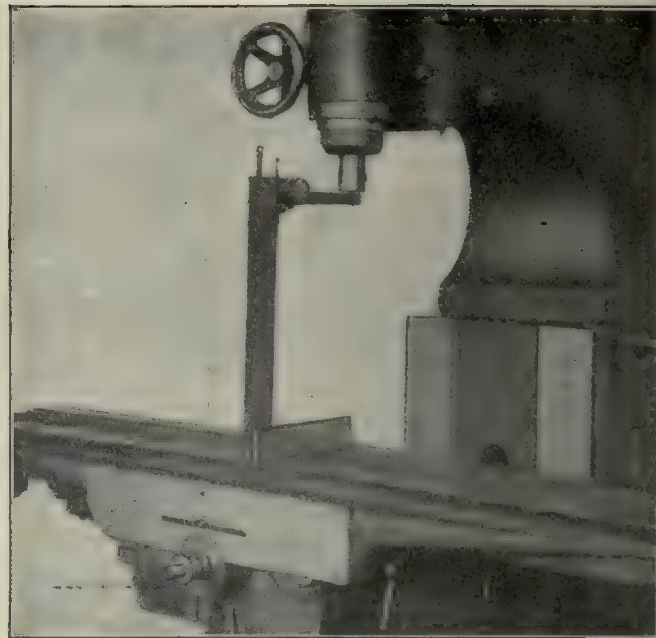


FIG. 6. TESTING ALIGNMENT OF COLUMN FACE WITH SPINDLE

to determine the accuracy of the carriage and knee bearings. A special indicator holder *E* is placed across the knee, having a bearing at *F* and *G*. This indicator holder has a long swinging arm with an Ames indicator attached to the end. A special angle block *H* is placed at one end of the carriage and the indicator is moved up and set at zero. The indicator block is then slid over to the other end of the carriage and the indicator bar swung over to the block; and, if the indicator registers zero, it shows the carriage to be square with the knee bearing.

Next in order is to scrape the table to the carriage and test work-angle *J* together with the table slot, by placing the indicator holder in the spindle with the point down in and against the wall of the slot, as in Fig. 4; then slide the table along its full stroke.

Fig. 5 shows the method used to test the top of table with the spindle. A test bar is used with the indicator attached to the end. The opposite end of the bar is arranged to fit the inside of the spindle hole; the indicator is set at zero while resting on the end of the table. It is then swung around to the opposite end of the table to detect any error that may exist. In the following test, Fig. 6, the knee is lowered to its bottom limit, the table is removed and a large square is placed on the carriage ways with the blade parallel to the spindle as shown. The test bar is swung around with the point of indicator touching the edge of the square blade; then by running the knee up and down the front knee bearing is easily checked.

The vertical side bearings of the knee are tested in a similar manner; the base of the square is set

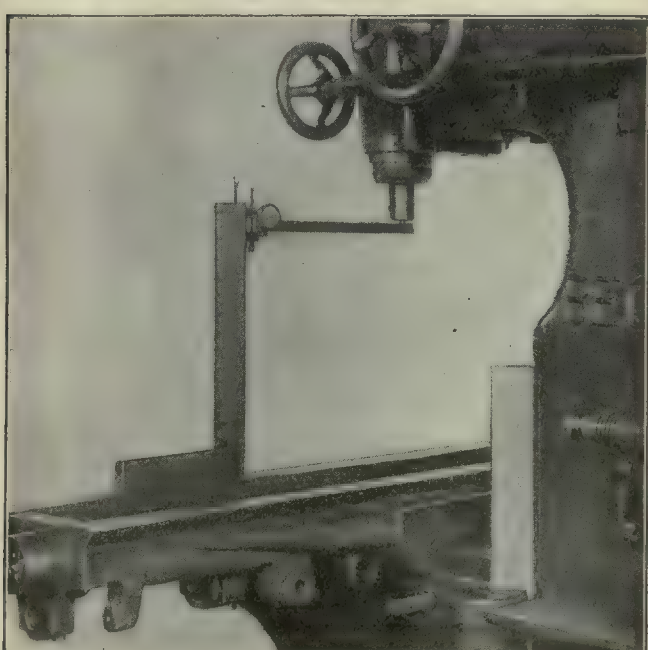


FIG. 7. TESTING ALIGNMENT OF COLUMN SLIDE WITH SPINDLE

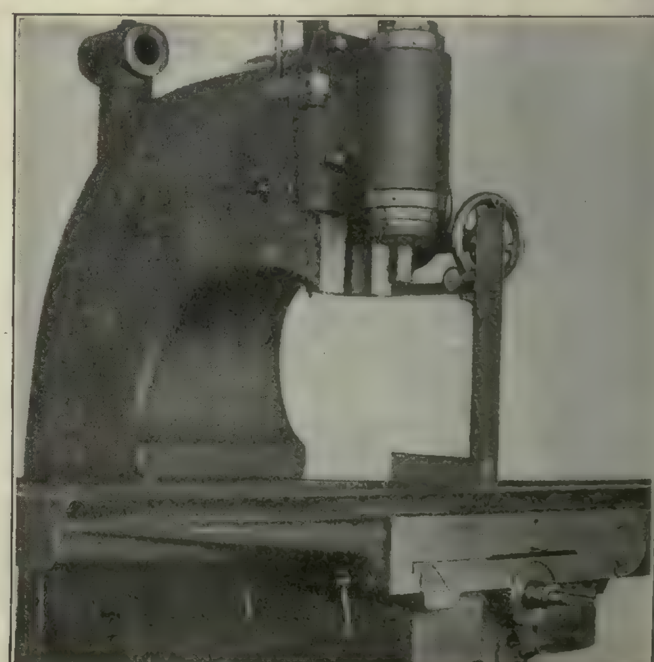


FIG. 8. TESTING ALIGNMENT OF SPINDLE-SLIDE FACE WITH COLUMN FACE

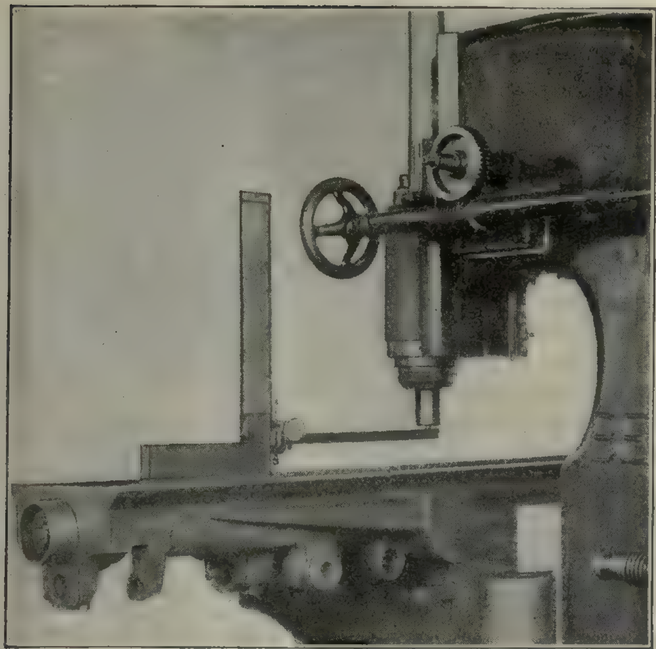


FIG. 9. TESTING ALIGNMENT OF SPINDLE-SLIDE GUIDE WITH COLUMN GUIDE

lengthwise with the carriage as in Fig. 7, the knee being in its lowest position as before. The same procedure is followed, with the indicator point against the edge of the square blade and the knee being raised and lowered to detect any possible variation that would be registered by the indicator.

The front-head bearing is tested, Fig. 8, by placing the knee at its highest position, the square setting crosswise on the carriage ways and the head being up as far as it will go. The indicator point being in contact with the square blade and the indicator registering zero, any inaccuracy of the front bearing is quickly discernible as the head is moved down.

The side bearings of the head are tested in a like manner with the square shifted to a lengthwise position on the carriage ways, as shown in Fig. 9. The head is run up and down as before with the indicator point contacting with the square blade. All of these tests as set forth, and others of less importance, take place regularly as part of the day's work, at the company's plant.

An Accurate Angle-Measuring Device

By E. A. Dixie

In Figs. 1 and 2 may be seen front and rear views respectively of an angle-measuring device that was originally developed in one of the Bridgeport shops, but after the beginning of the war was introduced into many other establishments that were making rifles and doing other equally accurate work.

The body *A* of the device is of cast iron. In making the casting great care was exercised to have it clean and homogeneous, especially at the corners, for it must be finished very accurately at these parts. For this reason it is advisable to cast such pieces in dry sand; the product will be well worth the extra expense incurred.

As soon as the casting comes from the foundry a roughing cut should be taken over all the surfaces to be machined, with the two-fold object of determining

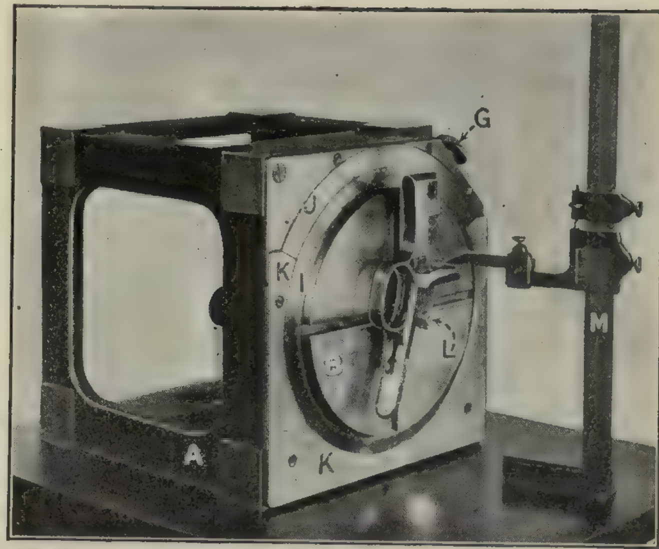


FIG. 1. FACE OF ANGLE-MEASURING FIXTURE

if the casting is sound and to remove the "skin" at the corners where the final finishing will be done. The removal of the skin at these points probably hastens the seasoning of the whole casting.

This may be considered a wild guess on the part of the writer but with other castings of similar shape—that is, a hollow cube—it has been found that when machined on the corners the castings seasoned just as rapidly as those which were machined all over.

The seasoning was done by the method formerly used by Pratt & Whitney for seasoning the beds of their precision measuring machines. These were placed for alternate weeks in the core oven and out in the yard. On the measuring-machine beds this procedure was carried out for a whole year at least, but on the castings under discussion we changed the time to alternate days in the core oven and in the yard over a period of about a month or six weeks.

After this seasoning, the bodies were carefully planed on all sides, the operator being instructed to keep the cutting edges of his tools very keen to prevent, as far as possible, the peening action attendant upon the use of dull tools. The bodies were then scraped to as near a perfect cube as the most skillful workman in the shop could make them. The inspector's records show that the cubes, though not all of the same size, were each within 0.0002 in. of being exact cubes.

It will be noted that two faces of the cube are closed; one, to which is fitted the faceplate and graduated circle, and one that in ordinary service forms the bottom upon which the device rests. The faceplate *B*, Fig. 1, is of cast iron and has in its face four T-slots at right angles and radiating from the center. These are used to hold work, such as gages, when laying them off or checking them up to see if the angles are correct. The faceplate is mounted on a hardened, ground and lapped spindle *C*, Fig. 2, which is provided with a bearing in the central boss projecting inwardly from the front face of the cube.

The rear end of the spindle is provided with a nut *D* for drawing the spindle and the faceplate to a seat. A knurled knob *E* on the spindle in front of the nut serves as a means of turning the spindle and faceplate rapidly for approximate settings.

The back of the faceplate has a circular T-slot in which the heads of two T-head bolts *F* are fitted. The

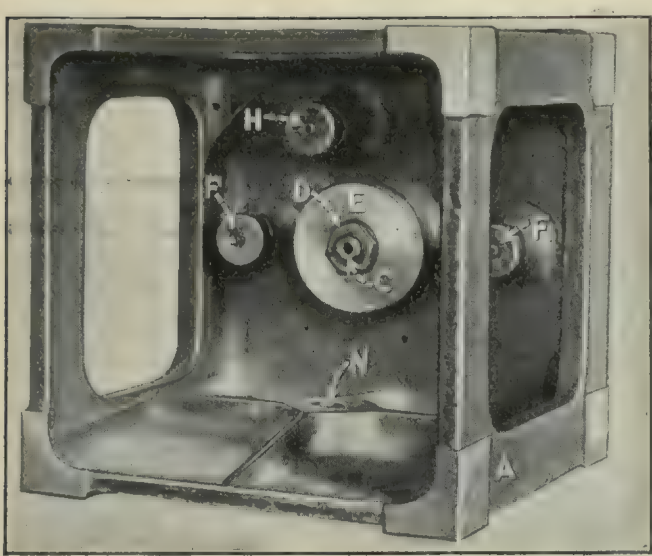


FIG. 2. BACK OF ANGLE-MEASURING FIXTURE

bodies of these bolts pass through holes in the face of the casting and knurled nuts are provided to clamp the faceplate securely in any desired position. It will be noted that the bolts are placed 180 deg. apart to preclude the possibility of their cramping the faceplate and spindle. Also mounted on the spindle and secured to the back of the faceplate is a worm gear with 360 teeth, and meshing with it, a single-threaded worm which is operated by the knob *G*, Fig. 1. The corner of the cube is cut away where this knob is located so that when an angle greater than 90 deg. is to be measured the indexing up to 90 deg. may be accomplished quickly by turning the cube over one face.

When the cube is thus turned over so that either of the sides adjacent to the cut-away corner is lying on the surface plate, the knob *G* is above the plate and out of the way of injury. The spindle of the worm is pivoted so that, if desired, the worm can be thrown out of engagement with the wormwheel, thus making it possible to rotate the faceplate and spindle rapidly by means of the knob before mentioned. On the inside of the cube a clamping screw with knurled knob *H*, Fig. 2, is provided for holding the worm either in or out of engagement.

Secured to an angularly disposed face on the edge of the faceplate at *I*, Fig. 1, is a full circle of silver graduated in degrees; and secured to the cube is a vernier *J*, also of silver, permitting the locating and reading of angles to minutes. The outer end of the spindle is bored, ground and lapped to a diameter of 0.3 in. The object of this hole is to accommodate a plug *L* on which some types of work may be located true with the axis. A sheet-steel plate *K* protects the graduated dividing circle from injury as the edge of the circle lies about $\frac{1}{16}$ in. below the surface of the plate.

In the illustration a rifle part is shown located by one of its holes on the plug *L*. The device is used on a surface plate as shown and the height gage *M* used to determine when a surface is parallel to the surface plate, or the distance from the surface plate to a projection or hole.

In the center of the lower face of the cube is a carefully located and finished round hole *N*, Fig. 2, for securing the fixture to an angle plate when the nature of the work makes this desirable.

The Trials of Old Baldy—III

By A. R. Durant

There were so many funny things happening at the Ajax Works that some of the old hands used to say that the only thing that kept them from "jacking up their jobs" was curiosity to know what "Old Baldy," the boss, would do next.

One day a young fellow came to work who claimed all kinds of experience in jobbing shops. His first and only job was to finish up a small pulley, the casting for which was given him with explanations and dimensions.

He knew enough about a machine shop to get a chuck on the lathe and center the pulley for boring, but the only boring tool he could find handy would go only half way through.

A little thing like that, however, could not phase a resourceful mechanic who had "run lathes on all kinds of work," so he bored the pulley to size half way through, and then turned it around in the chuck and bored the other half.

Just as he was finishing it up and "doctoring" the slight offset in the center, Old Baldy came along and, hearing unusual noises from a boring tool on a finishing cut, proceeded to investigate.

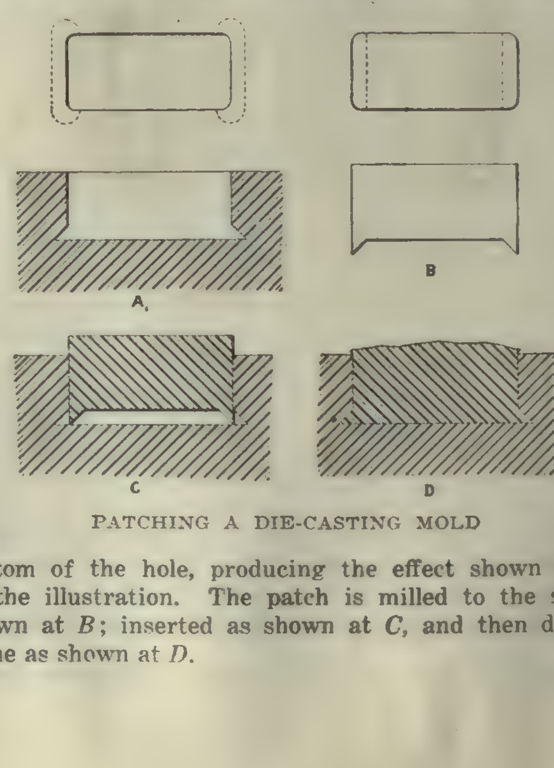
After being told how the boring had been accomplished, he expressed the opinion that while the method might be all right for the more refined class of work it wouldn't do for the Ajax Works, so the new guy packed up his kit and went out to hunt up a place where his ingenuity would be appreciated.

Patching a Die-Casting Mold

By Atol Maker

It frequently happens during the construction of die-casting molds or dies that patches must be put in. When for some reason or other the patch cannot be fastened with screws or dowel pins I fix it securely in place in the following manner:

After having milled to shape the hole in which the patch is to be inserted I run a dovetail mill around the



PATCHING A DIE-CASTING MOLD

bottom of the hole, producing the effect shown at *A* in the illustration. The patch is milled to the shape shown at *B*; inserted as shown at *C*, and then driven home as shown at *D*.

Training Arc Welders

By O. H. ESCHHOLZ
Research Engineer, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

This is a concise course intended to familiarize welders with the basic characteristics and operation of bare metallic electrode arc-welding processes. Exercises are outlined which will aid the apprentice in overcoming difficulties in manipulation.

MANY industrial engineers are now facing the problem of developing competent welders. This situation is attributed to the rapid growth of the metallic electrode arc-welding field as the result of the successful application of the process to war emergencies. The operator's ability, it is now generally conceded, is the most important factor in the production of satisfactory welds. To facilitate the acquirement of the necessary skill and knewledge, the following training course considers in their proper sequence the fundamental characteristics and operations of the bare metallic electrode arc-welding process.

It is well known that the iron arc emits a large quantity of ultra-violet radiation. Protection from the direct rays is usually afforded by the use of hand shields. Many uncomfortable burns, however, have been traced to reflected radiation. To secure adequate protection from both direct and reflected light it is necessary for the welder to use a fiber hood equipped with suitable glasses. Paper No. 325 of the Bureau of Standards on "Spectroradiometric Investigation of the Transmission of Various Substances" concludes that the use of amber and blue glasses will absorb most of the ultra-violet as well as infra-red radiation. To protect the operator from incandescent particles expelled by the arc, closely woven clothing, a leather apron, gauntlets and bellows-tongued shoes should be worn.

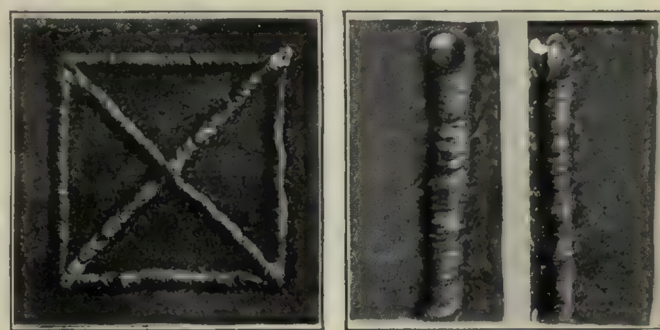
FIG. 1. CORRECT WELDING POSTURE AND EQUIPMENT

If the welding booth is occupied by more than one welder, it will be found desirable to equip each operator with amber or green-colored goggles to reduce the intensity of accidental "flashes" from adjacent arcs after the welder has removed his hood.

The Welding Booth

The difficulty of maintaining an arc is greatly increased by the presence of strong air currents. To avoid the resulting arc instability, it is desirable to inclose the welder on at least three sides, with, however, sufficient ventilation provided so that the booth will remain clear from fumes. By painting the walls a dull or matte black the amount of arc radiant energy reflected is reduced.

The electrode supply and means of current control should be accessible to the operator. When using bare electrodes the positive lead should be firmly connected to a heavy steel or cast-iron plate, mounted about 20 in. above the floor. This plate serves as the welding table.



A B C

FIG. 2. CONTROL OF ARC DIRECTION EXERCISE

(*A*) Exercise to develop control of arc direction. (*B*) Effect of weaving electrode across direction of deposit. (*C*) Effect of not weaving. These deposits were formed with the operator and plate in the same relative position, necessitating a change in the direction of arc travel for the deposition of each layer. Note that this direction is indicated by the position of the crater terminating each strip as well as by the inclination of the scalloped surface.

Welding Systems

Many commercial sets compel the operator to hold a short arc. This characteristic favors the production of good welds but increases the difficulty of maintaining the arc. By increasing the stability of the arc through the use either of covered electrodes, series inductances or increased circuit voltage and series resistance, the acquisition of the purely manipulative skill may be accelerated.

The Electrode Holder

The electrode holder should remain cool in service, shield the welding hand from the arc, facilitate the attachment and release of electrodes, while its weight, balance and the drag of the attached cable should not produce undue fatigue. A supply of different types of covered and bare electrodes should be carried by the welding school so that the operator may become familiar with their operating and fusing characteristics.

The degree of supervision the welder is to receive determines the source of operator material. If the

welding operations are to be supervised thoroughly and the function of the welder is simply that of uniting suitably prepared surfaces, the candidate may be selected from the type of men who usually become proficient in skilled occupations. If, however, the responsibility of the entire welding procedure rests upon the operator, he should be drawn from members of such metal trades as machinist, boilermaker, blacksmith, oxy-

FIG. 3. LONG AND SHORT WELDING ARC
Large arc stream causes excessive oxidation

acetylene welder, etc. Some employers find it expedient to use simple eye and muscular co-ordination tests to determine the candidate's ability to detect the colors encountered in welding and to develop an automatic control of the arc.

With adequate equipment provided, the operator may be instructed in the following subjects:

1. Manipulation of the arc.
2. Characteristics of the arc.
3. Characteristics of fusion.
4. Thermal characteristics.
5. Welding procedure.
6. Inspection.

Arc Manipulation

A sitting posture which aids in the control of the arc is shown in Fig. I. It should be noted that by resting the left elbow on the left knee the communication of body movements to the welding hand is minimized, while by supporting the electrode holder with both hands the arc may be readily directed. During the first attempts to secure arc control covered electrodes may be used, as these greatly increase arc stability, permitting the welder to observe arc characteristics readily.

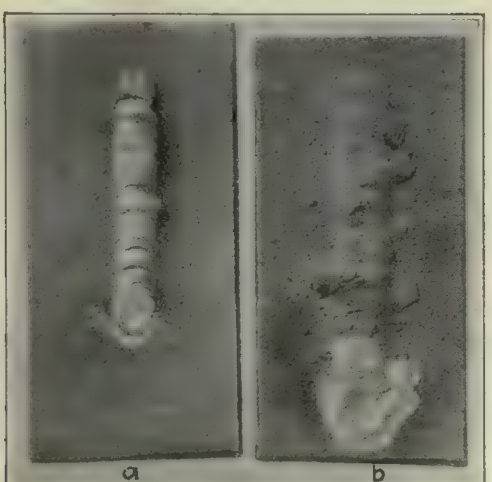


FIG. 4. DEPOSIT OBTAINED WITH SHORT ARC AND LONG ARC
Note that surfaces of deposit and plate in (*a*) are comparatively clean, while those in (*b*) are heavily coated with iron oxide.

It is suggested that throughout the training period the instructor give frequent demonstrations of the welding operations as well as occasionally guide the apprentice's welding arm.

Arc Formation

With the welding current adjusted to 100 amp. and a $\frac{5}{32}$-in. covered electrode in the holder, the operator assumes the posture shown and lowers the electrode until contact is made with a mild-steel plate on the welding table, whereupon the electrode is withdrawn, forming an arc. If an insulating film covers either electrode surface or the current adjustment is too low, no arc will be drawn. With the arc obtained the operator should note the following characteristics of arc manipulation.

Fusion of Electrodes

The fusion of electrodes is frequently called "sticking" or "freezing." It is the first difficulty encountered and is caused either by the use of an excessive welding current or by holding the electrodes in contact too long before drawing the arc. This fusing tendency is always present because the welding operation requires a current density high enough to melt the wire electrode at the arc terminal. When such fusion occurs the operator commits the natural error of attempting to pull the movable electrode from the plate. If he succeeds in separating the electrodes, the momentum acquired, unless he is very skillful, is sufficient to carry the electrode beyond a stable arc length. If, however, the wrist of the welding hand is turned sharply to the right or left, describing the arc of a circle having its center at the electrode end, the fused section is sheared and a large movement of the electrode holder produces an easily controllable separation of the arc terminals.

Maintenance of Arc

After forming the arc the chief concern of the welder should be to maintain it until most of the electrode metal has been deposited. If the movable electrode were held rigidly, the arc would gradually lengthen as the electrode end melted off until the arc length had increased sufficiently to become unstable and interrupt the flow of current. To maintain a constant stable arc length it is necessary for the operator to advance the wire electrode toward the plate at a rate equal to that at which the metal is being deposited. For the novice this will prove quite difficult. However, if the initial attempts are made with covered electrodes, which permit greater arc-length variations than bare electrodes, the proper degree of skill is soon acquired.

When the operator succeeds in maintaining a short arc length for some time, the covered electrode should be replaced by a $\frac{5}{32}$-in. diameter bare electrode, the welding current increased to 150 amp. or 175 amp. and either reactance included in the circuit or the voltage of the welding set increased. With increase in manipulative skill the reactance coil may be short-circuited or the supply voltage reduced to normal and practice continued under commercial circuit and electrode conditions.

Further instruction should not be given until the candidate is able to maintain a short arc during the entire period required to deposit the metal from a bare electrode 14 in. long, $\frac{5}{32}$ in. in diameter, on a clean plate $\frac{1}{2}$ in. in thickness when using a welding current of 150 amp. The arc voltage may be used as a measure of the arc length. The average arc voltage during the test

should be less than twenty-five, as this corresponds to a length of approximately $\frac{1}{8}$ in. Some operators meet this test in the first hour of their training, others require two or three days' practice. If arc-length control is not obtained within the latter period, the instructor may safely conclude that the apprentice is physically unfitted for the occupation of arc welding. If the test is satisfactory, training should be continued, using bare electrodes but with such stabilizing means as inductance or resistance again inserted in the circuit.

Control of Arc Travel; Direction and Speed

The plate arc terminal and the deposited metal follow the direction taken by the pencil electrode. The difficulty of forming deposits varies with the direction. The first exercise should consist in forming a series of

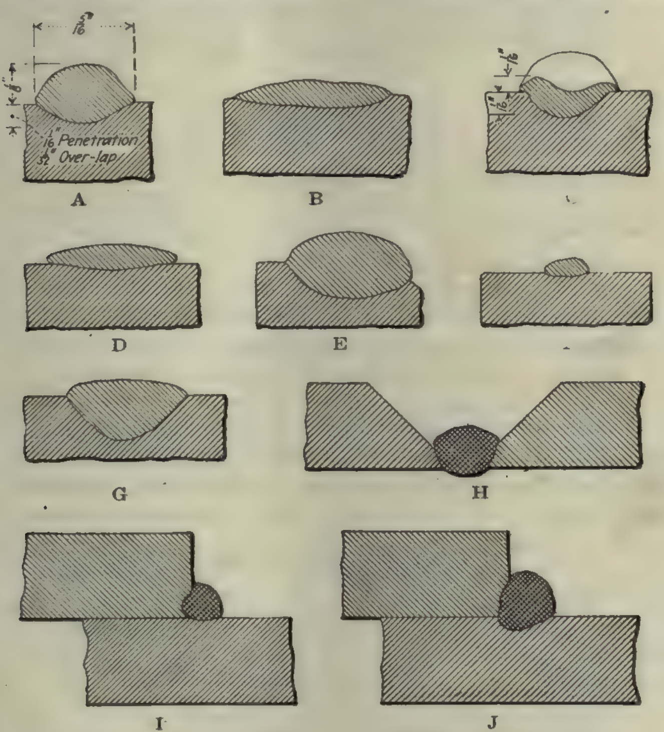


FIG. 5. OVERLAP AND PENETRATION STUDIES

(*A*) Typical section through a normal layer formed by depositing metal from a mild-steel electrode on a mild-steel plate. Note the contour of the deposit as well as that of the fused zone and the slight overlap and correct depth of deposit penetration. Parent-metal crystal structure is altered by thermal changes. (*B*) Typical section through a deposit formed when holding a long arc. Excessive overlap and no penetration exist. Most weld failures may be attributed to the operator maintaining occasionally or continuously too long an arc. (*C*) Section through crater formed on completing deposit strip. The depth of the crater is a measure of the depth of penetration. (*D*) Excessive overlap secured with a pencil electrode (drill rod) having a lower melting temperature than the parent metal (mild steel). (*E*) Elimination of overlap obtained by using a pencil electrode (mild steel) having a higher melting temperature than the parent metal (cast iron). (*F*) Incomplete fusion obtained with a low arc current. (*G*) "Cutting" secured through use of high arc current. (*H*) Section indicates proper selection of welding current and electrode diameter to secure fusion. (*I*) Poor fusion caused by too rapid flow thermal energy from deposit through plates. (*J*) Adequate fusion obtained by increasing arc terminal energy to compensate for increased rate of heat flow.

deposits in different directions, as shown in *A*, Fig. 2, until the operator develops the ability to form a series of straight, smooth-surfaced layers. Additional skill may be acquired by the practice of forming squares, circles and initials.

The speed of arc travel determines the height of the deposit above the parent metal. A second exercise should require the formation of deposit strips having heights of $\frac{1}{16}$, $\frac{1}{8}$ and $\frac{3}{16}$ in. The normal height of a deposit when using a welding current of 150 amp. and a bare electrode of $\frac{5}{32}$ in. diameter is approximately $\frac{1}{8}$ in.

Weaving

If the electrode end is made to describe the arc of a circle across the direction of deposit formation, the width of the deposit may be increased without changing the height of the deposit. This weaving movement also facilitates slag flotation and insures a more complete fusion of the deposited metal to the parent metal. *B* and *C*, Fig. 2, illustrate the appearance of deposits formed with and without weaving of the electrode.

A third exercise should consist in forming layers of equal heights, but having widths of $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$ in. when using an arc current of 150 amp. and a $\frac{5}{32}$-in. diameter bare electrode.

As the welder should now be able to control direction, height and width of deposits while maintaining a short arc, he should be given the fourth exercise of forming tiers of parallel, overlapping layers until inspection of the surface and cross-sections of the built-up material indicates good fusion of the metal as well as absence of slag and blowholes.

Arc and Fusion Characteristics

The arc is the welder's tool. Its function is to transform electrical energy into highly concentrated thermal energy. This concentrated energy serves to melt both the parent and the deposited metals at the electrode terminals, the arc conveying the liquefied pencil into the crater formed on the material to be welded.

The place arc terminal will always appear as a crater if a welding current is used. This crater is formed partly by the rapid volatilization of the liquefied material and partly by the expulsion of fluid metal due to the explosive expansion of occluded gases suddenly released or of gases formed by chemical reaction between electrode materials and atmospheric gases. To secure good fusion the deposited metal should be dropped into the crater. This is facilitated by the use of a short arc. On welding, the operator should frequently note the depth of arc crater and manipulate the arc so that the advancing edge of the crater is formed on the parent metal and not on the hot deposited metal.

Polarity

When using bare electrodes the concentration of thermal energy is greater at the positive than at the negative terminal. Since in most welding applications the joint has a greater thermal capacity than the pencil electrode, more complete fusion is assured by making the former the positive electrode. The difference in concentration of thermal energy may be readily illustrated to the welder by having him draw an arc from a $\frac{1}{16}$-in. thick plate with the plate first connected to a negative and then to the positive terminal. If a current of approximately 60 amp. is used with a $\frac{1}{16}$-in. diameter electrode, he will be able to form a deposit on the plate, if the plate is the negative terminal. On reversing the polarity, however, the energy concentration will be sufficient to melt through the plate, thus producing a "cutting arc."

An arc stream consists of a central core of electrically charged particles and an envelope of hot gases. The electrode material is conveyed in both liquid and vapor form across the arc, a spray of small globules being dis-

cernible with some types of electrodes. Since atmospheric gases tend to diffuse through this incandescent metal stream, it is obvious that some of the conveyed material becomes oxidized.

Through the maintenance of a short arc, not exceeding $\frac{1}{8}$ in., the resulting oxidation is a minimum because enveloping oxide of manganese vapor and carbondioxide gas, formed by the combination of atmospheric oxygen with the manganese and carbon liberated from the electrodes, serves as a barrier to restrict the further diffusion of atmospheric gases into the arc stream. Fig. 3 illustrates the degree of protection afforded the conveyed metal when using short and long arcs. With the latter convection currents deflect the protecting envelope from the arc stream. The effect of arc length on rate

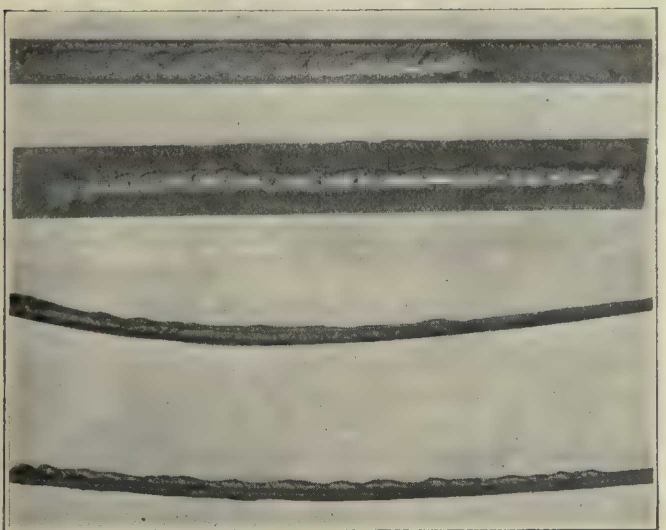


FIG. 6. WARPING OF THE PARENT METAL CAUSED BY THE TRANSVERSE CONTRACTION OF THE DEPOSITED LAYERS

of oxidation may be clearly indicated to the welder by forming deposits with a $\frac{1}{8}$-in. arc and a $\frac{3}{8}$-in. arc on a clean plate.

The surface of the first deposit will be clean and smooth, as shown at *a*, Fig. 4. The surface of the second deposit will be irregular and covered with a heavy coating of iron oxide, as shown at *b*. All oxide formed during welding should be floated to the surface, since its presence in the weld will reduce the strength, ductility and resistance to fatigue of the joint.

Stability

The ease of maintaining an arc is determined by the stabilizing characteristics of the electrical circuit and the arc gases. As noted above, increased stability may be obtained by the use of series inductance or higher circuit voltage with increased series resistance, higher arc currents and covered electrodes. A high-carbon-content electrode, such as a drill rod, gives a less stable arc than low-carbon content rods, owing apparently to the irregular formation of large volumes of arc-disturbing carbon-dioxide gas. Bare electrodes after long exposure to the atmosphere or immersion in weak acids will be found to "splutter" violently, increasing thereby the difficulty of arc manipulation. This "spluttering" is apparently caused by irregular evolution of hydrogen. If the electrode is coated with lime, its stability improves.

The evident purpose of a welding process is to secure fusion between the members welded. The factors that determine fusion in arc welding are arc current, electrode current density, thermal capacity of joint sections and melting temperatures of electrode and plate materials. By observing the contour of the surface of the deposited metal as well as the depth of the arc crater the welder may determine at once whether such conditions under his control as arc current, electrode current density and electrode material are properly adjusted to produce fusion.

The fifth exercise should consist of forming a series of deposits with arc currents of 100, 150 and 200 amp., using electrodes with and without coatings having different carbon and manganese content. Cross-sections of the deposits should then be polished and etched with a 10 per cent nitric-acid solution and the surface critically examined for such evident fusion characteristics as penetration and overlap, comparing these with the surface characteristics.

Overlap and Penetration

Examination of the boundary line between the deposited and plate metals in *A* and *B*, Fig. 5, reveals that the penetration decreases in both directions from the center of the layer, no fusion being evident at the edges of the deposit, the contour betraying the extent of this overlap. As shown in *C* the penetration may be estimated from the crater depression.

An exaggerated overlap obtained in welding a mild-steel plate with a high-carbon-content steel rod, having a lower melting point than the plate, is shown in *D*. The re-entrant angle of the deposit edge is plainly evident. *E* illustrates a condition of no overlap in depositing metal from a mild-steel electrode upon a cast-iron plate having a lower melting point. *F* and *G* show respectively the effect of using too-low and too-high arc currents.

The effect of heat conductivity, heat-storage capacity, expansion and contraction of the parent metal and contraction of the hot-deposit metal must be studied.

Heat Conductivity and Capacity

The effect of any of these factors is to increase the flow of thermal energy from the plate arc terminal and therefore to reduce the amount of metal liquefied. To maintain a given rate of welding speed it therefore becomes necessary to increase the arc current with increase in thickness or area of joint.

A welding current of 150 amp. will produce satisfactory penetration on welding the apex of scarfed plates $\frac{1}{2}$ in. thick shown in *H*. If the joint is backed by a heavy steel plate, increasing thereby both its thermal capacity and conductivity, a higher current, in the neighborhood of 175 amp. to 200 amp., will be required for the same penetration. If a lap joint is made as in I and the same current used as in *H*, the flow of heat will be so rapid that poor fusion will result. By increasing the current to 225 amp., *J*, the desired penetration, as indicated by crater depth, will be obtained with the maintenance of a high welding speed.

Expansion and Contraction of Parent Metal

The welding operation necessarily raises the temperature of the metal adjacent to the joint, producing strains in the structure if it does not expand and contract freely. This condition is particularly marked when

welding a crack in a large sheet or plate. The plate in the region of the welded section expands, the strains produced react on the cold metal at the end of the crack to open it further, with the result that as the welding proceeds the plate continues to open at a rate about equal to the welding speed. One inexperienced welder followed such an opening for 7 ft. before adopting preventive measures. The simplest of these is to drill a hole at the end of the crack and follow an intermittent

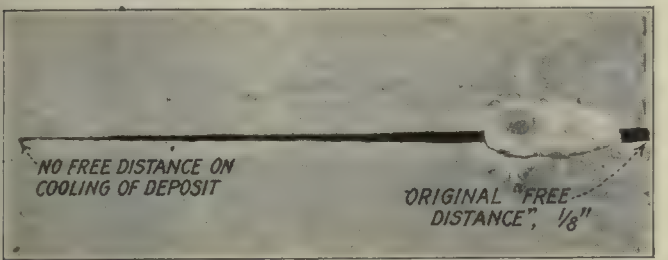


FIG. 7. REDUCTION OF "FREE DISTANCE" CAUSED BY TRANSVERSE CONTRACTION

Illustrates the necessity of rigidly clamping the joint members, or of assembling them by an increasing distance from the end to be first welded, to equalize the movement caused by the contraction of the deposited metal, if the desired "free distance" is to be maintained throughout the welding operation.

welding procedure which will maintain the plate at a low temperature. Under exceptional conditions, such as welding cracks in heavy cast-iron plates or cylinders, it is advisable to preheat and anneal the regions stressed. A second example is offered by the warping obtained on building up the diameter of a flanged shaft. The face of the flange adjacent to the shaft becomes hotter than that opposite, producing internal stresses which warp the flange to a mushroom shape. Preheating of the flange will prevent this.

Contraction of Deposited Metal

The contraction of deposited metal is the most frequent cause of residual stress in welds and distortion of the members welded. The magnitude of "locked-in" stresses depends upon the welding procedure and the chemical constitutents of parent and deposited metals. If the deposit is thoroughly annealed, practically no stress will remain. On adopting a welding sequence in which the joint is formed by running tiers of abutting layers, each newly applied layer will serve partly to anneal the metal in adjacent layers. If mild-steel plate, with less than 0.20 per cent carbon, is welded in this way, the locked-in stresses should be less than 5,000 lb. per square inch. With increase in carbon content the locked-in stresses will increase. If welded joints of high-carbon steels are not permitted to cool slowly, they will often fall apart when the joint is given a sharp blow.

To illustrate this characteristic, the following exercises are suggested:

Exercise 1—Deposit a layer 1 ft. long on a strip of steel about $\frac{3}{16}$ in. thick, $\frac{1}{2}$ in. wide, using 150 amp. direct current and a $\frac{5}{32}$-in. bare electrode. The longitudinal contraction of the deposit will bend the strip of metal as shown in Fig. 6.

Exercise 2—Deposit a layer of metal around the periphery of a wrought-iron tube. The contraction of the deposit will cause the tube to decrease in diameter.

Exercise 3—Place two plates, $\frac{1}{2}$ in. thick, 2 in. wide, 6 in. long, $\frac{1}{8}$ in. apart, and deposit a layer of metal joining them together. The transverse contraction on cooling will pull the plates out of line.

Exercise 4—If two plates, $\frac{1}{4}$ in. thick, 6 in. wide and 6 in. long, spaced $\frac{1}{8}$ in., are welded by depositing a short layer extending $\frac{1}{4}$ in. from the one end, it will be found that when the deposit has cooled the resulting transverse contraction will not only warp the plates as in Exercise 3, but will also draw them together as shown in Fig. 7, thereby decreasing the free distance between plates.

Welding Procedure

Satisfactory welds will be obtained only when the sections to be welded are properly scarfed or cut out and the surfaces on which the deposits are formed cleaned before and during the welding operation. The scarfs may be machined or cut with a cold chisel or the carbon arc. The surfaces of the deposited layers may be cleaned with a chisel or wirebrush, although the use of a sandblast is preferable. The joint sections should be separated by a free distance of about $\frac{1}{8}$ in. in order that the bottom of the V may be accessible to the welder.

The scarf angle and free distance vary inversely. Both are determined by the depth of the V. If the character of the work is such that it is not practicable to separate the joint sections, the V should be cut at the bottom to form a 90-deg. angle, this angle being reduced to 60 deg. as the surface is approached; otherwise the scarf angle may be reduced along the entire length to 60 deg., excepting in the case of very deep welds. It is usual practice now to scarf plate welds to 60 deg. and separate the sections $\frac{1}{8}$ in. for V's up to $\frac{1}{2}$ in. in depth.

At the left in Fig. 8 is shown the poor fusion obtained at the bottom of the V on welding a 1-in. square bar, scarfed 60 deg., without the use of a free distance. At the right is shown the satisfactory union obtained with the use of free distance of $\frac{1}{8}$ in. Whenever a butt joint is accessible to horizontal welding from both sides, it is preferable to scarf the sections to a double-bevel, double-V joint.

The choice of arc current is determined by the thermal

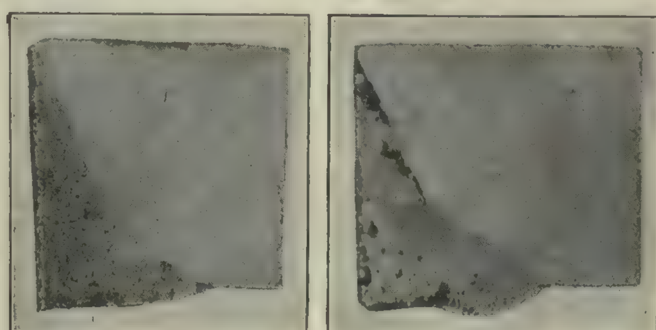


FIG. 8. WELDS SHOWING POOR AND GOOD FUSION

Section through one-half of a welded joint showing poor fusion obtained at apex of V as the result of assembling the joint sections without a "free distance." Section through one-half of a welded joint showing excellent fusion obtained as a result of the use of a "free distance" of $\frac{1}{8}$ in., thus permitting the operator to maintain a short arc when welding the bottom of the V. Failures of deep welds may be usually attributed to the use of too small a "free distance," low welding current, improper cleaning of scarf faces or incomplete slag flotation.

conductivity and capacity of the joint as previously discussed, a convenient criterion being the depth of arc crater. The arc current selected should be of such a value that on welding the given sections the depth of the arc crater or "bite" is never less than $\frac{1}{16}$ in.

The following is an abstract of the bare electrode specification prepared by the welding committee of the Emergency Fleet Corporation:

Chemical Composition:

	Per Cent (Maximum)		Per Cent (Maximum)
Carbon	0.18	Sulphur	0.05
Manganese	0.55	Silicon	0.08
Phosphorus	0.05		

Physical Properties: Wire to be of uniform homogeneous structure, free from oxides, pipes, seams, etc.

Finish: The surface shall be free from rust, oil or grease.

Operation: Electrode material shall flow smoothly in relatively small particles through the arc.

Electrode Current Density

To maintain a uniform flow of the metal, neither too slow, which causes excessive penetration, nor too fast, which produces excessive overlap, an electrode diameter should be chosen such that the current density is approximately 8,000 amp. per square inch. For the usual sizes of bare wire available this corresponds to the following welding currents:

Arc Current (Amp.) Normal	Maximum	Minimum	Electrode Diameter (in.)
225	275	190	$\frac{3}{16}$
155	190	125	$\frac{5}{32}$
100	125	70	$\frac{1}{8}$
60	70	45	$\frac{3}{32}$

If covered electrodes are used, the direct-current rating for the wires should be decreased roughly to 60 per cent of these values. If bare wires are used on alternating current, the rating should be increased from 20 to 40 per cent.

The first layer should thoroughly fuse the apex of the V. Wherever possible inspect the reverse side, as the deposited metal should appear projecting through. Subsequent layers should be fused then to the preceding layers or to the scarfed face. The final surface should be from $\frac{1}{16}$ to $\frac{1}{8}$ in. above that of the adjacent sections. This welt increases the strength of the joint or permits the joint surface to be machined to a smooth finish. If the weld is to be oil-tight, the metal projecting through the abutting sections on the reverse side as a result of the first step in filling the section should be chipped out and the resulting groove filled with at least one layer of deposited metal. This extension of the procedure is frequently used in the welding of double-bevel joints where the joint is to have a "100 per cent" strength.

If a vertical seam is to be welded, sufficient material should first be deposited to produce a shoulder so that the added metal may be applied on an almost horizontal surface to facilitate the welding operation.

If an overhead seam is to be welded, the operation is simplified by placing on the upper side of the joint a heavy steel plate covering the apex of the V. A shoulder is then formed by an initial deposit of metal, the operator continuing to add metal to the corner so produced and the vertical face of the shoulder.

The considerations pointed out under the section on thermal characteristics determine whether it is necessary to preheat and anneal the joint. The method used in filling the scarfed section is determined by the preference for either the rigid or non-rigid system.

When using the rigid system both sections of the joint are clamped firmly to prevent either member from moving under the stresses produced by the expansion and contraction obtained during the welding operation. If a proper welding sequence is not followed, the accumulation of "locked-in" stresses on cooling may be sufficient to rupture the welded area. To minimize these stresses it is the usual practice to tack the plates together at the apex of the scarf with short deposits at about 1-ft. intervals, and then to deposit single layers in alternate gaps, each tier being completed before adding a second tier at any section. This procedure tends to maintain a low average temperature of the joint and plate, thereby decreasing the amount of expansion, while the deposition of the metal in layers serves partly to anneal the metal beneath and materially reduce "locked-in" stresses.

In the non-rigid system both members of the joint are free to move. To prevent the edges of the plate from overlapping or touching as shown in Fig. 8, the initial free distance is made great enough to equalize the movement of the plates caused by the contraction of the hot deposited metal. On welding long seams of $\frac{1}{2}$-in. plate the contraction is limited by maintaining a spacing block $\frac{5}{16}$ in. wide, approximately 1 ft. ahead of the welded section. With a "free distance" of $\frac{1}{8}$ in. the contraction stresses draw the plates together a distance of $\frac{3}{16}$ in. This modification converts the non-rigid into a semi-rigid system.

Inspection

No direct, non-destructive means are available for readily determining the strength and ductility of welds. A number of indirect methods, however, are in commercial use which give a fair measure of weld characteristics if intelligently applied. They consist in estimating the degree of fusion and porosity present by critically inspecting the surface of each layer and in noting the depth of liquid penetration through the completed section.

In examining each layer the amount of oxide present, smoothness and regularity of the surface, its contour, freedom from porosity and depth of crater should be noted. After a little experience these observations will give the inspector a good indication of the manipulative ability of the welder and of the degree of fusion obtained, as discussed above.

A succession of unfused zones will produce a leaky joint. These sections may be detected by flooding one surface of the joint with kerosene, using a retaining wall of putty, if necessary, as the liquid penetrates through the linked areas and emerges to stain the opposite side.

Brief Terminology

The following terms are used most frequently in arc welding:

Free distance—The amount that the joint sections are separated before welding.

Overlap—The area of deposited metal that is not fused to the parent metal.

Parent metal—The original metal of the joint sections.

Penetration—The depth to which the parent metal is melted by the arc—gaged by the depth of the arc crater.

Recession—The distance between the original scarf line and the average depth of penetration parallel to this line obtained in the completed weld.

Re-entrant angle—The angle between the original surface of the parent metal and the overlapping, unfused deposit edge

Scarf—The chamfered surface of a joint.

Tack—A short deposit, from $\frac{1}{2}$ to 2 in. long, which serves to hold the sections of a joint in place.

Weaving—A semi-circular motion of the arc terminal to the right and left of the direction of deposition, which serves

to increase the width of the deposit, decrease overlap and assist in slag flotation.

Welt—The material extending beyond the surface of the weld shanks to reinforce the weld.

Questions and Answers

What does the welder's equipment consist of?

Welding generator, electrode holder with cables, welding booth, helmet or shield, gauntlets, high shoes with bellows tongue, heavy clothing or leather apron, proper electrodes.

What is the most important precaution the operator should observe?

To protect his eyes and body from the radiant energy emitted by the arc.

How is the operator prevented from drawing too long an arc after the electrode "freezes" to the work?

By twisting the wrist sharply to the right or left, thereby shearing the fused area.

What is the essential factor in securing the maintenance of the arc?

The electrode should be advanced to the work at the rate at which it is being melted.

What is the test of an operator's manipulative ability?

He should be able to hold an arc no longer than $\frac{1}{8}$ in., having a voltage across it less than twenty-five during the period required to deposit the metal from a $\frac{5}{32}$-in. diameter bare electrode, 12 in. long on 150 amp. direct current.

What is meant by "free distance," "overlap," "parent metal," "penetration," "recession,' "re-entrant angle," "scarf," "tack," "weaving" and "welt"?

Given under "Terminology."

What function does the arc perform?

It transforms electrical energy into thermal energy.

What polarity should the welder use on welding all but thin sections with bare electrodes?

The pencil electrode should be negative.

How may the amount of oxide formed be reduced to a minimum?

By holding a short arc and the use of electrodes containing a small quantity of carbon (0.18 per cent) and maganese (0.50 per cent).

How may an operator determine the degree of fusion obtained (a) by inspecting the surface, (b) by inspecting the cross-section of deposit?

(a) By examining the contour of the surface, noting the re-entrant angle and estimating the overlap; observing the depth of crater and estimating the penetration.

(b) By directly observing the depth of penetration of recession, the overlap and porosity or blow holes.

What are the factors in arc welding that determine the degree of fusion?

Arc current, arc length, electrode current density, electrode material, freedom of weld from oxides.

How may a welder determine when he is using the proper welding current?

By the depth the arc melts the material welded. The crater should be not less than $\frac{1}{16}$ in (1.6 mm.) in depth.

What is the most important thermal characteristic encountered in welding?

Contraction of the hot deposit.

How may strains produced by this characteristic be minimized?

By adopting a correct welding procedure, either non-rigid or rigid, which serves partly to anneal the metal and reduce "locked-in" stresses.

What is the effect of holding too long an arc with the metallic electrode?

The use of a long arc produces a poor deposit, due to insufficient penetration, and also produces a large amount of oxide which reduces both the strength and ductility of the joint.

What size of bare electrodes corresponds to welding currents of approximately 225, 155, 100 and 60 amp. on welding with direct current?

Sizes $\frac{3}{16}$, $\frac{5}{32}$, $\frac{1}{8}$ and $\frac{3}{32}$ in. respectively.

How should joint sections be prepared for welding?

The surfaces should be cleaned thoroughly and the faces of the joint scarfed to an angle of 60 to 90 degrees with the edges separated a free distance of approximately $\frac{1}{8}$ in. in the rigid welding process, and an additional $\frac{3}{16}$ in. per foot from the point welded for each foot length when using the non-rigid system.

What surface characteristics denote fusion?

Surface porosity, amount of oxide coating, depth of arc crater, surface contour, compactness, regularity and re-entrant angles.

Annual Meeting of the Indianapolis Metal Trades Association

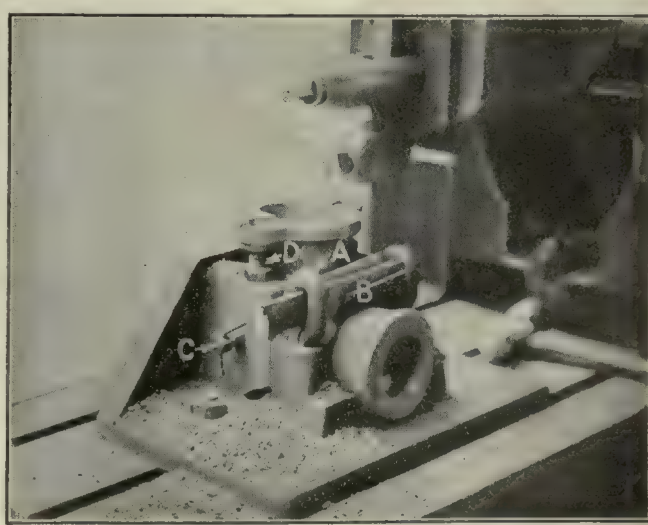
The fourteenth annual meeting and dinner of the Indianapolis branch of the National Metal Trades Association was held on March 16 at the Claypool Hotel. The following officers of the branch were re-elected for another year: H. G. Myers, of the Chandler and Taylor Co., president; W. B. Oakes of the Oakes Co., vice president, and L. M. Wainwright of the Diamond Chain Co., secretary.

J. W. O'Leary of Chicago, president of the association, spoke broadly upon industrial conditions. Among other things, he contrasted the open-shop policy, which prevails largely in America, with the European system of trade unions. J. A. Emery, general counsel for the National Association of Manufacturers, spoke on the alleged program of the American Federation of Labor which calls for the popular election of Federal judges and the prohibition of injunctions in labor disputes.

A Fixture for Use on the Shaping Machine

By John Vincent

The shaping machine seems to be used more for jobbing than for manufacturing work, and therefore one does not so frequently see fixtures built for handling work on this machine. In the shops of the Minneapolis Threshing Machine Co., Hopkins, Minn., the shaping machine is employed for facing off the flanges of a pipe elbow, and the fixture made for holding this part is shown in the accompanying illustration. The two eyes *A* were forged from a mild-steel bar, and were placed in the mold and cast into place in the fixture. Passing through these eyes, the wedge *B* affords a rapid and easy method of clamping the work firmly in position, while at the same time it is forced sideways by the thumbscrew *C*. Two jacks, one of which is shown at *D*, are used for aligning the work.



FIXTURE FOR THE SHAPING MACHINE

Notices and Claims Under Compensation Acts—III

BY CHESLA C. SHERLOCK

In concluding this series the author discusses the matter of attorney's and doctor's fees and shows clearly the enlightened attitude of most of the compensation commissions in protecting both employer and employee from the exhorbitant fees usually connected with common law cases.

(Part II appeared on page 560.)

THE question of costs and particularly of attorney's fees in proceedings under the workmen's compensation acts is a matter which has not only concerned employers but also the commissions and the courts.

Under the common law system whereby it was necessary for an injured workman to bring a civil action for damages against employer, it was necessary for him to engage an attorney and prosecute the case with such money or hope of recovery as he might have in the case. The usual result was that the attorney took the case on behalf of the workman on a contingent fee basis; that is, he was to receive a certain percentage of the amount recovered, and this was generally just 50 per cent.

The result was that the workman was getting only a portion of what he was rightfully entitled to in the cases where he did succeed in getting judgment against his employer, and a good share of the balance was taken up in costs and other fees.

The System Unfavorable

The system was decidedly unfavorable to all parties concerned, especially the injured workman and the employer. It was favorable only to the successful attorney. To the employer it meant that he was giving his money over to an attorney who probably had wrung a higher award out of him by appealing to the fleeting sympathies of the average jury, and it further meant that every aggrieved workman in the future would find himself speedily reinforced in his demands by some attorney anxious to engage in the legal battle if there was any prospect whatever for a fat fee.

The compensation system was adopted for the specific purpose of remedying the many evils of the common law system, among which were the long delay in getting claims adjudicated, and also to eliminate the attorney as much as possible from the settlement between the employer and the workman, for it was felt that there were only two necessary parties to such a settlement and outside help was needed only in rare instances.

The industrial commissions were not only created for the purpose of administering these laws, but also to audit the settlement, make awards and generally see to it that substantial justice was done between the parties. This being true, in the absence of a dispute as to a point of law, it can readily be seen that the need for an attorney was slight in the usual case.

The attorney, and I naturally speak favorably of him for I happen to be one, saturated as he was with his common law training naturally continued or tried to continue the same relation under the compensation acts that he had pursued under the common law system; namely, he expected a contingent fee from the workman he represented. And this was not necessarily due to his greediness for the award under the compensation system being fixed and to be paid promptly, was naturally so much smaller than he would have a prospect of winning at a common law action, that he felt that he would still have to have a stiff fee in order to justify him in taking up a case under this new and revolutionary system of jurisprudence.

The legislatures in many states anticipated this line of reasoning and specifically limited the amount of the fee which the attorney could charge the injured workman for representing him in a compensation proceeding, the usual amount of this limitation being 10 per cent.

They felt justified in doing this, for the compensation system itself practically eliminated all the work in getting the award. All the injured party had to do was to give his notice of accident and make claim for compensation. If there was any doubt as to his right to compensation, then he might need an attorney; otherwise he did not need an attorney any more than he would need a minister, for the industrial commission was there to look out not only for the employer's interests, but his own as well.

Attorneys Sometimes Overcharged

Nevertheless, the attorneys did not always tell their clients that their fee was limited to 10 per cent. of the amount recovered, and the writer is familiar with one or two instances where attorneys, through ignorance of the law, failure to look it up, or design, charged workmen receiving an award of something like five hundred dollars, as much as one-half of the amount recovered. It then became necessary for the commission in the state mentioned to prepare a form blank for attorneys upon which they were required to make an affidavit in all doubtful cases that they were not receiving more than 10 per cent. of the amount to be recovered, and in order to still further protect the workman, it was deemed advisable, especially in lump sum settlements, to have the claimant sign a similar statement.

Of course many were the surprises occasioned by this policy of "covenants openly arrived at" and it caused not only surprise to the members of the bar in many instances who had made arrangements in good faith thinking they were entitled to more, but in other instances, it caused no slight surprise to a workman who had imagined that he was at the mercy of his attorney in order to get the award.

This power was exercised by the commission under the grant of power vested in it by the legislature when it put a clause in the law stating that the commission should have the power to fix attorney's fees. And I might add that what has been said here of attorney's fees likewise applies to the fees of doctors and dentists who were called upon to treat injured workmen. These bills are all audited and approved by the industrial commission before they can be paid, and if there is any doubt as to the fairness of an

item it is taken up with the industrial commission who informally ascertains the facts and reduces, increases or approves the bill as seems fair for the actual work done.

The greatest trouble in this matter is not due to a desire on the part of the practitioners to swindle the workman as it is due to the fact that they forget for the time being that they are treating or serving John Doe, laborer, and assume that they are working for Hiram Moneybags, employer.

By provision of law, medical, hospital and surgical bills are paid, within a certain limitation, by the employer; while the attorney fees of the workman must necessarily come out of the award which he has received. In either event, the matter is of vast importance to the employer, for this money has been set aside by operation of law for the use and benefit of an injured workman, and just so much of it as is diverted into other channels means that there is a dissipation of that amount which otherwise might be doing greater good by actuallly accumulating to the benefit of the party the law intended should be benefited, the injured workman.

The Courts Try to Be Reasonable

The courts and the commissions make mistakes, but they try to be reasonable in this matter of fees and costs. All of them have not been as drastic as the commission mentioned above, but there is a growing tendency along this line and wherever it is apparent that fees or costs are mounting too high, the employer in justice not only to himself but to the injured workman as well should see to it that the matter comes to the attention of the proper parties.

Few cases have been handed down upon this point, for these disputes as a rule are kept under cover, but some have reached the white light of publicity in the court room. We will not discuss these cases at length, but will confine ourselves to a statement of the ruling of the court in order that employers may know what the courts are saying on the subject.

In New Jersey it was questioned as to who should pay the fee of the claimant's attorney, the claimant or the employer. The court held that the claimant must pay for his own attorney from the award, saying: "Nor is there any legal error in the award of $125 counsel fee generally, for in the contemplation of the statute this is to be paid from the award. There is nothing in the record before us that indicates any contrary purpose."

In Minnesota it has been expressly held that the law does not authorize the payment of attorney's fees at all under the Minnesota Workmen's Compensation Act, but it was said that the court may allow the statutory costs, even though designated in the order as attorney's fees.

In one case an objection to the allowance of attorney's fees was sustained, the court saying that under the law the costs allowable were only those for "like services and proceedings in civil cases," and the only costs allowable there were the actual disbursements and what are usually termed statutory costs. This amount seems to be arbitrarily fixed at $10 and the court held that all costs allowed over that amount would have to be reduced to $10.

In another Minnesota case where an attorney's lien had been allowed the court said: "The court allowed plaintiff's attorneys a lien in the sum of $400 upon the amount recovered. The relator raises no question concerning this lien except to call attention to the fact that if plaintiff is not entitled to recover. her attorneys are not entitled to a lien as against the relator.

"The amount for which the lien is allowed in this case is not questioned by any one and hence is not before us for consideration, but we wish to call attention to the fact that the proceedings under this law are informal and summary and are intended to be inexpensive; and that only extraordinary circumstances will justify the court in allowing a lien for any considerable portion of the compensation awarded the dependent."

In an Illinois case upon a compensation proceeding, the court rendered judgment against the employer and also, as per civil custom, taxed up attorney's fees of the claimant against the employer. The employer appealed from this and the appellate court said: ". . . it clearly appears that, if the arbitrator and Industrial Board render a decision in favor of the claimant, and no review is petitioned for or had by the party paying the compensation, the statute gives no authority to allow an attorney's fee to be taxed against the party paying the compensation, unless said party refuses to pay the compensation, or some installment thereof, when it comes due."

Another Illinois Case

In another Illinois case the court said: "The statute provides for attorney's fees where the employer does not institute proceedings for review and refuses to pay compensation. . . . There is no constitutional objection to such a statute and the facts authorized the allowance. The purpose of the statute is to provide a speedy method for the adjustment of compensation and the payment of the same, without the delays of litigation and the burden and expense and attorney's fees otherwise imposed upon claimants."

In Washington it was shown that the superior court, in a compensation proceeding, had allowed attorney's fees in the sum of $60. An appeal was taken and a motion made in the supreme court to have the allowance increased, due to the extra work occasioned by the appeal. The supreme court found that there was nothing in the statute authorizing it to increase an allowance, but that such power rested with the superior court, and denied the motion.

In a California case, the commission made an award directly to the attorney, stating that he had rendered services in the amount of $25 and directing the petitioner to pay it to the attorney. It was contended that there was nothing in the Act justifying the commission in making an award directly to the attorney. The court held that it made no difference, as the amount was to be deducted from the award anyway and that it seemed that this was as good a way to make the award as another.

In Nebraska it was held that the court has no authority to assess attorney's fees as costs. The compensation act there provides that the county attorneys and the attorney general shall appear in court on behalf of claimants for compensation. Said the court: "The Employer's Liability Act in its entirety is a summary proceeding. One of its main objects is to facilitate an inexpensive and speedy settlement of controversies between employer and employee that arise out of personal injuries. It does not appear that the coun-

ty attorney was requested to appear as attorney for claimant, or that he refused to appear. That such official would perform his duty in the premises when called upon to act in his official capacity is presumed."

In a Michigan case it appeared that the claimant and her attorneys had become involved in a dispute as to the amount of the fee which they were to receive. It seemed that the amount of the compensation awarded had been paid to the attorneys in the form of a check, that they caused this check to be indorsed and retained 25 per cent. of it as their fee. The claimant protested and asked the commissioner to determine the matter and fix a reasonable fee for the services rendered. The attorneys claimed that they had a contract with the claimant for a 25 per cent. fee, which was strenuously denied by the claimant.

The commission accordingly considered the matter and fixed $125 as a reasonable fee for the work done. This left a balance of $290.50 which the attorneys had collected and which they had been directed to repay the claimant. The court affirmed this decision holding that the approving of attorney's fees was something reposed in the commission by the statute, that it was constitutional, and that no appeal could be taken to any court from such a finding.

An Indiana Case

In an Indiana case it was attempted to appeal from the finding of the commission as to the reasonableness of attorney's fees. Said the court: "The act nowhere makes any express provision for an appeal from an order approving or disapproving attorney's fees, and we fail to find any provision from which any such right can properly be implied. Certainly a provision for an appeal from an award growing out of a disagreement between an employer and an injured employee with reference to the latter's compensation cannot be so construed as to imply the right of appeal in a collateral matter, based on the action of the board in approving or disapproving attorney's fees, which must necessarily arise out of an express or implied contract between the injured employee and his attorney. The two matters are so far unrelated as to forbid such an implication."

If there is any place where costs and expenses should be discouraged it is in a compensation proceeding, and the procedure has been so simplified and stripped of all technicalities that it is entirely possible for a workman possessing sufficient information and education to read and write to act as his own attorney throughout the whole matter. But where it is desirable to have the services of an attorney, and it is in many instances in even compensation proceedings, expenses should be reduced to the minimum.

Attorney's Fee and Costs

Some states recognize the attorney's fee as part of the costs and do not hesitate to tax them up against the employer, in many instances to be paid out of the award, while others do not recognize the right of an attorney to compensation in any particular.

Employers should be informed on this point, particularly in relation to the laws of the states under which they are operating, for it is as necessary to know when attorney's fees can legally be charged up against the employer as it is to know when the employer can legally be charged with a compensation allowance.

The general effect of this discussion has been to show that there is a marked change in the attitude of the authorities toward the technical provisions of the compensation as to notice of accident or injury, claims for compensation and as to costs in compensation proceedings; all of which is making for progress and a better understanding of this important new branch of our jurisprudence.

Questions of Machine Shop Ethics

By J. A. Raught

In regard to the questions asked by Charles D. Folsom, Jr., on page 437 of the *American Machinist* under the title "Rules of Etiquette for Foremen" I will say in answer to the first one that whether they be good, bad or indifferent shops I have never known any of them to give advance pay, and as to giving notice, this scheme has been tried several times with widely varying results.

I have known of instances where men who had been given 30 days' notice brushed up so as to make themselves indispensable and others were laid off in their stead; in other cases under similar circumstances men became absolutely worthless. However, I would say that if men must be laid off the deserving should be given ample notice.

As to the principle of secrecy in granting an increase in wages, I think both sides are justified in maintaining it. This reminds me of something that actually happened: A fellow workman walked over to another and remarked "It is none of my business, but George over there asked me how much you are getting." The answer he got was this "When George asks you that question again you can tell him its none of his business either."

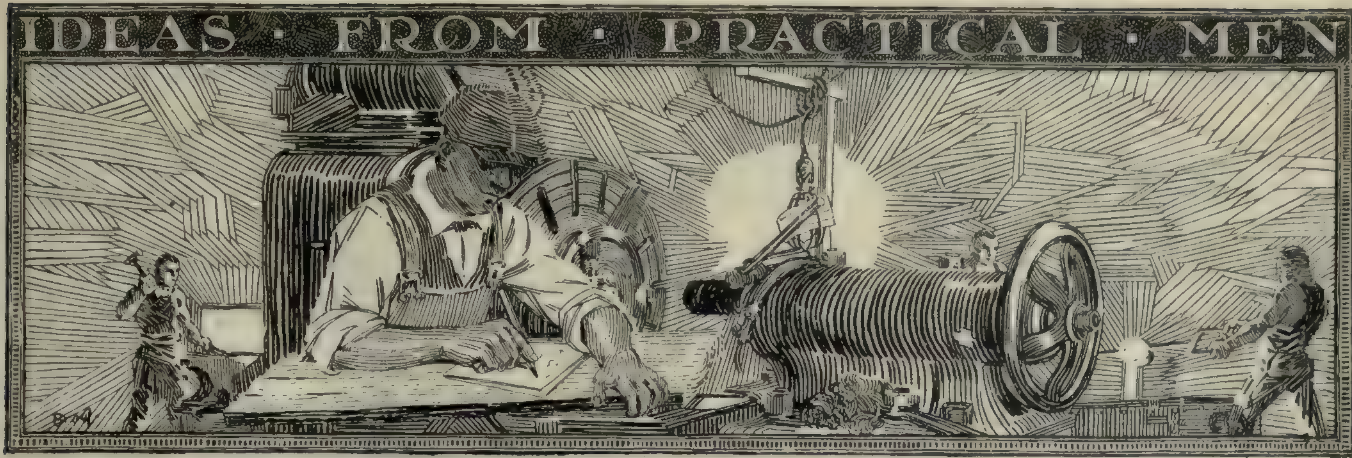
As to the amount of consideration to be given to data supplied by an applicant, it is a whole lot cheaper to believe the good things he says about himself than it is to prove they are not so. If we were back in the days of receiving applicants two to four weeks ahead of giving employment it would then be just and proper to investigate but in this day and age this scheme does not work, therefore I consider it better to take a man at his own word and if he cannot make good, it doesn't cost anything to tell him so.

Setting the Milling Machine Vise In Alignment

By George C. Hanneman

Referring to the method of setting a milling-machine vise parallel with the cutter, described by John A. Grill on page 356 of *American Machinist*, this seems to be a rather time-consuming way to accomplish the job.

A much quicker way is to clamp a tri-square in the vise so that the blade is at right angles with the arbor, and horizontal. A rod is clamped between the collars on the arbor and an indicator attached to the end of the rod. By adjusting the position of the rod, the indicator may be made to touch first one end of the square-blade and then the other by turning the spindle part of a revolution. Tapping the vise until the indicator reads the same in both positions will bring the vise square without moving the table, which is a slow, tiring job. Of course, the square must be accurate, and the vise jaws in good condition.



A Theater as Part of a Factory Group

By George F. Paul

The Clark Equipment Co., Buchanan, Mich., decided that its employees should have a light and comfortable place in which they could hold meetings and have entertainments. Accordingly, the theater, an interior of which is shown in the illustration, was built.

The wall behind the stage is a partition separating the theater from one of the factory work rooms, so that the theater is in reality a part of the factory group. The structure is 60 x 89 ft. and the auditorium and gallery will seat over 700 people. The stage is 30 ft. wide under the arch and is fully equipped with scenery and a lighting system.

INTERIOR OF THE THEATER

Arbor for Threaded End Mills

By William Older

One of the most difficult milling tools to hold properly is the ordinary threaded end mill. The difficulty is not so much in holding it while in operation as in removing it from the threaded arbor after use. Large end mills of this type can, of course, be held in soft jaws in the vise while other tools are used to persuade the arbor to let go, but the teeth of small ones are often broken when trying to remove the mill from the arbor.

A very efficient arbor for this type of end-milling cutter is shown with the cutter assembled on it in Fig. 1, and in Fig. 2, the cutter and the components of the arbor are shown.

Referring to Fig. 2, *A* is the arbor body with the ordinary taper shank. At the other end is the usual thread to suit the thread in the cutter which will be screwed on it. Behind the thread, between it and the flange, is a plain cylindrical portion for the reception of two washers. These washers are of about equal thickness and their combined thicknesses are, say, $\frac{1}{8}$ in. greater than the distance from the flange to the thread. The holes in the washers are an easy fit on the cylindrical part of the arbor.

The washers are placed on the arbor and either the threaded mill or a nut is screwed on the thread to force them to a seat. When thus assembled a radial hole is drilled and taper-reamed from side to side through the washers and the cylindrical part of the arbor, the drill and reamer cutting one-half into each of the washers.

FIG. 1. ARBOR WITH THREADED END MILL IN PLACE

The mill or nut is then removed and the hole through the cylindrical part of the arbor is enlarged so that the taper pin cannot bind in it; in other words, it is made large enough for the pin to drop through. The washers are then taken one at a time and about $\frac{1}{16}$ in. milled, ground or shaped off the faces which have the half holes for the taper pin. The arbor is now ready for use.

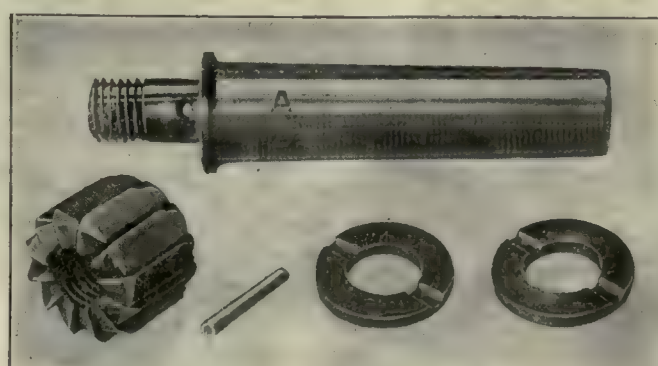


FIG. 2. ARBOR AND THREADED END MILL DISASSEMBLED

When assembling ready for work as shown in Fig. 1, the washers are slipped on the arbor in the same order and position in which they were when drilled. The cutter is next screwed on but, before tightening it, the taper pin is put in till the head is flush with the hole. This separates the faces of the washers about $\frac{1}{32}$ in. so that further screwing on of the cutter causes the taper pin to be pinched between the washers. The mill is now screwed on as tightly as is convenient and put to use, when the cutting resistance will screw it tightly in place. When ready to remove the cutter from the arbor, the taper pin is easily driven out which releases the pressure of the front washer on the threaded end mill so that it can be readily screwed off by hand.

When assembling to do the drilling and taper-reaming operation, it is as well to mark the parts as shown as it makes it so much easier to assemble correctly later under working conditions. The taper pin should be hardened so it will not upset when driven out.

Small Boring Tool for Milling Machine

BY J. W. GORE

The sketch shows a small, easily adjusted boring tool that I made recently for use on the milling machine. This tool worked so well in boring holes in

BORING TOOL FOR USE IN MILLING MACHINE

some large fixtures I had to make that I thought it might be of interest to others.

Note that the shank is turned eccentric with the body of tool, and also that the hole in the bushing is bored in the same manner.

More About the Spiral Gear

BY GEORGE A. PERRY

Mechanical Engineer, Jones & Lamson Machine Co.

We were interested in reading Sandy Copeland's letter on page 816, Vol. 51, of *American Machinist*, where he calls attention to the common mistake of calling a helical gear a "spiral." We are wondering, however, if he is exactly correct in saying that there "haint no such animal" as a spiral gear.

The illustration shows a gear which, if not a true spiral gear, is very nearly so, as the teeth are generated while the gear revolves at a constant speed. It is not necessary that all the teeth be part of the same spiral curve, any more than it is necessary that all the teeth of a helical gear be part of the same helix. This gear has been used in the bar feed of the Hartness flat turret lathe for about thirty years.

A "SPIRAL" GEAR

Handy Drying Rack for Small Drafting Room

BY HARRY JAY

The sketch shows a rack for hanging wet blueprints that is convenient and occupies but little space, besides being very handy to operate when one has his hands fully occupied with a wet print.

The device consists of a series of brass channels made from material of suitable thickness, say about 16 gage, inverted, and fastened by wood screws to wooden supporting brackets. The complete rack is shown in Fig. 1, and an enlarged detail in Fig. 2. A wooden roller is put into each channel and one edge of the latter bent in at an angle, as may be seen in the detail, so that the roller cannot drop out.

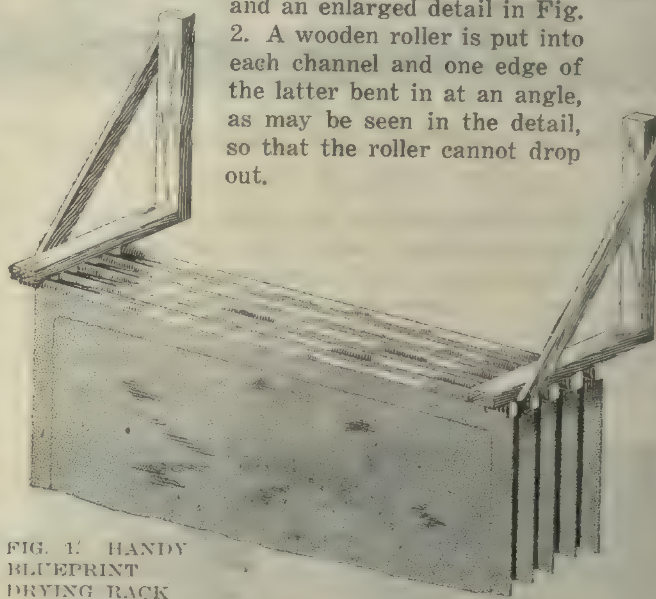


FIG. 1. HANDY BLUEPRINT DRYING RACK

As one approaches the hanger with a wet print held in both hands, he has only to let his thumbs extend above the edge of the print sufficiently to lift the wooden roll while inserting the print; then, upon slipping the thumbs down, which is easily done on the wet surface of the print, the roller drops back to place, pinching the edge of the print between it and the straight side of the channel.

The channels may be made continuous for the length of the longest print, in which case they will hold prints of any length shorter than the maximum, or they may be made in two short sections, so spaced as to take medium-size prints. They are more easily made in this way but are less adaptable.

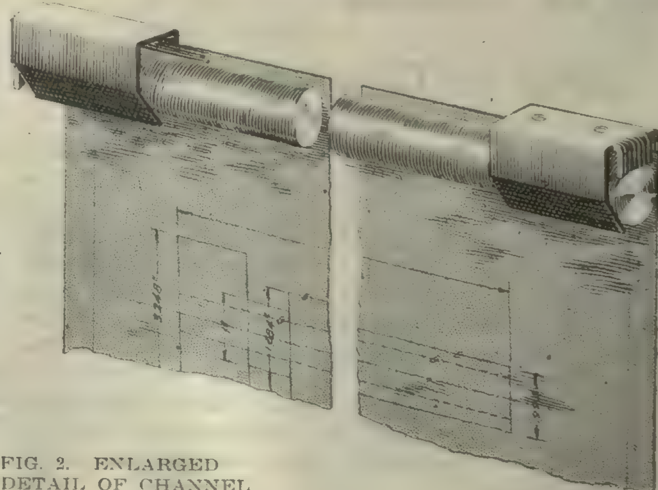


FIG. 2. ENLARGED DETAIL OF CHANNEL

The Compulsory Metric Law

Read This—and Then Get Busy

THE World Trade Club is sending out to all parts of the country, thousands of post cards, addressed to the Bureau of Standards, Washington, D. C., urging legislation in favor of the *exclusive* use of the meter-liter-gram in the United States.

These cards are being signed by doctors, lawyers, school teachers and all sorts of people who know absolutely nothing of real manufacturing or export conditions.

Probably a hundred thousand of these cards have been mailed to Washington favoring one side of the question only, and many Congressmen have been led to believe, in looking over the reports on this flood of cards, that the whole country wants a compulsory metric system, when in fact nothing is farther from the truth. This dangerous propaganda *must be counteracted* by the same means the "millionaire's club" has employed.

Now—Mr. Manufacturer—Mr. Exporter—Mr. Man—**You** whose **very existence** depends on the smooth running of our industrial machinery which would be hopelessly crippled by a compulsory metric law—**all of you turn in and help in this campaign by taking up our proposition.** Also get the help of every association you belong to.

Chairman of Committee on Coinage, Weights and Measures,
House of Representatives,

Washington, D. C.

I am against all legislation tending to make the use of the metric system compulsory in the United States.

*Name*______________________________

*Address*____________________________

____

*Vocation*___________________________

Here is our proposition! We will furnish you, **free of charge,** all of the post cards you can use, similar to the one shown. Distribute these cards to your employees and have them sign and mail them. The cards are all properly addressed and need only to be signed and a one-cent stamp affixed and then they are ready for mailing.

Ask us for enough cards for every employee you have and all their friends who are against the proposed compulsory metric law.

Ethan Viall

Editor

(Reprinted from our March 25th issue)

Inter-Racial Council Favors Modification of Immigration Laws

The immediate and urgent need for the modification of present immigration laws, the adoption of a policy which will offer a genuine attraction to European labor, and the consequent stabilization of American industrial conditions, was the overwhelming sentiment brought out at the National Conference on Immigration, held last Wednesday, April 7, at the Engineering Societies Building, New York City.

The conference was held under the auspices of the Inter-Racial Council, and was the first meeting of its kind in the United States. Men from all walks of life—farmers, merchants, captains of industry, financial powers and members of the legal and medical profession—all gathered together for but one purpose, to decide on some way to check the steady after-war emigration and devise a means of attracting and encouraging foreign labor.

The conference was divided into three sessions. The first session, beginning at 9:30 a.m., was opened by a few introductory remarks from General Coleman du Pont, chairman of the Board of the Inter-Racial Council. William H. Barr, president of the Inter-Racial Council, was then introduced as chairman of the session.

The morning session was taken up with a discussion of labor problems as affecting our industrial life. Each one of the speakers was a leader in his particular field, and each told from his own point of view what a more liberal immigration policy and a more humane treatment of the foreigner, would do for the future of American prosperity. What was probably the most inspiring and weighty address of this session was delivered by Louis Marshall, former chairman of the New York State Commission of Immigration. Mr. Marshall was assigned to discuss "Immigration Legislation" and he handled the subject admirably. He advocated a policy of "Selective Immigration" and urged the educating and Americanizing of the foreigners. He said "those who have been most objectionable have been the products of the best European universities. If you are looking for an Anarchist, don't look for him among the illiterate." He also took a fling at the Government officials at Ellis Island. He declared that the brutality of some of these officials was "worse than that of Czarist Russia." He asked the conference to go on record as in favor of a repeal of the literacy test or a modification of this test so as not to affect agricultural, domestic or industrial workers.

The afternoon session was presided over by John Williams, former New York State Commissioner of Labor. A set of resolutions was presented by Dr. Albert Shiels. These resolutions expressed the crystallized sentiment of the conference. Four articles were included; namely, Assimilation, Admission, Stabilization and Naturalization. Each one of these articles was discussed at some length by men prominent in American industrial life. Several amendments were offered and a general discussion followed. The resolutions were adopted at the close of the session.

The third and final session was held in the evening at the Capitol Theater. A reception, special music, several reels of industrial news film and the formal presentation of the resolutions as adopted, made up the program. The conference closed with the singing of "America" by the entire audience.

The Problem of Immigration*

By William H. Barr†

No other country is so profoundly interested in the problem of immigration as is the United States. Its industrial and economic history is, in effect, a history of immigration. There are in the country today sixteen million foreign born people, and they are the parents of more than twenty million American born children, and in so far as our national development depends upon the labor of its people, one-third of that progress is due to the immigrant and his immediate family. Never in the history of mankind has there been a migration so great in number, so orderly in character, as this. But we are dealing with conditions as they exist *today*. In Europe we are confronted with a new world, having changed international vision.

One thing is certain; no longer will the immigrant come here to enjoy freedom of worship or right of free speech, for these things he will have at home. The immigrant of the future will come and go for one dominant reason—that reason will be economic.

No man can tell how these conditions will change the course of immigration, but it will affect it profoundly. Already we have seen the signs. Men are returning to Europe—men trained in our fields and workshops. On the other hand, the number coming from abroad contains a large ratio of women and children, the men in many cases remaining at home. This is a new development and gives occasion for reflection.

One of the important industrial questions confronting us at this time is the problem of adequate production. There are certain basic truths no man can deny. One of them is that our permanent national prosperity depends upon sound production, and one of its essential features is a sufficient supply of unskilled workers. We need such labor on the farm, in industry and in the home.

Because America is a land of opportunity, those who are ambitious gradually rise from the ranks of the unskilled to the higher grades of skilled employment.

Their places must be filled with new recruits, and the supply must come from among those who are willing to do conscientious work. For years the labor of the immigrant has supplied this need and unless we have a dependable supply, even the raw material upon which skilled labor itself depends, will be lacking.

But the problem of immigration is not that of labor supply alone. We all agree that we must admit only those whose entry to the United States will insure the maintenance of a proper standard of living among the people, and that we must recognize the obligation which immigration entails upon us. If we admit immigrants we must accept only those who are potentially good citizens, and having accepted them, we must provide the means that will make good citizens of them.

I am confident that the conclusions reached by this conference will make a significant contribution to the solution of the immigration problem. It is an encouraging thought that the problem of immigration is to be considered by trained minds, without passion, and engaged only in the pursuit of truth.

*From an address delivered at the National Conference on Immigration, New York, April 7, 1920.

†President The Inter-Racial Council and President of The National Founders Association in the United States.

Metalwood Tappet Guide-Hole Broaching Press

EDITORIAL CORRESPONDENCE

A type of hydro-pneumatic press which has been designed for finishing motor tappet guide holes is described in this article. It is claimed that the method of sizing as shown is both economical and produces an accurately finished hole.

THE use of sizing punches, or "broaches," for finishing the tappet guide holes in motor cylinder blocks has created a demand for a type of press now being built by the Metalwood Manufacturing Co., Detroit, Mich. It is claimed the "broaching" method is less expensive than reaming in both the time required by the operator and in the upkeep of tools, the latter being by far the more important factor. It is also stated that the finish produced, which is somewhat similar to a burnished surface, is superior in wearing properties to that obtained by reaming.

The presses shown have been designed with a view to meeting the conditions which are considered to be peculiar to motor building plants in both the quality of work demanded and the requirements for mass production.

The press shown in Fig. 1 is of the pneumatic-hydraulic type in which the only power furnished from an outside source is compressed air. The air acts through an intensifying chamber to force a flow of the fluid to the hydraulic chamber where it operates the ram. Details of the action are shown in Fig. 2. The air enters the lower end of the large cylinder *A*, in which slides the piston *B*. As the piston rises a heavy pressure is created in the intensifying chamber *C* by the displacement caused by the entrance of the piston rod. From the intensifying chamber the liquid can flow through suitable regulating valves to the ram cylinder *D*. The regulating valves must be nicely proportioned to permit the liquid to flow through at a definitely fixed rate so that the velocity of the ram, and consequently the rate of broaching out, will be at the correct rate of speed. It is important that the speed of the cut be uniform, with no uneven impulses such as may occur where air is used and the regulating valves are therefore carefully designed to avoid difficulties of this nature.

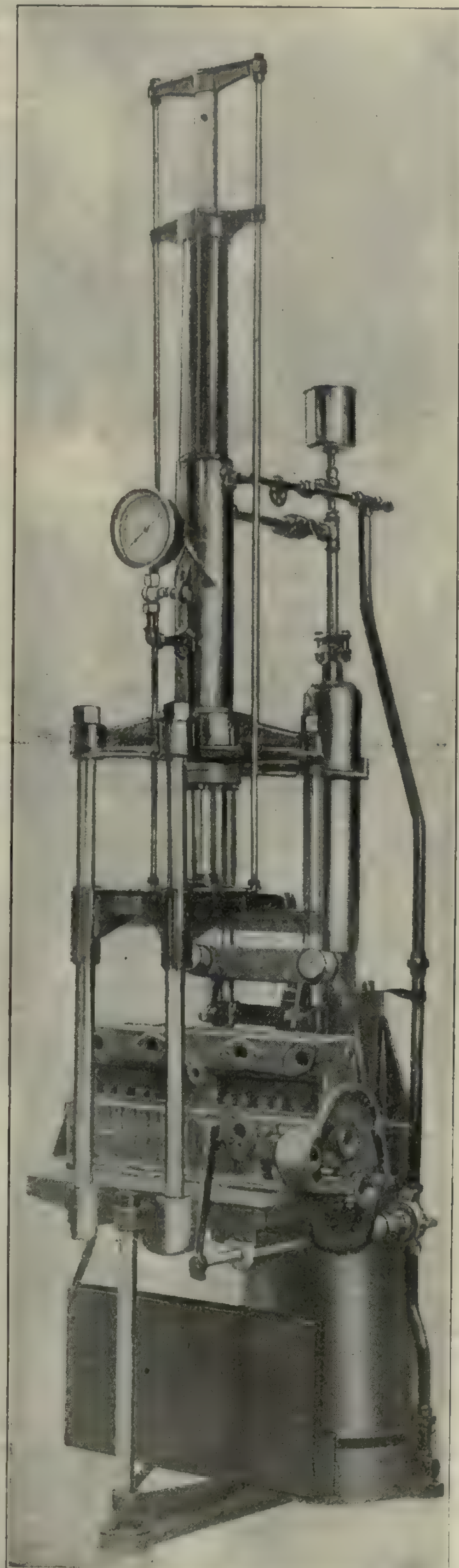


FIG. 1. THE METALWOOD TAPPET GUIDE-HOLE BROACHING PRESS

The sectional view *E* of the hydraulic ram cylinder shows that above it is a pneumatic cylinder *F* which is directly connected to the air service line and is never exhausted at any time. This air pressure is always in action against the under side of its plunger and serves as an aid toward giving a balanced uniform movement for each cutting stroke of the ram. The pneumatic cylinder also serves to return the ram to its original position at the conclusion of each stroke. The small upward pressure against this lifting piston relative to the much greater pressure of the liquid which forces the ram on its downward stroke, is so little as not to warrant consideration.

The entire operation of the press is controlled by a single lever in front, which admits the air beneath piston *B* for the down stroke of the ram, and releases the air pressure when the stroke is completed. The lifting stroke of the ram returns the fluid to the intensifying chamber.

The broaches are all loose tools and are each dropped into the tappet holes before lowering the ram head. At the conclusion of the stroke the broaches drop through into the oil-pan beneath the table. Each operator is provided with a duplicate set of tools and one set is being cleaned by his helper while the other set is in use.

In the average six-cylinder motor block with twelve tappet holes it has been found more practical to operate only six broaches at a time, since this number has been found more convenient to handle for rapid production. When broaching in two strokes it is the practice to finish alternate holes, but when the holes are spaced unequally it is sometimes necessary to finish all twelve at the same time and these presses are equally capable of forcing

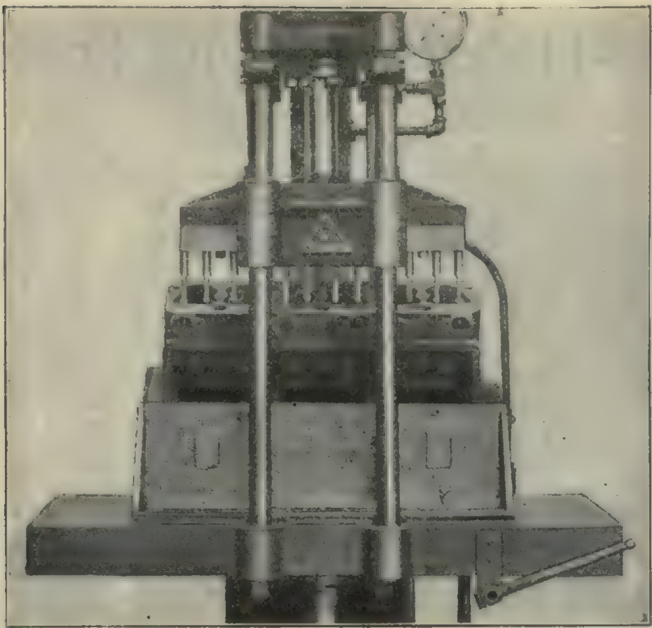


FIG. 3. BROACHING 12 HOLES AT A SINGLE OPERATION

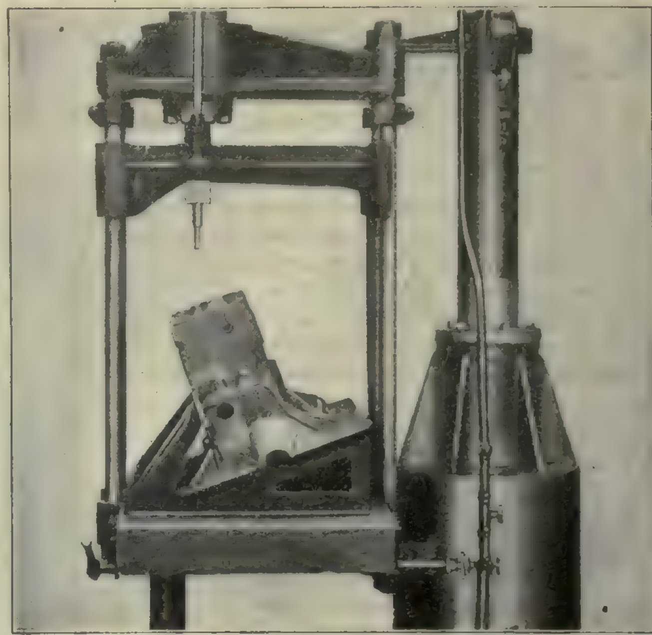


FIG. 4. FIXTURE FOR BROACHING HOLES AT AN ANGLE

through that number of broaches. A press which has recently been completed for operating on a block with unevenly spaced holes is shown in Figs. 3 and 4.

A feature of this machine is that it is built for a cylinder block in which the tappet guide holes are at an angle of 20 deg. from the vertical. This has required a few changes in the general construction of the press together with the application of a special fixture upon which the block stands at the required angle, as is indicated in Fig. 4. In this case when the tools fall clear of the holes they stand against the upright portion of the fixture from which they may be readily removed.

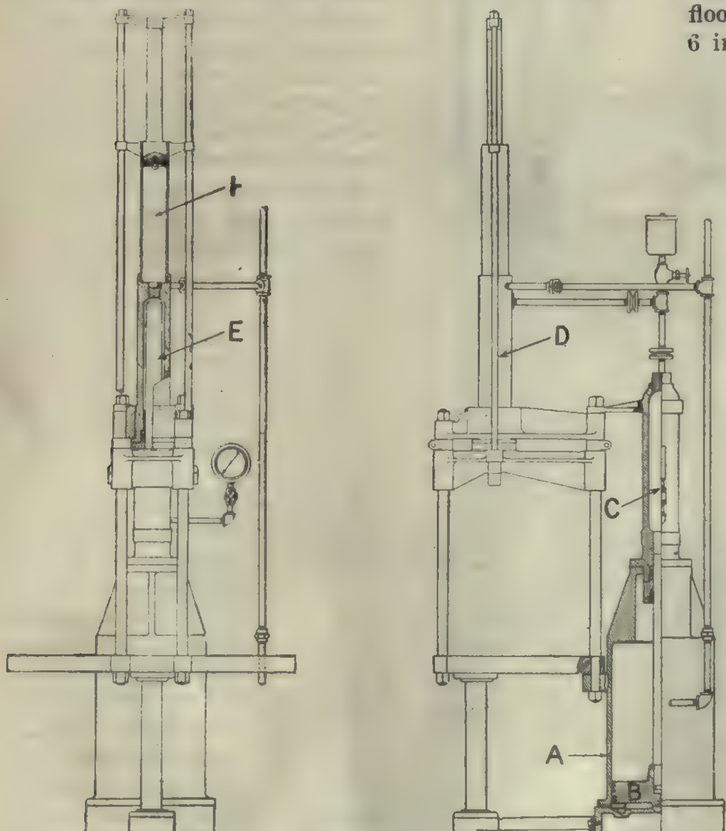


FIG. 2. SECTIONAL VIEW SHOWING BROACHING PRESS CONSTRUCTION

The average working pressure per tool for the broaching operation has been found to run between 800 and 1,000 lb. for holes from $\frac{7}{16}$ to $\frac{9}{16}$ in. in cylinder-grade iron. This pressure depends somewhat upon the sharpness of the tools. The presses are designed to operate with an air pressure of 80 lb. per square inch, which represents the usual average pressure on the working line when the initial pressure is established at 100 lb. by the compressor.

Specifications: Work space between columns for press shown in Fig. 1, 19¼ in.; ram shoe to table, 31½ in.; stroke, 18 in.; standard length of table, 27 in.; height, floor to table, 31 in.; floor space, 2 ft. 6 in. by 4 ft. 6 in.; height, 12 ft.

What Is a Spiral Gear?

By Sandy Copeland

Don't shoot! gentlemen; I'll come down.

When I said, in reference to a spiral gear, that there "hain't no such animile" I was voicing a conviction like that of the farmer who, on seeing a giraffe for the first time made the statement originally. There obviously was such an "animile" for there it was before him; but it was equally obvious that it had no business to be.

As L. D. Hayes says, on page 232, the dictionaries sanction the use of the word "spiral" as synonymous with helical, but I do not suppose compilers of the dictionaries are any more familiar with machine-shop practice or the engineering science than we are with philology. They were obliged to accept most of their material on hearsay evidence. Surely Mr. Hayes will not deny that the application of the same name to two fundamentally different things can but lead to confusion.

Most engineers, I believe, will agree that a spiral is a curve of constantly increasing radius, and though a spiral may be drawn into a helical form (in which it becomes a conical spiral, a conical helix, a helical spiral, or a spiral helix; the common

exemplification being the well-known "bee hive" spring), it is the fact of the increasing radius and not the linear advance that makes it a spiral.

In the instance quoted by Mr. Hayes of a spiral gear in which "a single tooth extended in an Archimedean spiral slightly more than once around the face of a rotating disk"; was not this more in the nature of a scroll plate? Such a "gear" exists in every scroll chuck, the mating teeth being on the backs of the chuck jaws.

E. M. Long, on page 278, is not very clear as to the shape of the gear that is associated with his "earliest recollections" but from the description of "a crown gear having a single spiral tooth" I should assume it to be the same as the one mentioned by Mr. Hayes in the earlier article. The device used by the Warner Speedometer Co., which had "several such teeth arranged in spiral form" has me guessing. It may be that there is a point where a scroll-plate ceases to be a scroll plate and becomes a "spiral gear." I should like to hear more about it.

Air as a Material of Construction

By Fred B. Corey

We have all heard the story of the irate customer who complained to the grocer, "In that last pound of cheese you sold me there was over half a pound of holes." Ancient as that joke is, many machine designers have yet to learn that in considering the feasibility of any proposed construction, air spaces should be given as much "weight" as the cast iron or steel. While much trouble and expense have been caused in the past by lack of sufficient iron and other stress-resisting materials in our tools and machines, the writer believes that about as much trouble has been due to lack of proper clearances. No one can deny the wonderful advancement that has been made in recent years in the design of machine tools, but many modern designers, with advantage to themselves, could take a leaf from the book of the old-time draftsman and learn to provide clearances ample for the proper care and repair of their creations.

It was many years after the advent of machine tools before the advantages of rigidity of construction were recognized. In those early tools, architectural and artistic effects seemed to be the dominating features of the designs and, naturally, accessibility was easily provided.

When the designers of machine tools came to realize that extreme rigidity was essential to accuracy of production, it followed quite as naturally that accessibility was often ruthlessly and unnecessarily sacrificed.

The incentive to the above remarks was furnished by the following incident. It was necessary to dismantle a tool of a modern and well-known make. Two of the principal members were held together by bolts through interior flanges which were inaccessible without special socket wrenches that were not to be had. By much labor and the use of long cold chisels the job was finally accomplished. A slight modification of the castings would have made the bolts readily accessible without any sacrifice of strength, rigidity, weight or cost, although there might have been a slight loss from an artistic point of view. The writer happens to be acquainted with the designing engineer who was responsible for this particular design. He is a man of great ability who should be given credit for much of the recent progress in his particular line. Lack of accessibility is the only criticism that can be brought against his otherwise masterful designs.

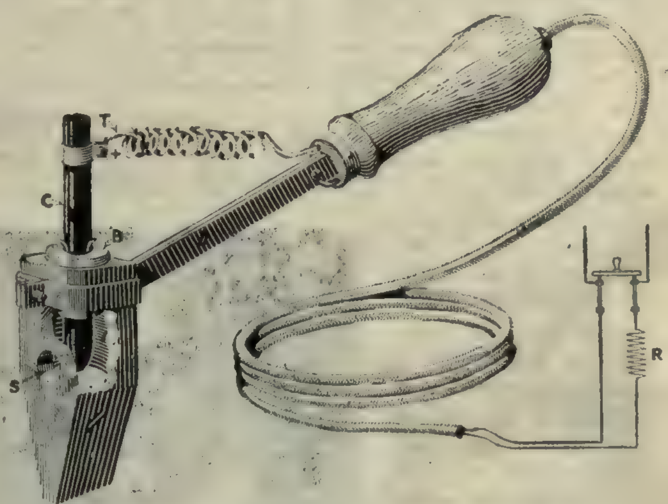
It is suggested that each drafting room be provided with a conspicuous placard reading, "Machines designed in this department must have their parts readily accessible both for proper care and possible repair. Provide ample working clearances at all points." Such a placard might have a beneficial influence on the work in progress.

An Electric-Arc Soldering Iron

By B. A. Briggs

Most electric soldering irons are constructed so that they are heated by the current passing through a resistance coil inclosed in a tube attached to the top of the iron.

The illustration shows an electric soldering iron that is heated by an electric arc in the iron itself. A hole is bored in the center of the iron, having a diameter equal to the outside diameter of the tube of a battery bushing, down to where the iron begins to taper. A standard battery porcelain bushing *B* is placed in the hole and a ⅜-in. arc-lamp carbon *C* is placed in the bushing, and allowed to come down in contact with the



ASSEMBLY OF ELECTRIC-ARC SOLDERING IRON

bottom of the hole, then the carbon is withdrawn about ⅛ in. to establish the arc. The iron should be connected to a 110-volt circuit and resistance enough connected in series to keep the current down to between two and three amperes. About 30 ohms will be sufficient. This resistance may be made of about 600 ft. of No. 18 B. & S. iron wire and connected in the circuit, as at *R* in the figure.

The soldering iron is connected to the circuit with the positive terminal on the carbon, as shown in the illustration at *I*.

The carbon is held in place in the bushing by small metal wedges, and adjustment of the carbon is made by tapping it down to give the desired length of arc.

A second hole *S* is bored at right angles to the first, so as to allow the arc to be cleaned of the nitrate that forms around it.—*Power.*

WHAT *to* READ
—*for the man in a hurry*

Suggested by the Managing Editor

> *Nobody who is holding down a man's job has time to read all of the "American Machinist." On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials—they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.*

THIS week's high spot is the first section of Fred Colvin's piston article. Aimed principally at automotive men, it has a message for the machine-tool builder and user which should not be overlooked. This installment takes up piston-machining methods at the Ford, Cadillac, Chandler and Autocar factories. If you don't believe this automotive stuff of ours is worth while, let us tell you what one big automotive engineer wrote us after reading our cylinder story in the April 1 issue: "After reading . . . the automotive articles . . on the subject of cylinder machining, I felt that if you had nothing else of interest to me in the remaining issues, my five dollars were exceedingly well invested. . . . You are giving something in the way of concrete automotive service that is beyond anything that I might have expected when I invested in a subscription to *American Machinist*."

True to our promise when we printed pictures of Packard and Franklin executives we are following up with two of the men who have made the Cadillac 8 "The Standard of the World."

The gentleman on the left is R. H. Collins, president and general manager of "Pop" Leland's old company. Under his direction, expansion and progress are the order of the day.

At the right is George H. Layng, production manager. Mr. Layng is a thorough-going mechanic with a genius for organization. In the old days he was a machinist at the plant of the Wheelock Engine Co. in Worcester, and also did quite a bit of outside work as an erector. He drifted West some years later and eventually wound up at the old Cadillac factory as a foreman. He soon became general foreman and finally production manager. When the Lelands left to start the Lincoln Motors, Layng went with them and did some valuable organization work, but soon came back to his old connections at Cadillac. Mr. Knowlton's second article on packing of merchandise begins on page 829. You will appreciate the importance of care in the packing room after reading this article.

Engineers and inspectors will want to compare their own testing methods with those used by the Becker Milling Machine Co. as outlined on page 833.

For directors of training, foremen of welding departments and any one else having to do with arc welding, the short course outlined by Mr. Eschholz which begins on page 837 will be unusually valuable. The leading article shows the details of the new Greenlee double-end center-drive lathe. Add one to our list of advance new-tool descriptions. Our Washington correspondent has just sent us the list of salary increases recommended by a joint Congressional committee. See page 855.

Last call! Page 849. Get your postals to show where you stand on compulsory metric legislation.

Latest Advices from Our Washington Correspondent

AFTER the most thorough investigation ever made of salary classification in the Government service, a joint Congressional committee has submitted to Congress a detailed report recommending substantial increases in pay for nearly every class of Government worker. Salaries for technical service were found to be strikingly out of line with those paid in private employment. Senator Jones of New Mexico, chairman of the committee, commented on the report as follows:

"Generally speaking, the lower clerical services and lower grades of other services have been remunerated reasonably well. They have received, perhaps, more than is paid for similar service in private employment. In the technical branches of the service, however, the pay has been grossly inadequate. It has not been comparable at all with the salaries paid for the same service in private employment.

"Our report will show that there was a crying necessity for this work. The personnel in the Government service is being employed and the work is being conducted without reference to any system. There is little to prompt efficiency and literally nothing to insure a maintenance of effort. To my mind one of the most important features of the report is that part which contemplates increased pay for increased efficiency and decrease in pay when there is a decrease in efficiency. If this can be put into practice I believe it will enable the work of the Government to be carried on more effectively with fewer employees. It will remove injustice and will increase the morale in the Government service."

Standardization of compensation and classification for mechanical engineering, automotive engineering, ordnance engineering and for machinist work are recommended by the committee as follows:

MECHANICAL ENGINEERING.

(An asterisk in space under "Compensation for Class" indicates that the rate of compensation for each position in such class shall be recommended to Congress by the Civil Service Commission after consultation with heads of departments or independent establishments concerned. The recommendation shall be based upon a full appraisal of the duties and responsibilities of the position and its relation to positions in similar classes; the rate of compensation in such case to be determined by Congress.)

Title of Class:

MECHANICAL ENGINEERING AID

Specifications of Class

Duties:

To perform, under immediate supervision, minor technical work in an organization engaged in mechanical engineering; and to perform related work as required.

Examples: Recording data in laboratory or field; assisting engineers in making tests on pumps, engines, or boilers; making tracings and simple drawings.

Qualifications:

Training equivalent to that represented by graduation from high school; not less than two years' experience in engineering work; familiarity with the use of the slide rule; ability to do lettering and drafting and to make simple computations.

Principal Lines of Promotion

From: Junior Engineering Aid.
To: Junior Mechanical Engineer.

Compensation for Class

Annual: $1200–$1320–$1440–$1560–$1680–$1800

Title of Class:

MECHANICAL ENGINEERING DRAFTSMAN

Specifications of Class

Duties:

To perform, under immediate supervision, routine drafting work in connection with the preparation of plans for mechanical engineering projects; and to perform related work as required.

Examples: Making tracings from original drawings; making drawings of minor importance; filing and indexing drawings; lettering; computing, revising tracings.

Qualifications:

Training equivalent to that represented by graduation from high school; not less than two years' successful experience in engineering drafting work; ability to letter and to make simple calculations.

Principal Lines of Promotion

From: Copyist Draftsman.
To: Junior Mechanical Engineer.

Compensation for Class

Annual: $1200–$1320–$1440–$1560–$1680–$1800

Title of Class:

JUNIOR MECHANICAL ENGINEER

Specifications of Class

Duties:

Under immediate supervision, to do routine drafting, computing, testing, and other engineering work; and to perform related work as required.

Examples: Carrying out routine tests, recording data, and writing reports on tests of boilers, engines, heating and ventilating systems, vacuum systems, hydraulic machinery, or pumps; assisting in making tests on structural materials, such as steel, wood, concrete, or stone; designing simple apparatus and instruments; making detail drawings and computations for mechanical equipment, ordnance, or gas engines.

Qualifications:

Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in mechanical engineering.

Principal Lines of Promotion

From: Mechanical Engineering Aid; Mechanical Engineering Draftsman.
To: Assistant Mechanical Engineer.

Compensation for Class

Annual: $1800–$1920–$2040–$2160

Title of Class:

ASSISTANT MECHANICAL ENGINEER

Specifications of Class

Duties:

Under specific administrative and technical direction, to be responsible for the conduct of the work of a minor subdivision of a mechanical engineering organization; to collect and compile data for specific items of mechanical engineering studies; to take immediate charge of field survey projects in, or the design, inspection, or construction of minor engineering work; to lay out and develop work from specifications, and to supervise the work of a drafting or computing force; to conduct specific tests or investigations of apparatus, material, or processes; and to perform related work as required.

Examples: Planning and carrying on tests on boilers, engines, or other mechanical equipment of buildings; making tests on structural materials, such as steel, wood or concrete; laying out heating and ventilating equipment, or conveying and elevating machinery; carrying on research on engineering instruments and methods of test; preparing instruction pamphlets; designing machinery and special apparatus; making tests on internal combustion engines; laying out and developing designs for shells, depth charges, gun mounts, fire control instruments, fuses, grenades, mortars, breech mechanisms, automatic and service rifles, tractors and tanks.

Qualifications:

Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in mechanical engineering; not less than two years' engineering experience in office, shop, or field; proven technical and scientific knowledge and proficiency.

Principal Lines of Promotion

From: Junior Mechanical Engineer.
To: Associate Mechanical Engineer; Associate Ordnance Engineer.

Compensation for Class

Annual: $2400–$2520–$2640–$2760–$2880–3000

Title of Class:

ASSOCIATE MECHANICAL ENGINEER

Specifications of Class

Duties:

To perform one or more of the following functions under general administrative and technical direction:—(1) To be in responsible charge of an intermediate subdivision of a mechanical engineering organization; (2) to exercise independent engineering judgment and assume responsibilities in studies and computations necessary for the preparation of reports, estimates, designs, or valuations; (3) to have immediate charge of the construction maintenance, or operation of important mechanical engineering works or projects; (4) to direct or to perform research in mechanical engineering lines; and to perform other related work.

Examples: Planning and supervising tests on mechanical equipment of buildings; designing heating, ventilation, piping and conveying systems, and writing specifications for such systems; directing a staff for the operation of plant equipment; checking plans and specifications; planning and carrying on research in the mechanics of materials; designing test apparatus and standardizing testing methods; supervising aircraft engine tests; preparing industrial safety codes; designing apparatus and machines.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in mechanical engineering; not less than five years' engineering experience, of which at least one year shall have been in the direction or performance of important mechanical engineering work; supervisory or administrative ability, or a high degree of technical skill.

Principal Lines of Promotion
From: Assistant Mechanical Engineer.
To: Mechanical Engineer.

Compensation for Class
Annual: \$3240–\$3360–\$3480–\$3600–\$3720–\$3840

Title of Class:
MECHANICAL ENGINEER
Specifications of Class

Duties:
To perform one or more of the following functions under general administrative direction:—(1) to have responsible charge of, and to initiate or execute policies for a major subdivision of a mechanical engineering organization; (2) to prepare for final executive action, reports, estimates, designs, and specifications; (3) to have charge of the construction, inspection, maintenance, and operation of mechanical engineering works of major importance; (4) to direct or to perform major lines of mechanical engineering research; (5) to furnish for executive action, expert or critical advice on mechanical engineering works, projects, or policies;—and to perform other related work.
Examples: Having responsible charge of the design of steam-power plants, pumping, refrigerating, or heating and ventilating equipment; supervising the installation, operation, and repair of mechanical equipment of large buildings and other mechanical projects; supervising rural engineering projects; having responsible charge of research in mechanical engineering laboratories; supervising aircraft power-plant investigations; supervising fuel purchases and making fuel investigations.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in mechanical engineering; not less than eight years' engineering experienc, of which at last four years shall have been in the direction or performance of important mechanical engineering work; and proven administrative and technical ability.

Principal Lines of Promotion
From: Associate Mechanical Engineer.
To: Senior Mechanical Engineer.

Compensation for Class
Annual: \$4140–\$4320–\$4500–\$4680–\$4860–\$5040

Title of Class:
SENIOR MECHANICAL ENGINEER
Specifications of Class

Duties:
To perform one or more of the following functions:—(1) to have chief administrative charge of a mechanical engineering organization or of a main division thereof, and to determine or execute general policies under the limitations imposed by law, regulations or other fixed requirements; (2) to be responsible for reports, estimates, designs, and specifications, or for the construction, maintenance, or operation of large mechanical engineering projects; (3) to have full charge of the collection and presentation of data for, and the conduct of valuation proceedings; (4) to direct or to perform the most comprehensive research in mechanical engineering; (5) to act as consulting specialist on important mechanical engineering projects, policies, or valuations; and to perform other related work.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, perferably in mechanical engineering; and not less than twelve years' engineering experience, of which at least eight shall have been in the direction or performance of important mechanical engineering work of a character to give substantial evidence of engineering knowledge and ability, or of executive capacity, of the highest order.

Principal Lines of Promotion
From: Mechanical Engineer; Ordnance Engineer.

Compensation for Class
★ See note at beginning of this list.

AUTOMOTIVE ENGINEERING.

Title of Class:
AUTOMOTIVE TRACER
Specifications of Class

Duties:
Under immediate supervision, to make tracings from original drawings prepared by others; to perform miscellaneous routine work in the drafting room; and to perform other related work as required.
Examples: Making simple tracings; copying data; filing and indexing under supervision; lettering; making simple drawings and diagrams; making hand corrections on printed charts.

Qualifications:
Training equivalent to that represented by graduation from high school; not less than two years' experience in engineering drafting work; knowledge of the use of drawing instruments, and ability to use them neatly.

Principal Lines of Promotion
From: Copyist Draftsman.
To: Automotive Draftsman.

Compensation for Class
Annual: \$1200–\$1320–\$1440–\$1560–\$1680–1800

Title of Class:
AUTOMOTIVE DRAFTSMAN
Specifications of Class

Duties:
To perform, under immediate supervision, routine drafting work in connection with the preparation of plans for automotive engineering projects; and to perform related work as required.
Examples: Making tracings from original drawings; making drawings of minor importance; filing and indexing drawings; lettering; computing; revising tracings; carrying on routine tests; recording data, and writing reports on tests of different assemblies of automotive vehicles, including engine, transmission, chassis, and rear axles.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in automotive engineering.

Principal Lines of Promotion
From: Automotive Tracer.
To: Automotive Designer.

Compensation for Class
Annual: \$1800–\$1920–\$2040–\$2160

Title of Class:
AUTOMOTIVE DESIGNER
Specifications of Class

Duties:
To perform one or more of the following functions under specific administrative and technical direction: (1) to be responsible for the conduct of the work of a minor subdivision of an automotive engineering organization; (2) to collect and compile data for specific items of engineering studies; (3) to take immediate charge of the design, inspection, or construction of minor automotive engineering work; (4) to lay out and develop work from specifications, and to supervise the work of a drafting or computing force; (5) to conduct specific tests or investigations of apparatus, material, or processes;—and to perform related work as required.
Examples: Planning and carrying on tests on internal combustion engines, transmissions, clutches, rear axles, or other parts of automatic apparatus; making tests on materials which compose such assemblies; laying out the general design of such units.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in automotive engineering; not less than two years' experience in automotive engineering work in office, shop, or field; proven technical knowledge and proficiency.

Principal Lines of Promotion
From: Automotive Draftsman.
To: Senior Automotive Designer.

Compensation for Class
Annual: \$2400–\$2520–\$2640–\$2760–\$2880–\$3000

Title of Class:
SENIOR AUTOMOTIVE DESIGNER
Specifications of Class

Duties:
To perform one or more of the following functions under general administrative and technical direction: (1) to be in responsible charge of an intermediate subdivision of an automotive engineering organization; (2) to exercise independent engineering judgment and assume responsibilities in studies and computations necessary for the preparation of reports, estimates, or designs; (3) to have immediate charge of the construction, maintenance, or operation of important automotive engineering works or projects; (4) to conduct or to direct important lines of engineering research; to perform other related work.
Examples: Preparing instructive pamphlets; designing special apparatus for testing; laying out general designs of parts of automotive equipment; designing and detailing motor cars; carrying on research work on instruments and methods of test.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in automotive engineering; not less than five years' engineering experience, of which at least one year shall have been in the direction or performance of important automotive engineering work; supervisory or administrative ability or a high degree of technical skill.

Principal Lines of Promotion
From: Automotive Designer.
To: Automotive Engineer.

Compensation for Class
Annual: \$3240–\$3360–\$3480–\$3600–\$3720–\$3840

Title of Class:
AUTOMOTIVE ENGINEER
Specifications of Class

Duties:
To perform one or more of the following functions under general administrative direction: (1) to have responsible charge of, and to initiate or execute policies for a major subdivision of an automotive engineering organization; (2) to prepare for final executive action, reports, estimates, specifications, designs, and data; (3) to have charge of the construction, inspection, maintenance, and operation of automotive engineering works of major importance; (4) to direct or to perform major lines of automotive engineering research; (5) to furnish for executive action, expert or critical advice on automotive engineering work, policies, or projects;—and to perform other related work.
Examples: Exercising responsibility for the proper execution or development of plans and specifications, calculation and estimates of cost for motor cars, trucks, motor cycles, trailers, tractors, tanks, and other forms of automotive apparatus; supervising the manufacturing and testing of experimental automotive models, and the inspection of automotive material and manufacture; handling technical correspondence; supervising the designing and detailing of motor cars, or other forms of automotive apparatus; estimating costs and checking specifications, contracts, and purchase orders.

Qualifications:
Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in automotive engineering; not less than eight years' engineering experience, of which at least four years shall have been in the direction or performance of important automotive engineering work; proven administrative and technical ability.

Principal Lines of Promotion
From: Senior Automotive Designer.
To: Senior Automotive Engineer.

Compensation for Class

Annual: $4140–$4320–$4500–$4680–$4860–$5040

Title of Class:

SENIOR AUTOMOTIVE ENGINEER

Specifications of Class

Duties:

To perform one or more of the following functions: (1) to have chief administrative charge of an automotive engineering organization, or of a main division thereof, and to determine or execute general policies under the limitations imposed by laws, regulations, or other fixed requirements; (2) to be responsible for reports, estimates, designs, specifications, and data, or for the construction, maintenance, and operation of large automotive engineering projects; (3) to direct or to perform the most comprehensive lines of automotive engineering research or design; (4) to act as consulting specialist on important automotive engineering policies, projects, or valuations;—and to perform other related work.

Qualifications:

Training equivalent to that represented by graduation with a degree from an institution of recognized standing with major work in engineering, preferably in automotive engineering; and not less than 12 years' engineering experience, of which at least 8 years shall have been in the direction or performance of important automotive engineering work of a character to give substantial evidence of engineering knowledge and ability, or of executive capacity of the highest order.

Principal Lines of Promotion

From: Automotive Engineer.

Compensation for Class

* See note at the beginning of this list.

ORDNANCE ENGINEERING

Title of Class:

ASSOCIATE ORDNANCE ENGINEER

Specifications of Class

Duties:

To perform one or more of the following functions under general administrative and technical direction: (1) to be in responsible charge of an intermediate subdivision of an ordnance engineering organization; (2) to exercise independent engineering judgment and assume responsibilities in studies and computations necessary for the preparation of reports, estimates, and designs; (3) to have immediate charge of the construction, maintenance or operation of important ordnance engineering works or designs; (4) to direct or to perform important engineering research and designs; and to perform other related work.

Examples: Designing gun carriages, "caterpillar" artillery, cannon, ammunition, mines, or torpedoes; supervising the making of complete working drawings and details for such work; writing specifications; checking specifications, contracts, and purchase orders; inspecting ordnance materials and construction; handling of technical correspondence.

Qualifications:

Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in mechanical engineering; five years' experience in mechanical engineering, at least one year of which shall have been in responsible ordnance work; ability to perform the highest grade of ordnance drafting; and proven supervisory ability.

Principal Lines of Promotion

From: Assistant Mechanical Engineer.
To: Ordnance Engineer.

Compensation for Class

Annual: $3240–$3360–$3480–$3600–$3720–$3840

Title of Class:

ORDNANCE ENGINEER

Specifications of Class

Duties:

To perform one or more of the following functions: (1) Under general administrative direction, to have responsible charge of and to initiate or execute policies for a major subdivision of an ordnance engineering organization; (2) to prepare for final executive action, reports, estimates, specifications and designs, and data; (3) to have charge of the construction, inspection, maintenance and operation of ordnance engineering projects or designs of major importance; (4) to direct or perform major lines of ordnance engineering research; (5) to furnish for executive action expert or critical advice on ordnance engineering works, projects or policies;—and to perform other related work.

Examples: Exercising responsibility for the proper execution of plans and specifications, calculation and estimate of cost of gun-carriages, cannon, ammunition, mines, or torpedoes, supervising the manufacture and testing of experimental ordnance models, and the inspection of ordnance materials and construction; handling technical correspondence; carrying on personnel work and office management.

Qualifications:

Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in mechanical engineering; not less than eight years' engineering experience, of which at least four years shall have been in the direction or performanc of important ordnance work; and proven administrative and technical ability.

Principal Lines of Promotion

From: Associate Ordnance Engineer.
To: Senior Mechanical Engineer.

Compensation for Class

Annual: $4140–$4320–$4500–$4680–$4860–$5040

Title of Class:

GENERAL MACHINIST

Specifications of Class

Duties:

To perform general machinist's work, involving the construction, assembling, installation, and repair of machinery of all classes; to do bench work, and machine or hand tool work; and to perform related work as required.

Qualifications:

Common-school education; not less than four years' experience as an Apprentice Machinist, or at least four years' experience in any branch of the machinist's trade; knowledge of spur gear cutting, planing, shaping, sizing, boring, punching, chipping, filing, tapping, reaming, and key seating, ability to use calipers, micrometers, and gages; ability to read blue prints; ingenuity and physical strength.

Principal Lines of Promotion

From: Apprentice Machinist.
To: Foreman Machinist.

Compensation for Class

Hourly: $0.80

Title of Class:

AUTOMOBILE MACHINIST

Specifications of Class

Duties:

Under supervision, to assemble, set up, maintain and repair all makes of passenger automobile trucks, tractors, tanks, or other automotive vehicles; and to perform related work as required.

Qualifications:

Common-school education; and experience as a machinist, at least two years of which must have been in assembling or repairing automotive vehicles; and physical strength.

Principal Lines of promotion

From: Apprentice Machinist.
To: Foreman Machinist.

Compensation for Class

Hourly $0.80

Title of Class:

PRINTING OFFICE MACHINIST

Specifications of Class

Duties:

Under supervision, to erect, maintain, repair, and be responsible for the mechanical condition of presses of all classes, binding machinery, drying machines, and other machinery used in the printing trades; and to perform related work as required.

Qualifications:

Common-school education; not less than two years' experience as a machinist, preferably on printing office machinery, or an apprenticeship in work with such machinery; ability to make and read drawings; broad knowledge of printing office machinery; and physical strength.

Principal Lines of Promotion

From: Apprentice Machinist.
To: Foreman Machinist.

Compensation for Class

Hourly: $1.00

Title of Class:

FOREMAN MACHINIST

Specifications of Class

Duties:

Under general direction, to supervise and direct the work of General Machinists, Apprentice Machinists, Helpers, and laborers employed in shops or on outside work in the machinist or related trades; and to perform the work of a General Machinist and other related work as required.

Qualifications:

Common-school education; not less than three years' experience as a General Machinist, or in work of equivalent character and standard; and ability to plan, lay out, direct, and supervise work.

Principal Lines of Promotion

From: General Machinist; Printing Office Machinist, Automobile Machinist.
To: Shop Superintendent; Chief Machinist.

Compensation for Class

Annual: $2400–$2700

Another Resolution Against Compulsory Metric System

BY THE NATIONAL ASSOCIATION OF MANUFACTURERS

WHEREAS, the agitation for the adoption of the metric system, has been again revived and is being vigorously conducted, and,

WHEREAS, the British Committee on Commercial and Industrial Policy after the War has made an exhaustive analysis of this question and concludes in language as follows:

"We are not convinced that the metric system is upon the whole even theoretically superior to the British system, and we are satisfied that the practical objections to the proposed change are such as to outweigh decisively any advantages which are claimed for it."

THEREFORE, Be it resolved, that we regard the agitation for the establishment of the metric system as particularly untimely because of war taxation on manufacture, and because under present conditions the overwhelming activity of manufacturers in war work makes proper consideration of such a subject impossible.

It is further resolved, that we endorse the work of the American Institute of Weights and Measures in opposing the adoption of the metric system.

Title of Class:
CHIEF MACHINIST
Specifications of Class
Duties:
Under general direction, to plan, lay out, and devise machinery and equipment for general or special purposes; to direct and supervise the installation of machinery and the work of Foremen Machinists, General Machinists, Apprentice Machinists, and Laborers, engaged on such work; to have general oversight and direction of shop and field forces; and to perform related work.
Qualifications:
Training equivalent to that represented by graduation from a technical high school; not less than two years' experience as a foreman of a shop or field force; supervisory ability.
Principal Lines of Promotion
From: Foreman Machinist.
To: Mechanical Engineer.
Compensation for Class
Annual: $2700–$3600

Title of Class:
SHOP SUPERINTENDENT
Specifications of Class
Duties:
Under general direction, to plan and direct the work of one or more trades in the mechanical shops of a department or bureau; to perform other related work.
Qualifications:
Training equivalent to that represented by graduation from a technical high school; general knowledge of the skilled trades; ability to plan, direct, and supervise the work of the different trades; ability to devise, design, and develop from rough sketches or oral instructions, special or unusual instruments, apparatus, furniture, or appliances; supervisory ability and good address.
Principal Lines of Promotion
From: Foreman Carpenter; Foreman Plumber; Foreman Steamfitter; Foreman Painter; Foreman Tinsmith and Sheet-Metal Worker; Foreman Machinist; Foreman Instrument Maker; Foreman Electrician; Foreman Blacksmith; Foreman Optician; Foreman Glass Blower; Foreman Glass Foundryman; Superintendent Textile Mill; Foreman Pattern Maker; Foreman Wheelwright.
To: Engineering Service.
Compensation for Class
Annual: $2700

MACHINIST WORK.

Title of Class:
APPRENTICE MACHINIST
Specifications of Class
Duties:
Under the immediate supervision of a Foreman or a General Machinist, to perform such machinist's work as may be assigned; to receive instructions in the fundamentals of the trade; and to perform related work as required.
Qualifications:
Common-school education; age between 16 and 21; preferably some knowledge of mechanical drawing; aptitude for the trade; willingness to learn and good physical condition.
Principal Lines of Promotion
To: Machinist; Printing Office Machinist; Automobile Machinist.
Compensation for Class

Observations of a Field Editor

IF MACHINE-TOOL straws indicate the way the wind blows, there seems to be every likelihood of general business continuing good throughout the year at least. Few dealers have any stock on hand and orders are so frequent in many lines that machines hardly have time to reach the showroom floor.

Reports of business in the Syracuse district are encouraging because, for one thing, the demand is not all in one line. This is almost an automobile-gear city with the Brown-Lipe Co. making transmissions, the Brown-Lipe-Chapin Co. making differentials, the New Process plant, now a part of the Willys-Overland Co., and the Weeks-Hoffman Co. also doing automobile work. This does not include the Meachem Gear Corporation which handles general gear work exclusively.

The machine-tool demand, however, is not confined to the larger shops or to the automobile industry but is very well scattered. New and well-equipped jobbing shops are springing up, vocational schools are being equipped in the smaller cities and the demand is generally pretty well scattered, which is a good sign.

Some of the larger shops are increasing their capacity by the erection of new buildings. This is noticeably true of the Franklin and Brown-Lipe-Chapin companies. Orders for machinery equipment for these additions are said to have been placed long ago, so that they have no influence on the present demand.

This demand, according to one especially reliable source, changes as to the kind of machines wanted, without much apparent reason. For example, there has been a large call for power hacksaws so that the first two months of 1920 exceed all of last year. Automatic screw machines had their inning a few months ago and orders then placed put deliveries off into 1921 in some cases. Just now small vertical drills, usually of more than one spindle, indicate that the demand here is for manufacturing rather than jobbing shops.

Woodworking machines, too, are in great demand at present and, though many are loath to class these as machine tools, it is not logical to draw the line against them. The old contention that the class of workmanship was inferior does not hold with some of our more modern woodworking machines. And when we find buzz planers used in surfacing aluminum castings, as I have in two different shops in different parts of the country, it is a bit difficult to draw the line. But no matter how we classify them, they are being bought in goodly numbers, which is a good sign.

The machinery dealer, however, cannot tell the whole story of machine-tool or machine-shop activities, as many of the large builders, particularly of special lines of machinery, are selling direct to consumers, either through travelers or branch offices. This is also true of special shop equipment such as metal-washing machines and the like.

* * *

It would not be natural to be in Syracuse without stopping a moment at least in the Straight Line Engine Shop. For even though our old friend Professor Sweet is no longer there, a splendid portrait of him hangs in the office and "Visitors Always Welcome" is still over the door. Inside Messrs. Chambers and Thomas radiate the same welcoming spirit as before.

Just how much this spirit would cool down if you tried to sell them on the idea of the compulsory use of the metric system, is hard to say. For their experience dates back many years to the time when they built the machinery for the Solvay plant from Belgian drawings. But the memory of their troubles still lingers and they are not at all anxious to repeat. They haven't the slightest objection to anyone who desires to use the metric units to do so, but they consider it a sign of weakness as to its merit, when it must be forced by compulsory legislation.

Metal Trades Activities in Cleveland

On March 23 at the Hollenden Hotel the annual meeting of the Cleveland branch of the National Metal Trades Association was held. L. H. Kittridge, president of the Peerless Motor Car Co., was toastmaster at the banquet, and Harry Atwood, an author from Chicago, was the principal speaker. Mr. Atwood spoke on, "Our Constitution the Antidote for Bolshevism." H. M. Rice, of the General Motors Corporation, Detroit, discussed the recent industrial conferences at Washington and H. D. Sayre, secretary of the National Metal Trades Association, talked on the activities of that organization.

The officers of last year were re-elected. They are A. W. Foote, of the Foote-Burte Co., president; W. D. Bartlett, of the Steel Products Co., vice president, and J. D. Cox of the Cleveland Twist Drill Co., treasurer.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Sullivan Portable Air Compressor

The portable compressor outfit here illustrated is made by the Sullivan Machinery Co., Chicago, Ill., and its construction is based on the company's experience with similar outfits.

It is known as the Class WK 31 compressor, and includes a specially designed two-cylinder, vertical air compressor, driven by a Buda four-cylinder, four-cycle, heavy-duty tractor gasolene engine.

The compressor and engine with the vertical air receiver, the gasolene supply tank, radiator and fan are all mounted on a truck body made up of heavy channel irons, strongly braced. The truck body is mounted on heavy steel wheels, or if desired, can be mounted on a flat car. The outfit is protected from the weather by a steel canopy top and canvas curtains.

The compressor has a displacement of 150 cu.ft. of free air per minute, and requires 32 hp. for operation against 100 lb. pressure. The air is admitted and discharged from the cylinder by means of wafer valves designed to give a wide port opening with small clearance loss.

The compressor is cooled by an open hopper jacket into which water can be poured from a bucket or through a hose.

Power economy is effected by an unloading device and pilot valve, connected with the air receiver, which raises the inlet valves from their seats when the demand for air temporarily ceases. Lubrication is secured by a force-feed oil pump inclosed in the crankcase and delivering oil under pressure to all bearings. Baffles and wiper rings on the piston prevent an excess of oil from working up past the piston and collecting on the valve and seats.

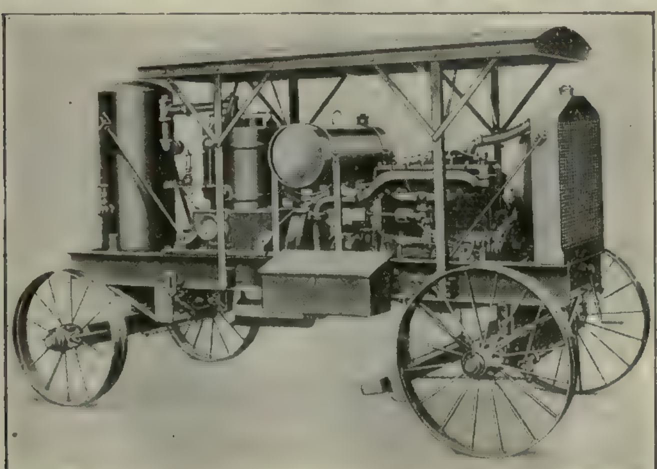
The drive is by gear and pinion. A heavy flywheel with internally cut teeth is engaged by a pinion on the engine shaft.

A disk clutch on the pinion shaft is thrown out when starting until the engine is up to speed.

The engine cylinders are cast "en bloc" with removable head and all working parts are inclosed by means of a movable covering. The camshaft is hardened and ground. The crankshaft is supported on three bearings, consisting of removable bronze shells which are lined with babbitt.

The accessories, such as the magneto, impulse starter, carburetor, speed governor, starting switch, spark control, and hand throttle are all of the automobile type.

The gasolene supply tank will hold 23 gal., which is sufficient for a day's run.



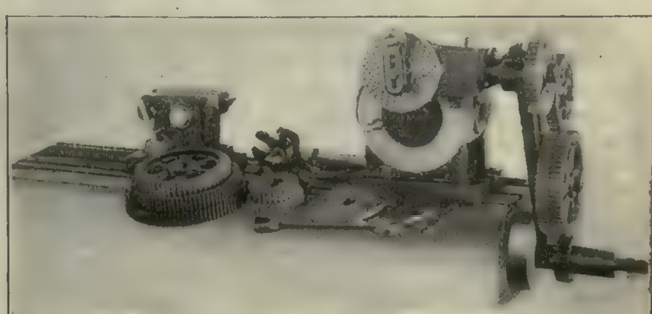
SULLIVAN PORTABLE AIR COMPRESSOR

Simmons Universal Dividing Head

A universal dividing head of improved design is being manufactured by the Simmons Machine Co., Inc., Albany, N. Y.

The new model shown in the illustration, in addition to having refinements of a minor character, is equipped with a spiral attachment. It is made to fit any milling machine, and has a 10-in. swing. The spindle has a No. 10 B. & S. taper hole, is provided with adjustment for wear, and can be firmly locked during the cutting operation, thus relieving the gearing, etc., from strain.

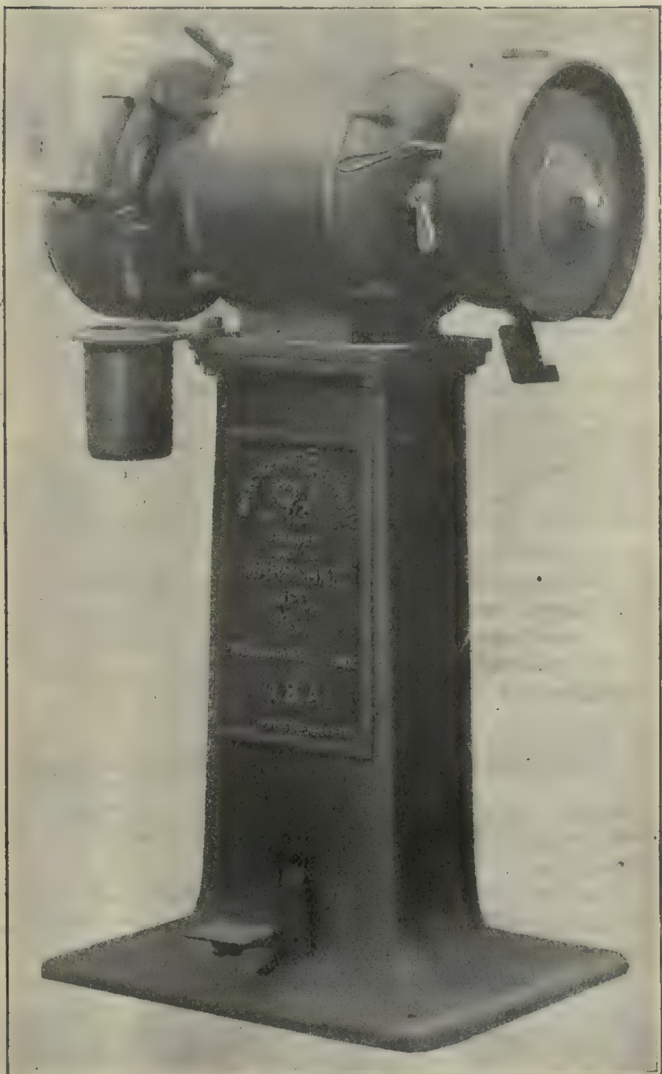
The head is graduated and can be adjusted to any angle from 10 deg. below horizontal to 10 deg. beyond perpendicular, and is provided with substantial clamping means. The worm gearing is built to resist wear and has a take-up adjustment. The equipment includes three index plates, four ⅝-in. bolts, and a malleable iron driving dog.



SIMMONS UNIVERSAL DIVIDING HEAD

Marschke "Economy" Motor-Driven Grinding Machine

The Marschke Manufacturing Co., Indianapolis, Ind., has brought out the motor-driven grinding machine shown in the illustration. The starting mechanism for the motor is placed inside the column and is controlled



MARSCHKE "ECONOMY" GRINDING MACHINE
Specifications: Wheel, 12 in. in dia., 2 in. face; motor, a.c., 3 hp., d.c. 2 hp.; length of arbor, 26 in., diameter of arbor, a.c., $1\frac{1}{4}$ in., d.c. 1 in.; center of arbor to floor, 39 in.; size of base on floor, 20 x 23 in.; weight a.c. type 575 lb., d.c. type, 550 lb.

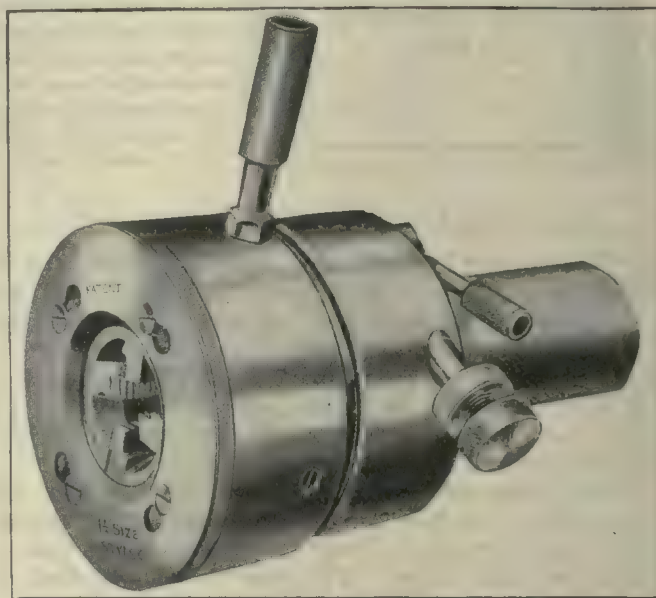
by a foot-treadle in front of the base. This treadle can be locked in running position until released by the operator or will work automatically to stop the motor when the foot pressure is released.

The wheel guards can be set in various positions for grinding a variety of work and the illustration shows the guards on the two wheels in different positions. A feature of the design is the ease with which the motor armature may be removed if necessary.

Coventry Self-Opening Die Head

Alfred Herbert, Ltd., Coventry, England, with branch offices at 54 Dey St., New York City, has introduced in this country a die head of the type shown.

The dies, which are made of high-speed steel, are cut by a milling cutter. The form of the die is such that a keen cutting edge is obtained at the front, with a non-cutting guiding portion farther back, acting like a guide nut. The cutting angle is such as to require only the minimum amount of power and large diameters can be threaded without over-stressing the material. The straight-cut dies can all be ground at the same operation, and to definite angles without requiring any

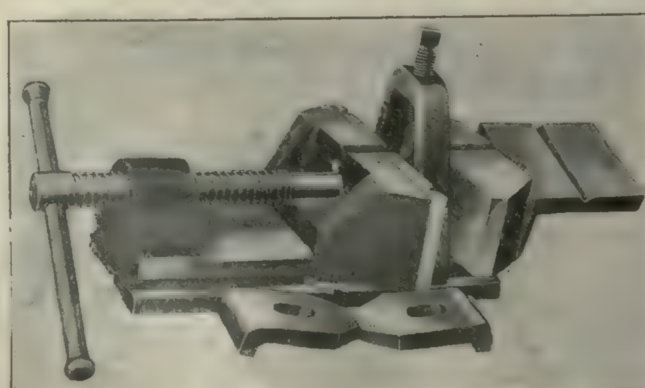


COVENTRY SELF-OPENING DIE HEAD

special skill or experience, as a grinding fixture is provided for that purpose. The die head will cut right or left hand threads equally well and can be used on screw machines. It is made in seven sizes with capacities ranging from $\frac{5}{16}$ to 3 in. diameters. The dies may be adjusted to cut above and below the standard size.

Germanow-Simon Combination Vise

The Germanow-Simon Machine Works, Rochester, N. Y., has introduced the G-S machine vise as illustrated. It is built to afford ample strength and durability. The base is a solid casting with two $\frac{5}{8}$-in. slots planed in the bottom. The jaws extend at both sides of the base and are faced with removable case-hardened steel plates; the slidable jaw is provided with vertical and horizontal V-grooves for holding the work. The other jaw is arranged to swivel and is held by



G-S COMBINATION VISE
Specifications.—Sizes Nos. 1 and 2. Opening of jaws, 5 in., 7 in.; height of jaws, $2\frac{1}{2}$ in., 3 in.: width of jaws, 8 in., $9\frac{1}{2}$ in.; width of bases, $6\frac{1}{2}$ in., $7\frac{1}{2}$ in.; capacity of clamps, 2 in., $3\frac{1}{2}$ in.; net weights, 75 lb., 106 lb.

a single nut. The V-groove across the top of the jaws, when used with the steel clamp shown, serves a useful purpose as it takes the place of V-blocks, bolts and clamps and permits the rapid handling of duplicate work. Two special fastening clamps are furnished with each vise. The vise is made in two sizes.

Ryerson-Conradson Selective-Head Lathes

Joseph T. Ryerson & Son., Chicago, Ill., is announcing its line of Ryerson-Conradson selective-head lathes which are built by the Conradson Machine Tool Co. These machines are made in five different sizes and with lengths of beds to suit the requirements of the user.

Either single-pulley or direct-reversing motor drive can be provided, the first being shown in Fig. 1 and the latter in Fig. 2. The change from one drive to the other can readily be made at any time. The machines can be furnished with or without spindle reversing attachment with the belt-drive type, and also with the motor-drive when a reversing motor is not desired. Practically all control of the machine is centralized in the apron.

Heavy box type of construction is used for the bed. The ways are of unusual design with their guiding surfaces inclined 15 deg. from the perpendicular and their supporting surfaces 15 deg. from the horizontal. The headstock is cast integral with the bed, and a portion of the latter serves as an oil reservoir for splash lubrication of the gears. The spindle is made from an alloy-steel forging and is provided with both ball thrust and an adjustable thrust bearing to take up end motion.

For belt-drive the pulley is mounted on ball bearings which are carried on a stud, thus relieving the shaft from the belt pull. The gearing of the reversing mechanism is of the planetary type, but this is omitted from the reversing motor-drive machines.

Twelve spindle speeds are obtainable through change and back gears controlled by two levers which can be shifted while the lathe is in operation. The handwheel and lever on the front of the headstock, when turned to the desired feed-rate indicated, automatically select the desired feed. Two sets of cone gears provide twenty-eight feeds, and provision is made for transposing and compounding gears, thus permitting the cutting of almost any desired lead of thread.

The longitudinal and cross feeds are operated through independent sets of worm gears which are driven by large friction cones.

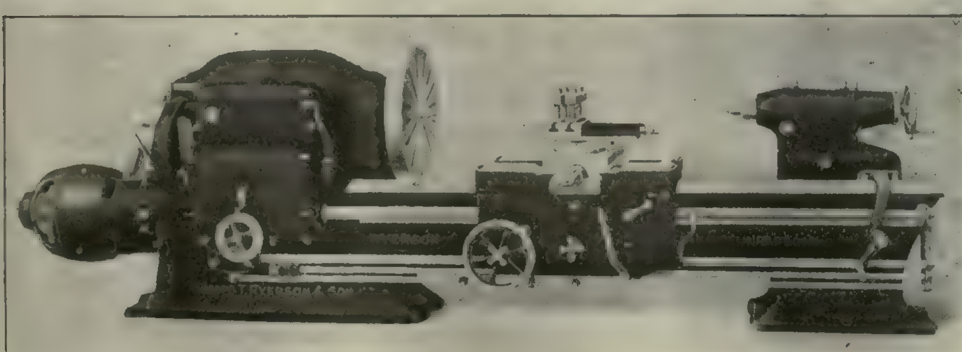


FIG. 1. RYERSON-CONRADSON MOTOR-DRIVE ENGINE LATHE
Built in five sizes, 15, 18, 22, 27 and 33 in. swing.

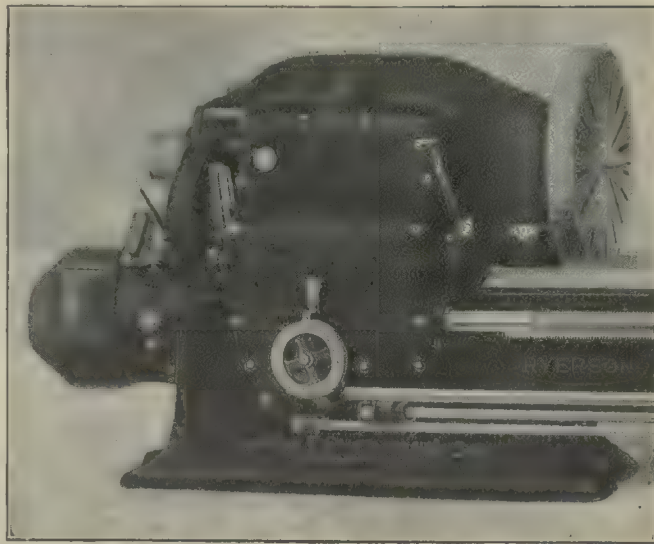


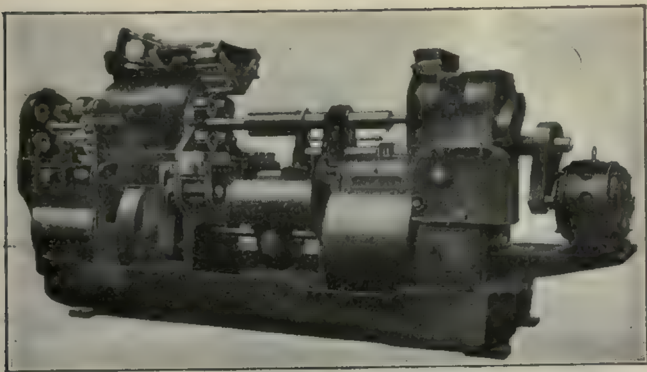
FIG. 2. LATHE FITTED WITH BELT DRIVE

Specifications:

	22 ft. x 10 in.	27 ft. x 12 in.
Swing over bed	$25\frac{1}{2}$ in.	$31\frac{1}{2}$ in.
Swing over carriage	$20\frac{1}{2}$ in.	$24\frac{1}{2}$ in.
Distance between centers	5 ft. 1 in.	5 ft. 8 in.
Front spindle bearing	$5\frac{1}{4}$ x 8 in.	$6\frac{3}{4}$ x 10 in.
Hole through spindle	$3\frac{1}{8}$ in.	$4\frac{1}{4}$ in.
Taper of spindle (center held in collet)	No. 14 Jarno	No. 20 Jarno
Diameter of threaded nose	$4\frac{3}{4}$ in.	$6\frac{1}{2}$ in.
Number of spindle speeds	12	12
Range of spindle speeds	10—222 r.p.m.	10—222 r.p.m.
Number of feed changes	28	28
Range of threads cut on standard lathe	2—28	2—28
Diameter of tail stock spindle	$2\frac{13}{16}$ in.	$4\frac{3}{16}$ in.
Speed of main drive shaft	900 r.p.m.	900 r.p.m.
Hp. required	5	10
Floor space	153 x $51\frac{1}{4}$ in.	193 x 69 in.
Extreme hight	$53\frac{3}{4}$ in.	61 in.
Net weight	7,000 lb.	12,500 lb.

Acme Multiple Spindle Screw Machine

Four-spindle screw machines with a capacity for bar work up to 3 and 4 in. in diameter are a recent development of the National Acme Co., Cleveland, Ohio. The machine here illustrated is of rugged design and employs the same principles characteristic of the Acme line. The main-tool turret is a one-piece steel casting supported on liberal bearings that permit heavy cuts and fast feeds without undue side thrust. The tool-holders have wide bearings on the flat surfaces of the end-tool turret, and support the tools directly below their cutting points. The forming and cut off-slide bearings are cast with the bed and arranged to support the full length of the tools. The slides are adjusted vertically and horizontally by taper gibs. The top slides are controlled by two interchangeable cams, and will accommodate the same holders and tools used on the forming and cut-off slides. The cylinder casing is let into the bed and securely bolted in place. Brass shoes are provided for easy adjustment, and to compensate for end wear. The front of the cylinder casing is counterbored, giving the cylinder a full-diameter thrust bearing. A threading spindle is not furnished, unless ordered. The back-gear bearings and worm drive are oiled



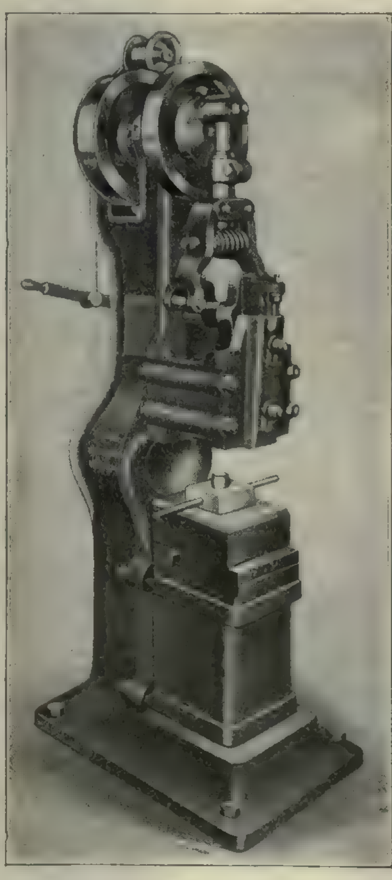
ACME MULTIPLE SPINDLE SCREW MACHINE

from the reservoir mounted above the gear box, and the main spindle bearings are provided with oil chambers and gravity feed cups. The cutting lubricant is supplied by forced feed pumps, and all gears, cams and other working parts are inclosed. The turret is at a convenient height for the operator. The worm gear on the camshaft is equipped with a safety device, and the starting clutch is controlled from either side. The machine is made in two sizes, 3 in. and 4 in., and is furnished with either belt or motor drive. A 10-hp. motor is required for the 3-in. machine, and 15-hp. motor for the 4-in. machine. High-speed drilling and reaming attachments are furnished when required.

Fairbanks Special Pulverizing Machine

The United Hammer Co., Oliver Building, Boston, Mass., has added to its line the pulverizing machine shown in the accompanying illustration. This machine is intended for laboratory use in pulverizing pig-iron samples for analytical purposes. It is claimed that it will pulverize $\frac{1}{2}$- to $\frac{3}{4}$-in. cubes in from 2 to 3 min. so that the particles will be fine enough to pass through an 80-mesh sieve.

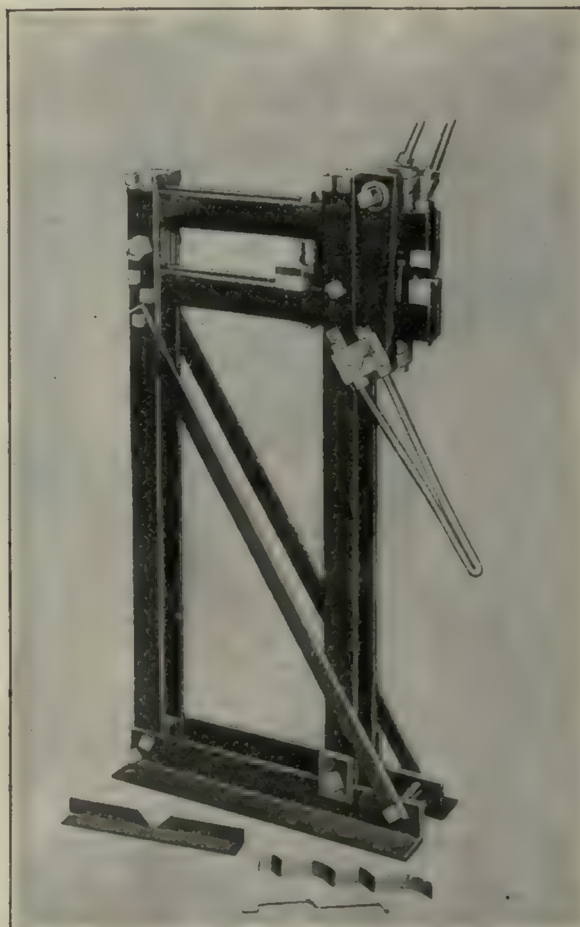
The machine is built in one size only and can be arranged either for belt or motor drive. Operation is by treadle, or by special starting device as shown in the illustration. The weight of the ram is 100 lb. and it is claimed that when running at 300 strokes per min. it will strike a blow of approximately 600 lb. Size of mortar and pestle, 2 inches.



FAIRBANKS SPECIAL PULVERIZING MACHINE

Armstrong-Blum "Marvel" No. 22 Punch, Shear and Bending Machine

The machine shown is made by the Armstrong-Blum Manufacturing Co., Chicago. It is built almost entirely of bar steel and is intended for light punching, bending and shearing operations. The horizontal or tool-holding bars are heat treated and are spaced $\frac{3}{8}$ in. apart to form a bolt slot for clamping on the tools. Pressure is applied by two levers to upper and lower eccentrics



MARVEL NO. 22 PUNCHING AND BENDING MACHINE

Specifications: Capacity: will punch $\frac{3}{8}$-in. hole in $\frac{5}{16}$-in. steel with 2-in. throat, or $\frac{1}{4}$-in. hole in $\frac{1}{4}$-in. steel with 6-in. throat: will shear $\frac{3}{8}$- x 2-in. bars; vertical movement of jaw, with one lever, $\frac{7}{16}$ in.; two levers, $\frac{7}{8}$ in.; total jaw opening, $3\frac{1}{4}$ in.; height 48 in. length 24 in.; width, 10 in.; weight, 260 lb.

connected by two links. The lower parallel bars remain stationary, all the motion being in the upper bars.

The front leg of the machine and the eccentric and link arrangement may be slid forward or back, thus changing the depth of the throat.

Efficiency Pipe Wrench

In the article entitled "Efficiency Pipe Wrench" on page 697, Vol. 52, of the *American Machinist,* it was incorrectly stated, "the wrench is made in two styles, with teeth and without teeth." This was an error as the wrench is made in one style only, with a friction grip, both the hook jaws and clamp are smooth and have no teeth of any kind.

A sailor, during the late quarrel, being examined for a machinists' mate rating, wrote that a steadyrest was from 10 at night until 8 in the morning.

What Other Editors Think

The Metric System

From *Railway Age*

THERE is constantly going on in this country organized propaganda for the adoption of the metric system of weights and measures. The organizations which have endeavored to create this pro-metric sentiment have recently been very active, and it is expected that a bill will soon be introduced in the House, making the use of the metric system, and that only, compulsory in all departments of the government. There is no question that the pro-metric propagandists intend this merely as an entering wedge to commit Congress in favor of the metric system and the bill, if passed, would no doubt be followed by drastic compulsory metric legislation for the whole country. Members of the House of Representatives and the Senate have received a deluge of communications urging the enactment of metric legislation, and in the absence of opposition, the legislators may form the opinion that there actually exists a widespread sentiment in favor of the substitution of metric weights and measures for our present system. However, investigation has disclosed that the greater part of the communications sent to legislators have been inspired by a campaign conducted by the so-called World Trade Club of San Francisco. This organization, we are reliably informed, is not a club in the ordinary sense of the term, the name being adopted merely to add prestige to a movement being carried on by a wealthy man who has made the metric system his hobby. Thus the artificial sentiment has been created almost solely by one individual and does not represent the views of manufacturers or responsible business men in this country. Regardless of the questionable methods that have been adopted to manufacture pro-metric sentiment, it will be well to consider the metric system on its merits. It was first adopted in France by drastic legislation enacted in 1793. The law was repealed by Napoleon in 1812, and even though the metric system had been in force for 19 years the people soon resumed the use of their old system of measures. In 1837 the metric laws were reinstated, with the omission of the decimal division of the year, of the day and of the circle. Now, after 83 years of compulsory use of the metric system, the old French units still survive in some of the French industries.

The experience of France has shown that old units never entirely disappear and the metric units introduce complication, resulting from a dual system. It is hardly necessary to point out how vitally the railroads would be affected if the use of metric weights and measures by all departments of the government were made compulsory. In all reports to the Interstate Commerce Commission the units would have to be changed from miles to kilometers, from pounds to kilograms, from ton-miles to metric ton-kilometers, etc. The cost of this work would be appalling in its magnitude and the benefits would be infinitesimal in comparison with the confusion and complexity that would result.

The Industrial Conference Plan

From *Iron Age*

THE report of the President's second industrial conference shows that it acted in a strikingly different manner from that of its ill-fated predecessor. When the first conference assembled, it immediately placed emphasis upon the points of most serious disagreement and never got beyond those points, or, in fact, beyond the question of open and closed shop. The second conference placed emphasis on the things upon which the members were likely to agree, and the gratifying result is that all of the members, representing widely varying professions and business interests, have signed the report.

Perhaps the most important feature of the report is its emphasis upon employee representation. The conference found that employee representation when worked out by employers and employees with sincerity and good-will has a record of success, operating in some cases under union agreement in organized shops and sometimes in non-union shops and in shops where union and non-union men work side by side. The conference very pointedly says that "the strategic place to begin a battle with misunderstanding is within the industrial plant itself," and it adds that "the settlement must come from the bottom, not from the top." The report deals very fairly with the arguments made against employee representation but its conclusion is that the employers who do not believe in any form of co-operation with employees, and the labor leaders who fear that such plant organizations may be used to undermine the unions are alike in error.

The conference shows sound judgment by not professing to discover any panacea for the industrial woes of the world. The report says definitely that employees representation offers no royal road to industrial peace, but it does afford a means whereby frank dealing, sincerity of purpose and the establishment of common interests may bring mutual advantage. Likewise, that part of the report which discusses profit-sharing rejects the belief sometimes met that it is a complete solution of industrial problems. The conference shows that profit-sharing has met with success under certain conditions, but no exaggerated ideas of what it will accomplish are entertained. "Like employee representation," says the report, "the usefulness of profit-sharing depends on the spirit in which it is organized and administered. . . ."

The plan for the settlement of industrial disputes by means of the various boards provided for in the report will probably be found in practice to have some imperfections. It is voluntary except that it subjects those engaged in controversies to the force of public opinion, which is often stronger and more effective than written mandates of legislators. As fully outlined elsewhere in this issue, the report of the conference is before the country and deserves most careful and sympathetic consideration.

Ruinous Excess Profits Tax Must Be Abolished

From *Manufacturers' Record*

WHY does Congress do nothing to remove from the shoulders of industry the intolerable burden which is everywhere crushing initiative and fomenting unrest by piling cost on cost in every article of consumption? The recent Secretary of the Treasury has denounced the excess profits tax as an economic monstrosity. Mr. Colver of the Federal Trade Commission has declared that it levies a tax of from four to five dollars on the consumer for every dollar that it diverts into the national fund. Economists are a unit in denouncing it, and not in this whole broad country, so far as we can find out, has a single authoritative voice been raised in apology for the imposition or in extenuation of its iniquitous and maleficient effects.

Yet Congress dilly-dallies. It could before this have begun the formulation of an alternative taxation policy; could before this have put the business world on notice of relief to come. But that dear darling of inefficiency—politics—has stood in the way. The Republicans do not want to trifle with the revenue law because they may make some enemies. It is pointed out that the present act was not finally passed until February, 1919, when it was made retroactive for 1918, and it is asserted that there will be plenty of time at the short session, beginning next December, to revise the present law, making it retroactive for 1920, so that the taxes to be collected next year will not be the present crushing imposts. And the Democrats, just as hungry for political capital, show no more interest than is involved in trying to put their opponents in the hole.

The most casual survey indicates the iniquity of this position. There is no business in America today that is not fixing its prices current with due regard for the excess profits tax. No manufacturer is going to lower prices in the hope that the law will be changed. He must know in advance that it is going to be changed. If, therefore, a revision is not effected until next December, January or February, business in America will already have collected the cost of the excess profits tax to it and will have it in hand. A revision that late, therefore, would afford not the slightest relief to the present irksome situation. More than that, with the tax already collected from the consumer, the country would never tolerate a revision which did not send that tax into the national coffers, which means that the revision could not be made retroactive.

There is no substantial reason whatever, no suggestion of one, why the revision of the present law should not be brought about now, and the national demand for it should be so loud and persistent as to compel prompt action.

It is true that revision of the revenue act is now unfinished business on the calendar of the Ways and Means Committee, which has before it a number of bills proposed as remedies, but the general understanding in Washington is that even if the House does adopt a revision measure, the Senate will not get to it in advance of adjournment. The stage is set for a sort of camouflaged revision—a hope instead of a fact.

But what is happening in the meantime? The Federal Reserve Board is endeavoring by other means to check the rising tide of cost that tax revision would straightway correct. And for the Reserve Board to do so, thus morally if not legally abusing its powers, is to play with fire and gamble with panic. If there were no excess profits law, there would be no necessity, fictitious or real, for the policy of which the Board is enamored. So, too, money which was formerly available for great constructive enterprises now hides itself behind municipal and other tax-free securities. How many millions that would otherwise be in sight for progress now conceal themselves on account of this infamous tax system we do not know, but there must be so many of them that they run into the billions.

We have gradually got rid of the war boards and of most of the machinery which the Government called into being with which to run the war. But the most extraordinary of all the exigent war measures, the one piece of machinery which could be justified only by the threat of catastrophe, is allowed to retain its form and character and to continue unimpeded its work of ruthless ruin. It is as if a man, having poured water into his house to quench a fire, insisted on keeping up the flooding for days after the last vestige of the conflagration had been extinguished. A nation of fools might countenance such action, but for a nation of sensible beings to endure it is not conceivable.

We have heard some idiotic talk about business trying to get rid of this tax in order to "hog more profits." If there are any people who really believe that, who want to pay five times the tax on every article they purchase so that the Government may get its small share of the return, let them assemble together and cut off their noses to rebuke their faces, for that would be the measure of their intellectual appreciation of sense and good judgment. No business man is glad to see his product sell for five dollars to the ultimate consumer when he knows that but for the excess profits tax three dollars would be a sufficient price. He knows that the extra two dollars is the tribute the excess profits tax is exacting as the article passes through the distributing agencies. A manufacturer likes to sell at as low a price as possible. Quantity production, quantity sales, is the American slogan. This idea of paying four times for something the Government does not get may sound like fine patriotism, but it could be characterized more aptly by an uglier expression.

There is not going to be any revision of the revenue bill until after the summer adjournment of Congress unless the people rise up and demand it. Congress may be deaf in a great many ways, but the rumble of popular sentiment is hardly heard in far-off California before the politicians get the signal. When they know that the people really want something and intend to have it, they find a way to break through the red tape of procedure and deliver the goods. The whip of public sentiment induces perfect obedience.

It is time for business to center its barrages on Washington, and business, in this case, means everybody, for there is no person so lowly in this whole country that the excess profits tax does not penalize him and take money out of his pocket. It hits the producer, it hits the consumer, it hits everybody, for even those who add to the cost of their own product to pay the tax find that the same action on the part of every other producer is striking at their pockets also.

Every individual should make it his own business to send his protest to Washington. When enough protests reach there, revision will be assured.

Business Conditions in England

By Our London Correspondent

London, March 19, 1920.

The large demands for capital made by new companies, industrial and other, formed the subject of a special warning by the Chancellor of the Exchequer when discussing civil expenditure recently. He cautioned "those who are capitalizing and recapitalizing old businesses on the basis of present inflated profits" that they "are entering upon a most dangerous course, and are laying up for themselves a very perilous future problem." The parenthesis is not without significance. Instead of increasing production, he warned, this expansion of the business of promoting companies, only creates increased competition for the limited supplies of labor and material.

As regards the iron and steel market, and in fact the whole of engineering, it may be stated that the demand largely exceeds the supply. France and Belgium have been buying steel. Equipment of an engineering character has lately been inquired for from these countries and also from Spain. In London once more German steel has been offered through Dutch and Belgian firms. Belgian iron, too, has been on offer but with little result, delivery being uncertain. As to other metals, during the past month fairly steady declines have shown in prices for tin, copper, zinc and lead.

In engineering, particularly perhaps in connection with machine tools, the handicap of the molders' strike remains and the introduction of molding machinery still makes slow progress.

The national roll of firms undertaking to employ a certain proportion of disabled ex-service men included up to the middle of February the names of 10,867 firms employing 1,755,431 workpeople, of whom 102,011 were disabled ex-service men. It is understood that the total number of firms now exceeds 12,000.

Need for Trade Legislation

Certain industries which regard themselves as of a key character have been urging on the government the need for legislation of a protective character. The imports and exports regulations bill which would have dealt with the matter is apparently dead, but resurrection in an amended form is probable. The law courts, of course, decided that certain war-time regulations prohibiting imports were illegal, and the industries concerned are fearful of the result of free importation, especially in view of the present state of certain continental exchanges. The industries include the optical instruments, tungsten, gage branches, and also the hop industry. In view of the results of the special trust-committee inquiries it is perhaps curious to find also the lamp industry included.

By the way, there is a movement, somewhat underground at present, to get the abrasive-wheel industry placed in the key category. The usual argument is adduced; namely, the danger to the country of dependence on foreign supplies. It is not certain whether the promoters of the scheme have yet made arrangements for the supply of raw material.

The Machine-Tool Trades' Report

The report of the Machine Tool Trades' Association, the successors, of course, to the Machine Tool and Engineering Association, Ltd., is naturally of a somewhat matter of fact character. The membership amounts to 145. Members are recommended not to support, that is by advertisement, any new publications or any journals that advertise German goods; in fact, members have been asked not to buy German machines. Other points relate to railway conditions, the liability of the companies for injury to machines, etc. In conjunction with the British Engineering Standards Association the Machine Tool Trades Association has been discussing the standardization of gearing and a preliminary conference has been held. As to T-slot cutters, the views of the association have been submitted to the appropriate sub-committee of the British Engineering Standards Association, and the latter have been recommended to ask the American authorities to adopt the same standards for the cutters named, as are ultimately decided on in Great Britain. The association will, of course, hold an exhibition from Sept. 4 to 25 next at Olympia, London, W., and it is announced that the whole of the floor space and about two-thirds of the gallery space has been let. Apparently, some 200 exhibitors will be included. As to the following exhibition, it was decided at the general meeting of the association that it should be held in 1923.

Piecework With Safeguards

The question of payment by results, which in Great Britain is usually another name for piecework, has yet to be decided in connection with the engineering industry. Skilled men are taking a ballot and the result will probably not be known for another month; but the unskilled men have in a general sense agreed. A conference was held in London yesterday, at which it was decided that "the question of payment by results with proper safeguards is worthy of the consideration of the trade unions affiliated to this federation." The safeguards proposed are of a fairly ordinary character. For instance, where by the introduction of the 47-hour week the worker cannot earn his previous pay at the same job, the employer will make adjustments on the piecework price; also piecework rates shall enable an average worker to earn at least one-third more than the present total on time rates, and piecework prices once established shall not be altered unless methods of manufacture are changed.

All the armament firms have, of course, turned over, as completely as possible, to peace-time productions, and W. Beardmore & Co., Ltd., Glasgow (a concern in which the Vickers firm is interested), has taken up the manufacture of locomotives, a recent contract being worth £1,500,000.

To aid its customers, the firm of Buck & Hickman, Ltd., Whitechapel, London, E., agent for a considerable number of well-known American machine tools, etc., has equipped a four-story building, which is arranged on the lines of a large toolroom, where the capacities of machines can be demonstrated to the fullest extent. This section of the organization has arisen out of a toolsetters', etc., training school which was organized by H. Purdy and W. E. Buskard toward the end of 1915, and subsequently taken over by the Ministry of Munitions as a special training center. Some eighty machine tools have been installed.

How Did the Cutter Cut?

By Robert Coates

In reference to E. A. Dixie's article captioned "Making or Manufacturing?" I would like to assure the author that I for one shall take heed of his timely warning and never in the future exceed the 20-ft. limit of credulity he advises in respect to the fish in Sydney Harbor.

With characteristic and becoming modesty Mr. Dixie draws the veil at the critical moment of the catastrophe, but I feel sure the story had a very happy ending. He was there, and I know he would not let the fellow drown —sharks or no sharks.

But after that—after receiving the S.O.S., so to speak, from the old ladies' home and making the acquaintance of the original Daughter of the Revolution, he gives a very interesting description of the methods used to produce a special link, and I see in one of the sketches (Figs. 5 and 6) a gang of cutters indicated as running at variance with usual practice. As no mention or claim is advanced in the text favoring retrogressive rotation as an improvement in the art I am compelled to assume that Mr. Dixie made the mistake of not "chalking one of the teeth."

SPARKS FROM THE WORK

Valentine Francis

Senate and Congress Add Proviso to Trade-Mark Act

Conferees of the Senate and the House have reached an agreement on H. R. 9023, a bill to give effect to the Buenos Aires Convention for the Protection of Trade-Marks and Commercial Names. The changes made in conference, for the most part, were slight. A proviso was added to the effect "that trade-marks which are identical with a known trade-mark owned and used in Interstate and foreign commerce, or commerce with the Indian tribes by another, and appropriated to merchandise of the same descriptive properties as to be likely to cause confusion or mistake in the minds of the public or to deceive purchasers, shall not be placed on this register."

The conferees agreed to the addition of a section intended to protect the rights of the American trade in foreign countries. It applies to other countries as well as to that with South America. The new section reads:

"SEC. 9. That section 5 of the trademark act of Feb. 20, 1905, being Thirty-third Statutes at Large, page 725, as amended by Thirty-fourth Statutes at Large, page 1251, Thirty-sixth Statutes at Large, page 918, Thirty-seventh Statutes at Large, page 649, is hereby amended by adding the following words thereto: 'And if any person or corporation shall have so registered a mark upon the ground of said use for 10 years preceding Feb. 20, 1905, as to certain articles or classes of articles to which said mark shall have been applied for said period, and shall have thereafter and subsequently extended his business so as to include other articles not manufactured by said applicant for 10 years next preceding Feb. 20, 1905, nothing herein shall prevent the registration of said trade-mark in the additional classes to which said new additional articles manufactured by said person or corporation shall apply, after said trade-mark has been used on said article in interstate or foreign commerce or with the Indian tribes for at least one year, provided another person or corporation has not adopted and used previously to its adoption and use by the proposed registrant, and for more than one year such trade-mark or one so similar as to be likely to deceive in such additional class or classes."

Young Johnny McNoodle got gay,
Took all his machine guards away,
Said he "they are junk,
Merely 'Safety First' Bunk,"
Now the doctor collects Johnny's pay.

Japan's Machinery Imports

Consul Robert Frazer, Jr., of Kobe, reports that 80 per cent of the machinery imported into Japan in 1918 came from the United States, 16 per cent from Great Britain and 4 per cent from other sources. The total value of such imports was $29,248,999. In order of importance they consisted of the following classes: Spinning machinery, steam boilers and accessories, metal and wood working machinery, dynamos, electric motors and transformers, sewing machines, gear cutters, paper-making machinery, gas compressors, pumps, pneumatic tools, weaving machinery, iron rollers, gas and petroleum engines, steam engines, cranes, capstans, locomotives and tenders, hydraulic presses, printing machinery and steam turbines.

Simmons Machine Company Expands

Buffalo, N. Y., has many natural advantages as a machinery center, a fact recognized by the Simmons Machine Co., Inc., which will open a branch warehouse in that city. The new property is located on Exchange St., directly opposite the New York Central Railroad Station. The building is particularly suitable for the display of machine tools, having an all-glass front and skylights throughout. It is 50 x 125 ft. and affords ample space for display purposes. In the front of the building there is a second floor, extending back 40 ft., that will be used for offices. The home office, warehouse and shops of the company are located at 981 Broadway, Albany, N. Y., and there is also a branch office at 801 Singer Bldg., New York City.

Don't Be Extravagant With Time

The main difference between the man who succeeds and the man who merely grovels along in a mediocre sort of way is that one utilizes every hour of his time to the best advantage he knows how, while the other is content to dwaddle.

When the amount of business is not particularly large and the weather is depressing there certainly is a temptation to sit at the window and watch the crowd go by. But those who succumb to such temptations wake up sooner or later to find that the whole procession has passed them and left them in the lurch. Don't sit at the window. Get out and hustle.—*Forbes Magazine.*

New Britain Machine Co. Elects Officers

Following the meeting of the stockholders of the New Britain Machine Co., New Britain, Conn., April 7, at which changes in the articles of association and by-laws were voted, the directors elected Frederick G. Platt to the newly created office of chairman of the board of directors, and Herbert H. Pease president to succeed Mr. Platt. Mr. Pease is also treasurer. Three vice presidents were also created and these positions were filled by election of Abram Buol, Charles R. Hare and Stanley T. Goss. Robert S. Brown was re-elected secretary and Herbert E. Erwin was re-elected assistant secretary. The stockholders also ratified the recommendation of the directors to increase the capital stock from $2,000,000 to $7,000,000.

By changing the by-laws to create the position of chairman of the board of directors, the New Britain Machine Co. follows the lead of the Stanley Works, which a few years ago created such a position, and later Landers, Frary & Clark did likewise. The chairman of the board of directors acts in an advisory capacity and in all three instances the position has been filled by advancing the president.

Carborundum Co.'s Improvements

The Carborundum Co., of Niagara Falls, N. Y., is spending approximately a half a million dollars in extending and improving its plant at Niagara Falls, and its two big furnace plants, one at Niagara Falls, Ont., and the other at Shawinigan Falls, Quebec.

The plan includes a three-story addition to the paper and cloth plant at Niagara Falls. This addition is 432 ft. long and 81 ft. wide, and will provide greater facilities for the storing and curing of all carborundum, garnet and aloxite paper and cloth products, and for the extension of the rubber-bonded-wheel department.

Another addition, just completed, will extend one of the wheel making and kiln departments, the new building being two stories high, 96 ft. long and 64 ft. wide. There will be additions to the crushing departments and improvements at the furnace plant at Niagara Falls, Ont., where the abrasive aloxite is made, and at Shawinigan Falls, Quebec, where an extensive carborundum furnace plant is located. Besides these building operations, fourteen different departments at Niagara Falls, N. Y., will be extended.

...LD'S INDUSTRIAL FORGE

News Editor

Canadian Machine-Shop Investments Are Enormous

Foundry and machine shop products of Canada were valued at $82,493,897 for the calendar year 1918, according to the report of the Dominion Bureau of Statistics that has just been issued. The total cost of raw materials was $27,788,059, and the aggregate of salaries and wages was $28,986,305, and total capital invested was $84,122,446. The operations of 667 individual plants is covered in the report, distributed by Provinces as follows: Ontario, 369; Quebec, 126; British Columbia, 69; Saskatchewan, 25; Nova Scotia, 23; Manitoba, 23; Alberta, 15; New Brunswick, 13, and Prince Edward Island, 4. Capital invested was distributed, geographically, as follows: Ontario, $56,884,631; Quebec, $14,276,674; British Columbia, $3,635,563; Manitoba, $2,781,536; New Brunswick, $2,623,056; Nova Scotia, $2,007,191; Alberta, $1,176,932; Saskatechewan, $508,423, and Prince Edward Island, $232,440.

A. G. M. A. to Meet at Detroit

Standardization in the manufacture of gears is one of the important subjects to be discussed at the fourth annual meeting of the American Gear Manufacturers' Association, which will be held in the Hotel Statler, Detroit, Mich., April 29, 30 and May 1. An entire day of the convention will be devoted to the various angles of this subject, and reports will be given by committees which have had it under consideration for months.

An interesting program has been arranged which will include papers on such subjects as "Gears From a Purchasers' Standpoint," by D. G. Stanbrough, of the Packard Motor Car Co.; "Routing of Gears and Machine Parts Through the Factory," by J. A. Urquhart, of the Brown & Sharpe Manufacturing Co.; "The Science of Manufacturing," by Henry M. Leland, president of the Lincoln Motors Co.; "Problems of the Gear User," "Mill Gearing From the User's Standpoint," and other phases of gear manufacturing.

A visit to the plant of the Ford Motor Co. will be an interesting event of the convention.

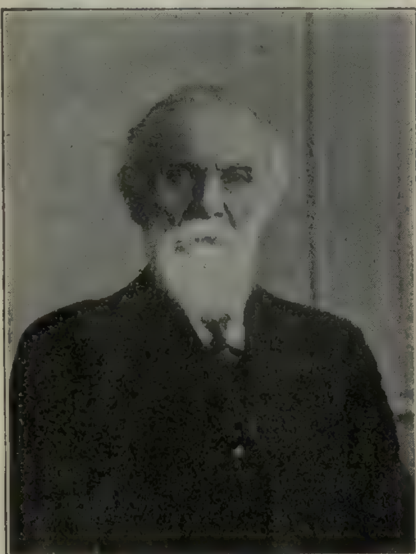
The annual A. G. M. A. banquet will be held on Friday evening, April 30, at which F. W. Sinram, president of the Association, will be toastmaster.

The principal speakers will be Edgar A. Guest, of the Detroit Free Press, and Henry W. Leland, president of the Lincoln Motors Co.

John Jeppson

JOHN JEPPSON, superintendent and one of the founders of the Norton Co., Worcester, Mass., died in his seventy-fifth year in Havana, Cuba. He was on a rest trip with his wife and son.

Mr. Jeppson was born in Sweden in 1844; he came to this country at the age of twenty-four. His first job here was in F. B. Norton's pottery shop. Later, he worked in different pottery shops in New England and finally returned to work for Mr. Norton who, at that time, was experimenting with emery wheels and grinding machinery.



JOHN JEPPSON

When the Norton Emery Wheel Co. was organized by Prof. George L. Alden and Milton P. Higgins, Mr. Jeppson was taken into the company, and later made manager. With the increased demand for emery wheels this company expanded along related lines and the Norton Grinding Co. was organized to manufacture grinding machinery and Mr. Jeppson was made a director. During this time the number of employees increased manifold, and new buildings were erected under his direction.

Mr. Jeppson had the active management of the Greendale plant until six or seven years ago. Since then he had gradually withdrawn from the routine of the work, acting in an advisory capacity. In 1916 he was honored by King Gustaf of Sweden who conferred upon him the insignia of the Knight of Vasa of the first class. Mr. Jeppson was also a thirty-second degree Mason.

He is survived by his wife and son, George N., who has gradually taken over his father's work.

Trade Currents from New York

NEW YORK LETTER

The week just closing, while somewhat quiet, returned a good sales total for all lines of machine tools. In one instance the high peak of 1920 business to date was reported, and another firm reports its April business well in advance of any previous corresponding period.

Power presses are being quoted well into 1921 with a demand in evidence that far exceeds the available supply for the balance of the year.

The Middle West, particularly Detroit, Toledo, Indanapolis and Cleveland, is buying heavily in this line. Repeat orders alone are taxing the capacity of the press makers and inquiries from new customers have reached large proportions. General Motors is a heavy press buyer at present.

There is a falling off in machine-tool inquiries, but this loss is compensated for by the appearance of several large lists.

The Lamoine Magneto Co., of Long Island City, is in the market with a substantial list covering a wide range of tools.

The Otis Elevator Co. has re-entered the market with inquiries for radial drills and turret lathes.

The Backe Engineering Co., of Brooklyn, is inquiring for several large lathes for shipment to Mexico, and the American Manufacturers' Export Association is inquiring for tools for several foreign buyers now in this country.

With the entry of the Lord Drydock Co., of Brooklyn, and the Newburgh Shipyards, Inc., of Newburgh, into the local market a fresh impetus is given to the sales of plate working equipment, and other shipyard necessities.

A department to handle electric motors exclusively has been added to the Fairbanks Co., and will be in charge of A. B. King, formerly of the Electrical Machinery Co., of Minneapolis.

Joseph T. Ryerson & Son are reported to have acquired the Conradson Machine Tool Co. and will be sole distributers of Conradson equipment.

The used-tool market shows little change. Sales continue steady, with the demand well distributed over standard lines. There is a noticeable let-up in the demand for woodworking machinery, and a considerable increase is noted in inquiries for small bench lathes.

The Rochester Cutlery Corporation has been capitalized at $125,000, with

W. H. Simmons, J. L. Wellington and S. L. Webster, all of Rochester, as principals.

Another up-state concern recently formed is the Diefendorf Gear Corporation, capitalized at $150,000. W. H. and M. A. Diefendorf, of Syracuse, are the incorporators.

The Maris Machine Co., with offices at 233 Broadway, appeared on the incorporation list this week, capitalized at $25,000. Knitting machines will be manufactured.

G. Franklin Stringer, of 1280 Pacific Ave., Brooklyn, is one of the incorporators of the Southern States Syndicate, a manufacturing concern recently incorporated for $250,000.

Bay City Foundry Plant Burns

A fire on March 30 destroyed part of the plant of the Bay City Foundry and Machine Co., Bay City, Mich., entailing a loss of more than $40,000.

The buildings destroyed were of frame construction, and are what formerly formed the plant of the M. Garland Machine Co., maker of mill machinery. The pattern shop and patterns were all saved. The machine shop, the largest unit, was also undamaged. New buildings will be erected shortly to replace those destroyed.

Reducing Idle Time

The idle truck not only earns no profits, but represents a steady loss. To obtain a maximum return on the investment, a maximum of work must be produced by the truck.

Overhead expense, including depreciation, interest on investment, insurance, garage charges, etc., is constant whether the truck be on the road or in the repair shop. But when the truck is working, this overhead expense is swelled by driver's wages, gasoline, oil and tire cost and similar items. It is obvious that the greater the amount of actual work accomplished, the more this cost is dissipated.

Owners increasingly are giving their attention to methods or devices that reduce a truck's idle time. Primarily, the truck must be maintained in good mechanical condition. This condition attained, it becomes a problem of increasing the number and frequency of paying loads.

Systematic and expert inspection should anticipate nearly every mechanical trouble, barring those caused by accidents. Thorough and frequent lubrication is the most effective preventive against the many seemingly insignificant troubles which cause costly delays.

Many factors enter into the problem of increasing the number and frequency of paying loads. Proper routing and dispatching, efficient loading and unloading methods, and the use of the logical size truck for the work to be accomplished, are among them. Each of these elements is treated specifically in other articles of this series.—*Pierce-Arrow Motor Car Co. Circular.*

John N. Derby

John N. Derby, vice president of Manning, Maxwell & Moore, Inc., New York, died at his Greenwich, Conn., home on March 28 from heart trouble. He was fifty-three years old and was widely known in the mechanical industries as an inventor. Mr. Derby was the inventor of the Hancock inspirator, the Metropolitan injector and other mechanical contrivances.

Mr. Derby was born in Saginaw, Mich., in 1866, was a graduate of the University of Michigan and a member of the Alpha Delta Phi fraternity. In addition to his connection with Man-

JOHN N. DERBY

ning, Maxwell & Moore was also associated with the Ashcroft Manufacturing Co., the United Injector Co., the Hayden & Derby Manufacturing Co., the Hancock Inspirator Co. and the Consolidated Safety Valve Co. He was a member of the Engineers' Club, the University of Michigan Club, the Machinery Club, and Greenwich and Indian Harbor Yacht Clubs.

Obituary

CHARLES H. McCULLOUCH, JR., president of the Lackawanna Steel Co., died April 3, in a Baltimore hospital, according to a telegram received at the offices of the company. Mr. McCullouch was appointed president Jan. 1, 1919.

ALFRED CARVER HEMINGWAY, president of the Hemingway Machine Co., Lynn, Mass., died Friday, March 26, at his home on Broadway, Lynnfield, after an illness of a week from pneumonia.

FRANK FERGUSON PHINNEY, president of the Warren Steam Pump Co., Warren, Mass., died Saturday, March 6, 1920.

Personals

H. D. SHUTE, vice president of the Westinghouse Electric and Manufacturing Co., has become a director of the West Virginia Metal Products Corporation.

J. F. GEARY, formerly superintendent for the Thatcher Furnace Co., Garwood, N. J., is now assistant superintendent of the Chicago plant of the American Brake and Foundry Co.

G. A. GRANDLUND, superintendent, and W. F. Roper, works manager, have left the employ of the Van Norman Machine Tool Co., Springfield, Mass., to pursue their profession in other fields.

GEORGE B. ASHLEY, Detroit, Mich., has been appointed to succeed J. J. Loftus, as sales engineer of the Reed-Prentice Co., Worcester, Mass. Mr. Ashley's headquarters will be in Detroit.

SIMON MACKAY, formerly works manager of the L. S. Starrett Co., Athol, Mass., has been appointed vice president of the Union Twist Drill Co., to which he will devote all his time and attention in the future.

CHESTER BERTOLETTE, until recently connected with the New York Machinery Exchange, is now representing the Wickes Machinery Co., and Bertolette Machinery Co., of Jersey City, N. J., in Cincinnati, Ohio. He has taken an office in the Lincoln Inn Court Building.

C. C. McDERMOTT has assumed charge of the Chicago office of the Brown Instrument Co., Philadelphia, Pa., succeeding J. W. Lazear, who recently resigned to take up other work in New York. Mr. McDermott has been transferred from the Philadelphia office where he has been district manager.

CHARLES F. OVERLY, pneumatic tool expert, has recently been appointed general manager of sales of the Structural Tool Co., Cleveland, Ohio, which is one of the city's newest industries. For several years Mr. Overly was connected with the manufacture of pneumatic tools, after which he formed the Overly Industrial Tool Co. of which he became president. Upon the formation of the Structural Tool Co., Mr. Overly was induced to combine forces with the new corporation.

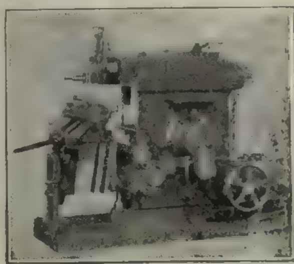
R. W. ELLINGHAM, who has been works manager of the Heald Machine Co., Worcester, Mass., for the past two years, has returned to the Van Norman Machine Tool Co., Springfield, Mass., as works manager. He has had a long and varied experience in the trade, having been works manager of the Hendee Manufacturing Co. for ten years, sales manager of the Bilton Machine Tool Co. for three years and general superintendent of the Remington Arms Co. of Bridgeport, Conn., for three years.

(*Continued on page 868b*)

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Shaping Machine
Columbia Machine Tool Co., Hamilton, Ohio
"American Machinist," March 11, 1920



Machine is back geared, with four-change speed box affords eight changes of speed. Speeds are arranged in geometrical progression. Illustrations show method of equipping machine with speed box, friction clutch and brake, adapting it for single- pulley or constant-speed motor. The friction clutch and brake enable the machine to be quickly started or stopped at any point of a stroke.

Net weight: 16 in., 3,000 lb.; 20 in., 4,000 lb.; 24 in., 5,000 lb.; 28 in., 6,000 lb. Crated weight: 16 in., 3,500 lb.; 20 in., 4,100 lb.; 24 in., 5,200 lb.; 28 in., 6,200 lb. Boxed weight: 16 in., 3,500 lb.; 20 in., 4,600 lb; 24 in., 5,800 lb.; 28 in., 7,000 lb. Cu.ft. (boxed): 16 in., 80; 20 in., 100; 24 in., 132; 28 in., 162.

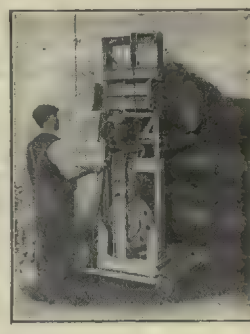
Furnace, Gas Forging
Richmond Gas Stove and Meter Co., Ltd., London.
"American Machinist" (English edition), March 6, 1920

Furnace is heated by two gas and air blast burners so arranged that there is no flame contact with the articles under treatment. Flames produced keep well to the lining of furnace; heating effected by radiation from the solid firebrick roof, sides and floor. This avoids formation of scale, an important feature for drop stamping work. There is no excessive heat at any one point; exact temperature required readily attained and maintained by dial cocks fitted to gas and air supply at both burners. Furnace is constructed of cast-iron and mild-steel boiler plates, strongly braced; heating chamber is lined throughout with refractory material, the whole being mounted on a strong stand to facilitate ease in operation.

Boring Machine, Precision, Spacing and
Modern Machinery Exchange, 25 Church St., New York, N. Y.
"American Machinist," March 18, 1920

Machine intended for spacing and boring jigs. Drilling head can be swiveled to any desired angle. Drive is from a cone pulley on the right-hand side through gearing to spindle. Ram and table carry adjustable micrometer heads. When spindle is located for boring first hole, end measures are placed between the micrometers. After boring this hole the location of the spindle for next hole found by removing the proper end measure and substituting another, differing in length by distance between the holes, and adjusting the movable member until the end measure has the proper "feel" between the micrometer head and its anvil.

Tiering Machine, Combination
Revolvator Co., Jersey City, N. J.
"American Machinist," March 18, 1920



The new model is arranged for dual control, and may be hand or motor operated, the same crank being used in either case. The Revolvator is made in several standard types and sizes that will raise loads from 800 to 1,800 lb. to various heights, maximum rise being 18 ft. For greater capacities machine will be built to order. The power equipment can be supplied for hand-operated machines now in use.

Boring Machines, Nos. 4 and 5 Horizontal
Moline Machinery Co., Moline, Ill.
"American Machinist," March 18, 1920

Specifications: Working surface of table, 24 x 48 in.; table travel, 48 in.; height of table from bed, 6 in.; height of table from floor, 26 in.; distance from table to top of rail on No. 4, 9⅝ in.; distance from table to lowest spindles on No. 5, 8¾ in.; minimum center distance of spindles on No. 4, 2 in.; maximum center distance of spindles on No. 4, 26 in.; end adjustment of spindle on No. 4, 1 in.; spindles bored No. 4 or 5 Morse taper; weight of No. 4, 5,000 lb.; weight of No. 5, 5,400 lb., floor space, 36 in. x 10 ft.

Drill Holder, Utility
J. C. Glenzer Co., Fort St. West and 14th St., Detroit, Mich.
"American Machinist," March 18, 1920

Intended for use with straight-shank drills, reamers, taps, etc. It is made of 3½ per cent nickel steel, heat treated and accurately machined, and can be furnished in all the standard sizes.

Truing Device, Froidset Diamond
S. Rose Co., Inc., 133 Broadway, New York, N. Y.
"American Machinist," March 18, 1920

The method employs a cold process to secure diamond to holder by imbedding it in a steel jacket. Diamond is first placed in the pocket of a receptacle, with cutting point projecting. A layer of special metal is applied and receptacle is then placed in holder

and screw pressure applied. This forces the metal to flow around surface of the diamond, thus forming a solid matrix capable of resisting heat to 1,200 deg. F. Small holder may be screwed to a handle and used as a hand tool. It is also furnished for attachment to trueing device of a grinding machine.

Toolholder, Martin
Martin Toolholder Co., Jackson, Tenn.
"American Machinist," March 18, 1920

Toolholder is particularly suitable for use in a four-way toolpost as the bit can be removed by loosening one setscrew and without disturbing the position of the holder. Is made of tool steel and is heat treated. It is made in all standard sizes, including the heavy-duty size (2¼ x 3⅜ in.) that carries a 1⅜-in. bit.

MAJOR R. C. HAVEN of the Ordnance Department, U. S. A., has been appointed secretary of the Minneapolis local council of the National Safety Council. Before being commissioned by the War Department, Major Haven was for several years connected with the Pittsburgh office of the Ford Motor Co. Previous to that he spent 15 years with the Westinghouse interests at Pittsburgh.

GEORGE C. BOA has recently become the representative for C. E. Johansson, Inc., manufacturer and distributor of Johansson gages, in the Chicago territory. Mr. Boa has had varied practical experience in toolmaking and designing. He also served in the Army in France, seeing active service. He has worked for such well-known plants as the Northern Electric and Manufacturing Co. of Montreal; the Ford Motor Car Co., Detroit, Mich.; the Western Electric Co., Hawthorn, Ill., and the Wahl Adding Machine Co., of Chicago. At the last-named concern he spent nine years in tool designing, inventing, and as superintendent of the adding machine department.

C. C. POUCHER, who formerly acted as the Johansson representative in the Chicago territory, has purchased an interest in the Star Tool and Manufacturing Co. of Chicago and is president of that concern.

Business Items

The Blevney Machine Co., Greenfield, Mass., announces that it has changed its name to the Production Machine Co. The directors decided to make the change, inasmuch as the company is manufacturing production finishing machines.

Charles T. Main, Boston, Mass., announces that his organization has been enlarged and is better prepared to undertake engineering work for all kinds of industries, including textile mills and other industrial plants; storage and terminal facilities; water power and steam power developments, and the examination and reports on plants with reference to their value, reorganization or development. Colonel F. M. Gunby, Fred. B. Cole, H. S. Sawtell, J. F. Osborn, W. F. Uhl, Charles T. Main and A. W. Benoit are associates.

The Lafayette Tool and Equipment Co., Lafayette, Ind., has appointed Sherritt and Stoer Co., Philadelphia, Pa., its exclusive representative for the sale of Lafayette universal grinding machines in the Philadelphia district.

The Halliday Motor Co. will move its plant from Attica to Newark, Ohio. Large additions to the present manufacturing facilities of the company are to be made, which will call for much new equipment. The Halliday Co. is now in the market for several lines of machine tools.

Frank L. Walter, for the last eight years head of the designing department and master mechanic of the Dayton Engineering Laboratories Co. and for six years previous in the National Cash Register Co.'s tool-designing department, has entered into business at 520-530 Lindsey Building, Dayton, Ohio, under the name of the Walter Engineering Co., and will design and build special machinery and tools of all kinds.

The Whitman and Barnes Manufacturing Co. held its annual stockholders' meeting at the general offices in Akron, Ohio, March 3. The following officers were elected: A. D. Armitage, president; Messrs. W. H. Eager and A. B. Hall, Akron, Ohio, and W. J. Elliott, St. Catherines, Ont., Can., vice presidents; E. A. Fisher, treasurer; W. E. Rowell, secretary; and S. H. Tuttle, assistant secretary, the last three of Akron, Ohio. Mr. Elliott is an additional vice president and has heretofore been manager of the St. Catherines' factory. He will have entire charge of the Canadian division of the company's business—selling and manufacturing.

The New Britain Machine Co. will soon increase its capitalization by issuing preferred stock valued at $1,000,000.

The Sargent, Greenleaf Co., Rochester, N. Y., held its annual meeting of stockholders and directors. Samuel E. Miller, who has been connected with the company for the last eleven years, in charge of sales, was elected director. Robert C. Lee, who has been connected with the Hooker Electric Chemical Co., was elected treasurer and director. The officers are: N. G. Williams, president; W. H. Foxall, vice president; P. R. McPhail, Levi S. Chaplin and Arthur N. Ellis, directors.

The Acme Machinery Exchange has opened offices to handle a general line of machine tools both new and second hand. They are located at the corner of Howard and Centre Sts., New York City.

The Mummert-Dixon Co., Hanover, Pa., is now occupying its new 60 x 112 ft. brick pattern shop which, with the side wings, gives about 7,000 sq.ft. of working floor space. The shop is fully equipped with modern machinery and a new feature is the method of heating which is done by two "pipe-less" furnaces.

The Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, has established a branch office in Buffalo, N. Y. For the present the new branch office is located in the Mutual Life Building and is in charge of R. K. Havlicek.

The Hart-Parr Co., Charles City, Iowa, has added Northern Africa to its foreign-trade territory through a contract with the French firm of Beauvis & Robin which has the agency for the Hart-Parr tractors in France and Belgium. This will add greatly to its Eastern trade.

The Euclid Broach and Machine Co., Cleveland, Ohio, has been incorporated with a capital stock of $50,000 and will specialize in the design and supply of superior broaching equipment. Charles S. Amadon, formerly connected with the J. N. Lapointe Co., is president, and Louis E. Peck, formerly connected with the same company, is treasurer.

The Midwest Forge and Steel Co., East St. Louis, Ill., recently held its annual meeting and elected the following new officers: J. W. Eschbrenner, president and treasurer; C. T. Coates, vice president and general manager; E. A. Eschbrenner, secretary.

H. H. Malone has purchased the business of the Precision and Thread Grinder Manufacturing Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinding machine. F. Rodger Imhoff will continue as field engineer with headquarters in Detroit.

The Western Optical Works, Inc., manufacturer of optical goods, Charles City, Iowa, has purchased the main building of the former Charles City College and has remodeled the building for manufacturing purposes, and is now moving in machinery. The officers of the company are as follows: E. W. Henke, president; G. W. Heitz, vice president; W. A. Barthells, secretary, and M. A. Hirsch, treasurer.

New Publications

The Model T. Ford Car. By Victor W. Pagé, M. S. A. E. 1920 Edition. 410 pp., 5 x 7½ in., cloth-board covers. 153 illustrations. The Norman W. Henley Publishing Co., 2 West 45th St., New York City.

This edition has been greatly revised and enlarged; it contains additional matter on the Fordson farm tractor, the F. A. starting and lighting system and the worm-drive one-ton truck. It is complete and practical, and it is evident that the book has been written for the benefit of the average man, in other words, for the student or the non-technical owners of Ford cars and Fordson tractors. All parts and operating principles are described in a thorough manner, as well as instructions for driving, maintenance and repairing.

The book is divided into chapters as follows: The Ford Car, Its Parts and Their Functions; The Engine and Auxiliary Groups; Details of the Ford Chassis Parts; Driving and Maintenance of Ford Cars; Overhauling and Repairing Mechanism; The Ford Truck and Conversion Sets and Genuine Fordson Tractor; Operation Maintenance of Fordson Tractor; Repairing and Using Fordson Tractor. These chapters in turn are subdivided into lesser groups. A ten-page index at the back of the book aids greatly in looking up information.

Safety Fundamentals. 228 pages, 5½ x 8 in. Published by the Safety Institute of America, New York.

This is a compilation of lectures by various well-known doctors and others closely related to the problems of safety in industrial plants. These lecturers include Drs. F. C. Smith and Loyal A. Shoudy, Adelaide Wood Guthrie, R. M. Little, Walter G. King, Harry A. Schutz, James L. Gernon, Chester C. Rausch, R. E. Simpson and Arthur H. Young. The chapters are: The Body Which Gets Hurt; The Injured Body and Its Treatment; Protective Clothing for Men; Suitable Work Garments for Women; Safe Heads and Good Eyes; Guarding Machinery; Arrangement of Machinery and Working Places; Heating and Ventilation; Illumination; Nature's Forces For and Against Workmen, and Safety Education and Shop Organization.

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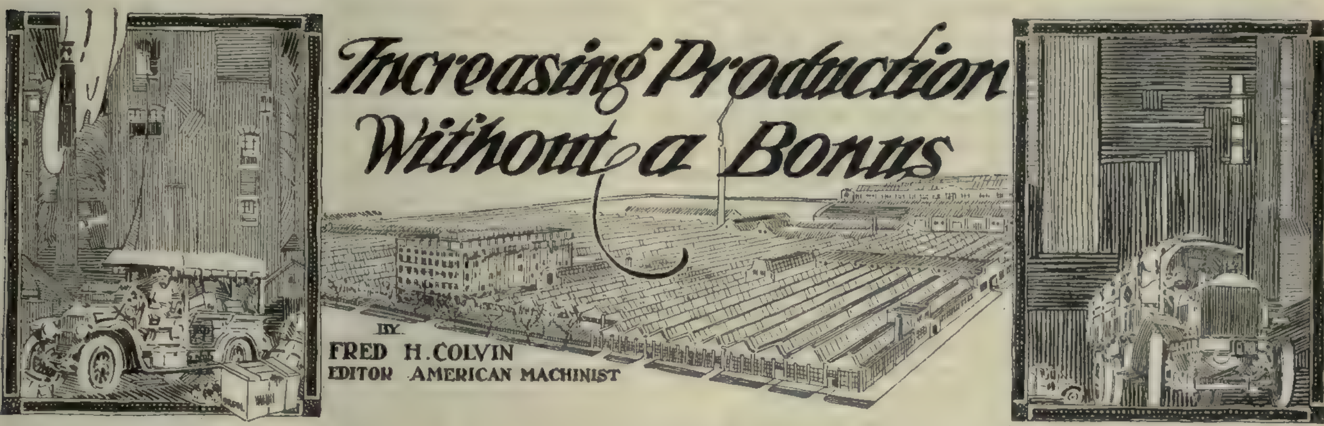
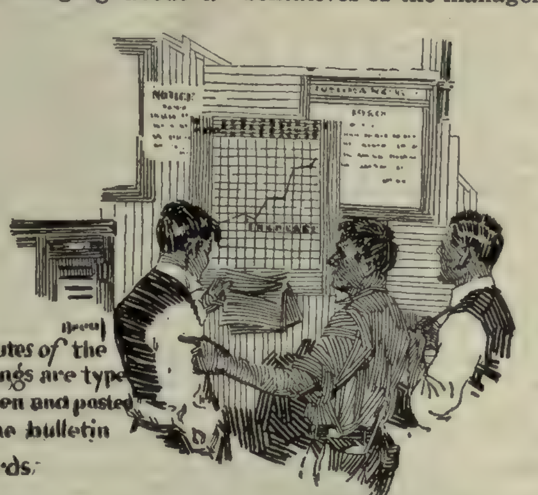


Increasing Production Without a Bonus

BY FRED H. COLVIN
EDITOR AMERICAN MACHINIST

Successful management does not depend primarily upon any set rule, plan, or method, but on the spirit which lies behind it. There is no royal road which will produce the desired result without sympathy and understanding on the part of the management. Here is a plant in which success has been attained, even in these trying times, without piecework or bonuses of any kind.

NEARLY five years ago, on June 1, 1915, to be exact, the White Motor Company, Cleveland, Ohio, formed and put into operation a plan of shop committees with the object of bringing about a closer relationship between the management and its employees, so as to increase the confidence of each in the other through an educational program which was particularly arranged to develop a better understanding of the other's problems. The shop committees are elected by secret ballot in the ratio of one representative for each ten employees, the management believing that any plan of this kind should be as representative and as democratic as possible. Each department is divided into groups of approximately ten men and a representative is elected by each group. The employees elected by the various groups in one department form the department committee.



Minutes of the meetings are typewritten and posted on the bulletin boards.

Any employee of the department in which an election is held is eligible to act as a committeeman. In order to secure complete representation new members are elected monthly to succeed others who retire after approximately one year's service, the personnel of the committee being thus automatically changed and tending to prevent the formation of cliques or political steering committees. A committeeman, however, is eligible for re-election should his constituents so desire.

Meetings are held bi-weekly but are so scheduled that each department meets separately so as to have only one committee meeting at a time. On special occasions, however, meetings are held which include the entire committeemen. All these meetings are held on company time. Committeemen are expected to attend all meetings. The superintendents over the departments represented, their assistants and the general foremen are privileged to attend the department meetings but are not considered members of the committee.

There are no printed rules or regulations pertaining to the formation or activities of the committees. All questions of interest, whether pertaining to the factory or not, are freely discussed as the committee meetings are open forums. Questions pertaining to policy, production, expansion or any of the various activities of the factory are discussed and illustrated by representatives of the management. Minutes of the meetings are typewritten and posted on the bulletin boards of the department locker rooms. Graphic charts and other illustrations which have been discussed in the committee meetings are also placed on the walls of the locker rooms for the benefit of the employees.

The very simple form of committee system here outlined has been in operation for nearly five years. It is as unhampered and free of machinery as the management has been able to make it. It is very similar in practice to a well-regulated family, in so far as it is possible to make it.

These committees are used as mediums through which can be transmitted the thoughts, feelings, requests and desires of the employees to management and vice versa. Through these committees the employees are taught to see the necessity of production and to look for the means of securing it economically. The beauty of the plan and the success which has attended it are largely due to the fact that the employees are taken fully into the confidence of the management and are given an insight into the problems which confront the managers. They have every opportunity to follow the problems up in detail and to make suggestions if they so desire. In other words, the "cards are laid on the table" and the various problems as they confront the management from time to time are discussed by a rep-

resentative of the management at the committee meetings. The charts and tables used are then permanently posted in the committee room for study and reference.

The committee is free to discuss any point which seems of interest and to make recommendations in the form of minutes to the department superintendent. If such recommendations are considered practical and do not conflict with the general policy, they are acted upon and put into practice. If these recommendations necessitate any considerable outlay or are radical departures from existing policies they are referred to the management by the department superintendent. If the management decides favorably, they become part of the general policy. If, on the other hand, the management does not see its way clear to their adoption, the manager goes before the committee, informs it of this fact and gives the reasons for his decision.

It is extremely interesting to note that at no time has the ability of the manager to judge and decide these matters been questioned in any way, and at no time has the management been called upon to bargain with the men collectively for wages, hours or conditions. The secret of the whole situation is that the management and the men have the utmost confidence in each other, both sides having always played fair and neither attempting to "put something over" on the other.

Another interesting feature of the White management is that no bonuses, premiums or other inducements are paid to employees. The highest possible wage on a straight-time basis is the plan of remuneration. This wage is established with careful consideration of the cost of living and amount of production.

In connection with the setting of wages there is a definite policy of increasing the hourly rate as fast as warranted by the individual production. The foreman is more apt to be called to account for not suggesting increases for his men than are the foremen in many shops for daring to suggest them. The theory is that, unless a workman becomes increasingly valuable to the company, there is something wrong either with the man in his present position or the foreman or both.

Care Exercised in Selecting Executives

Great care has been exercised in the selection of capable executives who are thoroughly in harmony with the general policies of the management, the company being particularly fortunate in having a number of men who have been connected with the company from ten to twenty years, and who are therefore thoroughly familiar with its policies. Men of this kind are particularly valuable as evidence to newcomers that conditions and relations are harmonious, and the effect is helpful in every way.

One of the striking features of the White plant is the complete freedom with which every employee is made acquainted with the problems of the management and the factors which enter into production. These are discussed not only in the committee meetings but in the *White Book*, which is issued monthly to each employee. The fundamentals of economics are clearly stated from time to time and all sorts of suggestions and questions are welcomed. The employees are told that "production is the great essential in a factory; for the whole community to maintain a comfortable and humane standard of living it is necessary for every man in the community to produce consistently, otherwise there will not be enough wealth to go around. The generally accepted idea and fear of overproduction is at bottom unsound and should not enter into the policy of either management or employees. There really can be no such thing as overproduction in industry. The term is merely a negative expression of the phenomena of underconsumption. Production means the creation of wealth. Without production a community will be without wealth and so will experience depression due to underconsumption.

"Production must first be arranged consistently with plant investment, inventories and personnel. These must be well balanced to attain maximum results for employees and management. Such activities as purchasing, stores, inventories, cost systems, maintenance and plant repairs, over which productive labor has no control and which, in the opinion of the management, it has no desire to be bothered with, are arranged to keep production standard and at a maximum. In this way it is made possible to earn the greatest amount with the least exertion and to build up a secure future for the employees in the factory.

"Second in importance to wages paid, in the mind of the average workman, are working hours. These must be regulated by the relation of earnings to living cost and by production, holding to the margin of safety between too long hours which result in inefficiency, and underproduction which endangers the future operation of the plant. It is the belief of the management that a community derives the highest benefit, social and economic, from maximum production paid for at a maximum safe wage rate."

Labor Not Bought at Lowest Price

The White Company abandoned the old employment policy that was in vogue something over five years ago of considering labor solely as a commodity to be bought at the lowest price. This has been fully justified in an increased production per man and a confidence and co-operation which mean more to any company than can be figured in dollars and cents.

The company's personnel department is now conducted on extremely modern lines, one of the most valuable employment officials being an ex-union labor leader, although this is an open shop in the true sense of the word no discrimination is made for or against members of any organization.

In hiring a man there are usually three men present besides the prospective employee. First the employment manager or his assistant determines the fitness of the individual for a certain class of work, after which the superintendent and foreman under whom he is to work are summoned. Together they secure a thorough understanding of the man's abilities and the sort of job he is to be fitted into is determined before he is finally placed on the roll. In a somewhat similar way, a man leaving the shop for any cause whatever is interviewed by these same men. This frequently brings out conditions which were unknown or not appre-

ciated and in a large number of cases results in an adjustment whereby the man goes back to his job or to some other department. This applies in cases of discharge as well as those who quit voluntarily.

No discrimination of any kind is made in regard to the nativity, politics or organizations of any kind. Only

three questions must be answered satisfactorily. These relate to whether the man is married or single, a resident of Cleveland, and if he has at least his first citizenship papers. No physical examination is required but may be had if the candidate for employment so desires.

[This is the first of two articles on the White Company's plan of management.]

Why the Blueprint?

By Frank Richards

W. D. Forbes, on page 182 of the *American Machinist*, locates the first suggestion of the blueprint process away back in 1790. That may be the first suggestion to be found in print, which I doubt, but light printing dates far back of that. Last summer I saw several beautiful prints of lace upon the arms and breastworks of fair ladies at the beach, and such sun-printing must have been going on in the days of Cleopatra, only that her skin may have been too dark for satisfactory results.

The present talk about the blueprint seems to make an opportunity for me to say a few words about a matter that I have been thinking of intermittently for a long time. The blueprint was surely a godsend to almost the entire industrial world. It came upon us all at once, as you might say, about half a century ago, fully ready for work, and it found immediate and universal appreciation and employment. It never required and never had any advertising or any pushing save what it did for itself. It has never been to the interest of any individual to either advocate it or oppose it; since, on the one hand, it displaced or superseded nothing, there was no great business to be developed in connection with its introduction, and no education was required as to its manipulation. Today, its use extends all over the world and to all industries dependent upon graphic and dimensioned delineation.

Yet the blueprint, it must be confessed, has never been altogether satisfactory in any use we have put it to. It has never been a thing that any one has ever thought of treating with any respect in the handling. Neither the blue surface nor the white lines are what they should be, and the printing gives neither fineness nor clearness of line, and if the lines are crowded they blur and confuse each other. To compensate for these deficiencies of the blueprint it must be made larger and less easily handled and studied than would otherwise be necessary. It is a crude, rough product at the best, not demanding respectful treatment and not suggesting strenuous effort to keep it clean and smooth.

Blueprint Not Likely to Be Discarded

I certainly could never have the hardihood to suggest that the blueprint is ever to be discarded, but I do venture to propose some lightening or dividing of its task. Without more ado I here call attention to Fig. 1, and it makes no difference to us here what it represents. It will at least be recognized as most likely to have made its first appearance as a blueprint, and as such it was probably not less than 30 x 20 in., and perhaps considerably larger. The cut as here presented shows every line of the drawing with perfect distinctness and must certainly be as clear and legible at every point as the blueprint. It can be seen more comprehensively as a whole at a single glance. As here reproduced it is a little less than the size of a post card, and its total area is less than 3 per cent of the blueprint area as above assumed. Why should I have any hesitation in asserting that for all the purposes for which the blueprint could or would be used, this black on white post-card drawing is much to be preferred? If not, why not?

Fig. 2, to which attention is now called, is a dimensioned working drawing of the steel frame of a standard railroad car. It is not a drawing prepared for my purpose, but one that I have picked up from some technical publication which I neglected to identify, and it is here reproduced without change. This cut is also within post-card size, and the scale of it is about

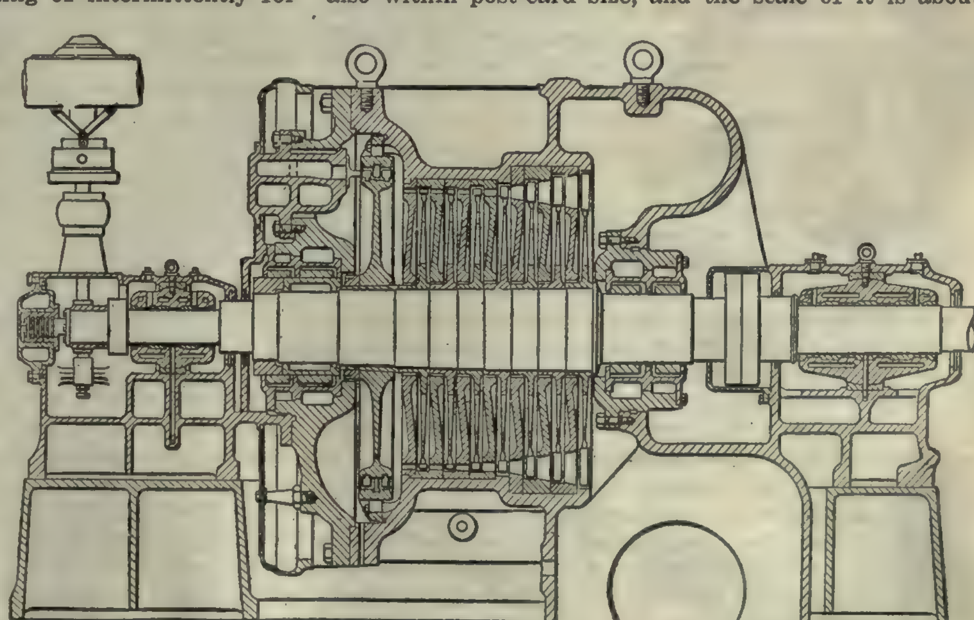


FIG. 1. REDUCED DRAWING OF A TURBINE

6 ft. to 1 in. It might have been reproduced precisely to that scale, or to any other as most convenient. The written dimensions, while as legible as could be expected, might have been made larger and heavier if our purpose had been in view. Now, what could the big blueprint tell anyone that this post card does not tell, and is not the post card handier and everyway to be preferred? Again, if not, why not?

The post-card shop drawing, if it should ever make a go of it, must shove itself along, just as the blueprint has done upon its merits alone and with no effective help outside itself. It is easy enough to turn it down immediately by suggesting the prohibitive cost of the scheme, and this is where a big surprise is lurking. The most astonishing thing is really the cheapness of it as compared with the result to be accomplished.

Photo-Engraving Process Is Not Costly

Probably few who have not looked into it fully realize how cheap and quick and handy is the zinc process of photo-engraving. We know in a general way that all the pages of a big dictionary and of entire, many-volumed encyclopedias have been reproduced by it, and how, when the printers' strike was on in New York, the pages of the *Literary Digest* and other papers were first typewritten and then photo-engraved for the printing; so it could not have been prohibitively costly. The process is awaiting the demand of the drafting room and is capable of working quite a revolution there. I think I have now in the process of writing this article sufficiently braced myself to enable me, notwithstanding what I said farther back, to suggest the giving up and abandoning of the blueprint entirely. See what would follow at once. There would be no more tracings, and only carefully finished line drawings which the draftsman could take pride in. These would be of any size most convenient for the working of the details, the photographing process ignoring the size of the original entirely and reproducing to any scale or size that might be desired.

Larger Sizes of Engravings

For our convenience here we have been carrying in our minds the post-card size, and that would seem to be large enough for the standard working drawings of a shop, but from the same drawing any other size could be produced with equal facility, up to, say, a square foot of area, which should be large enough to show all the lines clearly that would be practicable on the largest blueprint.

Assuming that the process which we are urging should find favor and should become the established practice, every big concern would naturally have its own photo-engraving equipment as a detail of its drafting department, and this should soon displace the blueprinting arrangements and drive them out entirely. The blueprint would cease to be, not only as the working drawing of the shop, but also as the unwelcome accompaniment of specifications, proposals, contracts and other responsible documents. In place of it would be the neat little cut which might not even require folding, and which one would instinctively stick in his pocket for preservation instead of throwing it away. In the literature—pardon the word—of business solicitation, the line cut would often be welcomed and studied where the blueprint would be discarded without a look. The paradox would result that the field and function of the blueprint would be extended by its extinction.

It would be a simple and easy job to make a trial of this thing. Select some standard shop blueprint from your lists and send the tracing of it, if there is no finished drawing, to any of the zinc-process engravers and have a line cut made of it within the post-card size. It might be that the lines would not be of the most suitable thickness, or the dimensions and written matter not large enough for the reduction required, and this would supply points for the making of a second drawing correct in these particulars which a second cut would verify.

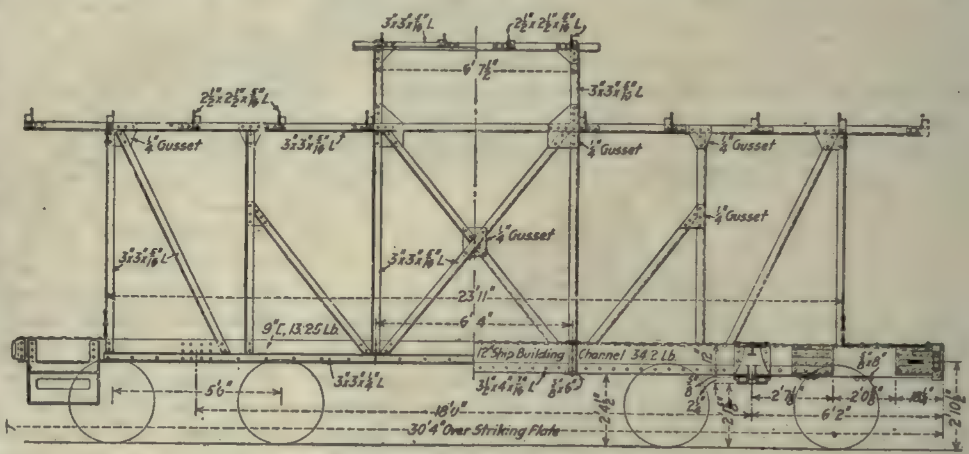


FIG. 2. REDUCED DRAWING OF A FREIGHT-CAR FRAME

The making of the first cut or two would also at once begin to bring information as to the cost of the process. The cost would of course all be in the making of the cut. Each copy printed from the cut would cost less than one-tenth of what each blueprint from the same tracing would cost, and would be of much more practical value. With the process fully established in a large works and all facilities provided, with reliable skill in the manipulation, the making of original cuts not larger than post-card size should cost not much over one dollar each. This is not mere guesswork but is deduced from information which I am not at liberty to make public.

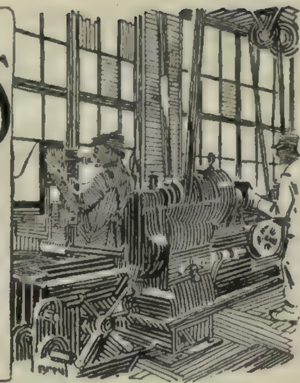
Unblocked Plates Easy to Store

There are details of practice that would develop which it is not necessary to speak of here. For instance, the cuts when completed are metal plates about ⅛ in. thick, and these plates are mounted on blocks of suitable thickness to make the same height as standard type, but for the purposes here contemplated it would be better not to mount them on the blocks at all but to print from the thin plates. This would save time and cost in preparation and also enable the cuts to be stored more compactly.

We ought to hear at once of some enterprising individual going to work and making an actual start on this thing. If not, why not?

MODERN PRODUCTION METHODS

By
W. R. Basset
of
Miller, Franklin, Basset & Co.



Part II. Purchasing, as a Tool of Production

The purchasing agent's job is looked upon by some people as a snap, by others as a graft, but by up-to-date manufacturers as a very important position worthy of an able man. He has many chances to save money for the company and the smooth flow of the production stream depends to no small extent on his ability. Different buying methods are contrasted and some forms described.

(Part I appeared in our April 8th issue)

"THE motto "well bought is half sold," is an excellent one for the merchant, for price is important in trade. The same expression is a safe guide for the machine shop provided price is not made the sole test of good buying.

An eastern machine shop hired, as a purchasing agent, an ex-salesman who for 15 years or more had been selling to machine shops. Because he had been on the other side of the counter, he knew the "tricks of the trade." It was assumed that since he would be able to play upon the fears and weakneses of salesmen, he would make an unusually good purchasing agent. As a buyer he succeeded in playing one salesman against the other and his orders were unquestionably placed at the lowest prices on record. He assured his employers that the quality of his purchases was satisfactory. But the shop felt differently about it. Castings were of uneven hardness—and sometimes full of holes; belts needed constant attention and although the price paid for them was low, a lot more were bought yearly than before. Tools were often unsatisfactory and the maintenance cost of machinery and equipment nearly doubled.

What with increased overhead expense, higher labor cost, returned goods and decreased life of supplies, this "shrewd" buyer was an expensive luxury. It should not be necessary to point out that, in the machine-shop industry, the price of raw materials and supplies is really the least important factor of good buying for material is usually the smallest item of cost. It is more important that materials be the best for the purpose and that they be received on time than that they be bought at the rock bottom price.

All of these factors, however, must be kept in balance.

Poor Buying

One of the best purchasing agents in the machine-shop industry does the poorest buying I have ever seen. This man knows personally every source of supply, he is a shrewd bargainer, a good judge of quality and a marvel at getting deliveries through in record time.

He has few equals in getting in materials of which the shop is short, the lack of which is holding up production and causing serious loss of profits. So good is he at this that he habitually postpones buying until a shortage report jars into action his really phenomenal abilities. He is what I call the "grand opera star" type. He won't tolerate routine; he won't use his talents for the maximum good of his organization. His buying is to him an art; an exercise for his talents, rather than a tool with which his employer can make profits. There are many like him. At the other extreme we have the purchasing agent who is merely an order-signing clerk. Where he exists, the shop superintendent, or perhaps an individual foreman, specifies what to buy, of what quality it shall be, how much to buy and when it shall be delivered. The buyer has little to do but specify the purveyor, and sometimes even that authority is taken from him. Where this method is used the purchasing agent has no chance to buy well, for shop men are inclined to wait until they run up against a need, and then to need it badly. Requisitions are for small quantities "wanted at once" and the buyer has no alternative but to place a rush order. The time given him and the individual orders placed are insufficient to enable him to buy to advantage.

Definite Statements Needed

It would seem obvious that production, the sole end of a machine shop, suffers under either of these ways of handling the buying. Without raw materials the shop cannot work, and if quality is not what it should be final costs will be high. It is not necessary to elaborate on these facts. But a definite statement of even the obvious sometimes is needed. Therefore, let us go on record that to make the purchasing department an effective tool of production, the following points must be considered:

1. Raw material must get to the shop *before* it is needed.

2. The amounts purchased must be in accordance with known future requirements of the shop, *neither more nor less than needed.*

3. The buyer must have sufficient time to enable him to buy well, except in occasional emergencies.

4. The materials must be the cheapest in the long run.

5. In order to achieve the first four points, the buyer

must have definite records of the past performance of all supplies, as to quality, price and delivery.

6. Fraud and clerical errors must be avoided by internal checks.

The last-minute buyer I have mentioned habitually violated the first of these rules. Time and again I have seen as many as 90 machines on the assembly floor, complete except for a small part which had been overlooked. These assemblies are worth—when shipped—about $800 apiece. That means that it is not unusual for $72,000 to be tied up for weeks at a time, because the purchasing agent has failed to place a small order for raw material. Obviously, the loss is greater than the mere tying up of working capital. Valuable productive floor space is being used as unproductive storage and congestion is caused at many points in the plant.

That is the effect of under-ordering or late ordering. Over-ordering is also an expensive practice.

What an Investigation Showed

A manufacturer of automobiles decided to find out why he required what seemed a huge amount of working capital to handle only a moderate volume of output. An investigation of his storeroom showed him.

Take one item alone—axle housings, which cost him an average of $35 apiece. He used from eighty to 120 a month and had, as a rule, little difficulty in getting prompt deliveries. His stock of these parts averaged 100 more than was needed to care for any likely emergency. The same condition existed throughout the stockroom. By regulating the purchases, he released nearly $175,000 of idle money.

This condition is bad enough, but it might be—and in many shops is—worse. The material overstocked might be obsolete. I have seen obsolete stock sold at less than 25 per cent of cost—a loss in one instance amounting to well over a quarter of a million dollars—all because of unregulated buying. Conditions of this sort exist as a rule where the size of orders is left to the judgment of the purchasing agent. It is emphatically out of his province to determine how much to buy, when to buy it and when it should be delivered. Those questions can best be settled only by someone closely in contact with the shop and the sales department. An exception occurs in a rising market when it may be good business to buy more than usual. This, however, should be done only after careful consideration of the future needs of the shop, the financial condition of the company, the facilities for storing unusual quantities of material and so on. It cannot well be decided by the purchasing agent alone.

Usually, purchases are instigated by the planning department. Even though no formal planning department may exist, there is someone who has knowledge of the needs of the plant, who can exercise this function. How the planning department arrives at the quantity of material to be purchased will be described in later articles of this series. In this article our only task is to show what is needed to make the purchasing department an effective tool of production.

Necessity of Routine

Routine is necessary and records must be kept, but neither should be elevated to an end, of itself. Sometimes production is facilitated by smashing routine for an emergency order. Records should be as simple as possible and only needed ones kept. I have seen the entire time of a clerk used to keep up records which might have a value to some learned society but which were never referred to by the buyer. Good sense must govern.

Often a report will be inaugurated for a temporary need, which will continue to be compiled long after the need has passed. It is well periodically to check up on all records and if they do not serve a purpose—throw them out.

The forms described here are simple and all are designated to aid the buyer to live up to the six requirements of good buying.

Let us consider the way an order is handled after the requisition is received by the purchasing agent.

The forms and routine for various shops need not differ appreciably, no matter what the size of the shop

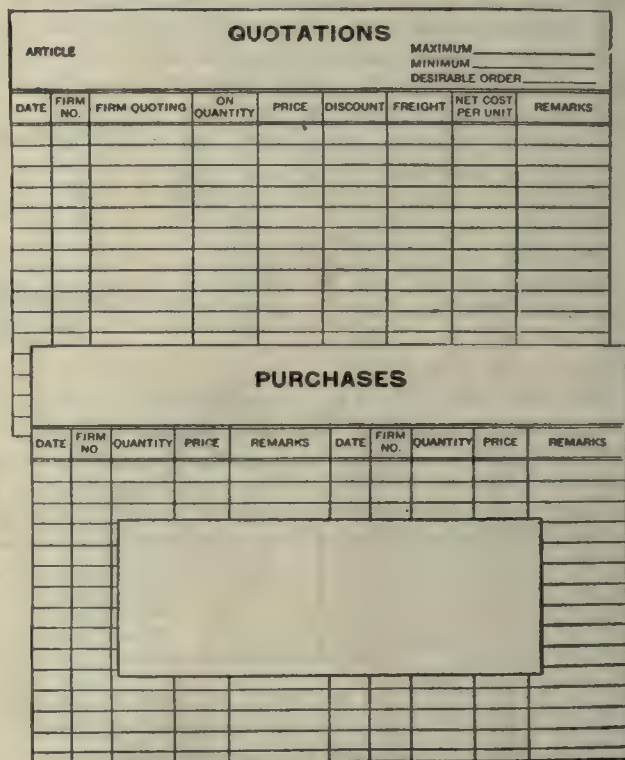


FIG. 1. BUYER'S QUOTATION RECORD

nor what its product. The methods I am going to describe are now in use in shops employing twenty-five men, and also in shops having more than 2,000 on the payroll. Some of these shops do a jobbing business. building any kind of machines; one, on the other hand, builds gears, transmissions, differentials, etc.—thousands of a type.

When a requisition comes in, the buyer turns to the form shown in Fig. 1 on one side of which is the quotation record and on the other a record of purchases already made. There is a copy of this form for each item.

For convenience, each supply house is given a number, which is used rather than the name. The information on this card is a valuable guide in showing which concerns have given the best prices, and the promptest deliveries in the past.

In buying many productive materials and especially in buying supplies and tools a performance record is a valuable guide. Such a one is shown in Fig. 2. It consists of a manilla envelope—one for each article—in which can be kept memoranda and comments made

by the shop and others on the article. This is an invaluable guide to the buyer who keeps in mind that his function serves a bigger purpose than to buy cheap. The persistent use of this performance record saved one concern $5,000 a year on its belting alone, and $25,000 a year on one of its principal raw materials.

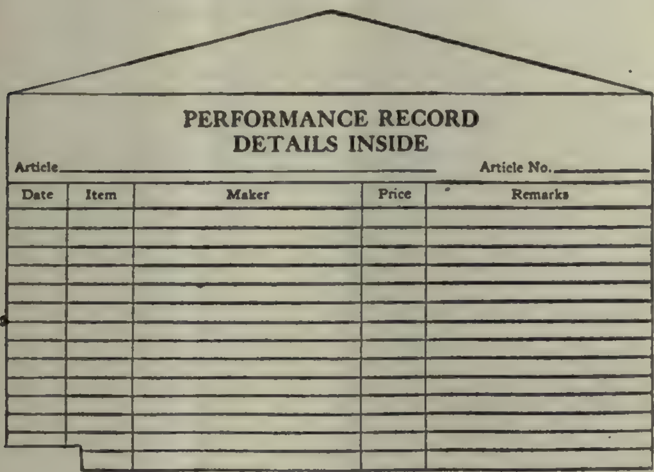


FIG. 2. PERFORMANCE RECORD ENVELOPE

This is how it came about: Belting had been costing this machine shop $17,000 a year. It seemed too much and the buyer decided to experiment with various makes and *keep a record.*

Belting Data Kept

In the envelope for belting he kept data as to every drive. He noted the location, the operating conditions, the power transmitted and other data having a bearing. When a belt was purchased, he recorded the description of the belt, the maker, price, the drive on which it was used; even the cost of the belt per unit of production on that machine.

With this data in hand, he had a guide more reliable than the usual foreman's guess, which is all that many purchasing agents have to go by. He bought on a basis of exact knowledge.

Formerly $17,000 worth of belting was bought annually. Last year he spent only $12,000 in spite of a 35 per cent increase in the plant's production and a 50 per cent increase in the average price of belting. This saving is all due to the fact that only the best belt for each drive is purchased. In addition to the direct saving of money spent for belts, there is an operating economy due to reduced shutdowns caused by belt troubles. It is expensive to pay for cheap belting with idle machines. The same method is used in judging the other supplies and raw materials used. Good judgment, knowledge of markets and of men still plays its part in this man's buying, but instead of dickering and jockeying for price advantage, he has a definite knowledge of his needs on which to base his shopping. Having settled upon the source of supply, the order is placed by means of a standard order form. At least three copies are needed, one for the purveyor, one for the purchasing agent, and one for the receiving clerk. Sometimes more copies will be needed, such, for instance, as one for the originator of the requisition.

The form in Fig. 3 shows a desirable design for the purchase order. If the nature of the business demands that frequently a large number of items be ordered at one time from a supplier, it is well to have order forms large enough. When only one or two items are ordered at a time, paper may be saved by having the purchase order correspondingly small.

On the left of the original copy is a perforated slip which the supplier is requested to return with a promise of delivery. This may be attached to the purchasing department's copy of the order.

Printing Purchasing Departments Copy

If most of the orders placed take a considerable time to fill, and a large amount of correspondence is usually necessary, it is handy to have the purchasing department's copy printed on the outside of a manila folder so that the order and all correspondence bearing on it can easily be kept together. As a rule though, only a few of the total orders placed require much follow up. Therefore, it is possible to have the purchasing department s copy printed on paper, and when needed, to paste it to a folder.

An excellent plan is to print this copy on cardboard or heavy manila paper so that it will stand on edge. This copy is used as a follow-up tickler so that deliveries may be watched. At the top of the order shown in Fig. 4 are numbers for the days of the month and letters representing the months. The dates promised by the supplier may be indicated on each order by tabs affixed to these letters and numbers.

The purchasing department is responsible not only for placing the order, but for getting the material into the plant. Hence the need for thorough and regular follow up. It should start when the order is placed. Each

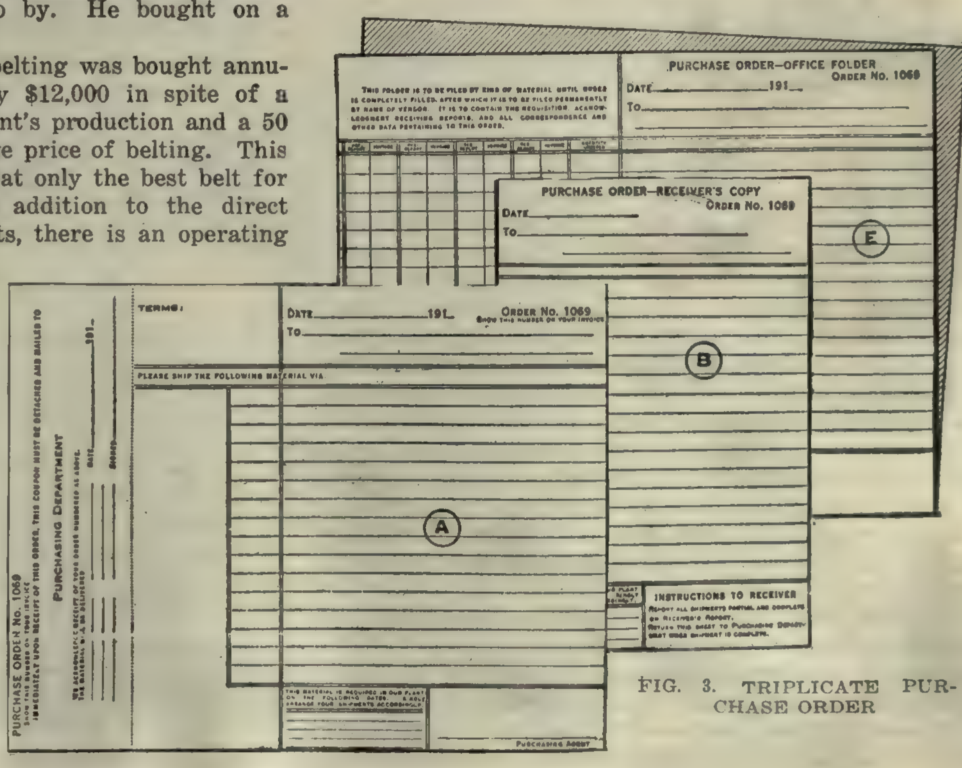
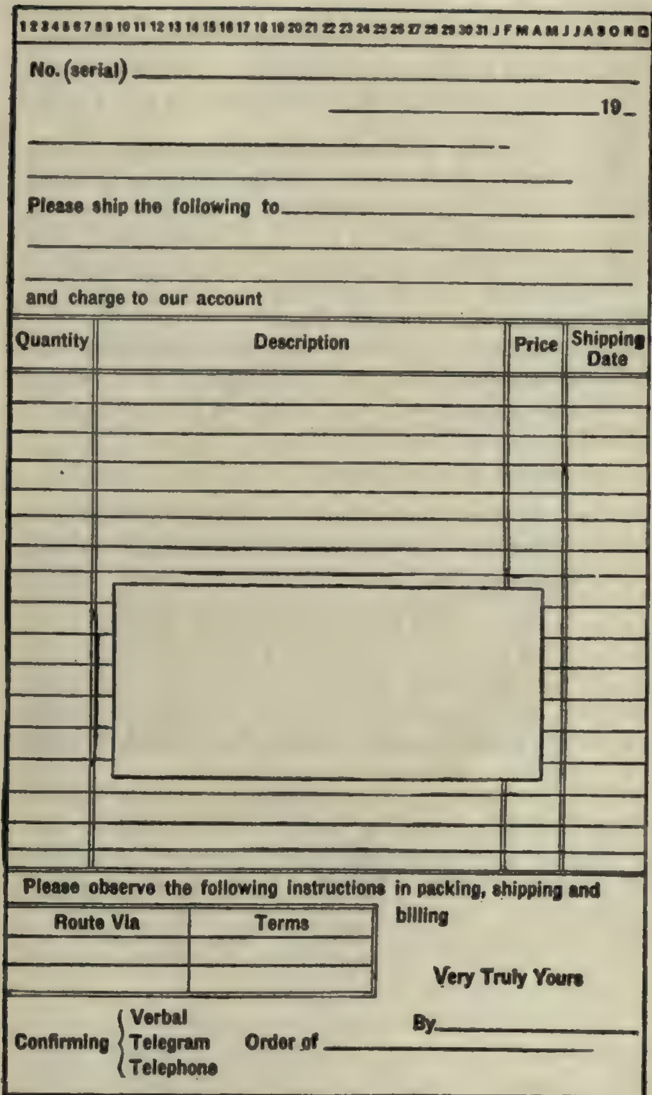


FIG. 3. TRIPLICATE PURCHASE ORDER


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 J F M A M J J A S O N D
No. (serial) ____
____ 19__
Please ship the following to ____
and charge to our account

Quantity	Description	Price	Shipping Date

Please observe the following instructions in packing, shipping and billing

Route Via	Terms

Very Truly Yours
By ____
Confirming { Verbal / Telegram / Telephone } Order of ____

FIG. 4. FOLLOW-UP ORDER FORM

day the one responsible for following up should go through the file in which the orders are arranged alphabetically by materials, and pick out, by means of the tabs, those orders indicated for attention on that day.

One Copy Goes to Receiving Clerk

One copy of the order goes to the receiving clerk. A valuable check will be supplied if the left-hand column of the order showing quantities be left off. This may be done by simply cutting the carbon paper so that the quantity figures on the original won't copy. This necessitates an actual count of the incoming material. Too often, a receiver, if at all hurried—and he usually is hurried at times—looks over a carload of material, "guesses" it is all there and turns in a complete receipt. This permits of dishonesty, and—what may be even more costly—may hold up production seriously because of lack of material supposedly received.

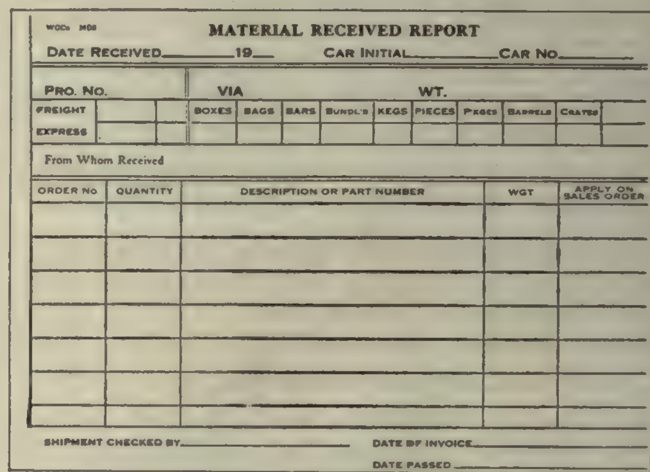
Sometimes it is also well to leave off the price from all but the original and the purchasing department's copy.

While for most concerns three copies of the order are enough, it is sometimes desirable to have more. For instance, it may seem well to send a copy to the cost department, so that it may enter the material costs on its records. In very large concerns, a copy is sometimes sent to the controller's office so that, knowing what payments are going to be called for in the future, sufficient funds may be provided when needed. If this is not done, the purchasing department should report monthly the payment's to be made for materials for the following month.

A simplified form of purchase order which may be used especially in the smaller plant is shown in Fig. 3.

When the goods arrive, the receiving clerk sends a material receipt, Fig. 5, to the purchasing department where the receipt is recorded on the office copy of the order. When the invoice for the material comes in, it is checked for quantity and price and sent to the accounting department for payment.

As can be seen, the forms and records of a properly run purchasing department are simple and each designed for a definite purpose. Proper records should


MATERIAL RECEIVED REPORT
DATE RECEIVED ____ 19__ CAR INITIAL ____ CAR NO. ____
PRO. NO. VIA WT.
FREIGHT
EXPRESS

BOXES	BAGS	BARS	BUNDL'S	KEGS	PIECES	PKGES	BARRELS	CRATES

From Whom Received

ORDER NO.	QUANTITY	DESCRIPTION OR PART NUMBER	WGT	APPLY ON SALES ORDER

SHIPMENT CHECKED BY ____ DATE OF INVOICE ____
DATE PASSED ____

FIG. 5. MATERIAL RECEIVED REPORT

be a guide to future buying rather than a tally of what has been bought.

The buyer must remember that it is not his occasional "breaking of the market" or getting a delivery in a pinch which makes for profit. The purchasing department's function is rather to keep up a steady flow of the materials best suited to the need of the business. They must be on hand when and in the quantity needed.

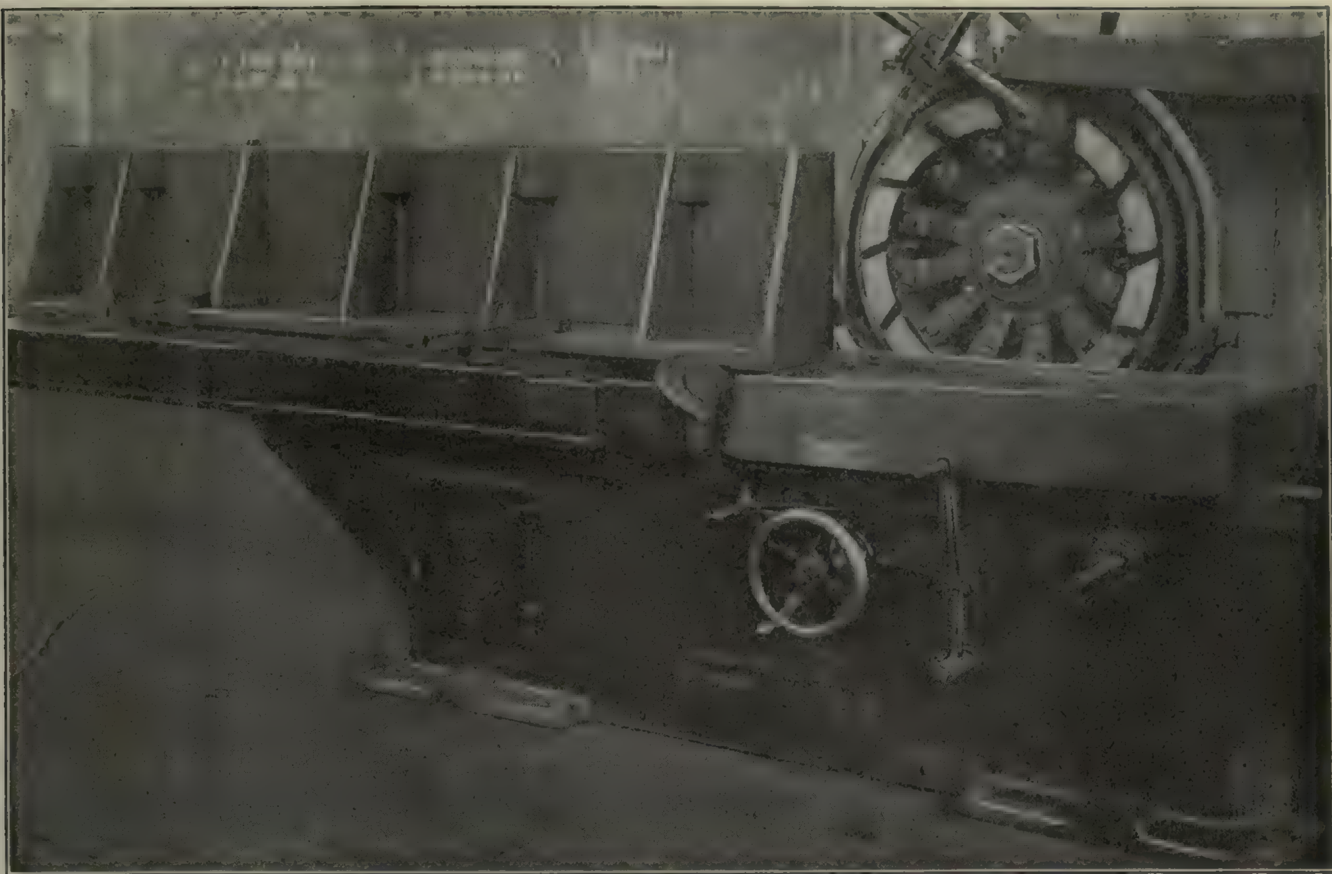
Purchases do not stand alone, but rather influence every part of the business. Probably no other function of a manufacturing concern has so great an effect on the profits of the business as a whole.

A Special Screwdriver

By Charles Hattenberger

Certain work which was being done at the Seneca Vocational School, required the use of some large fillister-head screws. To drive these securely in place required considerable power. This was secured by making a large screwdriver, as shown in the illustration, with a hexagon A integral with the shank. By using a monkey-wrench considerable purchase was obtained and the desired results were brought about. The screwdriver was made by a student at this school.

A HEAVY-DUTY SCREWDRIVER



Diamond Face-Grinding Machine and Its Work

By E. L. DUNN
Associate Editor, *American Machinist*

> *The development of grinding machines has probably advanced machine-shop production to its present state more than any other single agency. A close-up view of what is being accomplished in the grinding line is often surprising, even to those who are skilled in the art.*

THE scope of grinding operations is practically unlimited, and grinding machines are now competing with many other types of machine tools in the finishing of work. The value of such operations is, however, more pronounced with certain classes of work. Irregular shapes, thin pieces, hard iron, etc., are factors that come under this classification. The Diamond Machine Co., Providence, R. I., has solved many difficult problems with its machines and methods, some of which are herein described. One of the large face-grinding machines made by this company is illustrated in the headpiece. The long angle plate shown on the machine table is for a magnetic chuck, a front view of which may be seen in Fig. 1. This chuck, it will be noticed, is in the process of manufacture, as it is being ground. (For a detailed description of this operation, see Vol. 51, page 913, of the *American Machinist*.) Fig. 2 shows the finished chuck in use, holding drop-forged pump links in position for grinding. The time required to grind these, removing $\frac{1}{16}$ in. of stock from each side, is at the rate of four links in $2\frac{1}{2}$ hours.

The segment wheel seen on the machine in the headpiece, and also in the line drawing, Fig. 3, has particular application to the removal of large amounts of stock, and is said to be equally effective in obtaining a good finish. The wheel is constructed as shown, the chuck being of cast iron. The chuck fits the tapered end of the spindle and is held by a large nut. The twelve segments form a circle, 30-in. outside diameter and 24-in. inside. They are 6 in. thick and are held in position by special clamps. Since nearly all of the stresses in a wheel of this character are radial, but little pressure is required to hold the segments in place. The clamping method shown in Fig. 3 is a simple arrangement that is said to be very satisfactory. The clamps are angular-shaped, pivoted at the ends, and when the screws are tightened the segments are forced against the inside rim of the chuck and held securely.

The machine is heavily built and capable of handling very large work; however, it has a wide range of usefulness and is adaptable to many forms of light work. In this connection the rotary device, shown in Fig. 4, has proved of value. It is used to rotate the work, thus facilitating the grinding of flat, true surfaces as well as the removal of large amounts of stock. The chuck is revolved by means of a small motor located inside the casing at the top, the drive being through a chain and worm gearing.

The pulley-grinding fixture, shown in Fig. 5, is driven

FIG. 1. FRONT VIEW OF PARTLY FINISHED MAGNETIC CHUCK

from the rotary device through a universal shaft. When grinding pulleys, a solid ring wheel is used. The extent of the crown may be varied by changing the position of the pulley in relation to the wheel. If the pulley was ground on the face of the wheel there would be no crown, and if ground on the inside surface there would be too much crown; hence by using the beveled corner, as shown in Fig. 5, the correct curve is easily obtained. As to production, 8 x 6-in. pulleys are finished from the rough in 2 min. each. Another advantage claimed for this method is that no pulleys are discarded on account of hardness. The pulley-grinding fixture is provided with a ball-bearing thrust and the worm gearing receives lubrication from a single grease cup of the compression type. The feed is by handwheel.

Another class of work handled advantageously by the Diamond face-grinding machine is chilled cast-iron plates, of the type shown in Fig. 6. They are 10 x 36 in. in size and the finished surfaces are ground flat

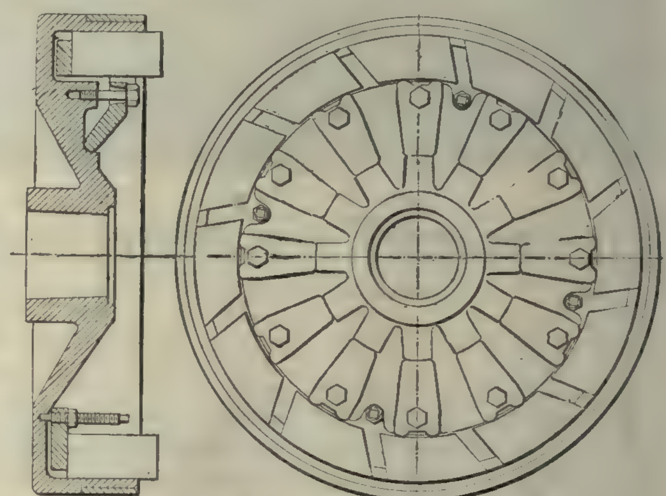


FIG. 3. DETAILS OF SEGMENT WHEEL

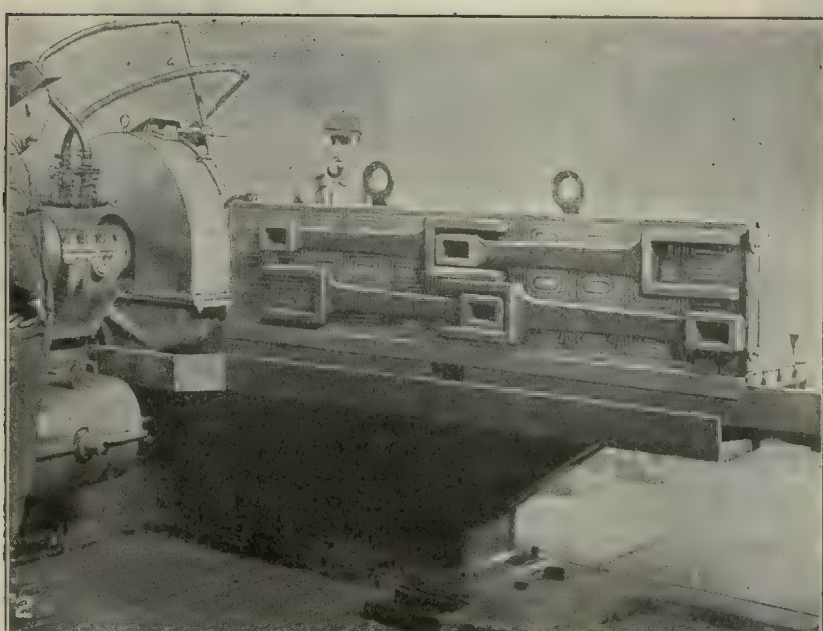


FIG. 2. FINISHED CHUCK HOLDING WORK

FIG. 4. ROTARY ATTACHMENT

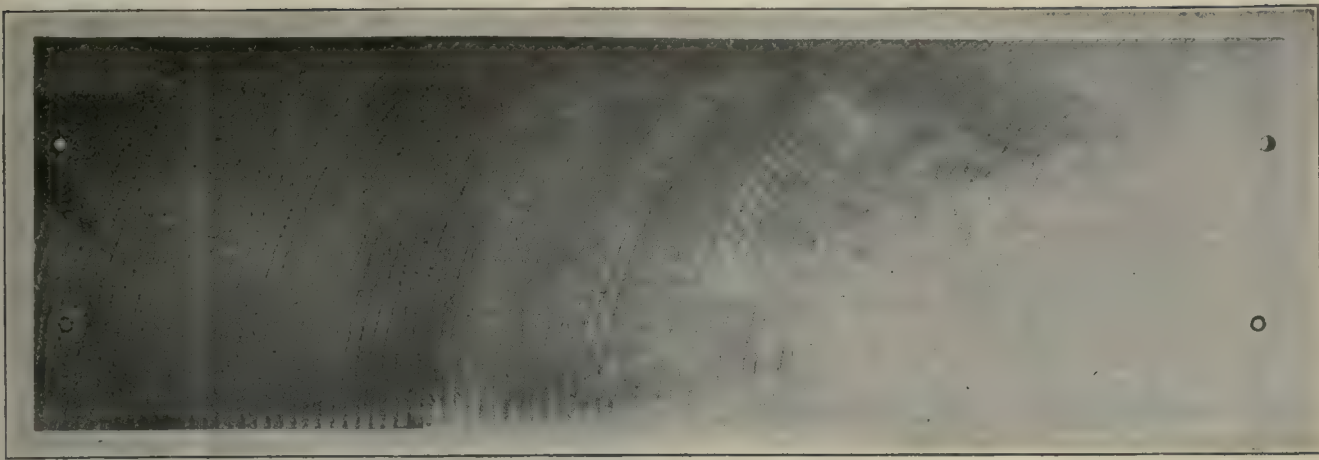


FIG. 6. CHILLED CAST-IRON PLATE

within 0.006 in. The time required is 18 min. for each plate. On account of the slight circular scratches in the polished surfaces of the plates, it was thought that it would be necessary to refinish them on a surface-grinding machine. This was found unnecessary as the same results were accomplished by a slight lapping with abrasive and oil. When grinding the ends of long, heavy

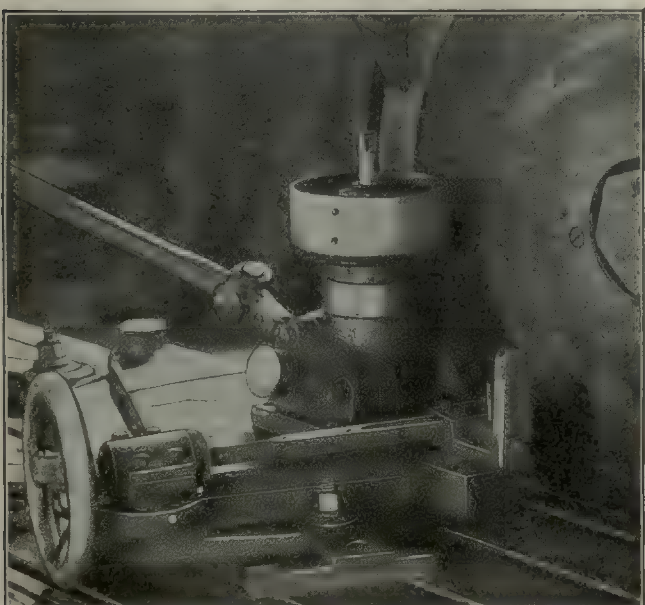


FIG. 5. PULLEY GRINDING FIXTURE

castings the work is handled in the same manner as on an open-side planing machine, where in the case of a long overhang, the outer end is supported on a roller table.

The segment wheel is recommended by the maker as being lower in first cost. The coolant solution recommended is 5 lb. of sal soda (sodium carbonate) to 45 gal. of water. The wheel segments are furnished in all grades.

The Life of an Airplane

The life of an airplane depends on two distinct assemblies: the power group and the structure of the machine. These have little in common, as far as their life is concerned, and their use requires different methods and usually a different class of mechanic for the upkeep.

Prior to the war the object of the designer was to get a machine that would fly, and little attention was paid to the durability of its parts. During the war it was discovered that the life of a machine in service was about three months, as it either was rendered obsolete or was crashed by the end of that period. This fact led most designers to sacrifice any considerations of durability in order to gain the prime military features.

Many of the larger aëronautical engine manufacturers of the world have remodeled most of their successful types with intention of increasing reliability. This has usually resulted in a slight increase in weight. Also the question of cost of overhauling has been gone into carefully and present-day engines are so designed that their accessories, valve gears, and similar parts are readily gotten at for cleaning and adjustment. The result is that most engines on the market today for commercial use can be relied on, with proper use and care, for from 125 to 150 hours without being overhauled. And if hoists, suitable benches, and other shop equipment are not available, valves may be ground and even pistons changed in many modern types without removal from the plane.

As mentioned above, war machines were designed for speed and not for durability. One feature, however, was developed as a result of the war which will have a great effect on the future use and development of aviation. That is the application of metal to the structure of the airplane. The Germans were driven to this by the lack of a reliable supply of suitable lumber. Some French and English firms also worked on this problem, notably Boulton and Paul in England and Louis Clement in France. Many inventors have brought forward alloys, new structural combinations, etc.

This development has been foreseen for many years, but presents a difficult problem. The effort to obtain the maximum of strength with the minimum of weight resulted in vastly refined types of internal structure and thorough investigations into the strength and properties of the available materials. All of this data and knowledge is now available to the designer who is working with the idea of durability.

The great shortage of good linen prompted an investigation of other materials as a substitute. Various weaves of cotton and cotton with linen were developed which have some properties of value that all-linen has not, besides being cheaper. Streamline wire was brought out of the experimental stage and can be obtained of equal strength and reliability with stranded cable.—*Automotive Industries.*

Handling Material at the Plant of the Greenfield Tap and Die Corporation

BY PETER F. O'SHEA

The handling of quantities of small-sized products in process of manufacture through a machine shop entails many problems. The author tells how material is handled in a shop that turns out a good many millions of small gages, taps and dies in a year. A look at the methods described may be interesting and instructive.

AT THE plant of the Greenfield Tap and Die Corporation, Greenfield, Mass., the rear end of the steel shed is the beginning of a long, low, single-story cutting-off shed where bar steel is cut up into short lengths as blanks for taps and dies. This building contains a long row of Nutter-Barnes cold saws, ranging all the way from the 3-in. to the 12-in. size.

The bars are put into the building through the side windows, from a driveway along the outside of the building. There are as many windows as there are saws, so that the most of the wall is windows. A truck may drive up alongside and by raising the proper window the bar stock is pushed in beside the saw which handles that size of steel. Each sill has a steel roller fastened upon it to facilitate sliding in the stock upon the piles.

Since each pile of stock may be 4 or 5 ft. high, a large quantity of steel is usually on hand in this shed. This obviates a lot of additional storage space. Moreover, as each pile is opposite the saw that is to handle it, no further handling of the rods is necessary, except to pull fresh rods into contact with the saw as wanted.

The material travels from left to right, coming in at the windows at the left as raw material, and falling into the aisle at the right in the form of blanks. Trucks are used to gather up the blanks, and, as the cement floor of the aisle and the passage to the main building and its floor are all on the same level, trucking involves the least effort.

Blanks Made in Bulk for Stock

Blanks for each size of tool are made in large lots, on orders applicable to blanks only. The lots called for on these orders are larger than orders for any given size of taps or dies. The blanks are put into partly finished stocks, and can be drawn against for any of the proper sizes.

The stockroom is wired off into a separate cage, has a wicket in the wire door, and is furnished with a desk for the stock clerk and a few racks for the more unusual blanks which are made in small quantities.

Blanks made in large quantities are stacked in boxes on the floor. Each box of blanks is formally received into the stockroom by the clerk, who inspects and counts the contents. This count he adds to an inventory card. The card stays with the box or boxes of blanks, one card to a size. The card has five columns, one each for the date, the amount received, amount issued, the order number, and net amount on hand. Each card therefore not only gives the current inventory of its size of blank, but gives the complete history of the number of blanks that passed through the stockroom, and what orders they were issued for.

The smaller sizes of blanks are stacked in small boxes. Some of the bulkier blanks are stacked in deep boxes on the same wooden truck platforms on which they came from the cutoff room.

From the stock cage all work is issued in small, shallow boxes, holding a standard number of pieces by count, according to the size. Of the larger size, 50 constitute a boxful; the smaller sizes contain as many as 200, or even 500. In no case is the boxful heavier than can be picked up by one man and handled quickly to and from his machine.

When an order is issued for a given number of pieces, as many order and routing tickets are made out as there will be boxesful needed to round out the order. One ticket, in a celluloid envelope to keep it from being soiled, is tossed into each box, after being marked with the letter corresponding to which instalment it is of the complete order. The order may therefore be sent forward in sections, provided enough sections are kept coming to supply an uninterrupted stream of work for the machines in their present set-up, and provided not so many sections are sent out so that they clog the stream.

Each work ticket accompanying a box shows the number of pieces in the box, the total number of pieces in the order, the number which have previously been routed through, and the number still to follow. The workmen as well as the foremen can therefore tell the progress of the work.

All stockrooms are caged in. A door in the wire has a spring lock with a latch inside. Since the stock clerk's desk is some distance from this door, he has rigged a strand of wire from his desk to the door-latch, so that he may admit anybody without walking to the door.

How the Size of an Order Is Determined

The frequency and size of the stock orders are determined in the administration office.

The sales department keeps statistics of its sales, including the quantity of each kind and size of product. From these statistics are determined the quantities of each product that should be kept in stock in the main stockroom ready for shipment. The stock is a reservoir which should be equal to the total demands of thousands of scattered customers, who order in all sorts of quantities, large and small. The minimum stock on hand must be enough to take care of all reasonable or expected demands.

The stock supervisor or the sales department and the general superintendent agree as to the amount of stock and the amount of each product which shall constitute a standard shop order. The sales department sees that it shall be sufficient to cover needs, and the general superintendent sees that the standard amount shall be economical to route and manufacture.

As soon as the stock for an article gets down to the minimum quantity the stockroom clerk sends a requisition to the production supervisor of the manufacturing department for the standard quantity. The production

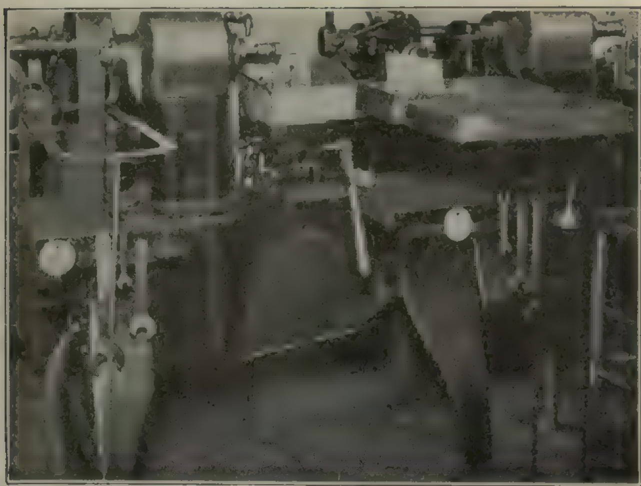


FIG. 1. BRACKET ATTACHED TO MACHINE AT ONE END; OTHER END SUPPORTED BY A ROD FROM THE FLOOR

supervisor then makes sure that he has the requisite amount of proper raw material stores on hand, and that the factory is not clogged too much with other work but what it can fit this order in. He then gets a promise of delivery from the factory itself and sends down the order. At the same time he tells the sales-department stock-supervisor when he may expect the finished order to be in the stockroom.

The Production Man

There is also a production man under the works manager. It is up to him to see not only that the order can be made or that the material is in the stores, but that the material is moved out of the stores and that the order is made and how it is going to be made, by just which machines, and on what schedule. He knows the individual machines by their machine numbers, and the workmen, and the detailed difficulties that are apt to come up at certain points.

The production man therefore takes the order as it comes from the general superintendent's department, and applies it. He has made out a standard routing card on which the necessary processes are printed in proper succession and opposite each process he writes in, in the second column, the department which is to do the work, and in the third column, the particular machine which is to do that process on that order. The next column is left blank for the workman to fill in the time he received the work. Columns are also provided for the number of pieces which were in each box when the workman received it and when he sent it on, so as to show any shortage from spoiled work.

These cards therefore determine the movement of the product from point to point in the factory.

The trucks used for moving material inside the factory are small, light and of a peculiar pattern. They are 36 in. long by 20 in. wide, built with a box-like frame-work of angle-iron, so that the surface of the truck is 30 in. from the floor. The top is of wood bound on the edges by the angle iron of the frame. The two strips of framework which bound the right and left edges of the top extend out from the truck for 5 in. at each end to furnish a hand hold and are the only handles. This truck is pushed, not pulled, by these handles.

The trucks are handled by young men called "bell boys," of whom there are a corps in each plant. When an order of product is ready to move, it is loaded upon one of these trucks; the bell boy consults the move card, gets hold of the truck and pushes it on its way.

The trucks gradually move from department to department from the cut-off or automatic room to the final inspection room at the front of the factory. Therefore, whenever a bell boy has an errand to take him toward the rear of the factory he takes an empty truck back to its starting point.

From the ground floor to the second floor a single elevator is rendered sufficient through proper routing of the work. The second floor contains the tap and reamer departments, where so much of the processes are done that when the work comes down it is on its way to the hardening room and does not have to be taken upstairs again. No material goes up on the elevator except blanks for taps and reamers.

Handling Work To and From Machines

The same shallow wooden boxes in which instalments of shop orders are issued from the stockroom are used at the machines. Each machine is provided with some sort of a resting place for a box of blanks, and another resting place for an empty box to receive the work as fast as the process is done on each piece.

The box of blanks is generally placed where the left hand of the operator will naturally reach, and the product box at his right hand. This order is reversed in case two machines are so related that the one on the left does the next process following that of the machine at the right. In this case the product box of one machine is the blank box of the next machine, and may be situated midway between them, with room for an extra box in case one machine gets ahead of the other.

The form of the resting place for the product box varies. In some cases it is a small table or bench. The resting place for the work box is sometimes on the truck which brought it to the machine, and which is backed up and left there. Another truck is stationed on the other side of the worker, with empty boxes on it to receive the finished work. The workman automatically does the loading of the truck; thus, the product can be wheeled away without rehandling.

A convenient form of support for work boxes is a bracket made of strap iron, attached either partly or completely to the machine, and supported by it. The form of bracket attached only partly to the machine, Fig. 1, is composed of a strap of iron bent into the shape of a U having about 18 in. between the arms. The two ends are bent down and holes bored for fastening the bracket to the base of the machine. Under the

FIG. 2. BRACKET FOR SUPPORTING PANS TO SERVE TWO MACHINES

middle point of the U a half-inch iron rod is put, reaching to the floor. Since the strap-iron ends are fastened firmly to the machine, this makes a rigid support.

The bracket is light, inexpensive and can be applied to the most convenient point of almost any sort of machine. Near the front and back ends of the bracket sharp steel points are inserted. These engage the wood on the under side of the product box and prevent it being shoved off by accident.

Another economical bracket for holding work boxes is made of strap and angle iron. This bracket is above the machine and is composed of a rectangular frame parellel with the machine, and raised above it on four legs, one at each corner. The legs fastened to the front of the machine are shorter than those at the rear, so that the frame slants downward toward the front. The lower or front edge of the frame is made of an angle iron with the angle up, so that it forms a lip that prevents the boxes placed upon the frame from sliding down. The upper or rear bar of the frame is made of flat strap iron.

A double form of the same bracket is shown in Fig. 2, and is used where there are two machines back to back. Here the side members of the bracket are of double length, bent in the middle at the proper angle to give the right slant at the front and rear. The bracket spans both machines. Two of the legs are fastened to the front of one machine, two to the front of the other. The bracket holds work for both operators, each operator's work facing him at the proper slant and at a convenient position over his machine.

Boxes Front and Rear

In another department there is a machine set up for practically the same operation all the time. It is necessary for the operator to hold the work in place against the cutting tool with his hand, while at the same time locating the cut from lugs in the chuck. By placing the product box on the rear of the machine, he is able to simply let go of the product as quick as the cut is finished, instead of bringing it forward again. This speeds up his work by a considerable ratio. The same idea is used in other processes and machines.

In fact, in a great many machines the principle is used of delivering the finished piece of work to a receiver as close to the cutting point as possible. For instance, the receiving mouth of a chute may be shoved up directly under the cutting point, or within a few inches of it. Such chutes discharge either into a product box or pail on the floor, or to a product box at the next machine which is to do the next process. Waste motion is thus cut to the minimum.

Chutes of galvanized sheet iron thus used were described in the *American Machinist* on page 1,069, Vol. 50. The same article on page 1,068 calls attention to the method of stopping the fall of small threaded work into product pails, by wooden blocks or buffer boards to check the speed so that the threads will not be injured.

Work, especially dies, is handled mostly in shallow, flat boxes of wood through the factory. Large taps above 1-in. pitch diameter are up-ended in boards having holes bored to receive them. These boards also count the work automatically, as the number of holes is standard. In trucking, several boards are piled one on top of the other, each board resting on the up-ended taps in the board below.

Reamers are handled in similar boards or deep blocks. A toolman in the reamer department has designed special boards, all of the same outside dimensions, and divided into smaller compartments, by strips of ½-in. wood, the number of compartments varying on the different boards according to the size of the reamers they are to hold. Thus, sixteen small reamers may fit on one board, while only twelve of a larger size will fit on another.

All work arrives at the final inspection room in the same boxes, boards or trays in which it was handled through the shop. As fast as it is inspected and passed, however, it is put into standard steel pans, except the large taps, which are left up-ended in boards.

Inspection

Each workman has a tolerance gage on his machine, usually a snap limit gage, and workmen who deal with the threaded portion of taps and dies have thread limit gages.

There is a floor inspector in each department who makes the rounds and tries out with an inspection gage, either of the snap limit or the rapid inspection snap variety, the product of the machines, thus catching any error that may have occurred in the set-up or the wear of the tools used.

All gages are set and adjusted by a gage supervisor for each division of the plant.

Bench inspectors inspect the product as it is brought to them after each group of processes and usually work with rapid inspection gages. In some cases they also count the work and keep a check on it.

In the automatic room, for instance, where small tap blanks are cut from bars, the pails of blanks from the machines are taken to a bench in the end of this room. Here the blanks are not only inspected for size and counted, but they are arranged in boxes with the standard number in a box. For instance, half-inch taps are handled 400 in a box. This function performed by the inspectors for small taps is the same as that done by the stockroom for dies and large taps.

The inspection department has another bench installed in the tap department. Here taps are brought in pails or boxes after each group of processes and must be passed by the inspectors before going on to the next group. This keeps the finished product of the correct accuracy.

Before each process inspection, the oil is removed from between the threads of the taps by washing in hot soda water.

As each box or pan of product reaches the hardening room, the foreman places in it a slip which gives instructions to the workman for the hardening heat, tempering heat, and time for tempering bath.

After coming out of the tempering bath an inspector tests each batch of work with a file and quickly catches any irregularities in the results of tempering. The proper tests, by the way, for the hardening of taps is that the file should neither slip over the steel as if it were glass, nor bite in, but just barely take hold.

By the time the product is ready for sale, it has received fifteen inspections. Thus, it is certain not only that the final product is pretty nearly right as to dimensions, but that spoiled work is caught as soon as it is spoiled, and is not handled uselessly beyond that point. One or two wrong pieces in a thousand may not only lose a reputation for the manufacturer, but they may also cause considerable trouble through the shop itself.

In the final inspection room every dimension on each

individual piece of product is gone over with limit gages and examined with a magnifying glass for roughness of threads, or cracks due to tempering. To catch any concealed flaw, each tap is put into a torsion tester before being finally passed.

The final inspection room is partitioned off at the extreme front of the building. There is nobody in the room but inspectors, so they can concentrate their attention on their work.

The last process is to clean the product thoroughly with gasoline and cover each piece with vaseline to prevent rust, and then pack in steel pans.

Into each pan is tossed a "count slip" which shows, not the theoretical number of pieces that would be in the pan if it started with the standard number and none were spoiled, but the actual number of finished pieces in that particular pan. There may be, for instance, 397 instead of the theoretical 400. This slip was especially useful during the war, when shipping difficulties arose simultaneously with an increased Government demand for small tools. More pans were needed to handle the product, but could not be got in time. Therefore, the plan of standardized numbers of pieces in every box was temporarily abandoned, and as many pieces were put into each pan as it would possibly hold. Under these circumstances the count slips became especially important.

Cutting Screws of Quick Lead

By L. A. Dixie

Some day some enterprising American lathe manufacturer is going to market a lathe on which one can cut almost any screw from, say, 40 threads per inch up to a lead of 6, or even 12 inches. In order to do this all that will be necessary is a slight lengthening of the headstock of the lathe, the introduction of a single small pinion and washer, and a slight change in the manner of mounting the tumbler gears. In this article I am going to tell him how to do it, so that after he reads, it will be up to him.

The lead screws of foreign lathes are, or at least used to be, not only much larger in diameter than those of American lathes but they are also much coarser in pitch; for instance, when I served my apprenticeship, the lead screw of a Scottish engine lathe of 20-in. swing was from 2 to 2½ in. in diameter and at least of ½-in. lead. Lathes of 10-in. swing had leadscrews of ¼-in. lead. The change gears had from 20 to 120 teeth, rising in increments of five.

In this country, however, one seldom sees lead screws coarser than ¼ in., and generally they are as fine as ⅙ in. lead on lathes up to 18-in. swing. For this reason the gear ratio must be much higher and the stresses on the gear teeth greater when cutting rapid leads. In our shop we recently have had to cut a number of screws of this kind and several methods have been employed to do the job, all of which are old, but

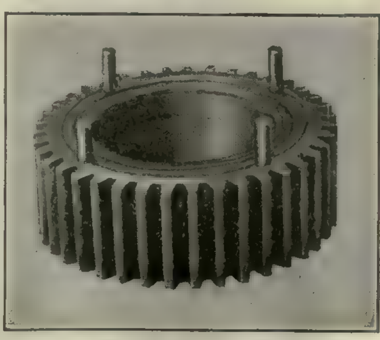


FIG. 1. THE NEW PINION

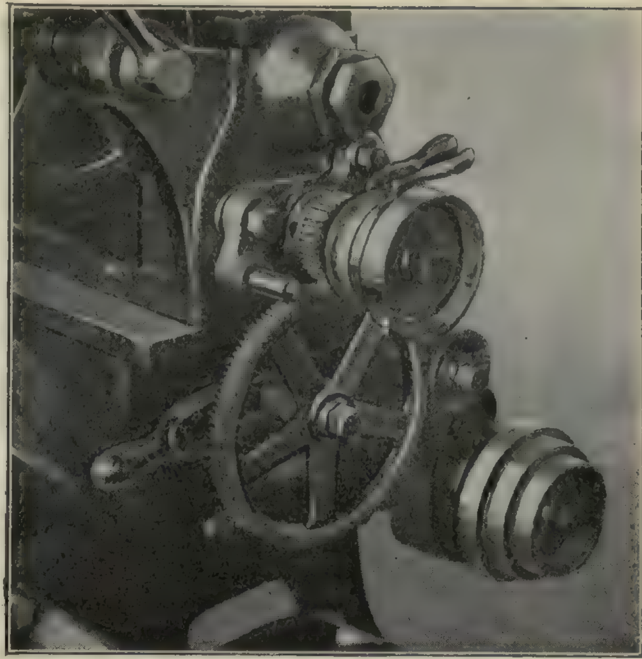


FIG. 2. CHANGE GEARS SET UP TO CUT 3 IN. LEAD

there is one that is so little known and so superior that it should be given publicity.

The usual method of placing a large gear on the stud and a small one on the lead screw is so well known that it is unnecessary to do more than call attention to it. The second method—that of driving the lead screw direct and turning the spindle through gearing from the lead screw, although not so well known, is not uncommon. The third method is so simple that it has always been a wonder to me that no lathe maker has incorporated it in the design of his product.

The speed of the cone with relation to the speed of the spindle of the ordinary engine lathe depends on the ratio of the back gearing. In conventional engine-lathe construction a pinion secured to the small end of the cone drives the large gear on the quill of the back gear and the pinion on the quill drives the large gear which is keyed to the lathe spindle.

For cutting coarse threads the lead screw must turn faster than the spindle, the speed ratio of course depending upon the lead of the lead screw relative to the thread being cut. With the back gears engaged, the cone is already turning faster than the spindle, so it is obvious that if we can arrange to transmit the power directly from the cone to the leadscrew through suitable gearing we will increase the speed of the latter without the disadvantage of increased gear ratios an consequent increased gear-tooth pressures. The change-gear ratio required to cut a given pitch would thus be reduced in proportion to the ratio of the back gears.

For instance, let us say this ratio is six to one and the lead of the screw one-sixth. Under the usual conditions with equal gears oi stud and screw the resultant lead would be one-sixth, or, as commonly spoken, six pitch (single threads only being considered). If the transmission were direct from the cone, the lead would be one inch.

Several lathes in the shops of the Taylor & Fenn Co., Hartford, Conn., have been adapted by Mr. Wilkinson, foreman of the lathe department, to cut coarse lead worms and oil grooves. The method of adaptation is as follows: The pinion that drives the tumbler gears is

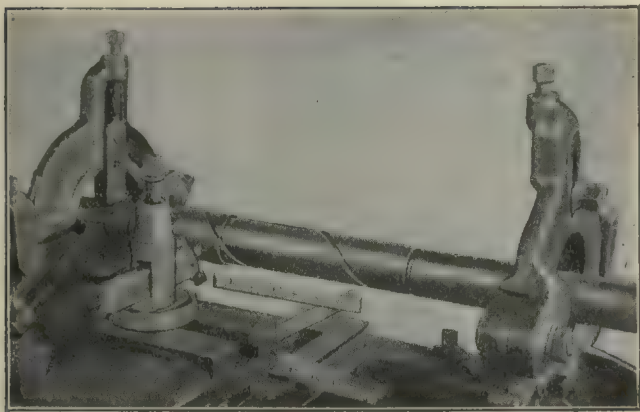


FIG. 3. CUTTING AN OIL GROOVE 6-IN. PITCH

replaced by a pinion of the same width of face and number of teeth, the new pinion being pinned to the cone pinion and turning loose upon the spindle. Fig. 1 shows the new pinion with the pins fitted tight in it but loose in the cone pinion. The cone with the new pinion attached to it is slipped on the spindle and the spindle put back into the head and the boxes adjusted. With this arrangement the spindle can, as usual, be driven by the back gearing, but the tumbler gears engage with the new pinion which is pinned to the cone pinion and turns with the cone.

Fig. 2 shows the change gears of a lathe thus equipped, set to cut a lead of 3 in. In Fig. 3 the lathe is cutting an oil groove with a lead of 3 in., and in Fig. 4 the shape and setting of the tool for doing this work may be seen.

In designing a lathe to incorporate the features above outlined, there are some points which must be borne in mind.

An extra pinion the size of the spindle pinion will have to be attached to the cone pinion. This will necessitate the keying of the spindle pinion further from the cone by an amount equal to the width of face of this extra pinion.

As the tumbler gear will be required sometimes to engage with the new pinion and sometimes with the regular one, it must be made to slide on its shaft in a direction parallel to the lathe spindle. Means must be provided so that it can be locked in either position, as some unthinking operator may attempt to engage the tumbler gear with both pinions at the same time.

Probably the simplest way to avoid disaster from this cause would be to put a washer between the two pinions, the outside diameter of which should be equal to the outside diameter of the pinions between which it is placed.

Fig. 5 shows the arrangement of new pinion and tumbler gears. To illustrate the advantage of this arrangement we will assume, as before, a lathe in which the back gear ratio is six to one and the screw of $\frac{1}{6}$ in. lead. With even gears on stud and screw and the tumbler gear meshing with the regular spindle pinion, the lathe would cut a screw of $\frac{1}{6}$-in. lead, duplicating the lead screw. By shifting the tumbler gear lengthwise of its shaft so that it would mesh with the new auxiliary

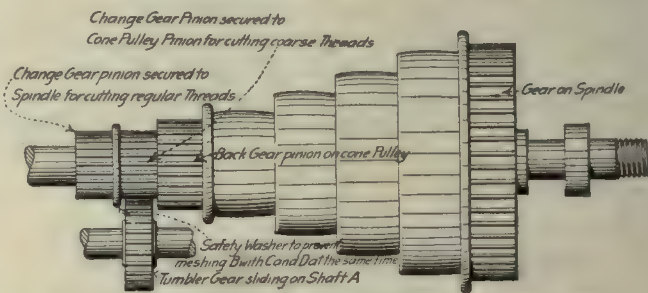


FIG. 5. ARRANGEMENT OF EXTRA PINION AND TUMBLER GEARS

cone pinion the resulting screw would be of 1-in. lead, no other change being necessary.

Another thing that the lathe designer will have to bear in mind is that the ratios of the back gears will have to be something definite. In many lathes, as at present constructed, this ratio is a more or less complicated fraction. This will have to be changed so that the speed of the cone is some exact multiple of the spindle speed.

FIG. 4. THE TOOL

The Trials of Old Baldy—IV.

By A. R. Durant

Old Baldy, the somewhat autocratic boss of the old Ajax Works, though austere and forbidding on first acquaintance, possessed a strong sense of humor and a commendable respect for justice. He could tell a bluffer as far as he could see him, and occasionally put one of them on the payroll apparently for the sake of having some fun with him.

One such came to work one morning and after falling down on several minor jobs Old Baldy asked him if he could run a "Dutch planer." Mr. Bluffer looked longingly out of the tail of his eye at Slim Benson, who was sitting on a soap-box and leaning comfortably against a post as he presided over the deliberate movements of the big planer at the end of the shop, as he replied: Oh, yes! I ran one for years up at the old Dingumbob works—the biggest one in the shop, too!"

"Well!" says Baldy, producing a 14-in. bastard file from a nearby bench drawer, "here is the biggest one we got; you can take the roughing cut over that row of castings there on the bench."

Mr. Bluffer took a cut 'cross-lots in the direction of the nearest saloon. He hasn't come back yet.

Common Errors in the Designing and Machining of Bearings*

BY CHRISTOPHER H. BIERBAUM

After presenting ten principles relating to the design, construction and operation of journal bearings, based on what is now known concerning the laws of lubrication, the author discusses among other things oil grooves and their proper distribution, the disadvantages of tight-fitting bushings, proper methods of finishing brasses to provide for expansion when running, and proper methods of clamping bearings during tooling. He then takes up the matter of the tools employed in machining bearings and shows by numerous photomicrographs of finished surfaces the importance of using sharp tools with the proper rake in order that the crystalline structure of the surface material of the bearing may not be so crushed and compacted that it will fail to function as a normal bearing alloy.

IN CONSIDERING the subject of bearings, their design, construction and lubrication, it is desirable to have in mind the fundamental laws discovered by Tower, Thurston, Goodman, Lasche, Stribeck and others. Taking the work of these investigators in the light of what is now known concerning these laws, it follows that in the operation of a properly designed, constructed and lubricated bearing we may lay down the following ten principles:

1. The bearing surfaces are completely separated by a film of oil.
2. The friction of operation is the fluid friction in the oil film, and adequate thickness of film is essential.

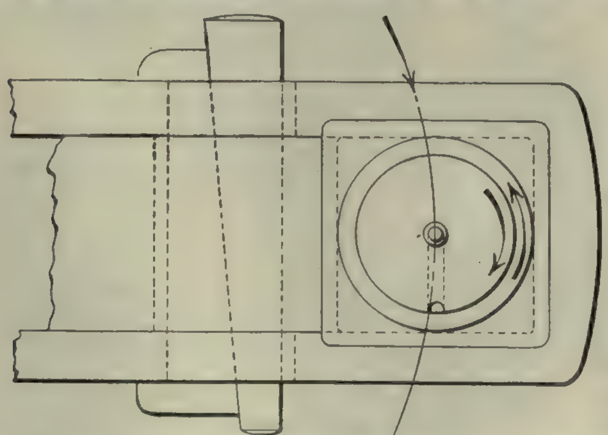


FIG. 1. EFFICIENT METHOD OF LUBRICATING A CRANKPIN BEARING

3. During construction proper clearance or space should be provided for a normal thickness of oil film.
4. The advance edge of a bearing surface must be rounded or chamfered off in order to permit a supporting film of oil to form.
5. The oil film forms most effectively upon a bearing surface, the advance edge of which is at right angles to the direction of motion.
6. An increase of speed increases the thickness of film, all other conditions remaining constant and clearance permitting.
7. An increase in the viscosity of the oil increases the thickness of film, all other conditions remaining constant and clearance permitting.
8. The larger the unbroken film of oil, the greater will be the average pressure-supporting capacity per unit area, other conditions remaining constant.

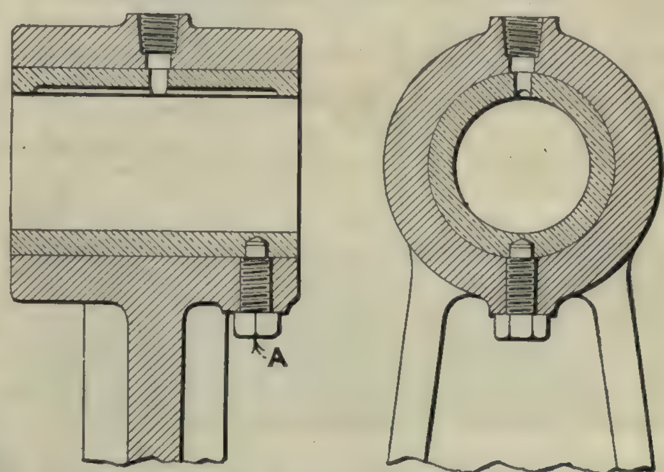


FIG. 2. SECTIONS OF AN ORDINARY BUSHING DRIVEN INTO A CAST-IRON HOUSING

9. Every unnecessary oil groove or interruption in the continuity of the oil film reduces the supporting capacity of the film.
10. For every bearing condition there is a film thickness corresponding to maximum lubrication efficiency.

The law governing the proper thickness of oil film has not as yet been investigated to the extent that the importance of the subject demands. In modern machinery the average thickness of film varies from 0.0002 to 0.006 inch.

PRECAUTIONS REGARDING OIL GROOVES

The application of the known laws can be discussed to the best advantage by considering specific cases. Fig. 1 represents a theoretical ideal, as well as a practical and efficient, method of lubricating a crankpin bearing, the journal receiving oil through the crankpin. The rotation of the crankshaft is in the direction indicated by the upper arrow, and in the position shown the engine is on a dead center at a point of reversal of pressure. The direction of relative motion of the rubbing surfaces is shown by the two arrows at the right of the figure. The oil film enveloping the right half of the crankpin has been completely restored during the stroke just finished, since the oil groove passed over this half of the bearing while no pressure was being exerted upon it. After the dead center has been passed, the entire pressure is then exerted upon the crankpin with its fully restored oil film, and at the same time the oil groove wipes over the other half of the bearing and restores its oil film while no pressure is being exerted upon it, after which it in turn is ready to receive a reversal of pressure upon a fully restored oil film. Thus, both halves of this

*From a paper presented at the Annual Meeting, December, 1919, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York.

crankpin bearing present alternately, for the maximum pressure of each stroke, a complete and uninterrupted surface for maintaining the film on an area equal to the projected area of the crankpin, but it is impossible to obtain so perfect a condition of lubrication in a bearing having the old-fashioned cross oil grooves which are still too often found in this class of bearing.

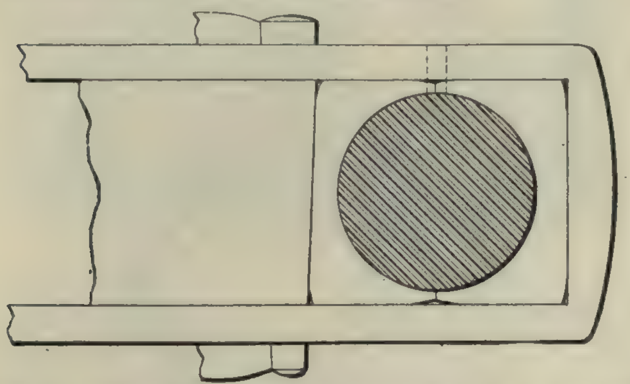


FIG. 3. PROPER METHOD OF FINISHING CRANKSHAFT BRASSES TO PROVIDE FOR EXPANSION

In many cases oil grooves are necessary evils, which should be minimized as much as possible by avoiding a useless excess of grooves and especially grooves in the direct line of maximum pressure of the bearing.

Disadvantages of Tight-Fitting Bushings

Fig. 2 shows a transverse and a longitudinal section of an ordinary bushing driven into a cast-iron housing. As all bearing alloys have a coefficient of expansion higher than that of cast iron, and as the bearing is directly subject to the friction of the journal, it follows

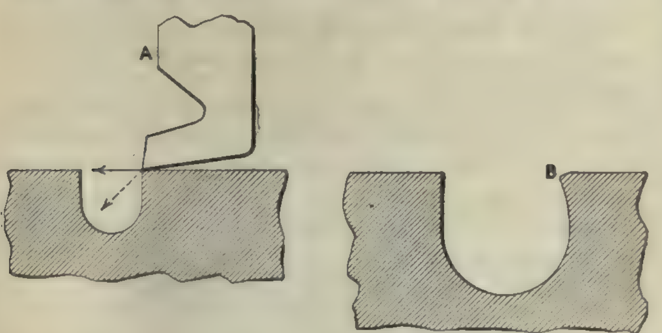


FIG. 5. SHARP EDGE OF AN OIL GROOVE PRODUCED BY AN ORDINARY TOOL

that the bearing is at a higher temperature than the cast-iron housing and must have an appreciable outward expansion when in operation.

When a bushing is driven in too tight, although it has been reamed before being placed in service, the amount of clearance which it will then have becomes a matter of guesswork and the amount of oil-film space provided an uncertainty. The idea that bushings must be driven in tightly in order to hold them in place is fundamentally wrong. For all ordinary machinery it will suffice if a bushing may be driven in place with a blow of the hand or with a small block of wood. The provision for fastening the bushing in place should be such that it will not bind or clamp the latter against outward expansion. In the construction shown in Fig. 2 a setscrew engages a hole in the bushing, but does not, however, bottom in the hole.

Fig. 3 shows a crankpin bearing finished in a manner providing for necessary expansion in service. The edges of the half-bearings should bear solidly against each other and should exert a pressure against each other somewhat in excess of the maximum crankpin load. The outer surface of both bearings near these edges should be relieved so as not to bear upon the straps, as shown, somewhat exaggerated, in Fig. 3. The four corners of the bearings should be relieved in like manner so that the horizontal thrust will be mainly borne upon the surfaces falling within the area of the

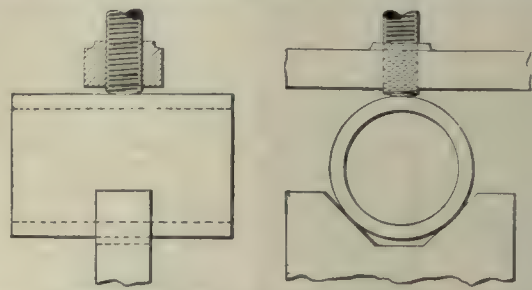


FIG. 4. IMPROPER METHOD OF CLAMPING A BUSHING FOR TOOLING

horizontal projection of the crankpin. A bearing thus constructed expands with the first slight increase of temperature, relieving the crankpin instead of clamping it as when these precautions are not taken.

Mention may here be made of a class of bearings which together with their supports are often improperly designed; namely, self-oiling ring bushings. These are nearly cut in half at mid-length in order to provide space in which the ring may operate, and the supporting wall beneath the bushing is slotted correspondingly at the center to permit the insertion of the ring into the oil well. This often unduly weakens the bearing at a point where normally the greatest film pressure is exerted. In general, much of the trouble at present encountered in bearings can be overcome by simply increasing the

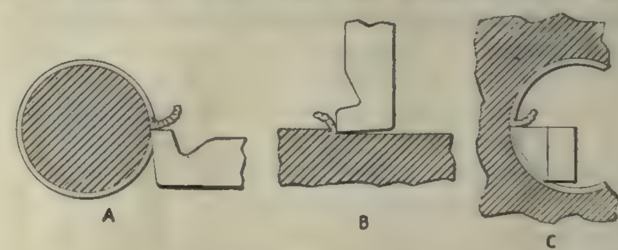


FIG. 6. IMPROPER FORMS OF TOOLS

strength and rigidity of the bearings and their supports, since an insensible amount of distortion and deflection is sufficient to produce all manner of annoyances.

Bearings Should Be Clamped Endwise for Tooling

Fig. 4 shows end and longitudinal views of an improperly clamped bushing. With a $\frac{5}{8}$-in. 16-thread setscrew and the application of, say, a 50-lb. pull upon a 12-in. monkey wrench, a pressure of 50,000 lb. can be carelessly exerted upon the bushing in question. Bushings tooled when clamped in the manner shown seldom have a bore that even approaches a true cylindrical surface, and if they are then driven upon an arbor and finished on the outside a very inaccurate product is the result. The best and most satisfactory method of holding bushings for tooling is that of clamping them endwise.

The matter of chamfering oil-groove edges deserves

special attention in that all advance edges of a bearing should be rounded and chamfered off, and the fact that this work should be done after all of the other tooling has been completed, is important. At *A*, Fig. 5, is shown an ordinary lathe tool at the edge of a groove on a finished surface. There are two forces exerted upon any surface which is being tooled, one horizontal or parallel to the finished surface and the other vertical or in a direction normal to that surface. The resultant of these forces is a force indicated by the dotted arrow, in a direction tending to deflect the edge of the groove obliquely downward, producing an effect which is shown somewhat exaggerated at *B*. An injurious effect is produced in a bearing if any tooling is done after the oil grooves have been cut, especially so if the direction of rotation of the journal is opposite to that of the tooling. In all cases sharp edges of the groove prevent the formation of an adequate oil film and should be carefully avoided.

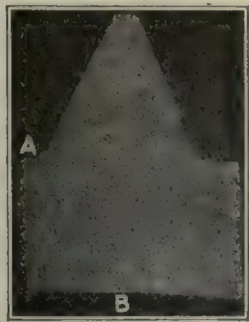


FIG. 7. CROSS-SECTION OF ONE OF THE TEETH OF A WORMWHEEL

For best results it is necessary that a cutting tool should have rake. The tools shown in Fig. 6 would be readily condemned even by a person with a very limited shop experience, and no journeyman machinist would think of setting a lathe tool as shown at *A*, a planer tool as at *B*, or a boring tool as at *C*. In the last-mentioned case the amount of radial pressure which it exerts upon the finished surface is far in excess of what is necessary. Consider, now, the standard multiple-cutting-edge reamer which is very often used in finishing bearings. A 2½-in. reamer would have, say, fourteen edges and the amount of bursting or internal pressure that it would exert within a bushing would be at least fourteen times that exerted in case the bushing were reamed with only one improper tool as shown at *C*.

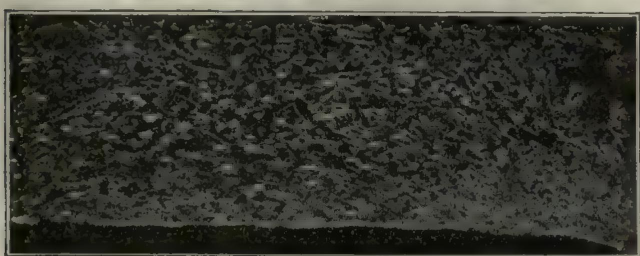
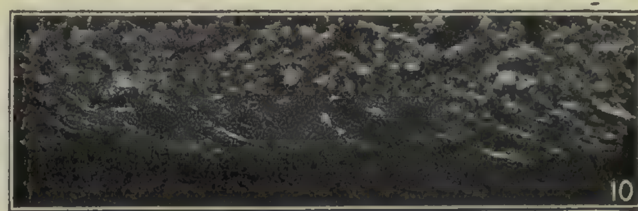


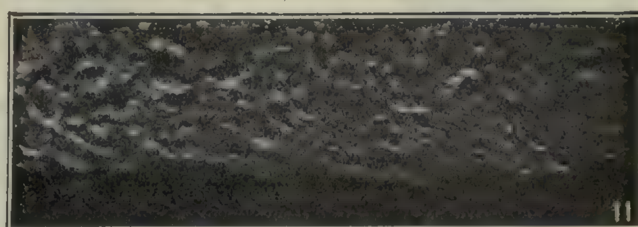
FIG. 8. PHOTOMICROGRAPH OF FIELD AT *a*, FIG. 7 (60 MAGNIFICATIONS), SHOWING DISTURBANCE OF CRYSTALLINE STRUCTURE DUE TO THE USE OF A DULL TOOL IN HOBBING

The final finishing in bearings should be done by reamers or cutting heads having only one or a limited number of cutting edges, and these cutting edges should have the proper amount of rake—such as would be given to any other proper cutting tool. Experiments made in a large manufacturing plant on bushings of the same dimensions, from the same lot of material, finished at the same time, some, however, being reamed with the standard multiple-cutting-edge reamer and others with a single cutting blade, showed that after a storage of six months those bushings which had been reamed with a proper single cutting edge retained their accuracy and shape much better than those finished with the so-called standard reamer. The latter bushings exhibited a decided tendency to decrease in inside diameter and to assume inaccurate, elliptical forms.

FIG. 9. PHOTOMICROGRAPH OF EDGE *b*, FIG. 7 (90 MAGNIFICATIONS), SHOWING THAT A SHARP TOOL PROPERLY GROUND WILL NOT DISTURB THE CRYSTALLINE STRUCTURE

In order to obtain the full value of bearing alloys it is necessary that these alloys should be presented as bearing surfaces having their natural crystallization undisturbed. The hard or bearing crystals should be embedded in a softer material, permitting the former to adapt themselves to the journal surface. The softer crystals under proper service conditions will wear slightly below the surface of the harder crystals. In order to retain these conditions it is necessary to preserve the natural crystallization upon the bearing surfaces, but this cannot obtain where they have been mutilated by improper tooling. This mutilation of the bearing surfaces gives rise to the crushing of the harder crystals and embeds these crushed particles into a compressed material which does not function as a normal bearing alloy.





FIGS. 10 AND 11. PHOTOMICROGRAPHS OF THE INNER EDGE OF A BUSHING FINISHED WITH A DULL BROACH (60 MAGNIFICATIONS), SHOWING MUTILATION OF THE SURFACE MATERIAL

An illustration of this is furnished by the bronze wormwheel of a certain motor-truck drive in which the teeth had been finished with a dull hob, Fig. 7 showing a cross-section of one of the teeth. After giving unsatisfactory service the wormwheel was examined in the usual way by chemical and physical tests, neither of which showed any defect whatsoever. On the other hand, microscopic examination showed that the trouble was due to improper tooling. Fig. 8 shows a photomicrographic section of a field at *A*, Fig. 7. This view clearly shows that the natural crystallization of the greater part of the area has been distributed, and that the edge of the tooth has had a cold-rolled or wire-drawn effect produced upon it by improper tooling, which proved to be the sole cause for the very unsatisfactory performance which this wheel gave in service. Fig. 9 shows a magnification of part of the edge *B* of Fig. 7, the inner edge or surface of this wheel from which it is centered upon

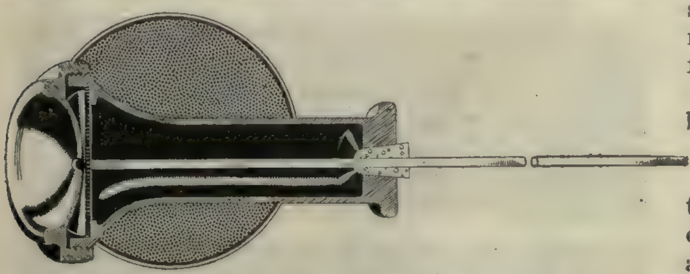
its spider. This surface had been tooled with a single cut, the tool ground and set so as to produce a smooth finished surface, showing that it is an easy matter to cut a bronze surface satisfactorily without distorting the natural orientation of its crystalline structure.

Figs. 10 and 11 are photomicrographic sections of the inner edges of a bronze bushing which had been finished by broaching with a dull broach. These micrographs show that the surface material has been distinctly mutilated and that the compression of the material upon the bearing surface is very uneven, and they prove conclusively that this treatment is not conducive to best service requirements.

A Sound Detector

By Cyril B. Clark

The article by D. C. Cook entitled "Locating Knocks in Motors," and published on page 1064, vol. 51 of *American Machinist*, brings to mind an experiment with a similar device, but for an entirely different purpose. Our plant covered considerable territory and was equipped with a sprinkler fire-protection system. Two



THE SOUND DETECTOR

large tanks held the immediate water supply and at the time of which I write it had been discovered that about 12,000 gal. of water was getting away every twenty-four hours by some unseen course.

An old telephone receiver was procured, the magnet removed and a drill rod of about No. 8 gage was attached to the inner side of the diaphragm. The wire extended two feet or so from the small end of the receiver case which latter was bushed with a common cork to prevent the wire from rattling against the sides of the hole.

With this device we went "looking" for the run-away water. It was a short job. Outside of every building were one or more valves to control the water supply from the mains underground. The stem packing of several of these valves was found to be leaking and as the plant was beside a river and the soil was porous the water got away unnoticed.

With the sound transmitter a very small leakage could be distinctly heard even though six feet under ground.

Repairing Expansion Reamers

By W. F. Hollis

The expansion reamer shown in the cut is a rather fragile tool, and to throw one away when broken, especially if it happens to be a new reamer, is a disheartening loss; but to be able to save them for further use instead of scrapping them is a saving of importance —a practical example of true conservation of resources.

They usually break at the end of the slots as shown at *A* and *B* where the blades join the solid body and as a result of one of the following causes: by a novice not being sufficiently cautious when using a new, sharp reamer and overfeeding it to the point of sticking, or "hogging in"; by those who desire to enlarge a hole "just a trifle" more and who, misjudging the amount of expansion the tool will stand, screw in the expanding plug until they overstep the limit of the blades; or, when the reamer rolls off the bench onto the floor.

To repair the reamers when thus broken, reduce the diameter of pilot or wrench end (or both ends for that matter, which has often been done) $\frac{1}{8}$ in. and of suffi-

REPAIRING AN EXPANSION REAMER

cient length to allow the fitting on of a tight steel sleeve well over the broken ends of blades, and they will be reclaimed to do service for years to come.

Having seen dozens of reamers broken in the manners stated, I think it would be a matter of good business for the makers of such tools to adopt a policy of drawing the blades at the weak point, as indicated, to a spring temper, thereby giving them a longer life; for many who do not know how to repair them, refrain from buying them on account of this weakness.

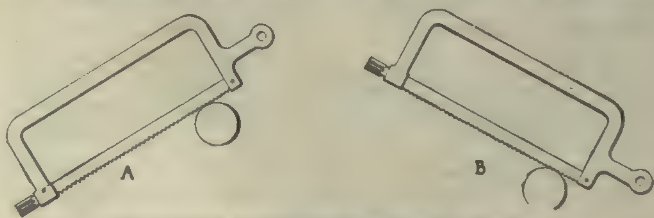
As a further precautionary measure, the reamers, before and after being used, should be incased in a piece of standard commercial ribbed-rubber tubing. This not only stops them from rolling but should they accidentally be dropped on the floor the chance of breakage will be greatly lessened. It also serves as a protection for the cutting edges.

Converting a Shaping Machine to a Power Hacksaw

By Hiram Hicks

I would like to ask Wm. Denton who, on page 307 of *American Machinist*, describes the conversion of a shaper into a power hacksawing machine, what was the range of sizes that the machine was capable of covering, without vertical movement of the tool slide (which involves personal attendance)?

If he put a 2-in. bar in the vise and started the saw anywhere near level, at the end of the stroke



EXTREME POSITIONS OF SAW FRAME

the saw would occupy the position shown at *A* in the illustration, unless it were held up by the limiting screw; in which case it wouldn't saw. If he started the saw with the tool slide low enough to cut clear through the bar without further attention the saw frame would assume the position shown at *B* as the ram came forward.

If he set the tool slide in the middle he would get both movements (at different parts of the cut) without reaching the extreme of either.

In any case, in my opinion the saw would promptly "bust."

The Evolution of the Workshop—VIII

BY H. H. MANCHESTER

The Second Half of the 18th Century

The discovery and use of coke to replace the rapidly vanishing supply of charcoal is responsible for the rejuvenation of the English ironworking industry. Various government publications in both England and France afford excellent records of the advancement in this period which just precedes the machine-tool era.

(Part VII was published in our April 1 issue.)

THE best sources of information in regard to the machine shops come from England and France. The patent lists of England give some idea of the machines which were thought to be in demand, while a number of highly important industrial treatises published in France present us with splendid engravings, illustrating the more advanced conditions in the shops of that era.

In England the new prosperity of the iron industry, due to the use of coke to take the place of the failing supply of charcoal, gave rise to a score of important inventions in this field as contrasted with practically none in the previous half of the century. The mere fact, however, that an English patent was allowed was no proof that an invention had not already been experimented with abroad.

FIG. 48. PRIMITIVE DIE PRESSING IN FRANCE

In 1759 a patent for rolling metals with shaped rollers was allowed to Thomas Blockley. This had been attempted before, but how successfully is uncertain. An important idea was involved in the patent allowed to James Knight in 1762. This was to place the ball of hot iron from the furnace into a screw engine, which was worked by a heavy fly, to flatten the ball, and the cutters which were in the same box as the press were to chop or slit it into blooms.

An interesting invention of 1768 was that of George Whately for plating wire by placing a silver strip on top of it with borax between and drawing out the two.

The rolling of metals was probably being carried on successfully at that date, for in 1769 we find Richard Ford patenting a machine with multiple rollers for this purpose. In 1774 Thomas Griffin attempted to use a windmill to furnish power for stamping and rolling such material as tin foil.

The increasing use of the lathe is suggested by the patent of William Sheward in 1775 for finishing the eyes of needles by means of a lathe carrying a small drill or a reamer.

What may be considered an advanced notice of the milling machine is the patent of John Talbot in 1778 for a circular file, or cutter, or large toothed wheel for taking the outer cut or surface off metal. The idea of pressing with dies is involved in that of William Bell in 1779 for pressing out metal buttons and buckles between rollers into which had been cut the proper design. The general conception of the possibilities of rolling was rapidly advancing, for in 1783 William Playfair took out a patent for the rolling or stamping of horseshoes; while Henry Cort, the same man who invented puddling, received a patent in 1784 for welding iron fagots by rolling, after heating them in a furnace. Two years later John Butler suggested the use of grooved rollers to produce various shapes of bars and bolts. In 1790 John Wilkinson received a patent for

FIG. 49. GRINDING CUTLERY

drawing and rolling lead pipe, and two years later devised an alternating motion for rollers to allow them to be rolled back and forth over a plate. Another patent for a series of rollers for use on metals was granted John Hazeldine in 1798.

The use of the lathe was likewise increasing if we may judge from the fact that in 1793 Samuel Benton invented a reciprocating lathe to be used, as he put it, for bending and curving, boring, mortising, turning and chucking.

It will be observed that although Watt invented his steam engine in 1767, there was, up to the close of the century, no notable attempt to apply it to machines for the working of metals. These seem to have been limited to the use of muscular and hand power. This is evinced not only by the list of English patents and other evidences of the conditions in England, but even more strongly by the industrial treatises published under the patronage of the French government.

These treatises on various phases of industry were embodied in the "Arts et Metiers," the publication of which began in 1761 and extended over some 10 years, and in the "Encyclopedie des Arts et Sciences," the printing of which commenced in 1762 and likewise extended over a number of years. The illustrations in these two publications are much the same, but those in the "Encyclopedie Methodique," the first volume of which appeared in 1785, show a good many changes which had taken place in the meantime.

FIG. 50. A SLITTING MILL FOR IRON

From the viewpoint of the evolution of the shop from hand work to machinery, it is almost as important to note the work that was still done almost exclusively by hand, as that to which machines were already beginning to be applied.

In a treatise of 1761 we find that in the forging of anchors, water power was in common use to work the bellows and the tilt hammer, and hand cranes were employed to help move the material, but the rest of the work was practically all done by hand. One noticeable improvement was a springing bar at the top of the rise of the tilt hammer to give it an impetus for the blow.

In nail and pin making the heading machines, already mentioned under the date of 1718, were still in use as well as were the turning of the wire for pin heads and grindstones run by flywheels for sharpening the points.

In brass work in 1764 an ordinary tilt hammer was used for plates, and interesting variations in the form of the hammer for beating out vessels of various shapes. A representative engraving of 1767 indicates that the methods of the period in an ironworker's shop involved the use of various forms of forges, anvils, vises, tongs, files and hammers. Other plates of the time are more or less copies of those published fifty years before, and

FIG. 51. IRON-WORKING LATHE WITH CRUDE SLIDE REST

show that hand work was usually employed in beating and punching out ornaments and iron. One interesting subject of 1767 is the making of springs for coaches and wagons. The only type shown as in use for that purpose is the strap spring, the work being done by hand.

A treatise of 1771 on cutlery illustrates a shop with a forge, anvils, and various tools. The grinding was done with wheels often turned by hand. There was considerable work with a file, and the finishing was likewise hand work.

In the making of the finer instruments, such as were used in surgery, however, we find various small machines employed. One form of a lathe was used for turning lancets, and other forms for various other surgical instruments. Lathes were regularly in use for boring small holes with exactness. A very important picture in this treatise, Fig. 48, illustrates an early form of die pressing in which some of the small instruments were actually pressed out by means of molds and some form of squeezer. Another interesting cut on this same subject, Fig. 49, depicts a sharpening room where the grindstones are turned by waterwheels through shafts and belts, and the sharpening is done by workmen while lying flat on their stomachs upon an incline reaching from the floor to the top of the grindstone.

FIG. 53. MAKING VISE SCREWS

This position was adopted to aid the workman as much as possible in avoiding the breathing in of dust from the wheel. This was particularly important in some departments of cutlery making where the grinding was done dry. In this connection it is recorded that the condition surrounding the grinding of forks at that date were so bad that the average age of the workman was only about forty years.

Probably the most complete bird's-eye view of the workshop toward the end of the 18th Centruy is that furnished by the articles of the "Encyclopedie Methodique." As this was published to show the best methods in use in the various industries of the time, it is only fair to presume that it included about all machines whose practical value had already been proved in France.

Needles were made almost entirely by hand, and so were large nails. The large nails, as in England, were headed by being inserted while hot in a vertical die and the head beaten with a hammer to fit the matrix at the top of the die. Pins and small nails, however, were headed with the foot machines mentioned in the previous article.

There is a splendid picture of a slitting mill for iron, Fig. 50, and still another very important one showing the use of a duplex machine for slitting. Big shears were also employed for cutting thin iron plates. For such heavy products as anchors and anvils, tilt hammers and cranes were employed, but no other important machinery. Where heavy boring was required, we find the use of machines run by water and horsepower. Boring machines of this character are illustrated as being used on cannon, arquebuses and rifles.

Lathes are illustrated in a special article which pictures a lathe for all materials, and another especially for iron. Here also we find the first steps toward a slide rest in devices to hold various tools, as depicted in one engraving showing the turning of iron, Fig. 51, and in another illustrating work on silver plate, Fig. 52. Lathe work is also pictured in the making of metal buttons, and especially in the manufacture of vises where it is employed in cutting the threads of the screws, Fig. 53.

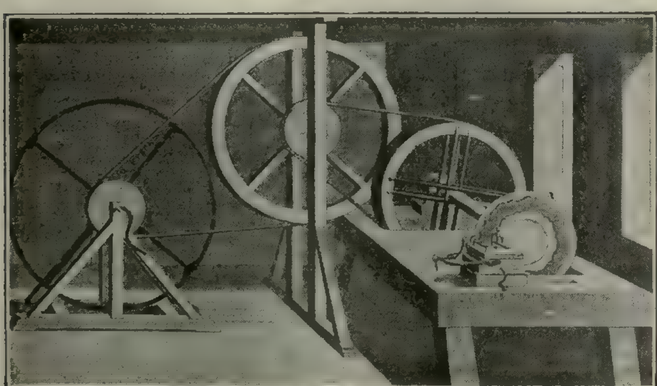


FIG. 52. TURNING A SILVER PLATE OF IRREGULAR OUTLINE. NOTE THE TOOL CONTROLLING ARRANGEMENT

Wire-drawing machines are shown in the article on brass and in the making of iron wire. Here the power was obtained by a waterwheel. The shaft from this had short arms which drew heavy pincers gripping the wire a few inches and then released them. This operation drew the wire, and a workman wound up the slack and saw that the pincers took another grip.

A pressing and punching machine was used on money, and one of a somewhat different type on buttons, buckles and other small articles.

Good examples of grinding and polishing machinery run by water power are shown in the work of polishing, furbishing and sharpening swords and similar weapons. Both shafts and belts were employed, but up to this date the belt seems to have been merely a round rope. The workmen employed at the grinding and polishing stones are, as in a case already noted, lying inclined on their stomachs with their faces practically level with the stone.

It is important to note trades in which machinery seems not to have been introduced as yet. The most important among those where only the simplest hand machines, if any, were employed, were balance making, gold beating, chain making, wheelwrighting, tinsmithing, engraving, spur making, zinc smithing, clock making, horseshoe forging and stove making.

This brings us to what might be called the beginning of the machine-tool era, which started in England at the very end of the 18th Century.

Machining Monel Metal Carbureter Float Points

By Philip S. Dodd

The International Nickel Co., New York

In the article under the above heading on page 629, *American Machinist,* W. H. Addis makes some statements regarding monel metal which are not correct. In the first place, monel metal is a nickel alloy, made up of 67 per cent nickel, 28 per cent copper and 5 per cent other metals. This formula, as the reader will note, is entirely different from the one given by Mr. Addis.

Another thing—far from being soft, monel metal is as strong as mild steel.

Location of Flaws in Rifle-Barrel Steel by Magnetic Analysis

By R. L. SANFORD and WM. B. KOUWENHOVEN
U. S. Bureau of Standards

One of the practical applications of magnetic analysis consists of the detection of flaws in bar stock used in the manufacture of steel products. At the request of the Ordnance Department of the Army and the Winchester Repeating Arms Co., an investigation was undertaken during the war with the end in view of applying this method of magnetic analysis to the testing of rifle-barrel steel.

IN VIEW of the fact that flaws, generally consisting of pipes or slag inclusions, interfere with the drilling of rifle barrels or may possibly affect their strength, it was considered that a nondestructive test which would detect and locate such flaws before further work had been done on the barrels would prove to be of great value. Such a method of inspection would make possible not only the rejection of faulty material, but also the acceptance of all the satisfactory bars in a given shipment and thus effect a great saving both of material and labor. It is the object of this paper to describe the apparatus used in the investigation and to present the results thus far obtained.

The method employed was that of the determination of the degree of magnetic uniformity along the length of the bars, based upon the theory that if a bar is uniform magnetically along its length, it is also uniform mechanically.

A number of barrel forgings were first tested by a point-by-point method originally used for the examination of bars intended for magnetic standards and which has already been described.[1] Fig. 1 shows a specimen curve obtained by this method, and Fig. 2 shows the flaw which was indicated by this curve.

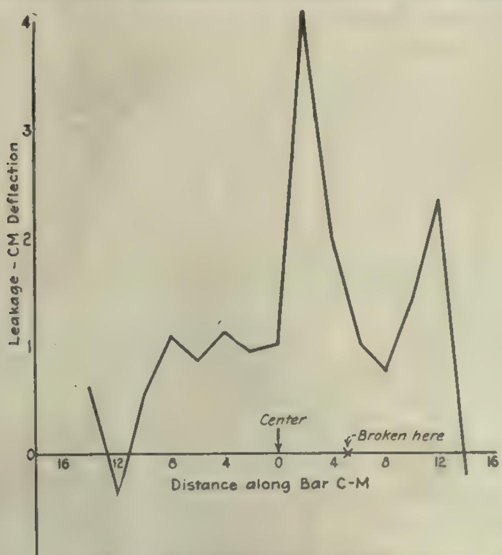


FIG. 1. MAGNETIC UNIFORMITY CURVE—PIPED SAMPLE

Since this method is not adapted to the examination of very long bars, and is too time-consuming for a commercial test, it was decided to use a somewhat different method, substantially similar to that used by Burrows[2] for the examination of steel rails. In this method the magnetizing force is applied by means of a solenoid which surrounds the bar and travels along its length. Mounted within this magnetizing solenoid is a test coil by means of which variations in magnetic flux within the bar can be measured. If the bar is magnetically uniform along its length its permeability is constant for a given magnetizing force and the magnetic flux at each point, as the solenoid is moving along, is constant. If this is the case, there will be no electromotive force induced in the test coil as the solenoid travels the length of the bar. If, on the other hand, the permeability is not constant, the flux will vary and a corresponding electromotive force will be induced in the test coil which, if the coils are moved at a constant speed along the bar, is proportional to the change in flux. If, instead of using a single test coil in the manner just described, we use two test coils connected in series opposition we obtain a result that is practically not affected by slight variations in the magnetizing current during a run, as any variations in flux linked with one coil is neutralized by corresponding changes in the other.

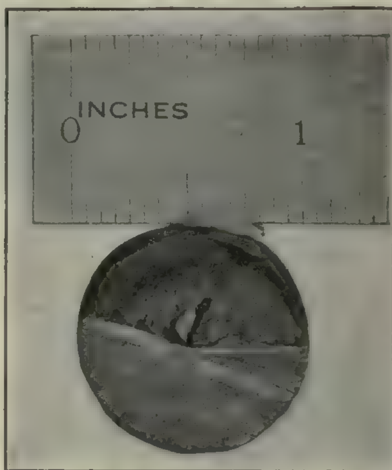


FIG. 2. FLAW INDICATED BY CURVE IN FIG. 1

Description of Apparatus and Procedure

Fig. 3 is a photograph of the apparatus as set up at the Bureau of Standards for preliminary experiments before it was taken to the Winchester plant at New Haven for test under factory conditions. The bar to be examined is clamped at the centers of two triangular end plates of cast iron. These end plates are supported by three wrought-iron pipes which also constitute the return circuit for the magnetic flux induced in the test bar.

The magnetizing solenoid, which is shown in more detail in Fig. 4, is supported between the pipes by means of cords running over pulleys and carrying counterweights which hang inside the supporting pipes. One of these cords is continuous and runs over a drum

[1]Sanford, The Determination of the Degree of Uniformity of Bars for Magnetic Standards, Bureau of Standards Scientific Papers No. 295.

[2]Burrows, Correlation of the Magnetic and Mechanical Properties of Steel, Bureau of Standards Scientific Papers No. 272, p. 203.

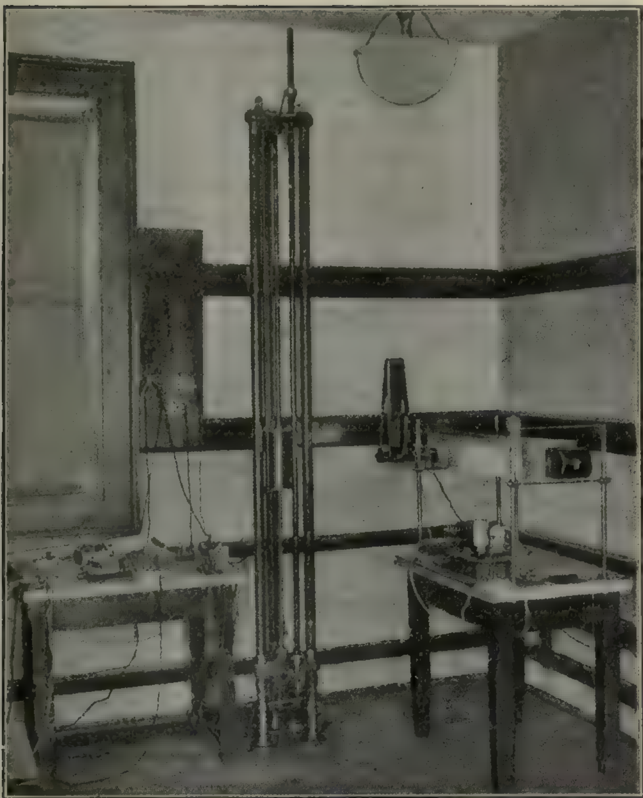


FIG. 3. THE TESTING APPARATUS

mounted on the shaft of a small electric motor. By means of this arrangement the coils can be run up and down along the length of the bar. Magnetizing current is supplied to the solenoid by means of a storage battery and regulated by means of sliding rheostats. The guiding rollers shown in Fig. 4 were later arranged to bear on the test bar instead of on the iron pipes, as it was found that many of the bars were not straight. The test coils are mounted on a separate tube and their position is adjustable. These test coils have 500 turns each, and are connected through suitable resistances to the galvanometer shown at the right of the apparatus.

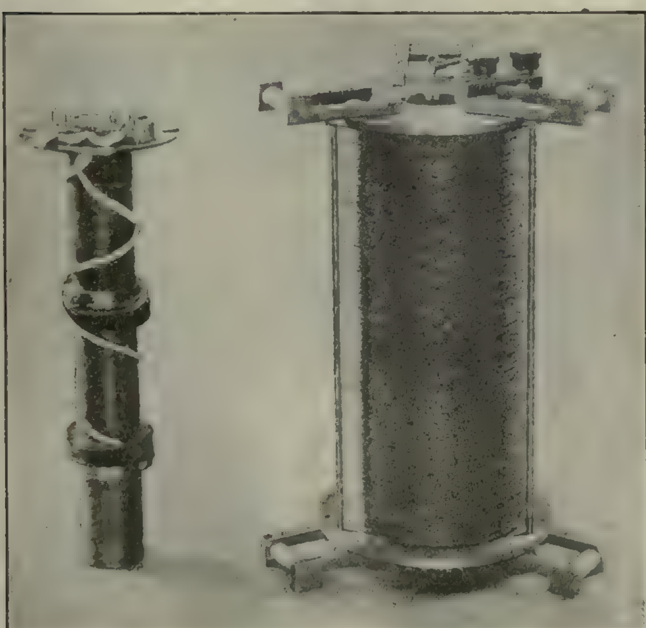


FIG. 4. SOLENOID AND TEST COILS

Deflections of the galvanometer are observed by means of a spot of light reflected from its mirror onto a ground-glass scale. Permanent records of these deflections are made by means of a photographic arrangement which consists of a long light-tight box upon one end of

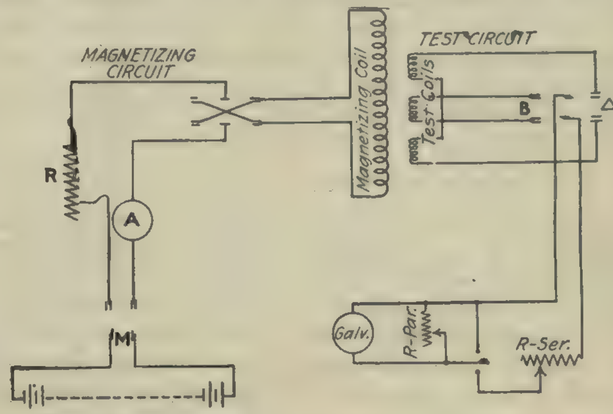


FIG. 5. DIAGRAM OF ELECTRICAL CONNECTIONS

which is mounted an ordinary oscillograph drum which carries the photographic film. This drum is rotated at the proper speed by means of a belt connected to the driving motor of the apparatus. By means of contacts located at one-foot intervals on the driving cord, a light is flashed inside the box which makes a record on the film for each foot of travel, and thus affords a means for locating the position on the bar of any observed non-uniformity. A diagram of the electrical connections is given in Fig. 5.

When a photographic record indicating the magnetic uniformity of a bar is to be made, the procedure is as follows: The bar is clamped in the apparatus, the galvanometer circuit is then closed, and the drum carrying the photographic film is given one complete revolution.

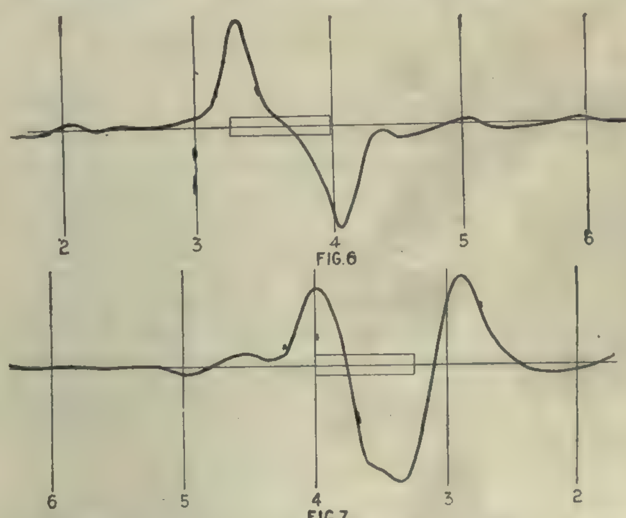


FIG. 6. RECORD WITH SINGLE TEST COIL. FIG. 7. RECORD WITH DIFFERENTIAL TEST COIL

The spot of light reflected from the galvanometer mirror thereby traces a straight line which serves as the reference axis. The switch *M* is then closed and the magnetizing current is adjusted to the proper value by means of the regulating rheostat *R*. With the galvanometer connected either to the single test coil or the differential coils as desired, the driving motor is then started and the coil is run the length of the specimen

with the film holder rotating at a uniform speed. Most of the records have been made by running the coils in one direction with the galvanometer connected to the single test coil, and in the other direction with the galvanometer connected to the differential coils. Fig. 6 shows a record taken by the use of the single coil, and Fig. 7 shows the corresponding record taken with the differential coils. A rectangle is drawn on each of these records to show the position and extent of a strip of transformer iron which was attached to the bar in order to give the effect of a flaw.

Preliminary Study and Adjustment

After the apparatus was completed and set up in the laboratory, it was necessary to consider a number of points in connection with its operation and to decide upon the proper adjustment of the test coils. The points to be considered included the proper flux density B in the specimen, the proper speed for the moving coils, the period of the galvanometer and, as just mentioned, the best location of the test coils. As a result of observations taken under a great variety of conditions, it was found that a flux density of approximately 15,000 gausses gives the best results. The speed of travel finally adopted was approximately one-half foot per second. It is necessary in order to insure that the record

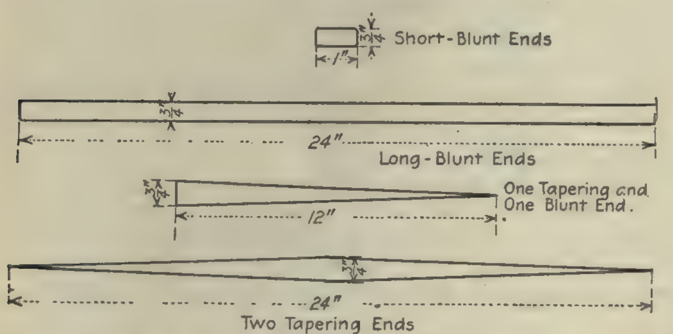


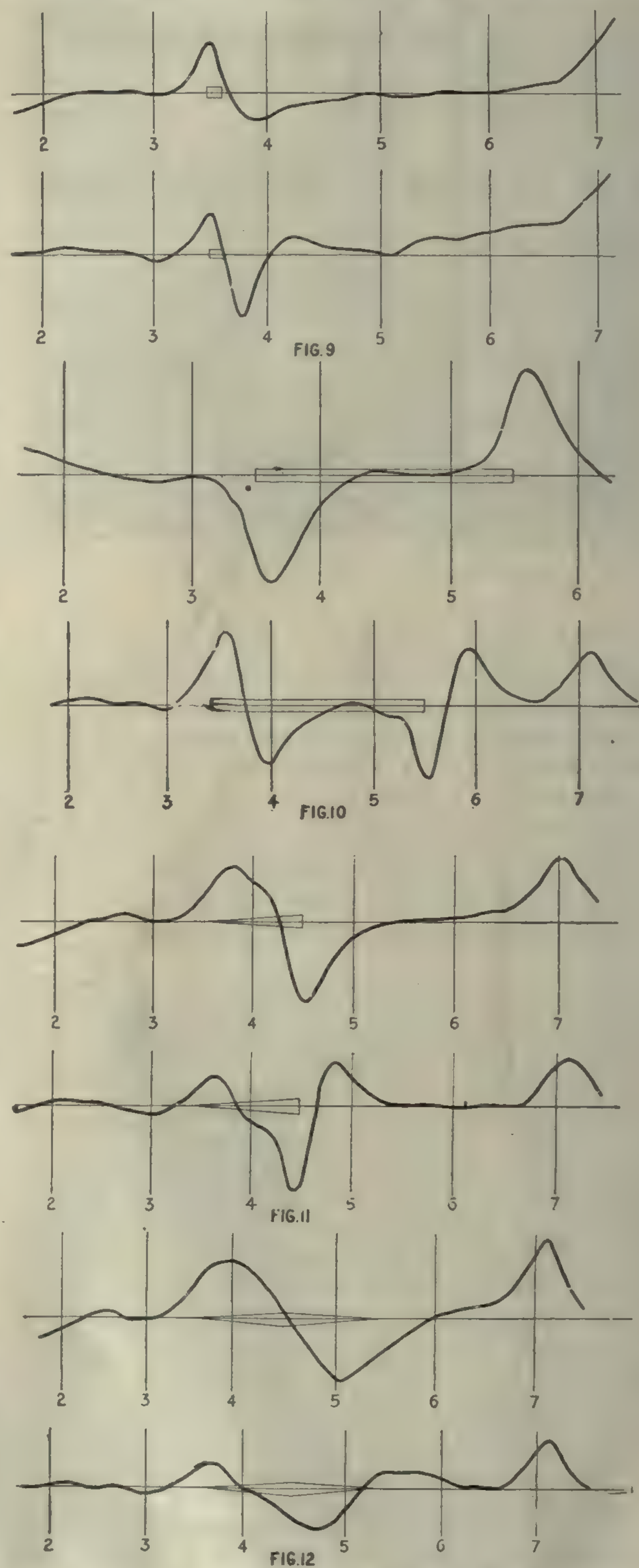
FIG. 8. DIMENSIONS OF ADDED STRIPS

gives a true indication of the condition of the specimens that the galvanometer have a fairly short period. If the period is too long, the galvanometer does not follow closely the changes in the induced electromotive force. A period of approximately one second was found to be satisfactory. The photograph of the test coils shows only two coils in position. For convenience, however, a third coil was made, and the differential coils were located 10 cm. apart and equidistant from the single coil which was located at the middle of the magnetizing solenoid. With this symmetrical arrangement, records could be duplicated by running the coils in either direction.

Preliminary Exploration Made

A preliminary exploration to determine the flux distribution along the specimen for different positions of the magnetizing solenoid was made by a point-by-point method, using the single test coil connected to a ballistic galvanometer. Readings were taken upon reversal of the magnetizing current. The result of this exploration showed that, for a given magnetizing current, the flux is constant at different points along a uniform bar except for the regions very near the ends.

In order to study the effect of flaws varying in extent and kind, a number of records were made on a bar previously found to be uniform, to which were attached strips of transformer steel of various shapes and sizes. This procedure was necessary, because of the difficulty of producing longitudinal flaws by artificial means. Fig. 8 shows the shapes and dimensions of the strips thus used. Figs. 9 to 12, inclusive, are records obtained in this way. The location and shape of the added strip is indicated in each case upon the record. The figures show records taken both by means of the single test coil



FIGS. 9 TO 12. RECORDS OBTAINED FROM ADDED STRIPS OF VARIOUS SHAPES AND SIZES

and by means of the differential coils. Figs. 13 and 14 show the effect of various treatments on a bar originally uniform. The treatments given, and the locations, are indicated in the figures. It was at first feared that, due to the sensitiveness of the method, spurious indications would be obtained for bars which had been slightly bent during shipment and handling at the factory. The result of this last test, however, indicates that such is not the case.

After the preliminary experiments just described, the apparatus was shipped to the plant of the Winchester Repeating Arms Co., at New Haven, and there set up for final trial.

Experimental Results

The greatest difficulty in this line of investigation lies in the interpretation of the results. This is due to the fact that there are many causes which may produce magnetic inhomogeneity and it is difficult to differentiate between them. The work at New Haven was done with the end in view of obtaining data which would establish the amount of variation and the type of curve which accompanies a pipe. The procedure was to make records of bars which in a preliminary test showed large variations. These bars were chosen from lots of steel which had previously been rejected as the result of tests in the drilling shop. It is an interesting fact that even though this lot of steel had previously been rejected on account of pipes, not a single pipe was discovered in the drilling tests on samples for which records of the magnetic uniformity had been obtained. This is true of all the steel examined up to Mar. 31, 1919.

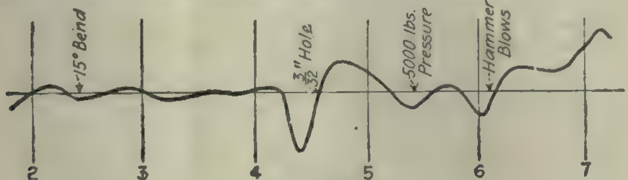


FIG.13

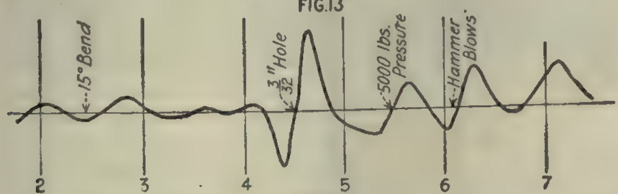


FIG.14

FIGS. 13 AND 14. EFFECT OF VARIOUS TREATMENTS ON A BAR THAT WAS ORIGINALLY UNIFORM

Records of Magnetic Homogeneity

Figs. 15 and 16 show records of the degree of magnetic homogeneity of four bars of steel. These records were made with the differential test coils and with a fairly low sensitivity of the galvanometer. The portions of these bars from which barrel lengths were cut are indicated in the figure. Barrels *A*, *B*, *C*, and *D*, cut from bars *1* and *9* and those cut from the entire length of bars *2* and *4* were sent to the shop for drilling tests. Barrels *B* and *D* gave trouble in drilling and each destroyed the edge of a drill, thus necessitating the use of a new drill to finish the bore. None of the other barrels gave trouble and the inside surfaces of all were smooth and bright. In view of the fact that additional data is necessary in order to draw satisfactory conclusions, the Winchester Repeating Arms Co. is continuing the investigation.

This paper describes an investigation which was undertaken for the purpose of determining whether an application of magnetic analysis was practicable for the detection of flaws in rifle-barrel steel. By means of apparatus especially constructed for the purpose a large number of bars were explored for magnetic uniformity along their length. In spite of the fact that these bars were taken from material which had previously been rejected as the result of drilling tests, not one was found which contained a pipe. The results obtained, however, demonstrated that the method is amply sensitive to detect and locate flaws. Further study is necessary to determine to what degree the sensitivity of the apparatus should be reduced in order not to cause the rejection of material which is satisfactory for all practical purposes, and also to determine the type and magnitude of the effect which will be produced by a pipe. For this reason the work is being continued by the Winchester Repeating Arms Co., who co-operated in the investigation and at whose plant the apparatus has been installed.

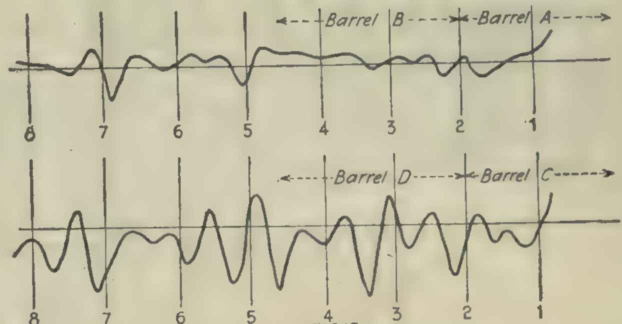


FIG.15

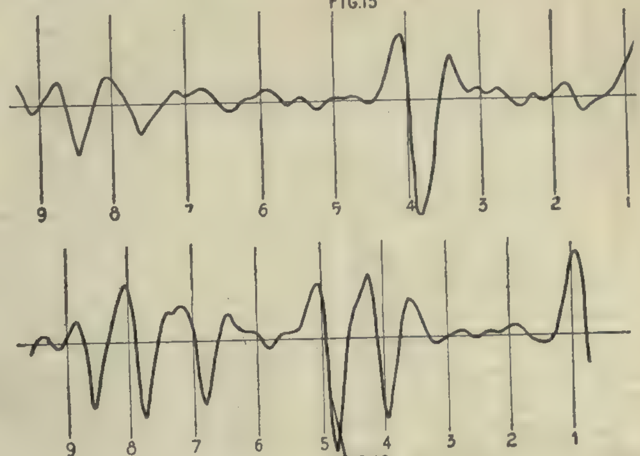


FIG.16

FIGS. 15 AND 16. RECORDS OF THE DEGREE OF MAGNETIC HOMOGENEITY OF FOUR BARS OF STEEL

The authors wish to take this opportunity to acknowledge their indebtedness to J. S. Gravely, M. F. Fischer, and J. S. Becker for their valuable assistance in carrying out this investigation.

There was a station mechanic who could not understand why a man younger in the service was made foreman instead of him. One day the foreman left an outline of some work for the mechanic to do. In too literally following instructions, the mechanic burnt out some valuable equipment and shut the plant down. Taken to task, he exclaimed: "I didn't make the 'bull,' he did it! *I only did what he told me to.*" Still the mechanic wonders why he was not made foreman.—*Power.*

Putting the Motor Together

BY FRED H. COLVIN
Editor, American Machinist

> *The methods used in assembling a motor, just as those used in machining the parts, depend to a large extent upon the amount of the production required. Modern methods, however, demand that practically no hand-fitting takes place in the assembling department, even with small production.*

THE assembling methods described in this article are used by the Chandler Motor Car Co., Cleveland, Ohio, and are of interest in showing some of those which have been found satisfactory and economical in the production program. Figs. 1 and 2 show two of the sub-assemblies, the first being the bolting of the connecting rods to the crankshaft, and the second, the studding of the crankcase. Fig. 1 shows the curved cheeks of the crankshaft and the spacing of the crankpins. The three cranks and connecting rods are separated into groups, indicating that the cylinders are cast in two blocks of three, as shown in Fig. 4.

The flywheel end of the crankshaft is held in a bench vise, while the outer end is supported on a stand, as can be seen. The rods are then attached to the crankpins and tested to determine whether the fit is of the kind desired. Removing or replacing shims enables the assembler to secure the correct fit.

In the meantime, the crankcases, which are in another department, are being studded for the main bearings, four studs being used for each bearing. These crankcases are mounted on very simple trucks or carriers as can be seen in Fig. 2. The trucks run in a channel or track which is at the proper height to bring the cases at a convenient height for the workmen. These cases move along from one position to another, finally going to the motor-assembly department after they are completely studded and inspected.

After the connecting rods are assembled on the crankshaft, the whole sub-assembly is placed in a specially constructed oil tank, which is arranged so that the crankshaft can be driven while the connecting rods are held in a vertical position. This is simply the Chandler method of running the connecting-rod bearings in, and seems to work out very satisfactorily. After running in for a specified time, the crankshafts are assembled

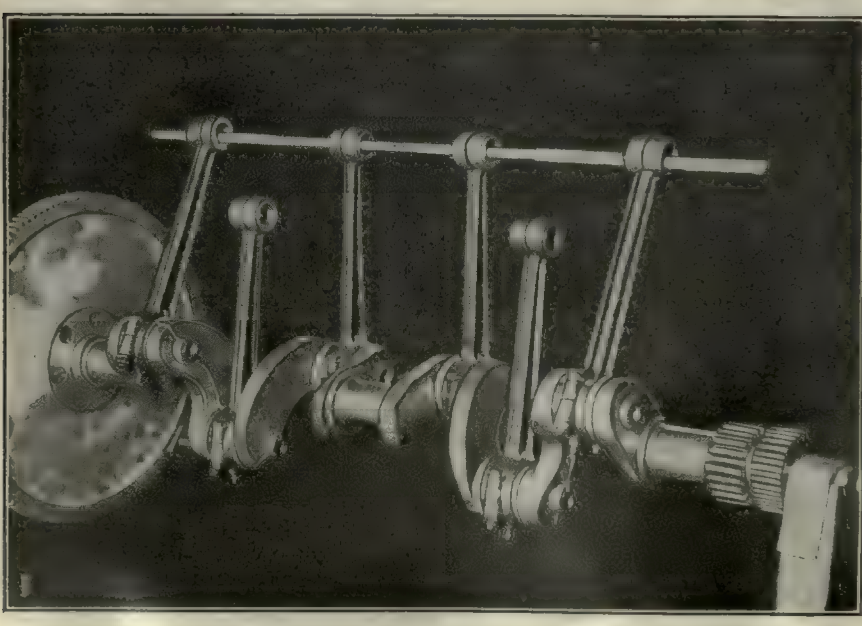


FIG. 1. CRANKSHAFT ASSEMBLY

FIG. 2. STUDDING CRANKCASE

AUTOMOTIVE CONSTRUCTION

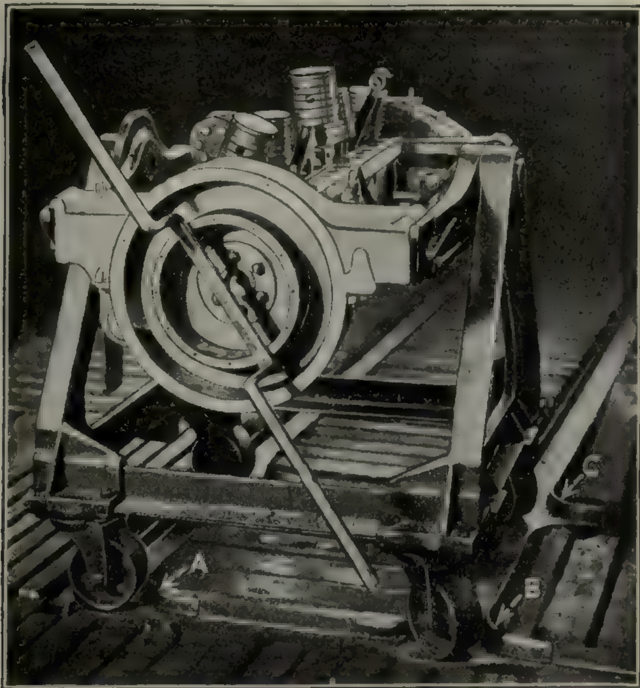


FIG. 3. ASSEMBLING STAND AND TRACK

in the crankcase as shown in Fig. 3, and the pistons put in place. This part of the assembly has not been completed, as one of the rods can be seen without a piston.

Assembling Stand and Track

This view also gives a good idea of the assembling stand with its swiveling frame and its large casters, and also the track in which the casters run. The base of the truck is square and the casters are equidistant from one another. This enables the truck to be readily shifted from one direction to the other by means of the special curved corner plates in the track, shown at *A*, *B* and *C*. In this case, the truck has just been moved to its present position from the track shown on the right, and, by pushing in the other direction, the casters easily swivel and enable the truck to be moved down the other track. This arrangement obviates the necessity of employing turntables, which are not only much more expensive to install but are also more or less of a nuisance in several ways.

Clamps for Holding Piston Rings In

After the crankshaft, connecting rods and pistons are in place, the camshaft, water pump and magneto are assembled, as shown in Fig. 4. This also shows how the cylinder blocks, of three cylinders each, are put in place. With crankshaft so turned that the pistons come in the position shown, the clamps *A* are placed around the piston rings and tightened sufficiently to close the rings to the cylinder diameter. These clamps are not screwed up so tightly, however, as to prevent their being easily pushed out of the way by the cylinder block as it is lowered into place. As soon as all the rings are entered in the cylinder bore, the clamps are removed by simply loosening the bolts and swinging them out of the way so that the cylinders can be lowered into place. The cylinder blocks are not so heavy as to be difficult to handle, and, as can be seen in the illustration, one man is lowering a block over the pistons.

The Final Assembling Operation

The final assembling operation is to face the end of the crankcase square with the crankshaft, so that the transmission unit may be in line with it when the clutch and transmission are assembled. To do this the crankshaft is driven from the front end by the special electric motor reduction-drive *A*, Fig. 5, while the facing head *B* is bolted to the flywheel in place of the clutch unit.

This head carries a special facing tool at *C*, this being controlled by the star feed wheel at *D*, and is fed out as the crankshaft is revolved, comparatively slow by the reduction drive *A*. The stationary or feeding pin *E* is attached to the arm *F*, the end of which rests on the floor to prevent it turning. This gives a positive method of securing a square face on the end of the crankcase. This figure also gives a good view of the assembling stand.

FIG. 4. PUTTING ON CYLINDERS

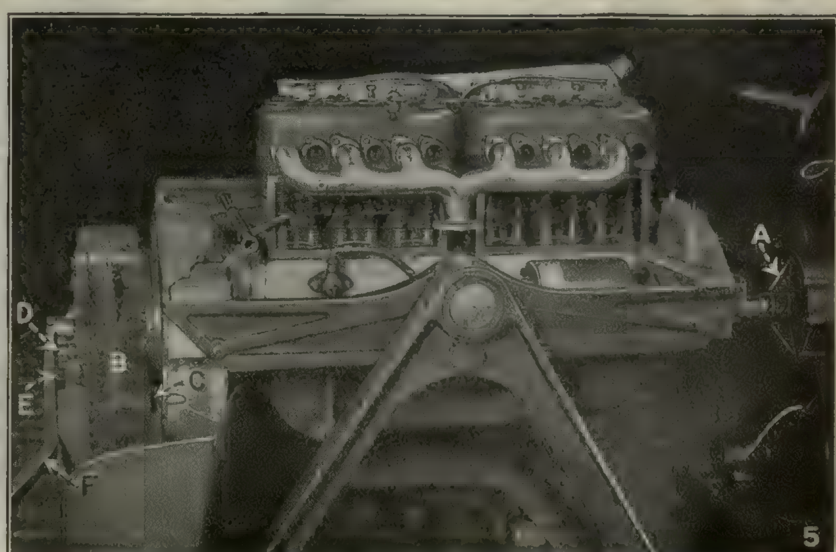
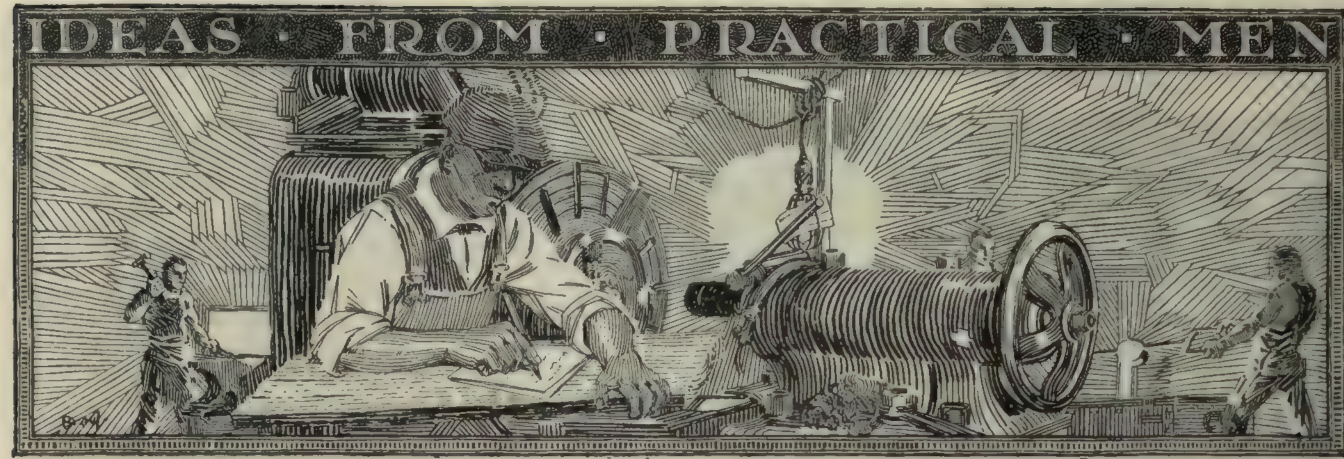


FIG. 5. FACING END OF CRANKCASE

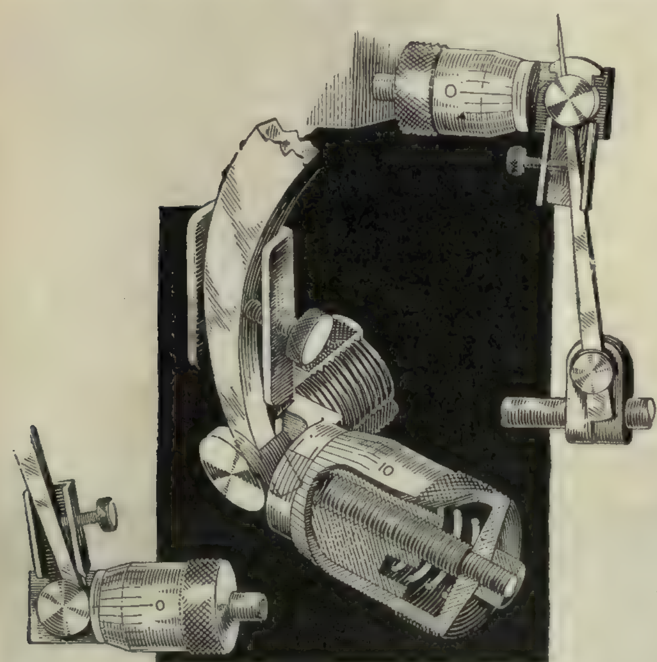


Micrometer Attachment for Calipers

By N. Renwick
Sydney, Australia

I have used the attachment shown in Fig. 1 for some time and have found it useful both on calipers and in the lathe. It can be used for fine adjustment on outside, inside, or hermaphrodite calipers; it can also be attached to a depth gage, or used on a scribing block as a height gage.

For setting a taper in the lathe it may be attached to a piece of drill rod held in the toolpost. A plug gage or something with the correct taper is held between the centers, and the crossfeed moved forward until the end of the spindle is about $\frac{1}{32}$ in. from the surface at the small end of the gage. The thimble is then turned into contact and the reading taken. The thimble (not the crossfeed) is then screwed back and the carriage moved up to the large end, where the reading is taken. If both readings are the same, the taper is correct, but if the taper reads larger at one end, that end should be moved slightly away from the operator.



FIGS. 1 AND 2. A MICROMETER ATTACHMENT FOR CALIPERS, SHOWING DETAILS OF CONSTRUCTTION

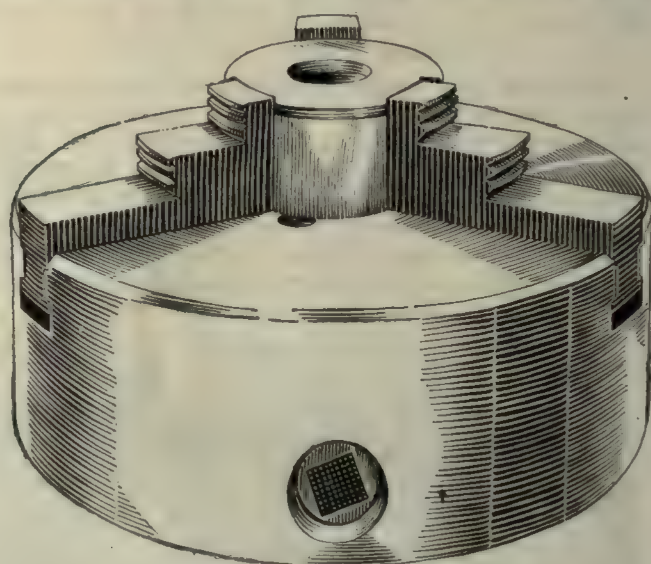
One slight inconvenience is that if the marking is set to read rightly for outside calipers (which is best) it reads the wrong way for inside. This may be overcome by double marking, but I find it quite convenient without this.

Details of construction are shown in Fig. 2.

Lathe Chuck as Work Holder on Drilling Machine

By H. H. Parker

An old universal lathe chuck of 6 in. or more in diameter, with the flange removed from the back to give a flat bearing surface, will be found convenient to hold washers, stub shafts, bolts and other small pieces of work for end drilling in the drill press. The chuck rests vertically on the table and may or may not be clamped down, depending upon the size and character of the work.



LATHE CHUCK TO HOLD WORK FOR DRILLING

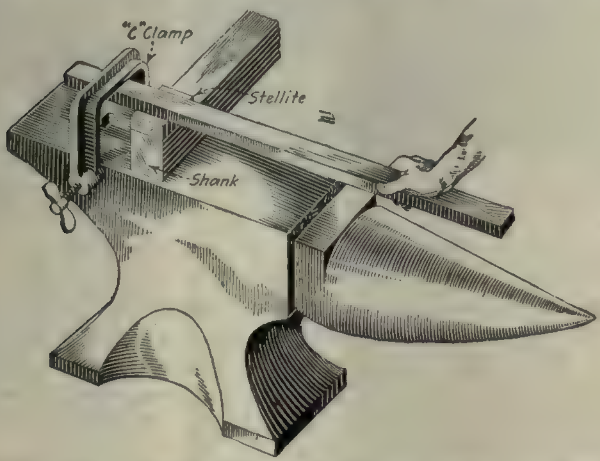
Washers or small thin disks are difficult pieces to handle for drilling, but by using a hardwood cylinder of about the same diameter as the washer as a packing piece in the chuck, this trouble will be obviated.

The wood packing is slipped into the chuck, the washer rested upon it, and the jaws tightened; the piece will then be held securely for drilling without danger of canting and loosening.

Welding Stellite to Carbon Steel

By Fred B. Corey

On page 295 of the *American Machinist*, Mr. Kronfeld calls attention to a most excellent method of welding stellite to carbon steel by means of Tip-It welding compound. This process has been in use for some time and produces results that leave little to be desired. The



IMPROVISED PRESS FOR WELDING ON STELLITE TIPS

making of perfect welds in the ordinary blacksmith forge is a matter of the utmost simplicity when this flux is employed.

To secure the pressure necessary to complete the weld, Mr. Kronfeld suggests the use of "a small air press, an arbor press, a screw press or a vise turned up vertically." While these are all excellent for the purpose, they are not always found in close proximity to the forge fire.

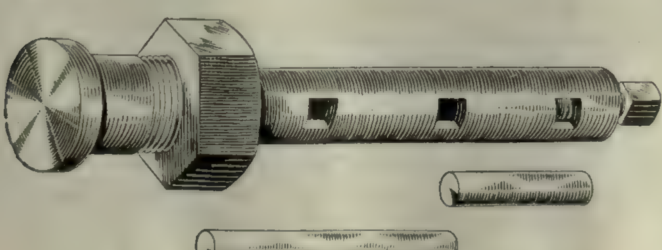
The accompanying sketch shows a very simple arrangement that is used in a number of shops with the greatest satisfaction. The C-clamp is quickly attached to the anvil and its height adjusted to secure an even vertical pressure on the tool to be welded. After bringing the two parts of the tool to the proper heat, they are simply pressed together by means of the bar, as shown. The pressure is required for a few seconds only and is absolutely under control of the operator.

A Tool Bar for the Shaping Machine

By John J. Burke

The accompanying sketch illustrates a tool bar for a shaping machine which is convenient for many special jobs. The bar has three square slots and a hole is drilled through the center to the last slot.

Two pins are provided as an extension from the setscrew to the different slots to hold tools firmly in position.



TOOL BAR FOR SHAPING MACHINE

An Offset Boring Head

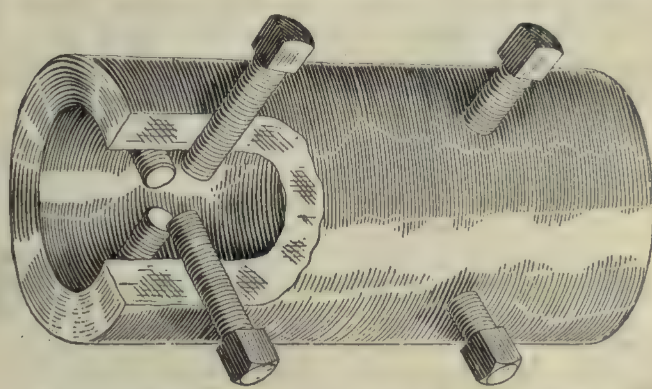
By Charles D. Folsom, Jr.

In boring holes on the milling machine or horizontal boring mill, the task of setting a cutter to bore to micrometer size is so slow and difficult that a great many devices for making it easier have been put on the market. These offset boring heads, as they are called, provide an accurate adjustment for the tool, and so eliminate the cut-and-try time to a large extent.

Although they do the work well, they are all too expensive and cumbersome for the average mechanic to include in his kit; and, I might add, they are apparently too expensive for most small shops to include in the tool crib.

I have seen several designs for home-made boring heads in the *American Machinist*, but although my foreman and I are on good terms, I should hesitate to mill out dovetail slides and turn little lead screws for myself on the company's time, as some writers suggest in making their boring devices.

However, I have a little boring head which I made



AN EASILY MADE BORING TOOLHOLDER

in about an hour. I took a piece of 1-in. round stock about 3 in. long, put it in the lathe and ran an $\frac{11}{16}$-in. drill through it. Then I drilled and tapped eight holes as shown in the sketch for $\frac{1}{4}$-in. setscrews. Then I got the screws and put them in place, and the job was done.

In use, this head is placed in the chuck and a boring bar (forged drill rod may be used conveniently) is inserted in it. The bar may then be trued up approximately by adjusting the setscrews as in a four-jawed chuck; and then, by further adjustment, any desired cut may be taken. The point of the tool should be in line with two setscrews.

A very sensitive and satisfactory adjustment may be made by slightly tightening or loosening the proper screws. Although this does not allow of "micrometer" adjustment, it is positive and certain in its action. And it is this definite adjustment, rather than a reading in thousandths, which makes such a device valuable.

Removing Broken Taps

K. L. Unland

On page 795, vol. 51 of the *American Machinist*, I note a description of a method of removing broken taps by means of the oxy-acetylene process. The method described would probably be comparatively simple provided the tap broke in such a way as to leave an exten-

FIG. 1. BROKEN TAPS REMOVED BY ARC WELDING

sion outside the casting. However, in case the tap broke from ¼ to ½ in. below the surface, it would be very difficult to make the weld strong enough to withdraw the tap and at the same time avoid welding the tap to the sides of the hole, or burning the welding tip.

Fig. 1 shows a pile of taps which have been removed, illustrating the great variety in sizes and types; while Fig. 2 shows two taps, the larger one of which was broken off ¾ in. down in the hole. These taps were all removed by the electric arc welding process using the metallic electrode method. The procedure is as follows:

The arc is struck on the top of the tap and is kept there, building up metal until the surface of the casting is reached. An ordinary machine nut is then laid over the hole and the welding continued until the deposited metal builds up inside of the nut, when it is welded fast to the nut. After cooling, the tap is removed by the use of a wrench. Very few cases are found where this procedure fails to remove the tap. Occasionally a tap splinters, but even in such a case the weld joins the parts so they all come out properly.

The vital point in doing such a job is to keep the arc from striking the side of the hole. Where the arc is kept on the bottom the metal is welded to the bottom and merely runs against the sides, but does not adhere. In some cases a thin sheet of copper or brass is bent to fit inside the hole to protect the threads and prevent welding to the sides of the hole.

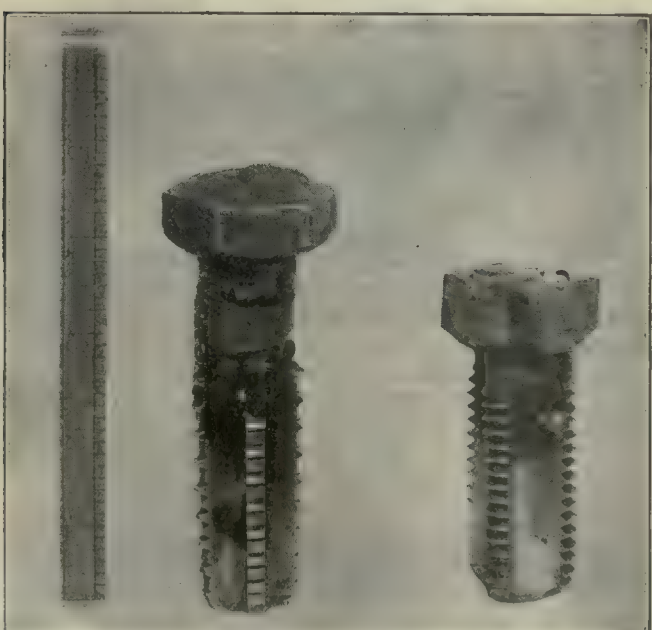


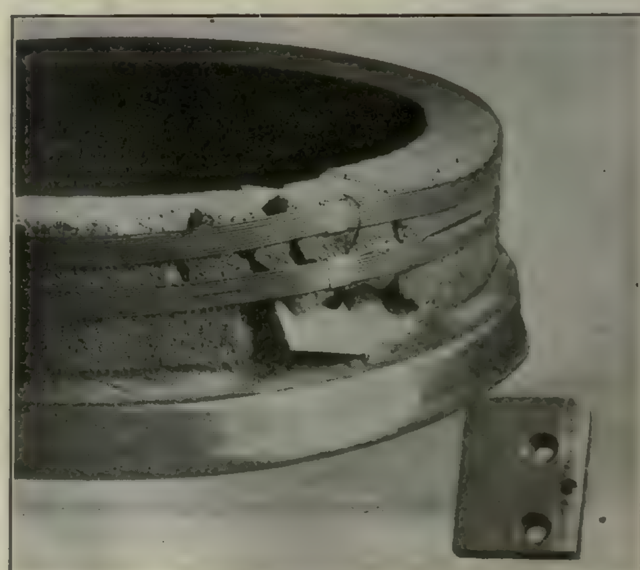
FIG. 2. THE MANNER IN WHICH THE REMOVAL IS ACCOMPLISHED

Where Safety First Paid

By Winfield W. Blakeman
Superintendent, Blanchard Machine Co.

The illustration shows an unusual accident that might have resulted seriously except for the precautionary banding of the cupwheel with wire, as shown. This wheel was grinding a number of double-edge cutter blades about 2 x 3 in. and ⅜ in. thick, as shown beside the wheel. In some unaccountable way one of these blades was picked up by the wheel during the grinding operation, and driven with such force that it penetrated the wheel from the inside, as shown in the illustration.

The wire banding not only prevented the operator from being injured but enabled him to continue his work until the job was finished and the machine stopped. He missed the cutter but thought it must have dropped off into the pan, and did not discover the broken wheel until he removed the guards.



HOW BANDING A GRINDING WHEEL RESULTED IN SAFETY

Safe Storage of Patterns

By J. V. HUNTER
Western Editor, *American Machinist*

When a manufacturer has been in business for many years and has found it necessary to make changes in the design of his product from time to time, the collection of patterns that will accumulate is generally very large. While apparently obsolete, such patterns must be kept for many years so that repair parts can be furnished for machines yet in use.

THE scrapping of obsolete patterns of agricultural implements is risky even when it is deemed that repair parts will no longer be called for, because some farmers who take good care of their implements are apt to send for repair parts after a lapse of years. Failure to supply such parts will lose the manufacturer the good will of the farmer who wants the repair parts, and the good will of the farmer is an asset that no manufacturer of agricultural implements can afford to ignore. Such has been the experience of the Minneapolis Threshing Machine Co., West Minneapolis, Minn., which has lately built a fireproof pattern-storage building to house what is conservatively estimated to be one million dollars worth of patterns.

The building, which is three stories high, is constructed of concrete and brick and has steel sash glazed with lights of wire-reinforced glass. A complete sprinkler system has been installed and all openings to the elevators and stairways are guarded by double fire-doors.

Provision has been made for adding another story and with this in view the roof was made flat so as to be utilized for the fourth floor. The pitch for shedding rain water was added by a cinder-concrete covering graded high in the center and covered with roofing material. This can be readily removed in case the additional story is added.

A general idea of the character of patterns stored may be obtained from the view of a portion of the storage space, Fig. 1, which shows patterns ranging from large gear wheels to some of the smallest used. The value of one of these gear patterns, together with its molding machine stripper plate, is in the neighborhood of $1,000.

A portion of the shelving, Fig. 2, shows its general character. The vertical columns are of 2-in. pipe.

A close view of the shelf bracket, Fig. 3, shows the manner in which it is fitted around the vertical pipe, and clamped in place by bolts which pass through the two parts. This bracket is also used as one of a pair for the intermediate supports at the ends of the sections.

The horizontal members across the ends of the sections are of piping but the transverse members are made of $1\frac{1}{2}$ x 2-in. angle irons, notched to pass over the cross-piping and riveted to brackets which clamp down to the main bracket *A*, Fig. 3. These transverse angles are placed 12-in. apart and across them at intervals of

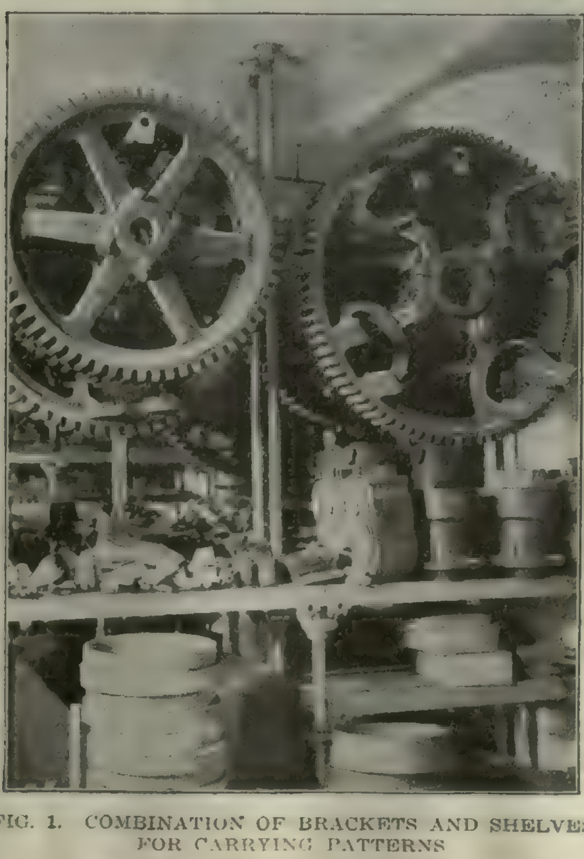


FIG. 1. COMBINATION OF BRACKETS AND SHELVES FOR CARRYING PATTERNS

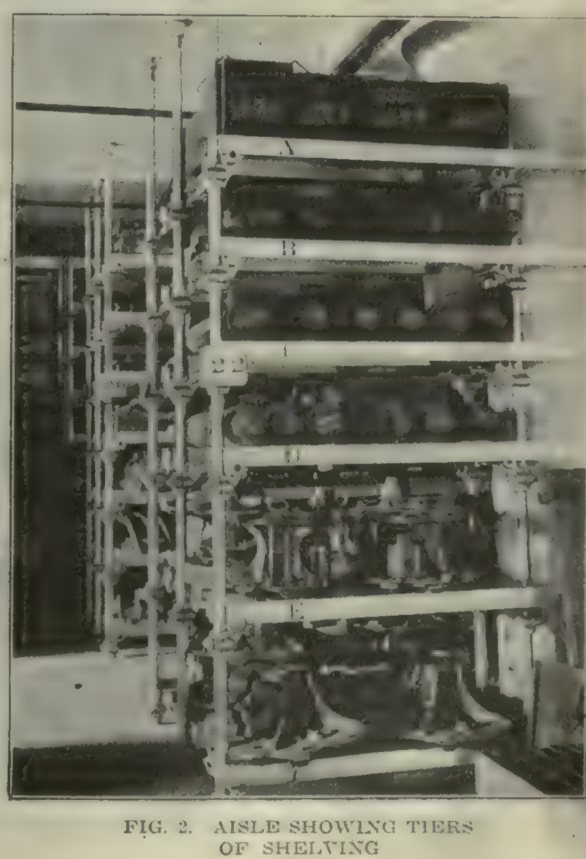


FIG. 2. AISLE SHOWING TIERS OF SHELVING

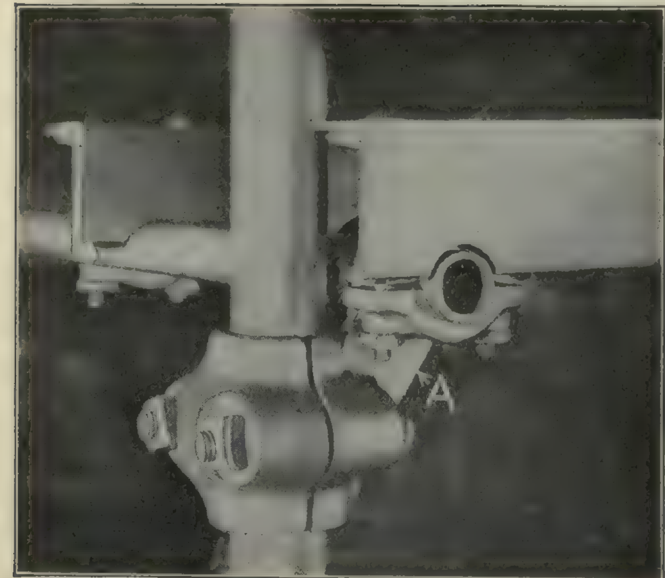


FIG. 3. BRACKET USED FOR SHELF SUPPORT

12 in. are strips of $\frac{1}{4}$ x 1-in. flat bars, lightly riveted to the angles, thus forming a sort of lattice which prevents the large patterns from falling.

To prevent small patterns from falling through, the shelves are covered where necessary by screen of $\frac{1}{2}$-in. heavy wire mesh laid across the lattice-like shelving and bent over the angle iron at the ends to prevent it from sliding out of place. It may also be bent up on the sides to form a vertical partition separating one section from the next. This open shelving has decided advantages because the dust and sand which fall from the patterns cannot lie on the shelf, but drops through and eventually reaches the floor where it may be swept away.

The tiers of shelving are numbered, and the designating number is placed on a sheet-metal plate located on the aisle corner of each tier, Fig. 2. The shelves are further designated by letters, which start in sequence with A for the top shelf, to F for the bottom shelf. In this same tier the shelf sections to the right of the concrete column will start with G for the top shelf in the next division, and so continue for all divisions.

This method permits the division of a large amount of shelving into a very large number of index spaces which can be readily identified by the pattern-storage keeper.

FIG. 4. STORAGE OF MOLDING EQUIPMENT IN BASEMENT

This man, on placing a pattern on any particular shelf, makes a record of the section and letter number in his book, and when this pattern is wanted again, reference to the book will quickly show in which one of several hundred sections it may be found.

Some shops make a point of trying to keep patterns stored in accordance with the sequence of shop numbers, but when thus placed on a shelf, the result is often the loss of much dead space in one section, together with overcrowding in an adjoining section.

Such patterns as large gear wheels that may be hung up are suspended from pipe brackets that extend from the side of the shelving, Fig. 1, each one bearing a number plate which identifies that bracket for reference in the pattern-storage record. These brackets will carry several gear patterns with no danger of damage. All patterns are stored on the two upper floors while the basement floor is devoted to other appliances of the foundry. This refers to match plates, mold boards and special flasks which are used for the molding of special work. A typical corner of this floor, illustrating the general character of the appliances stored, is shown in Fig. 4. They are usually of heavy character, and for convenience are handled by means of a trolley hoist, so that all bays of the floor are provided with an overhead I-beam trolley rail upon which are carried chain hoists for picking up and removing any of the heavier pieces.

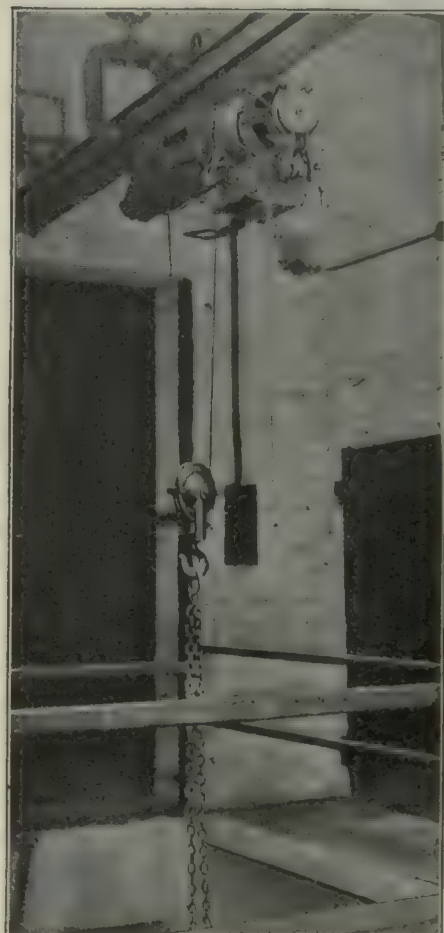


FIG. 5. ELECTRIC FOUNDRY HOIST CONVEYING TO ELEVATOR SHAFT

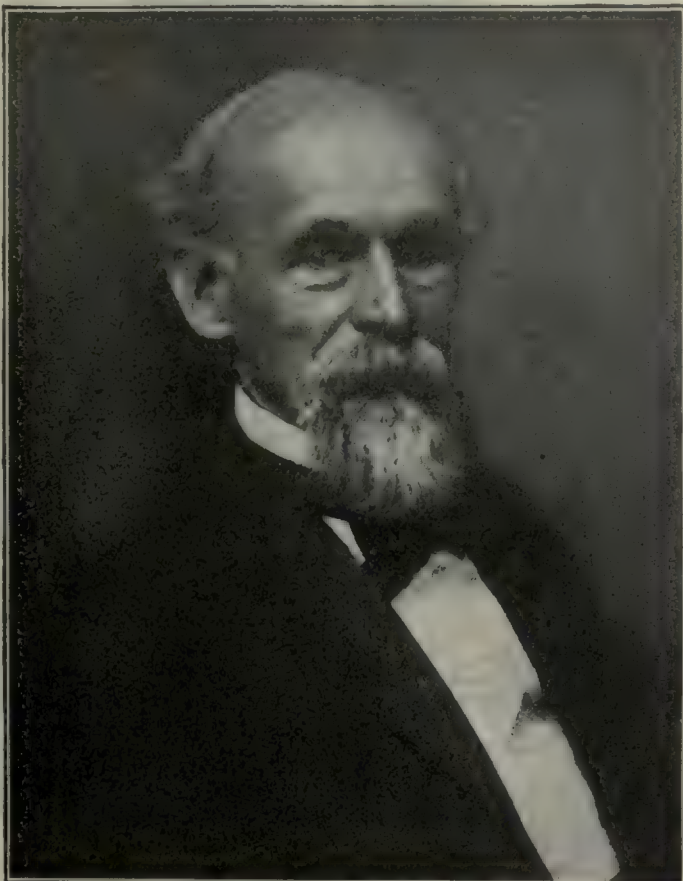
The foundry is located across an open areaway from the pattern storehouse and the double-rail electric trolley hoist, Fig. 5, conveys the heavy mold boards and flasks, which it picks up from the molding floors and lowers through the elevator shaft to the basement floor of the pattern storehouse. All openings into this shaft are thoroughly protected by firedoors. An additional purpose which this building now serves is for the storage of molders' tools that are furnished by the foundry, such as shovels, riddles, etc., and from here they can be served out as required by the storekeeper.

Dr. John A. Brashear

Dr. John A. Brashear, scientist-physicist-astronomer, died at his home in Pittsburgh, Pa., on April 8.

Dr. Brashear was born in Brownville, Pa., in 1840 and was educated in the public schools. He learned the machinist's trade and from 1860 to 1880 worked in the rolling mills of Pittsburgh.

As a boy he had caught a glimpse of the Heavens through a telescope and his ambitions to study astronomy were aroused. Being too poor to buy a telescope he and his wife set out to make one. In their little home, built with their own hands, they set up a shop having a small steam engine and a lathe, and here made the tubes and ground the lenses for a 5-in. telescope that took them three years to construct. Spurred on by what they saw through this little instrument they commenced to build a 12-in. telescope only to have the objective lens break after two years had been spent grinding and correcting it. Here the grit and perseverence of the man and his loyal wife were shown, for when he came home from the next day's work at the mill he found all preparations made for beginning work on a new lens. This lens was successfully brought to completion. In 1876 Dr. Brashear attracted the attention of the late Professor Langley, at that time head of the Allegheny Observatory, and after two years' work in a small shop he had established on the South Side of Pittsburgh, he was enabled through the assistance of one of the observatory patrons to establish works in Allegheny for the manufacture of astronomical instruments.



DR. JOHN A. BRASHEAR.

Perhaps his most important achievement has been in connection with the design and development of the spectroscope for astronomical uses, particularly with reference to the accurate optical and mechanical features. In 1888 he completed the spectroscope for the 36-in. telescope of the Lick Observatory, furnishing the optical and mechanical parts. The excellent results of the work done at the Lick Observatory has been freely attributed by Professor Keller to Dr. Brashear's skill and genius. Many of the spectroscopes in the principal observatories of the world are products of the Brashear workshop as are many of the largest telescopes and objectives for astronomical research.

Dr. Brashear's more purely scientific work also brought recognition and at about the time he established the Allegheny shop he was given an appointment in the University of Western Pennsylvania, of which the Allegheny Observatory was a department. From 1898 to 1900 he was acting director of the observatory and has raised $300,000 for the building and equipment of a new observatory in Riverview Park. He has always kept in close touch with this observatory and through his efforts one department has been put at the disposal of the public.

For twenty years Dr. Brashear was a trustee of the Carnegie Institute, for fifteen years of the Carnegie Institute of Technology and for twenty years of the University of Pittsburgh. In the latter institution he served also as Chancellor and it is said that he did more for the cause of education in Pittsburgh than any other three men. Several years ago a friend placed in his hands an endowment fund of $250,000 to be used for the advancement of teachers and teaching in the public schools and as a result over seven hundred teachers have been sent to different parts of the country for rest and study, bringing back new ideas and great enthusiasm. Dr. Brashear became a member of the American Society of Mechanical Engineers in 1891, was made a manager in 1899, and an honorary member in 1908. In 1911 he served as one of the representatives on the John Fritz Medal Board. During 1915 he was president of the Society. He was a Fellow of the American Association for the Advancement of Science; of the Royal Astronomical Society of Great Britain; past president of the Engineers Society of Western Pennsylvania, and the Pittsburgh Academy of Arts and Sciences; a member of the British Astronomical Association, the Société Astronomique de France, the Société de Belgique, the American Philosophical Society, the Astrophysical Society of America, the Washington Academy of Sciences, the National Geographic Society, and an honorary member of the Royal Astronomical Society of Canada.

Washington and Jefferson College, Wooster University and the University of Pittsburgh have each conferred upon him the degree of LL.D.; Princeton University and the Western University of Pennsylvania the degree of Sc.D. and Stevens Institute of Technology the degree of Doctor of Engineering.

Dr. Brashear was the kindliest of men and ever ready to assist others. No one ever appealed to him for help without avail. Truly it may be said of him that he was "Of the salt of the earth."

Long ago he and his wife agreed upon the following epitaph to be placed in their tomb: "We have loved the stars too fondly to be fearful of the night."


THE WATCH DOG OF INDUSTRY
ENTRANCE TO AMERICAN INDUSTRY
AMERICAN INSTITUTE OF WEIGHTS AND MEASURES
WORLD TRADE CLUB
COMPULSORY METRIC BOMB
This Bolshevik won't get in if you keep the dog in good condition.
AMERICAN MACHINIST
Breul

A Watch Dog of American Industry

NO sane man acquainted with present manufacturing conditions can fail to see the enormous confusion and added burden to already overloaded industry that the enactment of a *compulsory* metric law would cause.

The pernicious activities and influence of the World Trade "Club" with its millionaire "angel" to pay its bills, must be counteracted by telling the TRUTH.

The busy executive has no time to spare from his exacting business duties and only sees the danger confronting him in the possible passage of a compulsory metric law when his attention is jarringly called to it by the Klaxons of his favorite papers, or of some organization especially constituted to watch over his interests in things of this character.

Such an organization exists in the American Institute of Weights and Measures, 115 Broadway, New York City.

This Institute was formed to combat all metric legislation or propaganda tending to upset our present system of measurement. The men connected with it are live, able business men who *know* manufacturing and industrial conditions.

Several hundred prominent manufacturers and firms well known in our National industry are members. The National Association of Manufacturers, The National Founders Association, The National Machine Tool Builders Association and The National Metal Trades Association, are also enrolled in its membership list.

However—like all other things—the American Institute of Weights and Measures must have money to continue acting as the "Watch Dog of American Industry" in guarding against the passage of foolish compulsory metric legislation.

It is better to subscribe a few dollars to have the Institute guard your interests in this matter than to run the risk of paying out the thousands you would have to if a compulsory metric law was passed—and probably many of you would go under in the readjustment struggle with the compulsory metric weight pulling you down.

Get behind the Institute and PUSH.

Ethan Viall
Editor

MEMBERSHIPS

SCHEDULE OF ANNUAL DUES

Individual	$ 5.00
National Associations	100.00
Other Associations	25.00

CORPORATIONS, BASED ON NUMBER OF EMPLOYEES, AS FOLLOWS.

Number of Employees	Amount
500 or less	$ 25.00
501 to 1,000	50.00
1,001 to 2,000	75.00
2,001 to 3,000	100.00
3,001 to 4,000	125.00
4,001 to 5,000	150.00
5,001 to 6,000	175.00
6,001 to 7,000	200.00
7,001 to 8,000	225.00
8,001 to 9,000	250.00
9,001 to 10,000	275.00
10,001 to 11,000	300.00
11,001 to 12,000	325.00
12,001 to 13,000	400.00
13,001 to 14,000	425.00
14,001 to 15,000	450.00
15,001 to 16,000	475.00
16,001 and over	500.00

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TO THE .... 192....

AMERICAN INSTITUTE OF WEIGHTS AND MEASURES.

115 BROADWAY, NEW YORK

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AN ASSOCIATION / A CORPORATION / AN INDIVIDUAL MEMBER ....

WE DESIGNATE AS OUR REPRESENTATIVE IN THE AFFAIRS OF THE INSTITUTE,

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NUMBER OF EMPLOYEES ....

CHECK ENCLOSED AS PER SCHEDULE

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Problems of Industry and Trade—Editorial Interviews With Men Who Know Conditions

BY C. W. PARK

Changes in the circumstances influencing production are so rapid that they cannot be reduced to a rigid classification. The historian of the reconstruction period may write an interesting story later, when all the evidence is in. Just now the most significant facts and the most helpful suggestions come direct from the men who are engaged in actual production day by day. These men are too busy making industrial history to comment at length, but what they have to say is well worth reading. From time to time the "American Machinist" will publish interviews with prominent manufacturers and other subjects of current interest.

"IN TIME of prosperity, prepare for more prosperity," sums up the philosophy of O. H. Broxterman, of the John Steptoe Co., Cincinnati, regarding the machine tool industry. As chairman of the Committee on Equipment for Schools in China of the National Machine Tool Builders' Association, Mr. Broxterman has been making a careful study of trade conditions and prospects. His investigations have led to significant conclusions, not only concerning export trade with China and other countries, but also regarding undeveloped portions of the American market. For example, a study of how the metal trades should be taught in Chinese schools raised the pertinent question of whether these trades could not be taught better, or rather, more extensively, in American schools. Another parallel situation in the two countries lies in the relation between the machine tool industry and the increasing use of automobiles, trucks, tractors, and modern agricultural road-building, and other machinery.

Let European Market Wait

To a representative of the *American Machinist*, Mr. Broxterman spoke optimistically of the present trade situation. He said:

"It is true that unfavorable exchange rates now and unsettled political and economic conditions for several years to come make Europe an unpromising market for American machine tools. The best we can hope for is to keep enough of our tools in European factories to show the superiority of our product over those of Germany and other competitors. The distribution of U. S army equipment sold abroad, and especially the American machine tools supplied for the restoration of Belgium, will help to keep foreign workmen familiar with American machines, and they will be customers later on when conditions are more favorable.

"Just now, the best prospect for expansion of the machine tool industry is in developing further the domestic trade. This should be done immediately, not so much for the sake of the machine tool interests as for the allied branches of manufacturing which depend directly or indirectly on machine tools.

"Answering your question as to how such a campaign for developing domestic possibilities should be started, I believe that one approach must be the public schools. A good many schools have taken advantage of the government's plan to furnish them tools at nominal cost for instructional purposes. Others will purchase tools in increasing quantities and the school market will be just as good in dull years as in times of prosperity. The machine tool companies should take an active interest in developing this market. What remains is to emphasize the metal-working side of a boy's training and give his mechanical instincts an outlet. Too often the so-called 'manual training' courses have been given over almost entirely to woodworking. A boy makes a bird house or a table, and his training ends with amateur cabinet making. There is no objection to his learning to use a saw and hammer, but when you consider that metal work has almost entirely displaced wood, it is time to teach the use of metal-working machines and processes, the elements of automobile mechanism and other common machines, together with their proper use and repair.

"Particularly in the country districts, this kind of practical instruction should be given. A farmer's son, then, would not need to go to the city to develop his mechanical ability, but would become interested in analyzing agricultural machines, trucks and tractors, and in keeping them running smoothly. A boy who showed special talent for using metal-working machines would eventually build up a repair business that would keep a small machine shop going. Incidentally, he would do much to keep agricultural production at top-notch efficiency by insuring prompt and local attention to machinery instead of the long delays incurred by farmers waiting for repairs.

"Whether these local centers start through the schools or through other agencies, such as the automobile, truck, tractor and farm machinery companies, they are greatly needed. The manufacturers of all these kinds of machinery have a direct interest in seeing such shops established, and the initiative will doubtless come from them, rather than from the machine tool men who will supply equipment for the shops. Such a development is inevitable, owing to the wide distribution of machines, and it will provide an almost immediate market for metal-working tools.

Big Opportunities in China

"As for China, that is our big market for the future, if we are far-sighted enough to get ready for it. A country with 400,000,000 people, nearly four times our own population, China offers almost unlimited possibilities. She has immense mineral, timber, and agricultural resources, but is only getting ready to develop them. To show how far behind she has been, it may be noted that she has virtually no improved highways, and only 6,500 miles of railroad, as against 265,000

miles in the United States. The important thing is that China is now awake and is determined to learn from other countries, and particularly from America, to whom she is partial.

"To show what the situation in China is today I could do no better than to quote from some recent correspondence I have had in connection with the work of the National Machine Tool Builders' Association Committee. The following extracts are from letters received from Frank A. Foster, M. E., who has been Director of Technical Instruction in the Chihli Higher Normal College at Paotingfu, China, and also at the Peking Higher Normal College, and has acted as advisor to Chinese manufacturers.

"'Undoubtedly this is the psychological time for our getting American machine tools into Chinese schools. A nation-wide boycott of all things Japanese has recently been started and is in full swing. The students in most of the higher schools are most ardent in carrying it out. Today's paper states that some 12,000 struck, in Shanghai alone. In some cases they have taken out all the school material of Japanese origin and burned it. They have gone so far as to include their hats and clothes which came from Japan. The students are going out in groups of four to all the surrounding regions to show the people how they can get along without Japanese-made goods and are making an industrial survey of the situation. In the matter of machinery they are looking to America for sympathetic help. I have had several inquiries along that line already.

"'In the machine shop of the Chihli Higher Normal College there are several Japanese lathes. It does not take long for the authorities to see where the great difference lies, in favor of American machines when put side by side with Japanese machines. They are anxious to get from America a shaper, a planer, and an upright drill as additions to their plant.

"'I am negotiating with some Chinese capitalists who wish to put up one hundred thousand dollars for establishing some manufacturing along American lines and under American direction. I have given them a proposition which will involve quite a lot of machine tools, and they have considered it very favorably so far.

"'The boycott goes merrily on, stimulating American trade and encouraging native enterprise. Exchange is very favorable for China just now. There have been times in the last ten years when an American dollar cost $2.50 Chinese. Now, ninety-two cents Chinese will buy an American dollar.'

"One of the greatest needs of the Chinese today is an efficient body of trained instructors in metal working. The recommendation of the Committee of the National Machine Tool Builders' Association is that young men be sent from China to spend a certain amount of time working in American manufacturing plants. In this way they will not only learn the operation of American machine tools but will also become familiar with American industrial organization and American manufacturing methods, and will absorb some American 'pep.' The plan proposed by the committee has met with favor, and arrangements are being made to send over some five hundred young men on this basis. The only difficulty encountered has been with the Commissioner of Immigration, who, Mr. Foster reports, was inclined to the opinion that the young men could not be admitted, since they would work for pay. It is expected that the matter can be speedily adjusted, for the influence of such a group of young Chinese on the future trade relations between the two countries will be far-reaching, and no technicality of law should be allowed to stand in the way of the project. How greatly these men are needed is shown by the fact that, although 1,500 Chinese youths are studying other lines of industry in the United States, none have so far taken up the machine tool industry.

"With improved credit organizations between China and the United States, an active American Chamber of Commerce, a wide-awake consular service, and an American merchant marine to expedite shipments, there is no reason why a considerable expansion of the machine tool trade with China should not be brought about soon. American machine tool manufacturers can well afford to donate tools or sell them at merely nominal cost to Chinese schools and other agencies for instructional or demonstration purposes. In the more remote future, big rewards await those manufacturers who have vision enough to lay the foundation for Chinese export trade."

National Automobile Chamber of Commerce Against Compulsory Metric System

At a meeting of the Executive Board of the National Automobile Chamber of Commerce, held on March 3, 1920, the following resolution was adopted:

"WHEREAS, Efforts are being made to require by Congressional Legislation the use of the Metric System of Weights and Measures in this country, and

"WHEREAS, A canvass of motor car manufacturers, members of this organization, has failed to develop that any of them are in favor of such legislation owing particularly to the difficulty at this time of changing dies, factory equipment and mechanism and the great cost of same; also the confusion that would be created among workmen who have not been educated in the metric system, be it

"RESOLVED, That this Board is opposed to legislation making the use of the metric system of weights and measures obligatory, and recommends that members of the National Automobile Chamber of Commerce lend their support to the American Institute of Weights and Measures, which is actively opposing this movement."

Recent Papers of the Bureau of Standards

The Bureau of Standards recently issued two more of its Technologic Papers giving the results of tests which it has lately performed. Paper No. 150 is called "Physical Tests of Motor-Truck Wheels." It is written by C. P. Hoffmann, an Assistant Engineer Physicist of the Bureau. Paper No. 151 is entitled "Load Strain—Gage Test of a 150-Ton Floating Crane for the Bureau of Yards and Docks, U. S. Navy Department," and is the work of L. J. Larson and R. L. Templin of the Bureau staff. Copies of these papers may be obtained by addressing a request to the Bureau of Standards at Washington, D. C.

Paper No. 150 deals with the procedure and the

results of tests made upon twenty-one different types of truck wheels suitable for use on class "B" military trucks. The compression under radial load and the deflection due to side thrust were determined, stress-strain curves under these conditions being given for each wheel. The distribution of the stress throughout the various parts of a wheel under load was determined for one specimen. The data, results and conclusions are contained in a pamphlet of over sixty pages.

The other paper, No. 151, treats of a test made upon a big shipyard crane of recent design for the purpose of determining the stresses and the action under load. The crane was subjected to a maximum load of 180 long tons, the deflection at various points was observed, and the stresses in the different members were determined by means of a Berry strain-gage. In the paper the distribution of the loads is analyzed and the stresses of the members are presented in the form of curves. This booklet contains about thirty-five pages, is well illustrated and is of interest because of the fact that a crane of this type, built earlier for use at the Panama Canal, failed under load.

What Machine Men are Thinking About

EDITORIAL CORRESPONDENCE

Machinery dealers in various cities, including Rochester. Buffalo and Cleveland, report good orders and slow deliveries in most lines. Automobile building gets most of the machinery either directly or indirectly. The fact that material is hard to get may reflect itself in a decreased demand for machinery where deliveries are too far distant.

It seems to be pretty generally conceded that the automobile output has had to be cut to about 60 per cent of the original estimate of the year, which accounts for delayed deliveries of some of the more popular cars. Just how long this will last or how it will affect the business next year, remains to be seen.

Then, too, there is the effect of the increased price of fuel to be reckoned with, as there are indications that gasoline is going much higher than ever before. If this occurs it is sure to have its effect on the type of cars demanded even if it does not curtail the number sold and used. It is generally conceded that we must follow the trend of other countries with high priced fuels and use lighter cars with smaller and more efficient motors.

Piecemeal Buying

Some machine dealers are buying only as machines are ordered, following the consumers plan of putting it off as long as possible. So far this has not been a paying game as prices have not lowered but advanced in a number of instances.

On small tools, dealers are compelled to keep ordering ahead to insure any sort of a supply owing to uncertain deliveries, but as one remarked, "they might be pinched for ready money to pay if deliveries should be suddenly hastened to any considerable extent." A new feature in the small-tool trade is the offering of English twist drills in the American market during the last few months. This is a decided innovation and one that, according to one well known dealer, does not seem a serious menace unless we refuse to be contented with normal profits.

Going from drills and other small tools to heavy machinery such as huge planers and boring mills, we are again confronted with competition from abroad. As one well-traveled machine man put it, large machine tools are not quantity production propositions but must of necessity be very largely special and built without elaborate jigs and fixtures. This means more or less all around machinists, at day wages and high grade men at that.

Our specialty in this country is mass or large quantity production with jigs, fixtures and even special machines built for the particular job. On this work we use semi-skilled men, or even less, and get production at very low costs. We have very few all-around mechanics because we have not trained them, and according to the observations of the same, we have very little chance of competing with either England, France or Belgium on any kind of work where they are required. And as long as all export trade must in the long run resolve itself into an exchange of commodities of some kind, why not, he asks, supply them with the machines we can build best and cheapest, taking in exchange the kind of machines which they can build more cheaply than we can.

Money Is Less Free

Here and elsewhere there is a tightening up of the money market, loans are more difficult to secure and many are wondering when we will get to the peak of the selling curve. One machine builder who has weathered several financial storms, feels that we are a bit over the top already. The tightening up on loans is to curb speculation and ought to help some, according to close observers. The only fear expressed is, that in some cases where the preparatory outlay has been somewhat more than anticipated, the stopping of all further loans may prevent a perfectly sound business from getting a fair start. This is not theoretical but based upon the observer's experience in a previous occasion when the bankers were not broad visioned enough to see beyond the immediate future, or to realize the effect of preventing the completion of the plans under way.

Those who are in close touch with both sides of the industrial problem are by no means sure that our previous experiences are likely to be replaced as to the final outcome of another sag in the business curve.

A Rotatable Table for the Radial Drilling Machine

BY C. E. LICHENBERG

In some shops where the work is too large to be covered by the radial drill in one setting, much handling can be avoided by constructing a removable and rotatable table supported on flanged rollers running on an endless track of the desired diameter. When great accuracy is not essential, the table may be of angle iron covered with boards, should this prove cheaper than cast iron. The ends of the track rail may be welded or joined by fish plates, and machined true on a vertical boring mill.

The table can be rotated by pinch bar, ratchet, or other means, and can be locked to the rail by means of a clamp.

This suggestion is the result of past experience in the loss of time and production by excessive handling of material.

WHAT *to* READ *—for the man in a hurry*

Suggested by the Managing Editor

Nobody who is holding down a man's job has time to read all of the "American Machinist." On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials—they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.

IT IS always a simple matter to tell the other fellow how to run his business—particularly if you are strong on glittering generalities. But to our way of thinking the best way to help a manager or a company, struggling to improve a business, is to place before them clear accounts of the methods employed in other plants and leave them to draw their own conclusions.

With this end in view we have made an extra effort this week to present a group of major articles dealing with various phases of the management problem.

The leader is Fred Colvin's story—or rather the first part of it—of the way in which the White Motor Co., of Cleveland, is handling the "personal relations" side of the question. Raising wages 130 per cent and at the same time increasing the selling price of your product only 10 per cent, indicates a successful system, and—but read the story if you want to know how it was done.

Part II of Mr. Basset's "Modern Production Methods" begins on page 873 and takes up the purchasing agent's job. The first part of this series which appeared in our issue of April 8 dealt only with the importance of the subject and gave a general survey of the field. Mr. Basset gets right down to brass tacks this time, however, and gives valuable details concerning the method and forms used in modern purchasing departments. He tells how one purchasing agent reduced his belting expense from $17,000 to $12,000 annually while output increased 35 per cent and cost of belting 50 per cent. Sounds worth while, doesn't it?

Over on page 880, Mr. O'Shea of the Greenfield Tap and Die Corporation recounts the method of handling large quantities of raw stock and comparatively small parts in that plant. This article is chock full of details.

Hunter's article on pattern storage, page 901, is also along the same general line. It gives a short account of a system used for preserving seldom-used patterns in a readily accessible way.

On page 889 is part VIII of H. H. Manchester's "Evolution of the Workshop." This shows how work was done just before the beginning of the machine-tool era. Mr. Manchester has unearthed another lot of queer old pictures to illustrate the shops of that time. How would you like to operate a grinder all day long (and a day *was* a day in those days) lying on your stomach? See Fig. 49. This was not done because the mechanics were born tired, but to protect them from the abrasive dust.

Most of us are so used to fussing with square yards or bulky bundles of awkward blueprints that we look upon them as a necessary evil, like getting a haircut. But here comes one Frank Richards on page 871, who has the nerve to suggest that blueprints aren't really necessary! As he says, "If not, why not?" We will leave it to you to find out why not. There is certainly food for thought in this short article.

Practical applications of the discoveries of pure science have become more and more frequent lately and more and more useful. On page 892 is a description by two of the specialists of the Bureau of Standards of a method of testing steel bars for flaws without injuring the test pieces at all. If this happens to be in your line, you don't want to miss it.

We have blazed away at the "World Trade Club" until you are probably as sick of that name as we are, and that's quite some. There is another organization which we want to call to your attention and it is the American Institute of Weights and Measures. It has fought the metric fanatics from the start and well merits your support if you have a sincere regard for American industry. Pages 904 and 905 tell the story.

In this issue on page 906 is the first of a series of interviews with leaders in the machine-tool industry. The series is conducted by Professor Park of the University of Cincinnati.

On page 903 we note the passing of another of the old school of master mechanics, Dr. John A. Brashear. Our account was written by Ashton Hand, a close friend and admirer of Dr. Brashear. The lives of men like Brashear and See should be an inspiration to the younger generation of machinists and engineers.

Fixing the Compensation of Engineers

[FROM A COMMITTEE REPORT TO THE ENGINEERING COUNCIL]

In order to determine what is a fair rate of compensation for engineering service at the present time, the question may be approached from two different points of view: First, what increase should be made in engineers' pay to compensate for the great reduction in the value of the dollar which has taken place in the last five years? Second, how may the intrinsic value of engineering service be determined?

A GREAT deal of misunderstanding and injustice would be avoided in all our industrial relations were there a clear understanding of the fact that all prices today, whether of wages or salaries, or commodities, must be compared with the change which has taken place in the value of the dollar before it can be determined whether the price, measured by an absolute standard, has moved up or down. It should be obvious to everyone that the value of the dollar is measured solely by its purchasing power. Whether it be a dollar received as wages by workmen, a dollar received as salary by an engineer, or a dollar received by a manufacturer in payment for goods sold, the actual amount of value which will be received in each case will depend upon the average amount of other commodities which the dollar received will purchase.

Changes in Prices

The "index numbers" which are regularly published by various statistical bureaus are an average of the wholesale market prices of a large number of standard commodities. In making up the index numbers the prices of the different commodities and classes of commodities are weighted in proportion to the per capita consumption of each. Thus, a comparison of the index number at a given date with index numbers at preceding and following dates shows the change in average wholesale market prices and such a comparison shows also the change in the purchasing power, or value, of a dollar in the wholesale market.

In order to determine the change which has taken place in the value of the dollar it is necessary to investigate changes in retail prices as well as those in wholesale prices. Especially where wages and salaries are concerned, it is the changes in retail prices that determine the buying power of the dollar received.

In general, the changes in retail prices follow the general course of the changes in wholesale prices. There is, however, more or less variation in different localities. Where such variation occurs it will generally consist in a greater proportionate increase of retail than of wholesale prices. Under the stimulus of the abnormal demand of the past five years, which is chiefly responsible for the great increase in prices, it is common knowledge that the retailer has frequently advanced his prices faster than the wholesale dealer.

The curve showing the percentage of increase in prices plotted from the Dun index numbers, therefore, in so far as it is in error in indicating the change in the value of a dollar spent in retail purchasing, is in error by understating the decrease in the value of the dollar which has taken place.

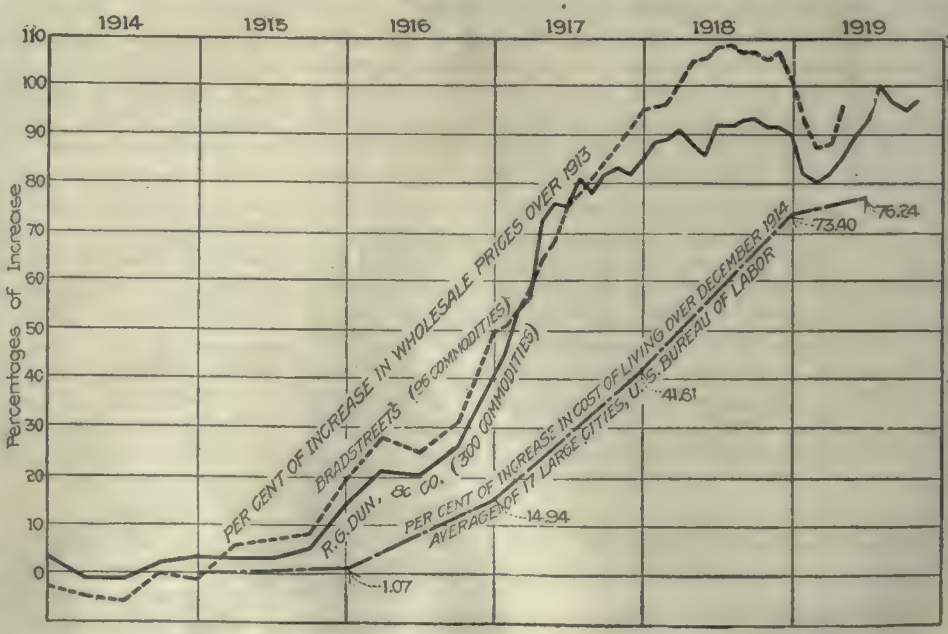
Changes in House Rents

In the long run the prices paid for house rents and for personal service change to correspond with the change in commodity prices; but rents change more slowly than the market prices of commodities, so that allowance must be made for this "lag" in determining the change in value of the dollar. This is especially the case where such a sudden and rapid increase in market prices of commodities occurs as has taken place in the past five years.

Furthermore, the rise in rents varies in different cities. In some munition towns, rents rose with a bound in 1915, and so did prices for personal service. In most of the larger cities rents did not rise materially until 1919.

In order to determine accurately the change in value of the dollar in a given community, therefore, an estimate must be made of the change in retail prices compared with wholesale, and of the rate of change in rents and personal service charges.

Since June 1, 1919, there has been a great increase in house rentals all over the country. There are no statistics to show the amount of this increase and its effect on the cost of living, but there is good reason



INCREASES IN COST OF LIVING

to believe that this increase, coupled with the general increase in charges for personal service that has taken place during 1919, and the advance of prices by retail merchants at a greater rate than the wholesale price increases is sufficient to make the percentage of increase in the cost of living indicated by the Dun statistics a true record of the change in value of the dollar at the present time.

The customary reference to the general increase of prices above reviewed as "the high cost of living" has tended to confuse the minds of many people. Some employers have argued that the high cost of living was not their affair. They have declared the real trouble to be "the cost of high living." On the other hand, engineers or other professional workers, and many classes of salaried men have hesitated to press claims for increased pay on the ground that changes in the cost of living make it difficult to live on their incomes. Such men rightly feel that their living expenses are their own private affair.

When, however, it is clearly understood that what has taken place is a change in the value of the dollar, the claim for an increase in the rate of pay measured in dollars rests on entirely different ground. The proper and dignified position for the engineer is to assume that his work should receive at least the same compensation in absolute value that it received five years ago and that therefore the compensation measured in dollars should be increased by whatever amount is necessary to offset the decreased value of the dollar.

There can be no denial of the justice of this claim even though the difficulty of satisfying it to the full extent in many departments of engineering work is recognized. The compensation of many engineers is dependent upon laws and ordinances, custom and precedent. Great inertia must often be overcome to effect a change. In many cases the compensation of the engineer, like that of many other public servants, is dependent upon revenue raised by taxation; and the difficulties in increasing tax rates to correspond to the great decrease in the value of the dollar are known to everyone.

Engineers engaged in business on their own account have to meet the difficulty of raising their fees to offset the changed value of the dollar, a task especially difficult in fields of engineering where work is inactive and the competition for it is keen; yet without such increase they cannot adequately raise the pay of their own employees.

This illustrates anew the urgent need for emphasizing the change in value of the dollar, rather than the change in living costs. The former is at once recognized to bear directly on fair prices for goods sold and for the fees charged by professional men as well as on wages and salaries.

On the other hand, there are cases where there is no real obstacle to a prompt adjustment of the engineer's compensation to the full amount indicated by the decreased buying power of the dollar. In carrying on construction work, the salaries paid to engineers are a small percentage of the total cost. The wage workers, both those organized in trade unions and even the unskilled and ignorant laborers on the work, have received increases in compensation in many cases fully equal to the change in the value of the dollar and in some cases far exceeding it. If the engineers on such work are paid the same percentage of the total cost that they were in 1914, their increased pay will fully offset the changed value of the dollar. The same thing is true of engineers employed in manufacturing industries, and here the compensation of engineers has been largely increased.

At this time especially, employers who represent invested capital and those responsible for work in the public service, stand in great need of the loyal support and co-operation of their salaried professional staff. It is exceptional where salaries have been increased to correspond fully to their decreased purchasing power.

The injustice in thus reducing the rate of compensation for loyal and efficient service paid to the very men on whose brains and fidelity the country is more dependent than on any other class is truly a fatal error.

The present price level is not considered merely

Railroads Oppose Compulsory Metric Legislation

To the Editor:

In view of the efforts now being made at Washington to persuade Congress to enact a law providing for the "compulsory introduction of the Metric System" the following reasons suggest themselves as to why such action would place an unnecessary burden on the railroads and incidentally on the people at large, for the reason that in the last resort the people must pay for all of these excessive and unnecessary expenditures:

1. The railroads of the country have spent several million dollars preparing plans in compliance with Valuation Orders of the Interstate Commerce Commission. These plans, as well as other plans, both of right-of-way, structures, standards, etc. will become, in effect, obsolete and their replacement would eventually be necessary on the metric system. This would entail a very large expenditure.

2. The enactment of this law would cause all freight tariffs to be revised and readjusted from their present pound and ton basis. This would not only involve a very large expense but great confusion and the loss in connection therewith would be intestimable.

3. All passenger tariffs would also have to be revised and changed from their mileage basis of calculation.

4. Platform, wagon and track scales would be of no value as they now exist until they were remodelled and changed to meet the requirements of the new measure. This would result in throwing away and scrapping a large amount of valuable railroad property.

5. In addition to the above would be the expense incident to educating railroad employees to adapt themselves to the new system and the resultant confusion in connection therewith.

6. It seems to me we ought to let well enough alone. The present system is taking care of all our requirements and there is no sound reason for any change. I sincerely hope that no such drastic proposition will get any serious consideration from Congress.

(Signed) B. A. WORTHINGTON,
President, The Cincinnati, Indianapolis and Western Railroad Co., Indianapolis, Ind.

temporary by such of our Government agencies as the Department of Labor and the Federal Reserve Board or by such economists as Irving Fisher and J. S. Holden. Substantial relief from the high cost of living therefore cannot reasonably be expected through a decrease in prices; it must be met by increases in salaries.

The Intrinsic Value of Engineering Service

It will be generally agreed that the salary of an engineer ought to be at least sufficient to enable him to live in the manner which his position and responsibility call for, and in addition to repay within a reasonable time the investment in time and money he has made in gaining the education and experience which is necessary for his work.

There is a wide general acceptance of the principle that the worker in any occupation should receive at least a reasonable living wage. By a "living wage" is meant the amount which will maintain in decency and comfort both the incumbent of the position and his dependents.

There are certain positions which are ordinarily occupied by young men and women who are starting on their life work and who have not yet assumed family responsibilities. In so far as the incumbents of these positions fill them temporarily as a means of advancement to positions of greater compensation—in effect serving as apprentices—the living wage need not be based on a "family" standard.

When, however, any position is likely to be occupied more than temporarily by individuals of an age at which they should naturally assume family responsibilities, the minimum salary for the position should not be less than that necessary to maintain an average family in respectability.

Why Engineering Work Has Been Inadequately Paid

Unfortunately there has been, for fully a decade, a tendency to lower the pay of engineers. The law of supply and demand has operated to reduce the pay of engineers in many branches of the profession far below reasonable standards.

This has not benefited the public. On the contrary by paying too low a rate for engineering service, the inevitable tendency has been to lower its quality. This has been especially marked in the case of engineers in Federal, state and municipal service. Here the inertia which prevails in all public affairs has prevented the engineers from receiving more than a trifling part of the increase in pay, measured in dollars, that is required to offset the shrinkage in the dollar value.

The obvious result has been to drive out of the public service the best and ablest men, who can obtain better positions elsewhere, and to leave only the men who by reason of age or inferior ability cannot make such a change.

Cheapened Engineering Service Means Waste and Danger

It cannot be too strongly emphasized that the public loses through cheap engineering service many times the amount it may seem to save through lower salaries. The professional engineer in a responsible position in designing, constructing or executive direction of important work should have initiative, sound judgment, broad knowledge and executive ability. Lack of these qualities often results in great loss of money, often by needlessly increasing the cost of work of which the public never knows. Safety of life and limb is also so frequently dependent on the skill and fidelity of the engineer that danger is incurred when the quality of engineering service is sacrificed through a false idea of economy. The investigation of the Quebec bridge disaster of 1907 showed that the engineer primarily responsible for the safety of its design was being paid at so niggardly a rate as to be unable to provide a sufficient and competent staff to supervise the work properly.

Movement to Benefit Public

The movement, therefore, to give engineers just compensation for their services is not merely a movement for the benefit of the engineering profession. It is even more a movement to benefit the public by securing for it a high quality of engineering service.

This matter deserves emphasis here because where readjustment of salaries has taken place to compensate for the changed value of the dollar it has been common to confine the increase to the lower paid men and to do little or nothing for the men receiving salaries above $2,500 to $3,000. There is no longer an excuse for this, as the above review amply proves. The measure of seeming economy, also, is very small; because the engineers in the higher positions are few in number compared with the rank and file of professional workers.

It is frankly recognized that there is another class of technical work of a routine order which calls for little in the way of initiative, originality or judgment. Much of this routine technical work in the field, the office, the shop, or the laboratory can be and is being done by boys and young men with limited education and no more training than that afforded by a correspondence school or a few months' study in a trade school. Most of this work does require, however, a degree of reliability and fidelity which deserves fair compensation. The best guide to fair rates of pay for this class of technical workers is found by comparison with the standard rates of wages paid to skilled workers in the trades. These workmen are now generally receiving rates of pay much higher than the routine technical worker and in many cases higher than even the engineer who carries large responsibility for design or administration.

Government Technical Employees Do Not Get a Living Wage

The Federal Government is now paying thousands of its highly trained clerical and technical force less than a living wage. Except for the temporary bonus of $240 a year for positions paying salaries of $2,500 or less, no attention has been paid to the constantly diminishing purchasing power of the salaries paid to this class of employees. On the other hand, the Government has given full recognition to increased living costs in fixing the wages of organized labor.

A "shipfitter" in a navy yard, for example, receives $1,750 a year while he is learning how to do his work. After three months of apprenticeship he gets $2,000. If he is made a "straw boss" in charge of twelve or more men, he gets $2,450, and if a "sub-foreman" in charge of thirty or more men, he gets $2,900. A blacksmith (heavy fire) gets $2,400. A "hammer and machine forger" (heavy) gets $3,700.

There has been reluctance to raise salaries to correspond to the changed value of the dollar because of the idea that prices were to drop back with the conclusion of the war. So far from this being the case, the records show that following the lull in business after the armistice, prices have risen above even the wartime scale and are now at the highest point ever reached. Business has largely readjusted itself to the changed conditions and the activity in some lines exceeds that registered during the war.

The only two things which can restore prices to their former level are increased production or decreased consumption. World-wide disorganization of industry and of government, deficient capital and deficient transport facilities all tend to reduce production. The world of consumers, long held down to a war diet and war clothing, now eagerly seeks to replenish its larder and wardrobe and to repair and renew its stock of buildings and machinery.

The Outlook

The outlook is that it will take years to again organize the world's equipment for production and distribution, including finance, transportation by land and sea, and merchandising, so that the demands of consumers may be met as before the war and prices be brought back to former level.

It may well be argued further that the high scale of prices or low dollar value has continued now for fully three years. During that time the engineer who has had but little increase in salary has suffered a heavy monetary loss through causes entirely beyond his control.

In many instances the amount paid for skilled labor is greater than the amount paid to the trained Government engineer. Over forty of the labor crafts were awarded a rate of wage of $2,000 and more by the Labor Adjustment Board.

The skilled laborer is not required to know how to read or write, and he may receive full pay after an experience varying from two weeks to six months. The Government engineering employee, on the other hand, to get an equivalent amount of pay, must have had from two to eight years' experience if he is not a technical graduate, and in many instances will not be admitted at all without a technical degree and then only with from two to four years' practical experience.

Many other comparisons might be made between the worker at a trade or the factory employee and the routine worker in engineering, showing how low is the pay of the latter compared with the former; but no further proof is necessary to show that the technical worker is not receiving what his services are worth.

The Inevitable Result

The inevitable result of such underpaid service is a deterioration in its quality. The men in these lower grades have as a rule not the same incentive of professional pride that often keeps the men carrying larger responsibilities faithfully at work, even when their pay is inadequate.

Even though a temporary oversupply of men trained in engineering work may make it possible to keep salaries for these brain workers below the wages of laborers, the inevitable result will be a dissatisfied working force, which carries out the daily routine without energy or good will, and the public's work will not be done with efficiency or economy.

"Spiral" Gears Again

By Joseph C. O'Brien

Chairman of the Worm Gear Com. A. G. M. A.

Referring to an article which appeared on page 278 of the *American Machinist* entitled "What's in a Name?" by E. M. Long, the writer, as Chairman of the Standardization Committee of the American Gear Manufacturers' Association, on Worms, Worm Gears and Spiral Gears, takes the liberty of replying to that portion which refers to worms and spiral gears.

There is no use in being too fussy about such matters as we must draw a line somewhere. If we try to make the name describe the gear technically, its manner of use and manner of operation, we would have to have a composite name which would be too cumbersome for ordinary everyday shop use.

It so happens in this case that we have a gear which may be technically described as a helical gear, that may be used in the commonly accepted sense, either as a helical gear, a worm or a spiral gear. To those who are extremely technical, these terms may be considered as a nick-name or trade name which designates only the gear's manner of use. I agree with Mr. Long that what is commonly called a single thread worm, is technically speaking, a true helical gear; however, either a worm, spiral or helical gear may have any number of threads or teeth whatever and should take its name from the manner in which it is used.

For example, suppose we take a six-thread true helical gear. If we mesh this gear with any other helical gear having teeth of the same angularity and opposite hand, the shafts will be parallel and in the same plane, such gears are known as "helical spurs or helical gears."

If we now take this same gear and mesh it with a helical gear having teeth of the same hand, the shafts will still lie in parallel planes, but will be askew to each other. The shafts may have any angle with respect to each other between zero and 180 deg. Such gears are known as "spiral gears."

If we now mesh this same helical gear with a wheel, in which the teeth have been conjugated by a facsimile of the helical gear itself, either by the hobbing method, fly-tool method or similar method, and the outside face of the wheel is concave so as to embrace the periphery of its mate, we have what are known as worm gears. The member having the straight face is known as the worm and the member which has the concave face is known as the worm gear.

When both members of the drive have a concave face the yare known as Hindley worm gears. The term "Hindley spirals" is led where the angle of the teeth is such that either gear will drive freely in either direction.

In ordinary practice helical gears are seldom made with less than 8 to 10 teeth, and seldom have greater than a 45-deg. helix angle. Worms seldom have more than 6 to 8 threads and seldom have less than a 45-deg. helix angle, and spiral gears are frequently used with as low as triple, double and even single threads, and the angle of helix varies from zero to 90 deg.

If the terms, helical, spiral and worm are limited and used in the sense explained, they will convey the idea of the manner of use, which is really the more important matter and to the writer's mind, for practical purposes, there is no need of a more descriptive name in either case.

EDITORIALS

Have We Over-Specialized?

THERE is a growing belief in the minds of some of the progressive thinkers along management lines that we may have overdone the specialization of workers in the shop; that the subdivision of work into operations and sub-operations may have been carried too far for real efficiency.

Some who have studied the question carefully are convinced that, while it may be possible to train workers to perform one operation in a very short time, the result is not always satisfactory as it fails to enlist their interest in the work. And lack of interest is not conducive to maximum production or to the spirit of co-operation, on which both production and shop harmony so largely depend.

We are apt to complain that workers in the shop no longer take the same interest as of old but we forget that our efforts toward efficiency have been largely responsible for their attitude. The man who only knows that the piece he works on is "PX2" and has no idea where it goes or what it does, can hardly be expected to show much enthusiasm in his work. True, he might find out by inquiry, but even this is sometimes rebuked by petty executives alone. This attitude discourages workers with limited initiative and affects production more than we realize.

Is it not better to encourage interest by seeing that workers know what they are working on, what it does and why it must be made accurately? This can be done in different ways, depending on the machines and the way in which the shop is run.

The method, however, is not important. The main thing is to realize that the more we specialize a man into an attachment to a machine, the less we can expect interest and co-operation. And it is time we were realizing the effect of these on production.

The Compensation for Engineers

THE report of a committee of the Engineering Council regarding the compensation of engineers, should be carefully considered by plant managers and by all citizens who want the best engineering service in all community activities. This report points out clearly that the only basis for consideration is the purchasing power of the dollar, and that this has been growing less ever since 1914.

There can be no question as to the necessity for increased production in all lines, and who can play a larger part in securing this than the engineer? But there has been all too little incentive in the way of increased salary to enocurage the average engineer to exert his best efforts in this line.

Then, too, both the engineer and the intelligent workman know too well that there are many cases where the cost of production bears no direct relation to the selling price. A slight increase in labor and materials is multiplied several times before the retailer passes it on to the consumer.

Manual labor, both skilled and unskilled, has demanded and received advances which probably will average to at least cover the decreased purchasing power of the dollar.

Does management realize that by failing to advance salaries of highly trained men, those who have spent years at college and in securing their experience and training, it is giving notice that organization and demands are the only way to secure the proper compensation for engineers?

Engineering unions are already under way. Whether they flourish or pass away, depends on the way in which management meets the situation. As long as management continues to pay an engineer as little as it can, and to pay unskilled men high wages because it must, it is encouraging the formation of wage organizations and destroying the close bond of sympathy and co-operation which is so necessary, especially with the engineering staff.

The relations between the management and the engineers should be of the closest. Men of this intelligence do not expect impossibilities and could be keenly interested in any fair proposition to make their income proportional to the services they render—to give them a direct return on the results of their efforts. But whatever be the method, it must be clear to all that engineers must be paid more fairly for the services they render.

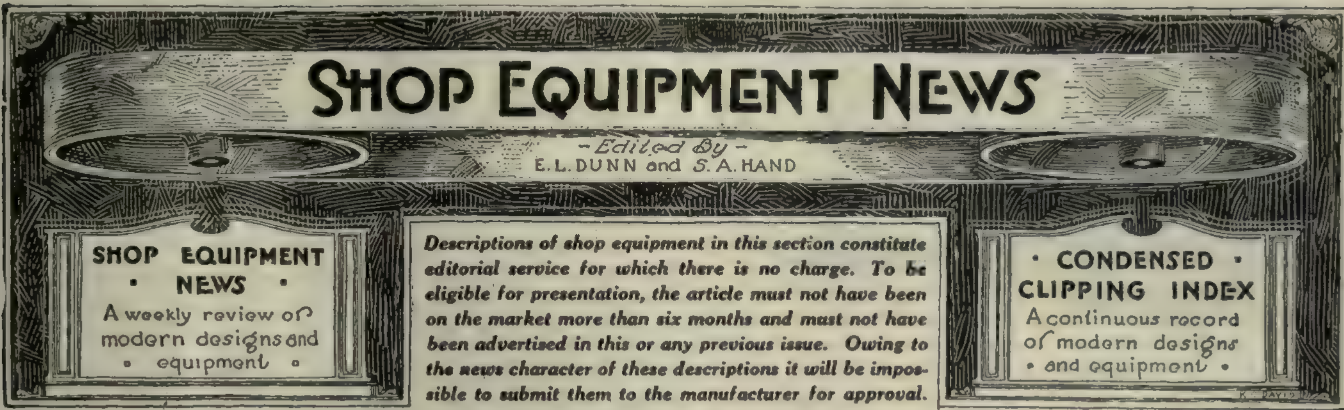
The attitude of the Congressional Committee investigating the remuneration of Government employees is an encouraging sign. That section of the report of this committee which refers to mechanical and automotive engineering positions, and which was published in the *American Machinist* for April 15, recommends rates of pay that are more commensurate with present living costs than are the salaries now received by some of our ablest engineers. States and municipalities should follow suit.

Reducing Spoiled Work

WE have been so accustomed to consider only the mechanical side of manufacturing problems that we too often fail to consider the other factors which enter into them. The last paragraph of the very instructive letter by John Adendorff, factory manager of the Brown-Lipe-Chapin Co., which appears on page 919 in this issue, is very illuminating and deserves careful consideration. Bad air and spoiled work are not usually connected in the mind of the mechanical engineer or the factory manager—yet they are probably more closely related than many of us realize.

In a similar way bad air, or a lack of sufficient good, fresh air, is doubtless responsible for many mistakes in both office and drawing room. It is a hopeful sign when managers of large shops are considering non-mechanical details.

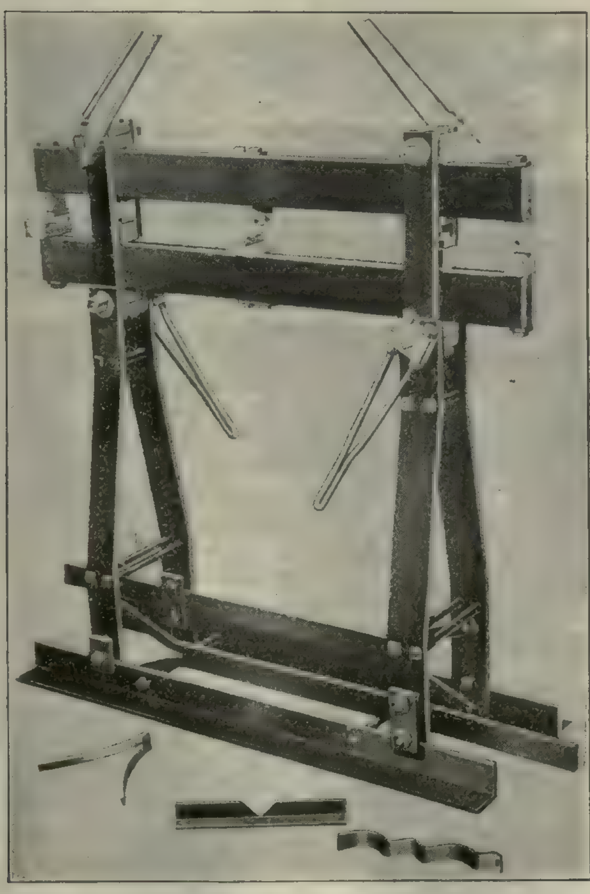
The human factor deserves more attention than the mechanical just at present.



Armstrong-Blum Marvel No. 23 Punching and Bending Machine

The No. 23 punching and bending machine shown is made by the Armstrong-Blum Manufacturing Co., 333 North Francisco Ave., Chicago, Ill. This machine has an eccentric and link arrangement at each end operated by hand levers. The tool-carrying bars are 4 ft. long which gives 40 in. between links and permits a number of punches and dies to be placed in this space in order to punch several holes in a wide sheet at the same time.

The machine can also be used with V-block benders, notching dies, or shears.



MARVEL NO. 23 PUNCHING AND BENDING MACHINE

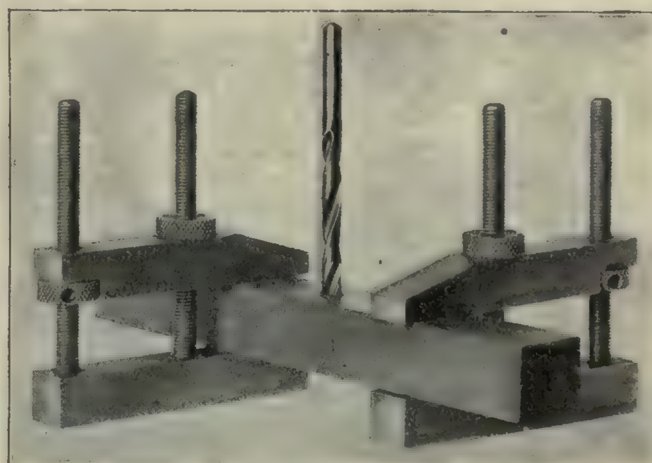
Specifications: Capacity, will punch $\frac{5}{8}$-in. hole in $\frac{3}{8}$-in. steel with 2-in. throat, or $\frac{3}{4}$-in. through $\frac{1}{4}$-in. with 9-in. throat; will shear $\frac{1}{2}$ x 2-in. bars; vertical travel of tool-bar, $\frac{7}{16}$ in. with one lever, or $\frac{7}{8}$ in. with two levers; space between upper and lower bars, $3\frac{1}{4}$ in.; height, 50 in.; length, 48 in.; width, 17 in.; weight, 475 lb.

The legs are so mounted on the angle-iron base that they may be shifted in or out to change the depth of the throat on both ends of the machine. The bars, links and lever are of heat-treated steel.

Knauel Toolmakers' Parallel Clamps

The Knauel Tool Works, Rock Island, Ill., has brought out the toolmaker's parallel clamps shown in the illustration.

The clamps are made in two sizes, the No. 1 with



KNAUEL TOOLMAKERS' PARALLEL CLAMPS

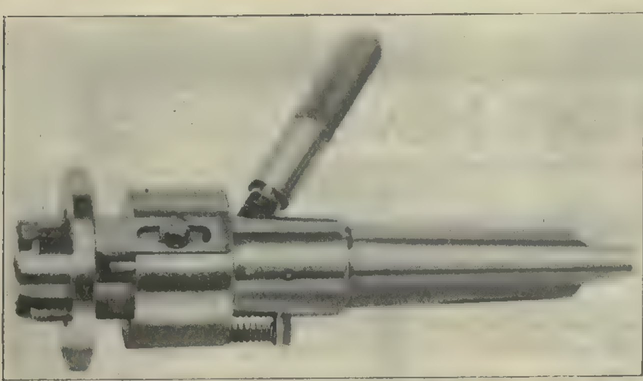
$1\frac{1}{4}$-in. opening, and No. 2 with $2\frac{1}{4}$-in. opening. A feature of these clamps is that the screws project on one side only, permitting their use in close quarters or standing in an upright position while holding the work. They are rapidly adjusted and may be tightened by the fingers or by using a pin on the rear nut.

Victor Collapsible Pipe Tap

The collapsible tap illustrated herewith is a late addition to the line of tools manufactured by the Victor Tool Co., Inc., Waynesboro, Pa.

It is used for tapping pipe threads in fittings and flanges but instead of being tapered or having tapered chasers it is provided with short straight chasers that automatically recede as they advance into the hole, the correct taper being given to the threaded hole by a cam which controls the chasers. As the maximum size of the taper hole is tapped first, it will be seen that the hole can not be tapped too large by running the tap too far in as would be the case with a taper tap.

It is claimed that as the work is all done by the



VICTOR COLLAPSIBLE PIPE TAP

ends of the chasers, less power is required to tap a hole than if a taper tap was used.

Taps of this type can be made in sizes from 2 to 12 in.

Herlth Adjustable Parallels

The adjustable parallels illustrated herewith are made by the O. B. Herlth Manufacturing Co., 32 Union Place, Hartford, Conn.

The parallels are hardened, ground and lapped. It is claimed that their accuracy is within 0.0001 in. and that they may be stacked in all combinations with uniform results.

They may be used independently or in combination with precision blocks for such work as gaging slots, setting sine bars, buttons, snap gages, etc.

HERLTH ADJUSTABLE PARALLELS

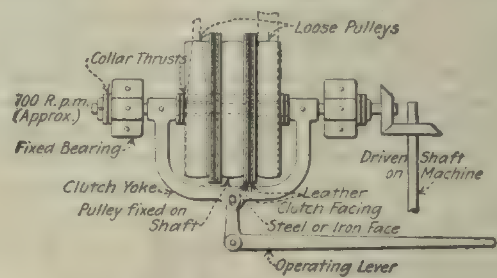
Each set comprises five adjustable parallels varying from $\frac{1}{8}$ to $\frac{7}{8}$ in. minimum thickness and from $\frac{5}{8}$ to $1\frac{1}{8}$ in. maximum thickness.

A Simple Quick Reversing Clutch

By H. H. Parker

The sketch shows a cheaply constructed reversing clutch which is well adapted for a drive requiring quick action but where no large amount of power is required. The clutch as described was used to drive, through bevel gears and screw, a piston working in a long cylinder which forced out a plastic material under considerable pressure through a small nozzle. As it was desired to be able to shut off the pressure instantly, this was accomplished by reversing the direction of rotation.

No sticking of the friction surfaces could be tolerated, hence the use of plain disks. The apparatus worked satisfactorily under these conditions and it would seem



A SIMPLE AND CHEAP REVERSING CLUTCH

that such an arrangement could be adapted to other uses, as an extemporized tapping machine, etc.

Three wood split pulleys were used; the sides of the rims of one were carefully trued up, also one side of each of the others. Then two disks of iron were screwed to the first pulley and one each to the other two, these disks being made of plate about $\frac{3}{16}$ in. thick. Leather disks were fastened to the iron disks by means of countersunk copper rivets to act as frictional engaging surfaces. Probably some regular clutch lining material would have been better than leather.

The two-faced pulley was clamped fast to the clutch shaft while the others were provided with babbitted bushings and ran as loose pulleys. Each bushing was faced off on the outside end and a ball thrust bearing set up against it. An iron yoke was then forged up, the distance between the forked ends being wide enough to accommodate the three pulleys and two thrust bearings plus a narrow clearance space between the adjacent friction surfaces. The ends of the yoke were drilled out and babbitted to fit the shaft and the connecting piece provided with a pivot for the operating lever.

Two babbitted dolly boxes and two more thrust bearings completed the essential parts of the device.

As will be seen from the sketch, the forward and reverse motion, obtained by a straight and a crossed belt from drive pulleys on the line shaft, was controlled entirely by manual pressure on the hand lever, the clutch never being engaged in either direction for any length of time.

While the loose pulleys might have been made of cast iron, wood was best for the reversing center pulley as there would be less inertia; though for a more elaborate set-up aluminum alloy could be used

What Other Editors Think

Metric Chaos in Daily Life

(From *The Iron Age*)

A STAGGERING PROGRAM OF OVERTURNING FOR INDUSTRY AND THE INDIVIDUAL.—Not since the free silver craze of 1896 with its 16 to 1 formula, which was to become operative "without the consent of any other nation," has a national policy been urged upon the country with a tithe of the possibilities of chaos in business that are involved in the compulsory adoption of the metric system. What it would mean in matters affecting the everyday life of the average member of the community is suggested in the following, which is contributed to the current discussion by a well-known testing engineer:

WHAT THE METRIC SYSTEM WOULD MEAN IN SOME ORDINARY AFFAIRS

In domestic life:

Grocers' scales all require new poise weights, all notched balance beams scrapped and new ones provided, with new sliding weights.

Peck and bushel measures discarded.

Liter larger than a quart, new containers required.

Hectoliter, equal to 2.8 bushels, not a practical unit.

Prices on all commodities to be readjusted to new units.

In culinary matters:

All recipes to be readjusted to kilograms and liters; cook books to be rewritten; general confusion in kitchen operations.

New milk bottles.

In other household affairs:

Gas meters to be replaced by new system of units of volume, or readings of meters taken in one system and converted into the other, to avoid scrapping meters in use.

Water meters in same category as gas meters.

Tape measures and yardsticks to be discarded.

In shopping:

Counter measuring machines to be reconstructed, yards to meters.

Dry goods to be folded at cotton and woolen mills in meter folds instead of yard folds, requiring change of machinery.

Photographic plates in common sizes to be known by awkward combinations of figures. An 8 x 10 plate becomes 203 x 254 millimeters.

Quires and reams to be displaced by decimal multiples, requiring changes at manufacturing plants.

All containers and cartons to be modified in sizes and shapes to be adapted to new unit sizes.

Shirts, collars and cuffs to be known by strange names of sizes. A 16-inch collar becomes a 406-millimeter collar. A 187-millimeter hat is worn instead of 7⅜ inches.

In building materials and construction:

Abandon board measure and substitute square decimeters, centares or ares.

Doors familiar to all builders as 2 feet 6 inches by 6 feet 8 inches become 762 by 2,032 millimeters.

An ordinary brick is 51 x 101 x 203 millimeters. Sizes of sash also are converted into strange units. Weights of tin, terne, copper, zinc, lead sheets and plates placed before builders in unknown units, in awkward combinations.

Molds and pallets in brickyards to be changed to new units or inconvenient numbers used to represent sizes.

Earth excavation on basis of cubic meters, representing about 1.3 cubic yards. Designation of shovels and dippers in excavating machinery to be in fractions of cubic meters instead of definite yards.

All architects' drawings to be in new units, involving a most perplexing conversion of current building material units or made up on a system that will involve changes in all woodworking machinery to meet metric units.

In railroad affairs:

Change in position and renumbering of, say, 100,000 mileposts, an incidental and minor affair relative to other changes.

Standard gage of track becomes known as 1,435 millimeters.

Changes in time-table mileages.

Books of rules rewritten and speeds given in new units instead of miles per hour. Slow boards all repainted with new speeds thereon.

Speed recorders scrapped or remodeled.

Employees instructed in new methods of estimating speeds.

Dimensions of all wheels, axles, standard parts of car construction changed into new units.

Railroad track and warehouse scales to be reconstructed into metric units. Capacity of cars to be in new units.

In public land surveys:

Lands in many states surveyed and staked out in townships, sections, quarter sections and eighth sections, in none of which divisions is there an easy conversion into metric units.

In reconveyance of lands, present deeds giving metes and bounds in English units would require expensive and elaborate efforts to put dimensions and areas in metric units, which if correctly made would still be unintelligible to most people.

As great as the confusion in the few respects above mentioned and as expensive as the process would be in all the usual affairs of life, these few enumerated examples pale into insignificance beside the cost involved in making the conversion in the manufacturing industries. The cost of war is but a fraction of that which would confront the general industries of the country. Virtual scrapping of all small tools and fixtures would be faced by manufacturers were such an act of Congress passed.

A colossal fortune in changes of lead screws and screw-cutting gears, in lathes alone is involved.

In all machinery the changes become of such a staggering nature their mere contemplation is most depressing. Days would be required simply to state the number of changes involved in the industries.

The ravages of war have fixed and definite limits of territory. The ravages of the metric system changes would be universal in domestic affairs.

Compulsory legislation in this matter would plunge the nation into economic disorder, wiping out values in billions of dollars.

A dual system is confusing beyond description. Two systems do not admit of being in common use. A gradual change, piecemeal, is impracticable. A sudden sweeping change would throw the entire country into disorder.

In the chemical laboratory the metric system is used. It is there because it has advantages in chemical work. It was adopted because of its advantages there.

The metric system would be adopted by the industries if it possessed advantages for them.

The rewriting of all textbooks, engineers' tables, the changes in architects' drawings, in mechanical drawings, the education of the personnel of machine shops and other industries in the use of a new system of units are matters of greater magnitude than any yet undertaken by this country.

The Industrial Outlook

FROM *Mechanical World*, ENGLAND

THE prevailing conditions are not such as to bring peace of mind to the harassed manufacturer. It is a subject we wish we could keep away from, but it is impossible not to notice how manufacture is being artificially hampered at a time when all artificial barriers should ruthlessly be swept away, for there are other handicaps of a more less legitimate nature which call for all the resource and skill of the traders and manufacturers of the country to overcome. The unwise refusal of the molders as a body to accept the terms which their executive urged them to do must have one or two effects. It will either result in closing down more enginering works and so hit still further the funds of other unions, or the strike will peter out of itself by the simple process of some men going back to work and others following in increasing numbers. We believe this is what will happen, for when over seven thousand men are willing to go back to work, it will take very strong views on the principle of abiding by the majority decision to keep them out. A point which strikes us about the matter is that we are told there are fifty thousand union molders, and nothing like all that number voted, and it would be interesting to know the views of the remainder. Meanwhile, one large engineering firm has announced its decision to close down the whole of its works until the dispute is settled. On the other hand, the conditions generally are none too bright in regard to supplies of raw materials, having regard to the effect of the increased railway rates and threats of further labor trouble. Orders from overseas are coming over in increasing numbers, but manufacturers of iron and steel do not seem disposed to quote any prices, and the prospect of any further advances in the near future is causing considerable competition for the available supplies, which is tending to force prices up. The feature of the situation is that very little relief can be looked for from foreign supplies, for, contrary to anticipations, other possible countries are too busy making up their own arrears due to the war to be able to spare much in the shape of raw or semi-finished materials for export.

Heads Win

FROM *Power*.

THE other day on a street corner, I saw two little newsboys matching pennies. As I passed, one of them shouted, "Heads win!"

That little ragged urchin did not realize that he was proclaiming a great truth. But he was.

Time was when money was looked upon as being the chief factor in every branch of life. The capitalist was looked at with envy, and sometimes with fear. That day is fast passing away. People know differently now. It is headwork that wins today.

In the great world war it was not the money, the men, the tremendous amount of ammunition, the submarines, which won. It was brains. If the enemy produced a deadly gas, then the brains of the opposing forces were set to work to produce a gas more deadly than the other. When the submarines began to take their daily toll of ships sunk and destroyed, the allied nations realized that they must think out a way to get rid of these reptiles of the sea. And they did it. The magnificent brain of Foch and his generals planned a campaign which wore down the German hosts and in the end accomplished their defeat. Brains did it, not guns. Heads won!

In the industrial world it is not the man with the biggest muscles that gets to the top. It is not the man with massive arms and iron hands, who can lift a hundred-pound weight with ease, who gets the most money in the pay envelope at the end of the week.

It is the man whose brain is active, who thinks and plans and studies the best way to do a job. It is the man of power. And power does not mean brute force. Power comes from constructive thinking, cumulative thought or, in the parlance of the street, "using your head."

Men are beginning to think for themselves. The day when they were driven or led to do things by soft words and unctuous phrases has gone by. Today men in all branches of industry are fast thinking out their problems, without help from others. They are using their heads and they glory in it. Just in proportion as they learn to think for themselves will men grow in power to do and live and prosper.

The next time you hear a man grumble over the amount he gets in his pay envelope, tell him the story of the newsboy who unwittingly emphasized the great truth, "HEADS WIN!"

Reducing Spoiled Work

BY JOHN ADENDORFF,

Factory Manager, Brown-Lipe-Chapin Co., Syracuse, N. Y.

During the month of January, 1920, there were seven and one-half million mechanical operations performed on work in the Brown-Lipe-Chapin Company's plant. The average spoiled, wasted and defective material, per major operations, was 2.2 per cent. This 2.2 per cent does not refer to all of the minor operations included in the seven and one-half million figure, but does cover major operations as well as including defective and spoiled material.

A considerable amount of attention has been given to defective material, spoiled material, etc. in this plant. As to defective material, it is the policy of this company to have experts follow the sources of supply and inspect material, especially in the steel lines, before it is shipped from the mills. Very close inspection is also given at the forge plants. All raw material as it enters the company's plant is inspected. As soon as a machine operation is completed in the plant, it is the policy of this company to inspect the work immediately.

The individual operators have blueprints from which they take their dimensions. Each operator is held responsible for his own work. A set-up man in each group of machines, as well as the gang boss, is also held responsible for the work coming off the machines.

A System Instituted, Employing Machine Inspectors

When our spoilage was excessive we instituted a system of employing machine inspectors; that is, putting an individual inspector in charge of the work coming from a group of machines. This inspector would circle around the machines and inspect as many pieces as he had time for. We believe that through this method many improvements were made, and it has lately been possible for us to withdraw these machine inspectors in all cases, except that of inspecting finished teeth of gears. In this case we still employ a machine inspector for each group of machines. We find that it is good practice to inspect work continuously as it is completed. The "moveman" circulates around the different groups of machines and picks up whatever piece or pieces there may be around each machine and carries same to the inspection bench for inspection.

To improve the status of inspectors, regular classes were held by a competent instructor. Inspectors received instruction as to proper knowledge of reading blue prints, skilled handling of micrometers, vernier calipers and other tools used by them. Also a knowledge of the product, more especially the reason why close limits were held in certain dimensions and limits not so close in other dimensions. In these classes the inspectors were impressed with the importance of their duties and were instructed to report all faulty dimensions, no matter who the operator was that produced such work. As the inspectors became more competent their wages have been increased accordingly.

In Some Departments Operators Are Not Paid For Spoiled Work

In some departments we do not pay operators for work spoiled, even though we have repair men who can repair such work. We are working toward the object of establishing this principle throughout the factory. Written inspection reports are obtained daily and closely watched by certain executives of the company. As soon as the spoilage exceeds a given figure, steps are taken to immediately remedy the condition.

It has been our experience that the condition of the operator's machine, as well as the tooling, has a great deal to do with wastage and spoilage.

We also believe that the conditions surrounding the operator, especially atmospheric conditions, have a great deal to do with spoilage and wastage. We are now working toward the end where we can get a complete circulation of fresh air into each department every fifteen minutes, or at least every half hour.

A Step Toward Accident Prevention in Massachusetts

On March 9, 10 and 11, the first annual Massachusetts Accident Prevention Congress was held at Worcester, Mass., under the joint auspices of the Worcester, Springfield and Boston locals of the National Safety Council and of the Associated Industries of Massachusetts. The convention was adjudged a decided success in every way. The attendance was good, over 250 registering at the Hotel Bancroft, which served as headquarters. The various phases of industrial accidents and their prevention were well covered by competent speakers, so that the character of the proceedings was chiefly of an instructive nature.

Probably the most important work of the congress was the action taken toward the establishment of a hospital and vocational school for the care and education of serious disability cases. Worcester was selected as the preferred site, and efforts are to be made to interest the state in the building of such an institution there.

In the event that Massachusetts does not take action upon this matter, it is possible, and even probable, that insurance companies and industrial concerns will found and support the institution without the aid of the state.

The first day of the convention was devoted to topics of a rather general nature, the initial session opening with a luncheon. The first speaker was C. W. Price, who is the general manager of the National Safety Council, Chicago. In his opening statements, Mr. Price said that, while the Government reports show that 47,949 of our soldiers were killed in Europe during the 19 months that we were engaged there, 126,000 people were killed in this country during the same period of time and 35,000 of these were killed in industry itself. Among the statements of Mr. Price that were worthy of especial note are the four facts which follow:

First: That it has been demonstrated in actual practice that three-fourths of all deaths and serious injuries in industry can be eliminated if the manufacturer so desires.

Second: That the safety movement offers the first common ground where employer and employee can meet for mutual benefit.

Third: That the reduction of serious and fatal accidents which has been accomplished so far has been due only one-half as much to the introduction of mechanical devices as to the reaching of the foremen with the safety idea and to the subsequent passing of it to the men.

Fourth: That the safety work can be looked upon as profitable business, because big dividends are paid upon the investment.

The rest of the session was taken up by addresses given by J. F. Ginsley, vice president and general manager of the Crompton and Knowles Loom Works, Worcester; by D. S. Beyer, vice president of the Liberty Mutual Insurance Co., and by W. Hall of the Wickwire-Spencer Steel Corporation. In the evening, entertainment was provided by moving pictures dealing with safety-first principles and by a Court of Inquiry on Accidents which was acted by the permanent Safety Committee of the American Steel and Wire Co., of Worcester.

The morning of the second day of the congress was devoted to a surgical session, the chief speakers being W. I. Clark, Service Director of the Norton Co., of Worcester. Mr. Clark's subject was Fractures in Industry. D. M. Holman, manager of the United States Mutual Liability Insurance Co., at Quincy, Mass., talked on the Rehabilitation of the Handicapped Men. In the afternoon, a session was devoted to the influence of the house organ in promoting the safety-first movement followed by an inspection of several of Worcester's chief machine plants. In the evening a session of especial interest to foremen was held, the importance of the foreman in preventing accidents being well brought out.

The morning session of the third day was occupied by addresses by representatives of insurance companies on the means of safeguarding employees. The principal speakers were F. H. Wentworth, secretary of the National Fire Protective Association, Boston, and William Ferguson of the Travelers' Insurance Co., Hartford, Conn. In the afternoon session R. M. Little, director of the Safety Institute of America, New York, gave figures upon the number of industrial accidents and upon their cost. Among the other speakers of especial importance were V. T. Noonan, of the Bethlehem Shipbuilding Corporation, Quincy, Mass.; W. W. Kennard of the Massachusetts Industrial Accident Boards, Boston; J. P. Meade, of Boston, and A. L. Powell, of the Edison Lamp Works, Harrison, N. J.

The resolution supporting the foundation of a rehabilitation hospital and training school was drawn up and adopted.

The congress ended with a banquet, the chief speaker being Channing Cox, Lieutenant-Governor of Massachusetts, who commended the congress for the task it had undertaken. The session was closed with an address by H. L. Smith, general manager of the Bethlehem Shipbuilding Corporation, who reviewed the work done by the congress and urged co-operation in the great work that it had begun.

The International, or Supernational, Organization

By W. Osborne

A number of men were unloading sand. They were over on the back track out of sight and were improving the opportunity by having a little talk among themselves.

"Did any of you fellows hear that chap who was talking up on the corner last night? He was some talker, now, I tell you. If we all got what we earn we would not be shoveling sand here, and that's a fact. He knew how to show them fellows up who make us pay rent, and interest and all that sort of thing. He said that us fellows are just a lot of jackasses that are working along more than half asleep, and he is trying to wake us up so that we will reach out and take what is coming to us. You bet I went up and chipped into his hat without being asked to."

The speaker leaned on his shovel while he waited for signs of how his words had been received.

"Did he mean," said an old man, "that the bank shouldn't ought to give me any interest on the money I got in there in a savings' account? When my old woman died and I sold the farm the man who bought it didn't have all the money and I took a mortgage for what he didn't have. He pays me six per cent on that mortgage. Did that fellow last night mean that the man who bought my farm shouldn't pay me any interest?"

"He ought to be able to get the money from the Government so he could pay you for the farm," said the first speaker.

"When work played out in our town and I came here I rented my house back there. According to that bird who was talking last night, who you have been telling about, I shouldn't get any rent. Don't I have to pay taxes, and didn't I have to save up my money and build the house and isn't it getting run down all the time with them people living in it and not taking any kind of care of it?" Evidently this speaker was a capitalist.

"You hadn't ought to had to build a house. The Gov-

ernment had ought to build it," said the first speaker, "and then you shouldn't need to be worrying about rent."

"Where is the Government a going to get all of this money, I'd like to know? Maybe some of you fellows never pay any taxes; or anyhow maybe you think you don't because you don't own any property, but let me tell you somebody has to work for every cent that the Government either uses or wastes. You don't need to talk to me. The only thing you get for nothing is to get it in the neck. Lookey here, now, ain't we getting more money than we ever did, and ain't we able to buy less for it than we ever did, and ain't the Government spending a lot of money for things that it never did before, and ain't everybody blaming everybody else for being to blame for the high cost of living, and—"

The speaker was getting warmed up to his subject and there is no telling where he would have ended had not a fellow, who up to this time had not spoken, broke into the discussion.

A Mysterious Speaker

"See here now," he urged in a mysterious manner, as he held up his hand for attention, and looked around so as to be sure that he would not be overheard by any outsider. He motioned for them all to gather closely around. Evidently he had something of importance to disclose. Lowering his voice until it was not much above a whisper he continued. "You knew that last young fellow that the company took on? I mean that good-natured one that is always trying to jolly a fellow. Well, he was trying it with me the other day and I just let him keep at it to see what he would say, and he let something drop

that I don't think that he meant to let drop. Do you know why them kind of fellows have it on us? Well, sir, I can tell you. They all belong to some kind of an organization that has a lot of laws. Every one of them has to obey these laws and so they all work together for each other. Of course there was a lot of it that I didn't get, but it is, so he says, the strongest organization in the world.

"He says that it is a bigger thing than the Masons, or the Knights of Columbus, or Lenine and Trotsky or any of them things, and that these laws of their's are worked on you whether you like it or not. Why, he says that they have knocked out business men, and big corporations, and even governments that would not join with them. He said that these laws can't be changed by anyone, but that if you buck against them they just up and get you in one way or another. Some funny things he said. He said that there was a lot of different degrees that you could take, and that nobody got to where they had all of them, but that if you wanted to know the laws of any of them the ones who had taken them would tell you what they were, or what you had better do.

Every Educated Man a Member

"He said that every educated man was a member of this organization and had some of the degrees. The way he talks it seems most of the trouble in the world comes from two things. One is that a lot of fellows like us are trying to do things without knowing anything about this organization and its laws, and are balling things up; and the other is that a lot of fellows, who are in, are trying to do a lot of things that are under laws where they have never taken their degrees. Just like this, you know, where men try to make laws in Congress that can't be made.

"I told him right there that Congress could make any kind of a law that it wanted to (that is, if the President would sign it, it would be a law), and he laughed and said, 'I guess you never heard of the congressman who moved to repeal the law of gravity, did you?'

"I can't understand about this organization and its laws and how it is that I never heard of it before, but I'll be darned if I don't think that there is something in it; for else why would we fellows all be out here shoveling sand while them educated fellows are having the easy time of it in shops, and stores, and banks and such places."

What the Farmer Said

Said the old man who had once owned a farm: "I don't know whether or not that fellow was stuffing you about that powerful organization and its wonderful laws, but I am almighty sure that if we do not mind the law that applies to getting sand out of a car by moving our shovels faster than we have been doing the boss will come around pretty soon and we will have to see how we can work the law of hunting for other jobs."

"It's fellows like you that are scared of the boss that helps him put it all over us. You ought to have heard that fellow last night," said the fellow who had started the talk. "He could tell you some things."

"Maybe he could, maybe he could," muttered the old man, "but out on the farm I never got no potatoes planted by setting in the shade, a whittlin' and a cussin' of the neighbors who had better crops than I had." With that he began throwing out the sand as though he was working for himself back on the farm.

Why One City Failed to Pass a Localized Daylight-Saving Law

By Frank H. Williams

In Fort Wayne, Ind., the proposition of passing a local daylight-saving law was thrashed out extensively—a voting campaign on the proposition being conducted by one of the newspapers, and all sorts of organizations meeting and registering their opinion regarding the proposition. As the result of this thrashing-out process the city council voted not to pass a daylight-saving bill for Fort Wayne. When the bill was originally introduced all the councilmen were in favor of it. The reason for the change in attitude was due to the widespread opposition to the bill among all classes—employers and employees, manufacturers, office people and store owners and workers.

Believing that the reasons for the failure of the bill to pass in Fort Wayne have been more clearly summarized than in most cities where the daylight-saving law has not been put into force, a little information regarding the reasons will be given for the purpose of showing just how widespread and general the opposition to daylight saving is in this locality.

Employees generally, in letters to the newspapers and in their meetings, declared that their opposition to the bill was based on the fact that it is much easier in the summer time to get refreshing sleep in the early hours of the morning than it is in the hot hours of the earlier part of the night. They further declared that daylight saving simply meant for them that they must get up earlier, lose this refreshing sleep and go to bed later at night than formerly because everyone knows that under the daylight-saving law it is really only 11 o'clock at night when the clock says 12 o'clock and that, therefore, people as a rule go to bed at the same time as usual under daylight saving no matter what the clocks say. They further stated that this had the effect of making them lose an hour's sleep.

The opposition of the manufacturers to the bill was based on the fact that with a daylight-saving law, the time in Fort Wayne would be different from that of the railroads and the surrounding towns and that consequently, shipping schedules would be confused and there would be constant trouble and fussing over trying to make town time agree with railroad time and with the time of surrounding towns. They also said that as the mails would arrive in Fort Wayne at the usual time and that with Fort Wayne saving an hour of daylight it would make the delivery of the mails seem to be an hour late, thereby having the effect of cutting an hour's time off the day's work.

The opposition of store and office employees was equally positive. The majority declared emphatically that an extra hour of daylight meant nothing to them and that they much preferred sleeping an hour later in the morning to arising an hour earlier and having an extra hour of sunlight in the afternoon.

Farmers, of course, were very greatly opposed to it, as were drivers of milk wagons, bakery wagons, etc.

The opponents of the bill also claimed that the only ones in favor of it were automobilists and golf players who wanted to stop work an hour earlier so they go riding or play golf. The very extensive opposition to the bill was a surprise to the councilmen—the opposition of the manufacturers being particularly surprising.

SPARKS FROM THE WOR

Valentine Francis

American Commercial Association Advocates Trade with Russia

Over one hundred prominent business men, manufacturers and exporters gathered together at the Hotel Astor last Wednesday at the second meeting of the American Commercial Association. This association was organized last February for the purpose of taking united action in prevailing upon the government to open up trade relations with Soviet Russia, so that American business and American industry might enjoy some of the great opportunities which that country holds forth in the commercial world.

The meeting was opened by a few introductory remarks from the president, Emerson P. Jennings, president of the Lehigh Machine Co., of Lehighton, Pa. Mr. Jennings spoke briefly of the purposes of the association and of the efforts made so far to further this end. He said that England, France and other European countries were trading with Russia and that if the United States government persisted in ignoring this new republic, the commerce of this wealthy country would be soon swallowed up by foreign competitors. He declared that the recent supposed exchanges of war prisoners between England and Russia were nothing more than "trade missions, thinly disguised."

Eugene Schoen, general manager of the International Oxygen Co. of Newark, N. J., was the next speaker. Mr. Schoen was a member of the committee from the association, which went to Washington on two different occasions, to urge the State Department to take some action in this matter. He told of the difficulties encountered in getting an interview with anyone who knew anything about this condition and said that the committee found absolute ignorance in the State Department on Russian affairs. He said that the committee was informed that the Kolchak government was the proper one to deal with, but since Kolchak had been dead several weeks, it would be quite difficult to do business with him. "Russia is potentially the greatest open market in the world to day," he said. "Congress, the State Department and all other official bodies are willing and anxious to resume trade relations with Russia. The only power that stands in the way is the President. But the United States will be compelled to recognize Russia in a short time, for those who owe us millions of dollars, need Russia's export and import trade in order to pay their debts.

Soviet Representative Speaks

What was probably the most important address of the session was delivered by Santeri Nuorteva, secretary of the Russian Soviet Bureau. Mr. Nuorteva gave a short history of the activities of the Bureau since its appearance in this country over two years ago. "Russia," he said, "wants to establish trade relations with the United States more than with any other country in the world, because you are the only country not interested in European politics and your economic interest does not lie in political and commercial exploitation of European countries. And the United States is better equipped to supply the needs of Russia at the present time. Russia, after six years of war and revolution, is stripped bare of all the ordinary necessities of life. During the reign of the Czar the people did not know the use of the simplest things; but now that they rule they want these things, and if trade relations are opened, Russia will absorb all that American industry can produce and ship .The Russian Soviet government has $575,000,000 in gold to spend in the American market and can readily pay for what it needs."

Don't Want Diplomatic Privileges

Mr. Nuorteva declared that the Soviet Bureau in Washington was not looking for diplomatic privileges, salutations or social recognition, but was merely interested in establishing friendly commercial relations with our government. He said that all the investigations to which the bureau has been submited, have brought no proof that it has been disloyal to the United States. In conclusion he said, "Russian trade is now at a very critical point. Are realtions possible and practicable at this time? Russia holds unceasing regard for America, she has the money and everything needed to establish trade with you if given the chance to develop her commercial and economic life."

Before the meeting adjourned the members authorized the president to appoint a committee to draw up a set of resolutions calling upon the government to open up trade relations with Russia. These resolutions will be in the form of petitions and will be circulated around the country to be signed by men interested in this movement. They will then be forwarded to the State Department at Washington in the hope of prompting official action.

American Can Company to Hold Large Auction

Large quantities of metal working machinery, electrical equipment, tanks, conveyors, other machnery, small tools, general factory equipment and general stores and materials will be sold at public auction by the American Can Co., which is eliminating its war equipment.

Thirty-one buildings, from small frame to large steel structural, will also be sold, dismantled and removed. The 133-ft. twin-screw steamer "Nassau" is included in the auction. It is 400 tons gross and has a capacity of 750 passengers.

The sales will take place on April 27, 28, 29, 30 and May 1 as follows:

Geneva, N. Y., April 27—Motors, testing machine, presses, lathes, grinding machines, heat-treating furnaces, tool steel and various other machinery and equipment.

Kenilworth, N. J., April 28-29—assembling machines, paper cutting machines, etc.

Edgewater, N. J., April 29, 30 and May 1—750 metal working machine tools, 100 power presses, electrical equipment and motors, furnaces, etc. The buildings and steamer will be sold May 1 at 1 p.m.

An inspection can be made at all plants from April 19 up to the days of sales. For further information apply to the American Can. Co., 120 Broadway, New York.

Machine Tool Exports in February

Metal working machinery valued at $3,769,161 was exported during February, according to figures just compiled by the Bureau of Foreign and Domestic Commerce. This compares with exports valued at $6,400,717, for the corresponding month of 1919. The exports of February, 1920, were made up as follows: Lathes, $587,348; other machine tools, $895,675; sharpening and grinding machines, $261,209; all other metal working machines, $2,024,929.

The principal exports were to France, which took $1,105,955. The United Kingdom was in second place, taking the metal working machinery to the extent of $482,845. Exports to Canada were $435,436; to Spain, $229,131; to Japan, $156,785, to Belgium, $149,151; to Italy, $147,673; to Cuba, $115,836. The exports of metal working machinery for the eight months ending with February, aggregated $32,415,882. This shows a slight decrease over the corresponding periods of 1918 and 1919 when exports were $40,547,436 and $35,004,408, respectively.

While in February of 1919 imports of machine tools were valued at only $355, imports increased until in February, 1920, they were valued at $38,410. The total imports for the eight months ending with February were 1,229 machine tools valued at $180,964.

Ralph G. Macy Elected Vice-President of Engineering and Appraisal Co.

The Engineering and Appraisal Co., Inc., of 103 Park Ave., New York, announces the addition to its engineering staff of Ralph G. Macy, who has been elected vice-president of the company. Mr. Macy has resigned his position with Walter Kidde Co., where, as chief engineer of the construction department, he has made a remarkable record for personal ability and energy in organizing local working forces and carrying on important factory construction in various cities simultaneously.

Mr. Macy has to his credit a long experience in engineering and industrial work. When the United States entered the World War he was at once granted a commission in the Army and ordered to Aberdeen Proving Grounds and almost immediately was detached and sent to Fort Worth, Tex., to construct from start to finish the first helium gas-plant establishment of the war. Upon the completion of this plant, he returned to Aberdeen as ordnance proof officer, and was then sent to Sandy Hook as armament officer in the Coast defense.

Mr. Macy has been a resident of New York City since 1910, and engaged successively in the construction or operation of gas work, power plants, underground caisson work, under compressed air, and high-tension electrical distributing systems and sub-stations. In 1914 and 1915, he was in charge of maintenance and distribution of the gas-works system supplying the west side of Manhattan.

Some Do's and Don'ts That Will Help in Foreign Trade

An interesting feature of the meeting at Lakewood, N. J., of the members of the Association of National Advertisers was the address of J. B. Benson, chairman of the Association's Export Committee. In the course of his remarks, Mr. Benson gave the following list of "Do's" and Don'ts," which will be appreciated by all who have served a foreign trade apprenticeship:

The Do's and Dont's

(1) Don't attempt foreign trade unless you expect to stick; analyze the market before you start. Build on known facts, not hunches.

(2) Don't think of a foreign market as a dumping ground, an outlet for left-overs and "seconds."

(3) Don't go into foreign trade just to fill in—a temporary expedient—if you start with a customer, stand by him.

(4) It takes time to develop profitable foreign trade—unless the exporter is willing to so build, he had best keep out of it.

(5) Careful planning and consistent, intelligent effort have developed the big foreign trade of England, Germany and France—haphazard tactics can develop nothing but disappointments and ultimate failure.

(6) The American manufacturer who has made a success of his domestic business owes it to a thorough knowledge of his market, the tastes and peculiarities of the potential users of his product, the use of merchandising methods that fit definite, known conditions, and a broad vision. He can make the same success in foreign fields if he plans as carefully.

(7) Put yourself in your customer's place. First see the foreign buyer's side of it, then educate him to see yours. Change his tastes by education, not by force.

(8) The first order is merely an opener—it takes repeat orders to build a profitable foreign business.

(9) Be explicit in specifications, prices, terms—don't leave anything to the imagination of the other fellow.

(10) Don't abuse your customer's confidence. He expects you to send exactly what he orders, not a substitute, and to send no more or less than he orders. He expects you to fill at the prices you quoted to pack and ship exactly as he instructs.

(11) Follow your customer's instructions explicitly. He has learned by experience what is essential and necessary. You may be thinking in terms of a through shipment and delivery at the dock. Your customer is thinking in terms of a through shipment and delivery over land on mule back.

(12) A satisfied customer is your biggest asset here at home—it's no different in a foreign country.

(13) Don't stop when you've put your goods upon the importer's shelves—help take them off, just as you would do with a retailer in this country.

(14) Don't over-sell the importer or induce him to stock goods that don't fit the market.

(15) Don't jump at the selection of the importing house you appoint as resident agent—know that he means business, that he is going to push your goods and not throttle them.

(16) Just because a man speaks the language of the country does not mean that he is the type of man fit to represent your concern as a salesman. Your house is judged by your representative.

(17) Diplomacy in a man is a bigger asset than speed.

(18) Don't forget the little things—they probably big things to your foreign customer.

(19) Allow enough in your foreign selling prices to include ample and constructive merchandising help.

(20) Know that your promotion matter fits conditions and is acceptable to your foreign representative. Work far enough ahead to get your customer's point of view.

(21) Take care in selecting the one who translates your cataloges. There's a difference between a catalog that is "transposed" and one that is "translated."

(22) Answer your correspondence in the language of his country and don't make your letter too short or curt.

Drive for 32 Hours

The Standard Steel and Bearings Co., Plainville, Conn., has adopted the use of automobile trucks to convey material to and from the plant to distant cities. Ernest Johnson and Clifford Cee made a trip to Philadelphia last week with a six-ton load of steel, making the trip in 32 hours, driving steadily during that time.

LD'S INDUSTRIAL FORGE

News Editor

English Trade Letter

(From Our London Correspondent)

March 26, 1920.

One of the most notable features in the commercial world of late has been the relative failure of appeals by new manufacturing and other companies to the money market. It would appear that for the time being investors are getting more cautious; perhaps they are actually reading the prospectuses put before them.

The importance of increased production to the prosperity of Great Britain has been recognized by the government, and committees will be established to make inquiries. The committees are "to consider and advise as to the best means of securing the greatest possible production consistent with the permanent well-being of industry and of the employers and employees engaged therein."

A decimal coinage for Great Britain has been definitely rejected in the majority report issued by the committee appointed in 1918 to consider the subject. It is admitted that generally speaking, the prevalent public attitude is indifference. The report suggests that many of the witnesses expected the decimalization of weights and measures to follow that of the coinage, but they reject this and say "we find, on the other hand, that the existing system is regarded as admirably suited to the needs of everyday life."

Iron and Steel

In iron and steel market conditions no change can be reported. London once more has noted offers from Germany and Belgium. It is understood that American billets, too, may be offered, the prices being somewhat below those current in Great Britain. Recent advances here, in fact, have had the effect of rendering buyers cautious. This has been noted particularly as to foreign inquirers. The considerable reduction in Indian galvanized sheet, namely £18 a ton, had a somewhat depressing effect recently; but for the most part there is little decline in prices. Turning to machine tools in particular, as the result of wage advances almost due, arrangements are being made to increase prices to correspond.

Engineering firms, of course, depend very directly on the supply of raw material and the larger firms have of late been acquiring interests in steel and other firms. Thus, D. Colville & Sons, Ltd., Motherwell, has been joined to Harland & Wolff, Ltd., the well-known shipbuilder and internal-combustion-engine manufacturer, etc.; while the Steel Co. of Scotland Ltd., has been acquired for about 1 ¾ million pounds by a syndicate of Clyde shipbuilders and others. Then the recent purchase of Pearson & Knowles shares by Armstrong, Whitworth & Co., Ltd., was for the purpose of putting the engineering firm in control of important supplies of raw materials. The latest move of Armstrong Whitworth, in fact, is to add civil engineering and public works contracting on a large scale to its other enterprises, a civil engineering department, it is announced, having been formed under the control of R. H. Mackenzie.

A Firm Whose Hourly Output Has Not Decreased

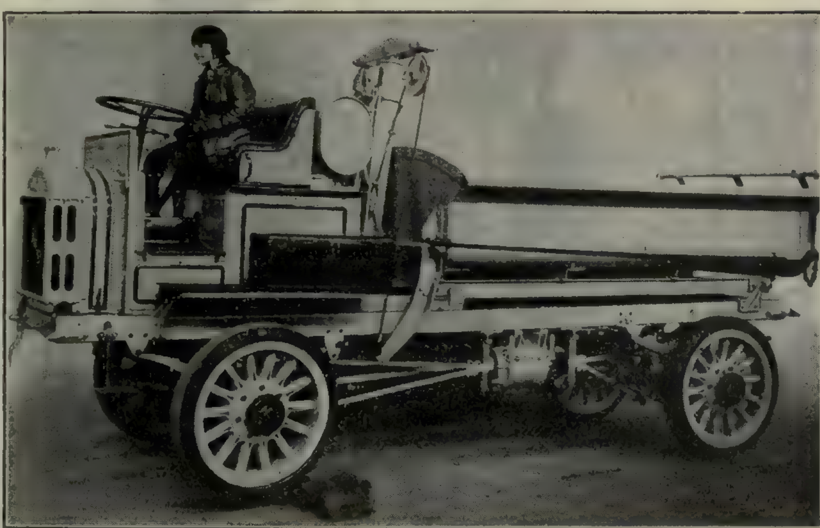
The writer recently visited a works, about fifty miles from London, which was devoted to the manufacture of a single type of machine tool, and was perhaps a little surprised to learn that the hourly output was about equivalent to that of pre-war days. Of course, the weekly output is not the same, the 47-hr. week being worked instead of the 53-hr., while now no overtime working is permitted by the operatives. The works employs about 100 workers and essentially forms one large room so that they are easily overlooked. If a machining job seems to be taking a time markedly longer than was usual in the past the reason is investigated, and, where necessary, a new process is devised and put into operation; but not by the same man. The work is moved to another section of the building. Erectors work on a bonus plan and if they do not earn a bonus, are discharged; or rather the threat of discharge has in the past been enough.

One result of the molders' strike which might possibly not have been expected is that this firm has had to extend its lines of manufacture. Before the war the firm was gradually eliminating sizes and types, and during the war, being under government control, was practically compelled to manufacture but two machines in quantities. This policy would have been continued and, in fact, it may be that in the future machines of but one type and size will be produced. Unfortunately, in the course of the molders' strike the stock of castings was almost used up and obviously with resumption of work the foundries have an overwhelming demand. In order to get a sufficient quantity of castings to keep the whole working force going, the firm therefore used existing patterns, thus getting supplies from several sources. In this way it has been forced into the production of tools of several types which otherwise would have been completely dropped.

Alfred Herbert, Ltd., which has long given special attention to the export of its machine tools, has for a considerable period been running a journal which, nominally monthly, comes out as circumstances may dictate. Its rival in overseas trade—namely, the Associated British Machine Tool Makers, Ltd.—is now also issuing a monthly journal.

Watt's Heathfield Hall

Heathfield Hall, which was built for Watt and to which he moved in 1790, may possibly be purchased by the Birmingham municipality. It was of course visited last September by a number of engineers on the occasion of the centenary of the death of Watt. The hall has for many years been occupied by George Tangye, but is the property of Major J. Gibson Watt, a grand-nephew of the first occupier, and he has made an offer which is under consideration. The building and grounds (about 40 acres) will be sold, but the relics, being heirlooms, will be on loan, provided they are kept at the ha''



Miss Luella Bates, who learned all about trucks, doing a man's work during the war at the Four Wheel Drive Auto Co., Clintonville, Wis., shows how thoroughly she has mastered this three-ton FWD truck. She is holding the front wheels less than two inches from the ground with foot brake only, which is effective on all four wheels. The foot brake is located on a bracket attached to the cross-member, directly in the rear of the transmission.

The Lakewood Engineering Co., Cleveland, Ohio, has announced that Clarence I. McNair of the Northwest Paper Co., was awarded the first prize of its contest for the best treatise on industrial haulage, using the Lakewood Tier-Lift Trucks. The prize was $1,000; a second prize of $500 and a third of $250 were also awarded. F. C. Peters and G. R. Reese, New Jersey Zinc Co., won the second prize, and T. M. Prudden, Whitin Machine Works, won the third.

Trade Currents from New York and Chicago

New York Letter

In common with most other lines of business, the machine-tool industry has suffered severely as a result of the railroad strikes. The teamsters' strike, that was declared on the sixth day of the railroaders' walk out, made an already bad situation much worse. It was next to impossible for New York machine-tool dealers to get shipments from the outside, and rail deliveries were out of the question.

Various means were resorted to in order to overcome the difficulties that have presented themselves during the past week. Much business has been transacted by telegraph, and long-distance 'phone on account of the uncertainties of the mail service. One concern has resorted to the expedient of dispatching motor trucks to Cincinnati for a consignment of tools, and another firm has chartered a special steamer to get deliveries from the factories that it represents along Long Island Sound.

The quiet of the past few weeks continues through the present writing. The only list of note that appeared in local dealers' offices this week was that of Shuttleworth Brothers of Amsterdam, N. Y., who have inquiries out for about twenty tools. It is rumored that the Erie is shortly to put out a good sized list, but the present labor difficulties besetting this corporation is likely to delay definite action for the present at least.

The Willys-Knight interests were inquirers during the week for a limited list of small tools for their Poughkeepsie plant, and the American Chain Co., of Bridgeport, had a list out for about eight presses and drop hammers. Western mining interests were represented in the current inquiries by a short list from the Shattuck-Arizona Copper Co., of Bisbee, Arizona, which is asking quotations on several drill presses and lathes.

Chicago Letter

New orders continue to be booked by the trade at the pace set some four or five weeks ago—considerably less in volume than that recorded in January and February but sufficient to render excellent business. Steady production by all manufacturers keeps the total of goods shipped slightly in excess of orders placed and the aggregate back orders on dealers' files is shrinking slightly. The present transportation tie-up resultant from the "outlaw" strike is now less serious here than in the East and has not caused sufficient derangement of affairs to seriously affect either production or delivery.

A review of production schedules shows that, in general deliveries are now no worse than they were a couple of months ago, and in some cases are even better. Various dealers are promising deliveries as follows: Ordinary capacity boring mills can not be had until late this fall and heavy machines are being scheduled for 1921. Multiple-spindle drills are even worse, eight to nine months being required by most builders. Planing machines require five or six months, gear hobbers the same and most types of milling machines take about three months. All styles of lathes continue in heavy demand. Medium pattern lathes can be obtained in two months but heavy-duty lathes require from three to four. Heavy-duty drills can be had in from two to three months as also can punch presses. Light toolroom equipment can be supplied in sixty days or less and grinding and shaping machines in from thirty days to two months.

Quotations and delivery prices on one make of keyseating machine have been withdrawn, as is also the case with some makes of pipe threading machines. On this latter item the most recently quoted deliveries ran into November and December.

The largest single inquiry received in some time is being made by the Chicago, Burlington and Quincy Railroad. The list embraces up-

wards of $300 000 of miscellaneous equipment engine lathes being the most prominent item in point of numbers. Aside from this, the heaviest buying factor is the agricultural implement industry, several manufacturers being in the market.

Dealers in parts and machine supplies report good business. As the deliveries of tools continue the consumption of supplies should reach and maintain a high figure. The only threatening indication in this field is the extreme difficulty of securing raw materials, due to rail troubles.

A Telephone Development

A development in telephony which has a very wide scope for industrial uses in conditions where there is considerable noise is due to the requirements of our airmen during the war. Incidently, it has the inestimable advantage of being immeasurably more hygienic than the present telephone transmitter. Conversation during the early stages of the war between pilot and observer was mainly by hitting each other on the back, or by means of written messages. The speaking tube followed, and then came the telephone on the ordinary principle of shouting into the receiver, such as we are all familiar with. This problem of transmitting speech in an airplane in flight was not an easy one, for not only had engine noises to be overcome, but other difficulties of a purely telephonic nature imposed themselves. The Post Office authorities took the matter up, and Captain Cohen, an old National Telephone Co. officer now with the Post Office, 'it upon an ingenious plan which has all the possibilities of being extremely useful under other conditions than those prevailing in an airplane. In short, a combined transmitter and receiver is employed, but the usual mouthpiece is eliminated in favor of a transmitting device which fits against the larynx. Using this device and speaking in an ordinary tone in the midst of the most deafening noises, speech is transmitted in the clearest possible manner, the effect being produced by the vibrations of the throat of the person speaking. The complete effectiveness of this instrument under aircraft conditions—it has been tested satisfactorily—with 400-hp. Liberty engines running at full blast—suggests that it would be a boon in engine rooms and similar places where there is always noise and where it is usually necessary to shout at the top of one's voice in order to be heard. It also has great sanitary properties from the standpoint of the public telephone which, however, is another matter.—**Mechanical World.**

Director's Meeting of the Material Handlers' Association

The directors' meeting of the Material Handling Machinery Manufacturers' Association of New York was held in that city on April 6. Charles F. Lang, president of the Lakewood Engineering Co., of Cleveland, was elected president and Rumsey W. Scott, of the Otis Elevator Co., of New York, was elected vice president.

Three new companies were added to the membership rolls and two men who have been active in the organization of the association were elected to honorary membership. A general discussion of present-day labor problems, high wages and the demand for increased production brought out some very good suggestions from those present.

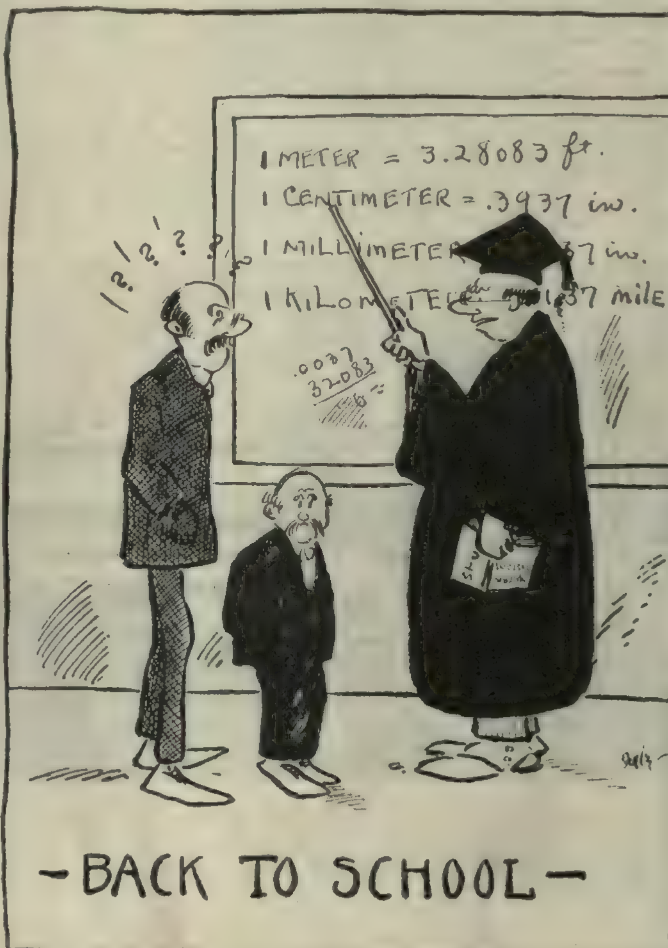
The subject of material handling was also gone into and several new and interesting points were brought out.

U. S. Machine Tools Get Business in Java

American machine tools are rapidly gaining an enviable reputation in this market. One of the largest and most successful machine shops in Soerabaya is completely equipped with modern American machine tools and is securing an abundance of orders for shopwork which, it appears, it is able to fill more satisfactorily than any of its competitors. It is announced that this concern has recently been awarded the contract for the iron and steel work of a new government railway terminal at Tandjong Priok, the port of Batavia. This speaks well for the Soerabava shop, with its American equipment, in view of the competition of Batavia firms located so much nearer the work.

Europe Reduced Purchases Here in February

American exports to Europe during February, reported by the Department of Commerce as valued at $384,661,000, were only $10,500,000 greater than in February of last year and were less by $83,525,000 than in January, 1920, whereas the decline in the total of export business of the country as compared with that month was $86,976,000. February imports from Europe registered a gain of about 250 per cent over the same month of last year, being reported at $106,743,000, against $30,020,000, but showed a drop from $112,030,000 in January. The excess of exports in the trade with Europe during February was $277,918,000, against $356,156,000 in January and $344,038,000 a year ago. On this basis the showing is regarded as more favorable than for either of the months with which comparisons are made.



A feature of the month's returns is the further expansion in the export trade to Germany, much of which is understood to be financed through the marketing in this country of German municipal bonds. The value of exports to Germany during February was $18,598,000, an advance from $14,675,000 in January. Imports, on the other hand, declined from $4,385,000 in the first month of the year to $3 881,000 last month. The ban on trade with the enemy had not been lifted a year ago so that there was no commerce with Germany in February, 1919.

The Four Principal Countries

The bulk of American export to Europe continues to be taken by the four principal countries of the Allied group, Belgium, France, Italy and the United Kingdom, the latter accounting for a greater share of the total during February than any other nation or than any grand territorial division excepting Europe. The exports to this group dropped sharply as compared with February, 1919, and even more sharply as compared with January, being valued at only $289,190,000. In the case of France and Italy, shipments were smaller than in February, 1919, as well as in January, while exports to Belgium were approximately the same as a year ago. Exports to the United Kingdom were less than in January but almost $3,000,000 greater than in February, 1919. The declines from the January figures are attributed to the break in exchange and the shorter month. Imports for the group were valued at $75,485,000, off somewhat from January, but almost 300 per cent higher than in February, 1919.

National Safety Engineering Section's Spring Conference

A number of the engineers who are foremost in accident prevention work and in engineering education are on the program of the first spring meeting of the Engineering Section, National Safety Council, to be held in the Engineering Societies Building in New York City on April 27. The relation between safety and engineering and the engineer's place in the modern industrial world will constitute the motif of the entire program. C. P. Tolman, Chairman, Manufacturing Committee, National Lead Co., and Chairman of the Engineering Section will preside.

The detailed program follows:

MORNING SESSION

10 A. M.

The Relation of Safety to Engineering Efficiency—L. A. DeBlois, Manager, Safety Section, E. I. du Pont de Nemours & Co., Wilmington, Del.

Discussion opened by—F. P. Sinn, Assistant to the Vice President, New Jersey Zinc Company.

Safety Instruction in Engineering Colleges. "The University of Illinois Plan"—Paper by Bruce W. Benedict, Manager of Shop Laboratories, University of Illinois.

How to Interest Student Engineers in Safety—Professor G. S. Blessing, Department of Engineering, Swarthmore College, Swarthmore, Pa.

AFTERNOON SESSION

2 P. M.

General Subject: Safety Standards.

The Movement for Uniform Safety Standards and the Engineering Section's Part—David S. Beyer, Vice President and Chief engineer, Liberty Mutual Insurance Co. Boston, Mass.

Round-Table Discussion of:

Proposed Standards for Guarding of Belts, Gears, and other Power Transmission.

Statement of problem and opening of discussion by Thomas Stanion, Manager of Safety and Sanitation Department, Aluminum Manufacturers, Inc., Cleveland, Ohio.

EVENING DINNER

Subject: The Engineer's Place in the Modern Industrial World.

David Van Schaack.

Lew R. Palmer.

H. W. Forster.

It is expected that there will be a very heavy demand for places at the evening dinner which will be served in the Hotel Commodore. It is essential that the officers of the section be informed of the number of plates to be reserved. All who plan to be present at this dinner are therefore requested to send their reservations to the headquarters of the National Safety Council at Chicago, before April 23.

R. E. Plimpton, Formerly of S. A. E., Joins Wales Agency

Raymond E. Plimpton, formerly publication manager and field secretary of the Society of Automotive Engineers, has joined the Wales Advertising Co. of New York.

He will devote his time primarily to the handling of advertising campaigns of a technical and semi-technical nature.

He was for two years an engineering student with the General Electric Co. of Schenectady, N. Y., following which he was for three years assistant engineer of the General Vehicle Co., Long Island City.

After a year as assistant editor of *Power*, he was appointed publication manager and field secretary of the Society of Automotive Engineers which position he held for three years.

During the war Mr. Plimpton was an automotive engineer in the Motor Transport Corps, at Washington, and after the armistice was signed he was in entire charge of the Engineering Division.

He remained with the Motor Transport Corps for some months as one of the authors of the "History of Motor Transport Engineering in the World War."

Mohawk Valley Engineers' Club Has Talks on Welding

At the regular meeting of the Mohawk Valley Engineers' Club held recently, Jean P. Leinroth of the Bossert Corporation, spoke on electric and acetylene welding. Byron E. White, president of the club and of the Utica Gas and Electric Co., gave an interesting talk on heavy plate welding.

Obituary

Michael R. Conway, of Conway & Co., Cincinnati, Ohio, died April 1, at his home, 614 Hawthorne Ave., Price Hill, Cincinnati, Ohio.

James H. Kelly, president of the Rochester Lantern Co., and president of the Rochester Headlight Works, died recently at his home, 90 Oxford St., Rochester, N. Y.

William Milnor Roberts, Sr., at one time engaged in the machine and foundry business at Cumberland, Md., under the firm name of Gephart & Roberts, died on April 5 at his home in Cumberland. He was 81 years of age. In recent years he was engaged in farming.

Nathaniel W. Bishop, an official in several Bridgeport manufacturing plants, died at the Bridgeport Hospital, Sunday, April 4th. He was in his fifty-fifth year. Mr. Bishop was at one time secretary and general manager of the American Ordnance Co., Bridgeport, which is now the American and British Manufacturing Co. At the time of his death, Mr. Bishop was a member of the Library Board, Board of Finance of the City of Bridgeport, and also a director of the Connecticut National Bank, of Bridgeport.

Elmer Apperson

Elmer Apperson, president of the Apperson Bros. Automobile Co. of Kokomo, Ind., died on Mar. 29, while watching an automobile race. Mr. Apperson, with his brother, Edgard, built America's first mechanically successful automobile in 1894. He was in his fifty-eighth year; he died as he had lived—interested in that to which he had given his life's work. He was one of the best-known figures in the industry and his loss will be sincerely mourned by many.

Elmer Apperson was born at the family's homestead, three miles southeast of Kokomo, on Aug. 13, 1861. He was the second of three sons born to Elbert S. and Anna E. Apperson, and was also a great-great grandson of Daniel Boone, Kentucky's most famous pioneer.

Young Apperson began his education in the Dyar district school in Taylor township. He also attended the grade schools of Kokomo, and the normal school at Valparaiso. From his early youth he had an aptitude for mechanics. His apprenticeship as a machinist was served in the old Star Machine works in Kokomo, and his first employment as a finished craftsman was in the railroad shops at Peru. In 1888 he established a small machine shop in East Sycamore St., Kokomo, and in 1889 with his brother, Edgar, founded the Riverside Machine Works, on the site now occupied by the south side plant of Apperson Bros. Automobile Co.

The Riverside Machine Works was the first automobile factory in America although it never assumed that name. In this place Elmer and Edgar Apperson built America's first automobile. This car is now on exhibition in the mechanical department in the Smithsonian Institute at Washington, D. C. Mr. Apperson, in association with Elwood Haynes organized the Haynes-Apperson Automobile Co., the first automobile company organized in America for the production of motor cars. In 1901 the Appersons withdrew from the Haynes-Apperson Co. and organized the Apperson Bros. Automobile Co., of which Elmer Apperson has been the president since the organization. Success has crowned the work of the Apperson Brothers, all of which was merited, through the energy, skill and business foresight of its first and only president.

In the death of Elmer Apperson the automobile industry loses a man who has been potent in its development since the beginning. He was a prominent figure not only at the races but at all meetings where better work was talked over and improvements suggested. By many he has been referred to as "The Father of the American Automobile."

Mr. Apperson did not confine his investments to the automobile industry alone, but always manifested a deep interest in the city's commercial growth. He was a director in the Kokomo Trust Co. and a stockholder in the Curtiss-Indiana Co.

He was a member of the order of Elks; a member of the South Shore Country Club of Chicago; the Chicago Athletic Association of Chicago; the Burgesses Corps of Albany, New York, and the Kokomo Country Club.

For some years Mr. and Mrs. Apperson had maintained a home in Chicago and another in Kokomo. Most of their time, however, was spent in Chicago, where Mr. Apperson had a wide circle of business and club friends.

Mr. Apperson was united in marriage in 1912 with Catherine Elizabeth Clancy, the daughter of Matthew Clancy of Chicago. He is survived by the widow and two brothers, Oscar W., who resides on the Apperson homestead in Taylor township, and Edgar Apperson, of Kokomo.

Exports declared at the consulate at Lisbon, Portugal, for the United States advanced from $3,477,172 in 1918 to $6,725,685 in 1919, owing to increases in almost every line.

Business Items

The Davenport Machine and Foundry Co., Davenport, Iowa, has a new structural steel shop under construction.

The Murchey Machine and Tool Co., Detroit, Mich., has a Cleveland office at 511 Schofield Bldg., and a New York office at 99 Warren St. The Cleveland office is in charge of L. W. Arnold and the New York office is in charge of Charles M. Neth.

The Latrobe Electric Steel Co., Latrobe, Pa., announces that its recent fire has been greatly exaggerated in Pittsburgh papers. The fire was confined to the heat-treating department, the damage being $8,000. It will not interfere with the regular schedule of filling orders, and no employees will be laid off.

A six-day-a-week schedule will soon be resumed at the Pearl St. plant of the New York Air Brake Co. A new universal air valve for air-brake equipment has recently been invented and patented by C. E. Gray, superintendent. Quantity production of this new valve is one of the main reasons for resumption of full-time schedule.

The firm of Ellenwood & Doyle, 29 Great Jones St., New York City, which has just completed its first year as a distributor of tin plate, black and galvanized sheets, copper, brass, zinc, etc., in order to provide additional capital for its rapidly expanding business, has decided to incorporate under the laws of New York State for $150,000.

Joseph T. Ryerson & Son, Chicago, Ill., is issuing copies of its new bulletin, No. 1301, descriptive of its new line of Ryerson-Conradson high-power precision, selective-head engine lathes. These lathes are being built in five sizes of swing and with length of bed to suit the purchaser. All the details of construction are thoroughly described in this bulletin.

A new corporation, chartered under the laws of Indiana and known as the Hastings Manufacturing Corporation, Goshen, Ind., has taken over by purchase all the assets, good will, etc., and assumed all liabilities of the National Dairy Machine Co., an Indiana Corporation. The new corporation has been organized with the same officers and management as the old concern.

Mechanical consulting engineering offices have been opened at 226 Superior Ave., West Cleveland, Ohio, by Clifford H. Peters. Mr Peters was recently a captain of the engineering division, Ordnance Department. His engineering practice includes the design, and construction of various types of automatic and semi-automatic machines, as well as plant layouts, production systems and similar engineering service.

Domestic Exports of Metal-Working Machinery from the United States by Countries During February, 1920

Countries	491 Lathes	492 Other Machine Tools	493 Sharpening and Grinding Machines	495 All Other
Azores and Madeira Islands	....	....	$292	$1,367
Belgium	$9,064	$21,256	6,034	112,797
Denmark	1,639	7,969	10,602	19,493
Finland	1,587	1,023	....	....
France	151,135	160,726	32,198	761,896
Germany	....	....	2,570	....
Greece	....	....	34	10
Hungary	....	....	....	2,324
Italy	4,059	67,864	1,926	73,824
Netherlands	6,975	4,681	3,694	24,900
Norway	3,240	4,139	804	300
Portugal	2,080	....	687	3,154
Roumania	....	99	....	....
Russia in Europe	....	....	....	1,484
Spain	95,966	45,850	13,035	74,280
Sweden	4,460	922	1,691	9,773
Switzerland	2,187	3,013	....	357,703
Turkey in Europe	....	292	....	....
England	100,200	200,853	99,910	....
Scotland	....	26,305	....	16,338
Ireland	....	....	....	39,239
Canada	63,722	155,767	41,622	174,325
Costa Rica	....	424	....	....
Guatemala	30	170	....	....
Honduras	....	76	....	634
Nicaragua	....	264	14	651
Panama	98	514	....	....
Salvador	470	126	342	89
Mexico	3,804	7,632	586	6,077
Jamaica	....	100	28	....
Trinidad and Tobago	....	507	70	182
Other British West Indies	....	22	....	....
Cuba	28,232	61,800	2,570	23,234
Danish West Indies	....	850	....	583
Dutch West Indies	....	28	....	....
French West Indies	1,175	....	....	385
Haiti	....	560	....	....
Dominican Republic	....	111	203	115
Argentina	4,425	16,562	....	14,697
Bolivia	2,000	....	248	....
Brazil	3,695	11,050	1,947	30,239
Chile	6,863	10,088	5,443	8,319
Colombia	6,761	2,200	303	505
British Guiana	....	270	....	....
Paraguay	....	....	....	46
Peru	2,882	2,530	1,533	3,205
Uruguay	....	2,830	180	5,050
Venezuela	....	368	5,740	240
China	17,080	4,469	1,228	21,679
Kwantung	....	90	....	....
British India	5,093	19,069	2,204	62,063
Straits Settlements	....	203	....	200
Other British East Indies	....	....	64	10
Dutch East Indies	2,870	7,958	124	16,851
French East Indies	....	108	....	80
Hongkong	....	201	15	....
Japan	18,942	15,109	14,876	107,858
Russia in Asia	3,966	....	590	2,730
Australia	13,548	16,047	5,733	24,144
New Zealand	4,997	4,435	434	1,888
Other British Oceania	....	....	....	12
Philippine Islands	3,837	398	....	1,769
British South Africa	5,916	7,496	1,594	14,441
Canary Islands	....	17	....	....
French Africa	....	....	....	3,438
Morocco	1,200	95	....	....
Portuguese Africa	....	139	....	308
Egypt	3,150	....	41	....
Total	$587,348	$895,675	$261,209	$2,024,929

Personals

C. L. Sonen has recently resigned as production engineer of the Teetor-Hartley Motor Corporation, Hagerstown, Md., and the Ansted Engineering Co., Connersville, Ind., and has organized the C. L. Sonen Co., industrial manufacturing engineer.

William Ochse, formerly tool supervisor of the Gould & Eberhardt Co. plants of Newark, N. J., has become associated with Manning, Maxwell & Moore Co., as representative in its Chicago office.

Colonel James B. Dillard, formerly chief of the engineering division of the Ordnance Department, has resigned his commission in the Army and is now a member of the executive staff of the Cleveland Twist Drill Co., Cleveland, Ohio.

Fred J. Passino, who has for many years covered the Southwest for the Independent Pneumatic Tool Co., of Chicago, has just been appointed assistant manager of the Eastern division, with headquarters at 1463 Broadway, New York.

G. E. McCabe has recently become associated with the Miller Saw-Trimmer Co., of Pittsburgh, as advertising manager. He was formerly with the Challenge Machinery Co. and the Keller Pneumatic Tool Co.

F. Ward Marcellus, formerly of Utica, N. Y., and who for the past two years has been treasurer of the Davis Machine Tool Co., has left that concern and has accepted an executive position with the High-Speed Hammer Co., Inc., Rochester, N. Y.

Leroy A. Rushford, former manager of the Interior Metal Manufacturing Co., Jamestown, N. Y., has been appointed general manager of the Prendergast Building Corporation.

John T. Lanman, assistant production manager of the Walworth Manufacturing Co., Boston, has been appointed assistant superintendent of materials at the Kewanee plant of that company. He has been succeeded at Boston, by John McCrahen, who has been with the Walworth company since 1916, save for a period with "Uncle Sam" across the water.

Clarence Bradley, formerly employment manager at the Automatic Machine Co., Bridgeport, Conn., is now an assistant employment manager at the Columbia Graphophone Manufacturing Co's West plant, in Bridgeport, Conn.

Vance McCarty, general sales manager of Edw. R. Ladew Co., Inc., maunfacturer of Ladew leather belting, has been made vice president of the Company. Mr. McCarty's connections with the company covers the past 20 years and embraces every phase of the leather belting business including manufacture, sale, branch management and general sales direction.

Russell B. Reid has been made assistant to the vice president of Edw. R. Ladew Co., Inc., manufacturer of Ladew leather belting. He has been with the company for 20 years.

Trade Catalogs

Machinery and Tools. Brown and Sharpe Manufacturing Co., Providence, R. I. Catalog, pp. 609, 3⅝ x 5¾ in. This catalog is an annual edition of what has been called the "Tool makers bible." It contains a description of the various machines, tools and appliances produced at the Brown and Sharpe shops and in addition considerable information as to the care and grinding of cutters. About 32 pages are devoted to gear cutter and gear cutting, some very useful formulas being given. This handy little catalog is much in demand by tool makers, nearly all of whom would not consider their kits complete without a copy.

Eye Protection. Strauss and Buegeleisen, 438 Broadway, New York City. Catalog, pp. 48, 7 x 4¼ in. These pages contain a collection of notes for the prevention of eye accidents.

Hump Method for Heat Treatment of Steel. Leeds and Northrup Co., Philadelphia, Pa. Catalog No. 90, pp. 30, 7¾ x 10½ in. In this catalog the company describes a new way of hardening steel. Accurate measurement of temperatures and the independent determination of transformation points is rendered unnecessary. A number of concerns are using this method for hardening tools and dies and for the quantity production of automobile gears, races for ball bearings, etc.

Milling Machines. Ingersoll Milling Machine Co., Rockford, Ill. Bulletin No. 39, pp. 23, 8½ x 11 in. This catalog contains descriptive matter of its continuous type milling machines, and it also describes fixtures and cutters.

Chucks. Frank G. Payson Co., 9 Soutn Clinton St., Chicago, Ill. Circular, 8½ x 11 in. It shows a number of illustrations of the Logan air-operated chuck, giving a brief description.

Gages. Greenfield Tap and Die Corporation, Greenfield, Mass. Catalog No. 43, pp. 110, 4¾ x 7¼ in. This company has issued a catalog containing information on screw cutting and gaging data. Complete gaging systems are shown and graphic tolerance charts. The latest methods in "precision" measuring and inspection are given and some gaging hints.

Radius Former. W. T. Smith Manufacturing Co., Bridgeport, Conn. Circular, 8½ x 11 in. An illustrated and descriptive circular of the Smith universal radius former.

Oilless Bearings. Massachusetts Oilless Bearings Co., Worcester, Mass. Catalog, pp. 15, 6 x 9 in. The first four pages of this catalog tell about the invention of the oilless bearing and the remaining pages are devoted to the description; several half tone illustrations are given.

Oil Burning System. Moore Shipbuilding Co., San Francisco, Cal. Catalog, pp. 40, 8 x 11½ in. The Moore Shipbuilding Co. has issued a new catalog on heavy coated stock, illustrating and describing its oil burning system. The interior of its machine shop, a general view of a ship under construction and a general plan of the Moore Shipyard at Oakland, Cal., are illustrated. There is a partial list of steamships built by this company in which this system has been installed and there are also several illustrations of these ships.

Drills. Silver Manufacturing Co., Salem, Ohio. Booklet, pp. 8, 5 x 7½ in. An interesting booklet describing the use of the drill in the World War; also gives two illustrations showing the layout of the first machine shop in the American sector and a rough sketch of the exterior.

Stubs Steels. The Selson Engineering Co., Inc., 24-26 Stone St., New York City, has announced that it is now distributing its catalog on stub steels.

Small Tools. Gale-Sewyer Co., South Weymouth, Mass. Catalog No. 3. 5½ x 7 in. This catalog describes and illustrates the various tools manufactured by this company.

Shepard Technical Night School. Electric Crane & Hoist Co., Montour Falls, N. Y., has issued a booklet announcing the different courses during the year 1920. It also gives several illustrations of its courses in machine-shop practice, blueprint reading, typewriting, office training and many others.

Flange Thread Miller. Smalley General Co., Inc., Bay City, Mich. Circular, 11 x 8½ in., contains suggestions on the operation of the Smalley general No. 1 flange thread miller.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An importing firm in India desires to be placed in direct communication with manufacturers of hardware, engineer's tools, iron and steel products, such as mild steel plates, bars, angles, rivets, bolts, nuts, annealed wire, and barbed wire; industrial, agricultural, and textile machinery; ginning, weaving, and spinning parts of machinery; electrical goods, provisions, perfumery, motors, and dynamos, stationery, and sundries, and colors and chemicals. References. No. 32,447.

The manager of a farmers' cooperative association in South Africa desires to receive full particulars and prices from manufacturers for the purchase of small-size oil-mill machinery, particularly machinery for extracting cottonseed oil. Firms are also requested to submit catalogues, outline sketch plans of a small mill layout, and prices. Quotations should include power equipment, alternative gasoline or kerosene engine, electric engine, or possibly a small steam engine. No. 32,446.

General importers and exporters in Syria desire to be placed in touch with manufacturers and exporters of agricultural implements, automobiles, machinery, pumps, engines and tools, tin, iron and steel. No. 32,458.

A firm of engineers and merchants in India desires to import and secure agencies for all classes of hardware, such as wood screws, wire nails, galvanized wire bolts and nuts, rivets, files, tool steel, and anvils; mill, cotton-gin, and railway supplies; machinery, electrical goods, metals and metal ware, brass and copper tubes, motor cars, motor cycles and parts. Reference. No. 32,493.

A commercial agent in Switzerland desires to secure the representation of firms for the sale of machinery, machine tools, and agricultural machinery. Correspondence should be in French. Reference. No. 32,497.

The representatives in the Mediterranean countries of a firm in the United States desire to obtain agencies for the sale of machinery and agricultural implements. Reference. No. 32,472.

A firm of engineers and contractors in Siberia desires to get in touch with manufacturers and exporters, in order to secure agencies in Russia and Siberia for steel, mining equipment, pumps, piping, saws, files, nuts, bolts, rivets, wire and wire rope, pneumatic drilling equipment, tin plate, electrical machinery, steam engines, metal working and woodworking machinery, tools, metals, rubber goods for industrial purposes. Correspondence may be in English. References. No. 32,473.

A former president of the Victorian Institute of Electrical Engineers in Australia, is anxious to make early connections with an American manufacturer who is able to participate in bidding on tenders soon to be called for by the Victorian Government, covering equipment for a high-tension project involving three turbo-generators of 25,000 kw. capacity, for 130,000-volt, 50-cycle transmission, and the appliances and accessories required with such an installation. Reference. No. 32,083.

A city in Canada is in the market for $200,000 worth of rolling stock to be placed on the civic car lines. Tenders should be submitted, and it will be for the city council to decide whether American cars are purchased. No. 32,093.

One of the largest printing plants in Czecho Slovakia wishes to purchase presses for the printing of bank notes, bonds, etc., and also equipment for the making of necessary plates, printing and embossing presses, and complete engraving equipments, also outfit equipment and presses for steel engraving. Catalog and prices are requested. No. 32,094.

A commercial agent in France desires to represent firms in France and colonies, and in the principal cities of Europe, for the sale of machine tools. Quotations should be given c.i.f. France, Dantzig, Antwerp, Genoa, Constantinople, Oriental ports and Black Sea ports. Correspondence may be in English. References. No. 30,095.

An agency is desired by a man in New Zealand for the sale of wire nails, nail wire galvanized plain and barbed wire, plain and galvanized corrugated iron, malleable pipe fittings, galvanized and black pipe, and galvanized slice cut staples. Quotations should be given c.i.f main ports of New Zealand. Payment by sight draft against documents. References. No. 32,096.

Forthcoming Meetings

The National Chamber of Commerce will meet in Atlantic City, N. J., on April 26, 27 and 28.

The spring conference of the engineering section of the National Safety Council will be held at the Engineering Societies Building, New York City, April 27. Sidney J. Williams is the secretary; headquarters, 168 North Michigan Ave., Chicago, Ill.

The American Gear Manufacturers' Association will hold a meeting at the Hotel Statler, Detroit, Mich., on April 29, 30 and May 1.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association, will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

The National Association of Manufacturers will hold its annual convention in the Waldorf-Astoria, New York, on May 17, 18 and 19. A "Silver Jubilee" session will be held on the evening of May 17.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21, at the Hotel Traymore, Atlantic City, N. J.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The American Drop Forge Association will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

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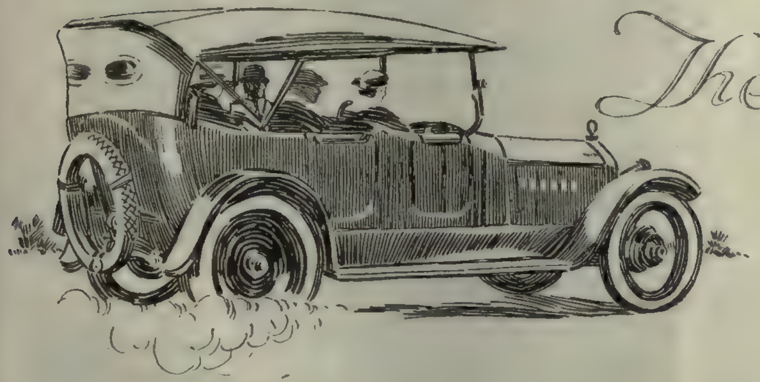
METHODS of MAKING The WINTON PISTON



by Fred H. Colvin
Editor American Machinist

As the quantity of pistons needed for repairs will in some cases amount to 75 per cent of that used in new motors, it will be seen that the total production must be greatly in excess of the number required to supply the cars being turned out.

THE transformation sheet shown in Fig. 1 indicates that in most ways the Winton practice follows the usual line. The open end of the skirt is first bored and faced in a semi-automatic machine as shown in Fig. 2. This is a very simple operation and forms the starting point as in most cases. The method of holding the boring tool by means of the split bushings, as well as the simple construction of the boring tool itself, is of interest.

The next operation bores the holes for the piston pin in the substantial fixture shown in Fig. 3. This is in the form of a special chuck, which locates the piston-pin bosses by means of centering V's fastened in the fixture by the capscrews shown at *AA*. The strap *B* holds the piston in position on a centering projection in the bottom of the fixture. The pistons are then turned, the heads faced, and the grooves rough-turned on a Potter & Johnston semi-automatic as shown in Figs. 4 and 5. These show the piston partly turned and also with the head faced, the piston-ring and oil grooves cut. The tools

Here we have the remaining piston machining articles giving the practice in the Winton, Franklin, White and Packard shops.

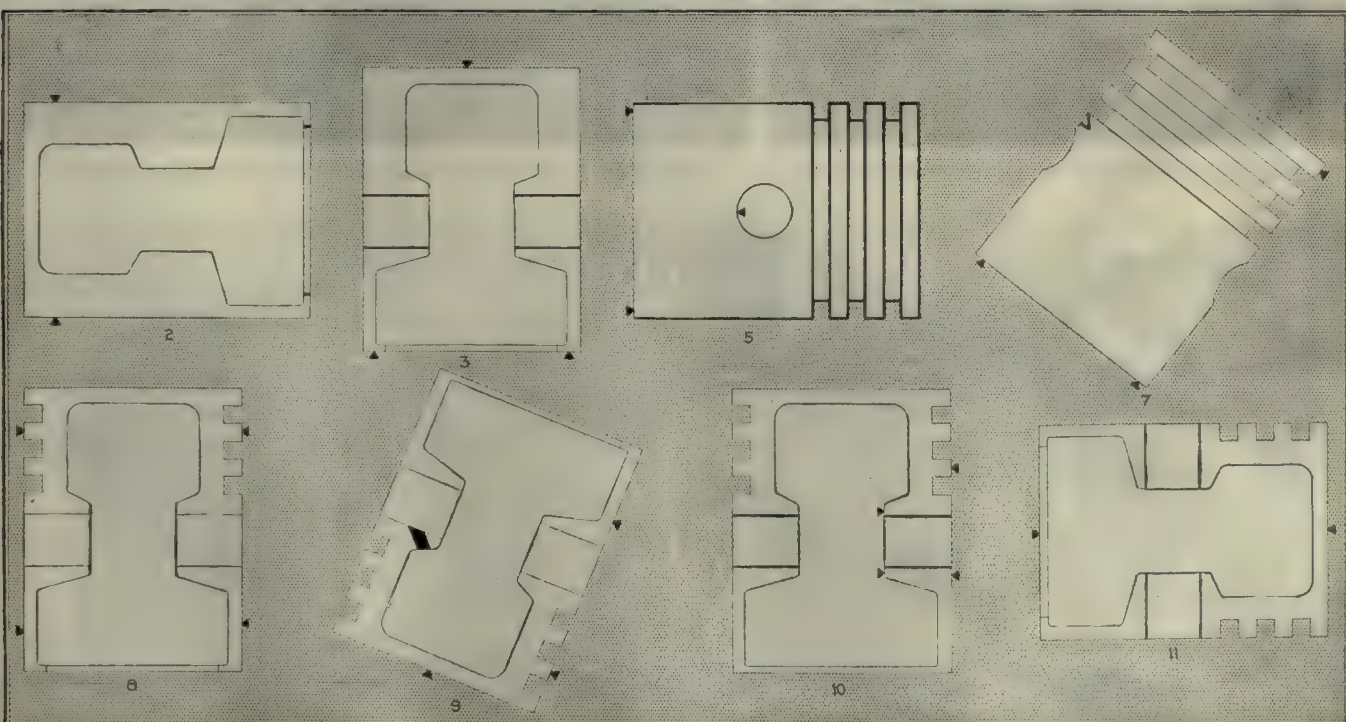


FIG. 1. TRANSFORMATION SHEET OF WINTON PISTONS

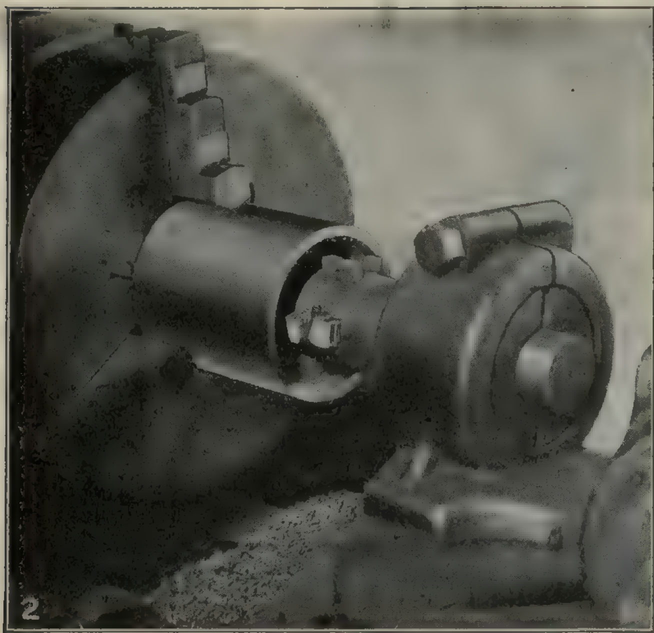


FIG. 2. BORING AND FACING THE SKIRT

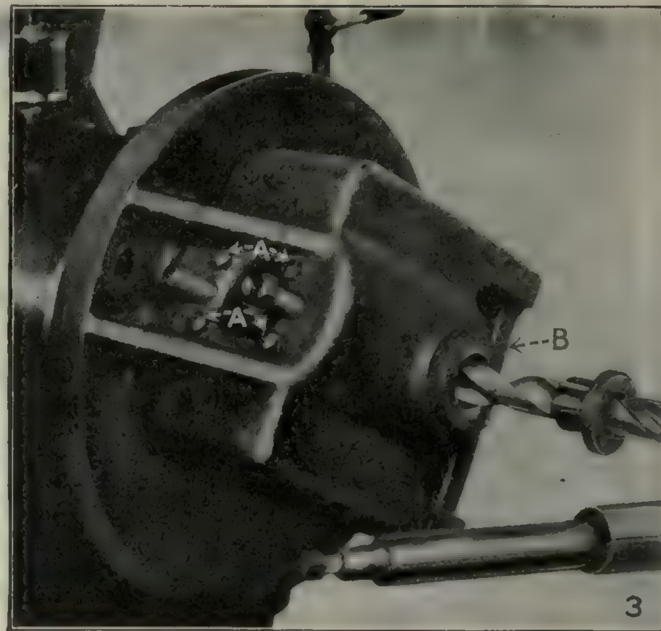


FIG. 3. FIXTURE FOR DRILLING PISTON-PIN HOLE

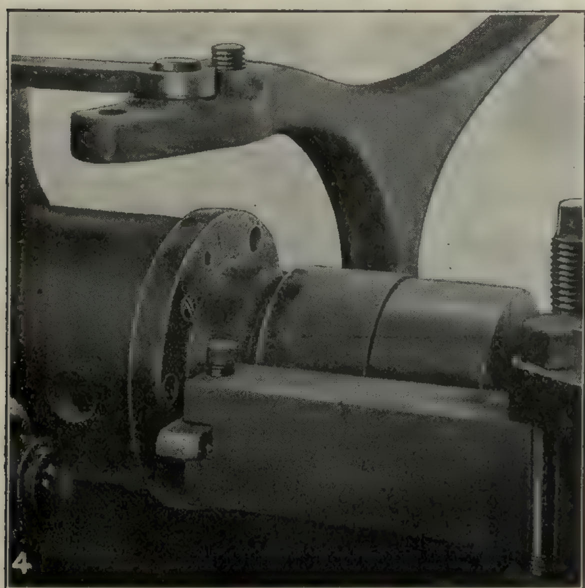


FIG. 4. TURNING OUTSIDE OF PISTON

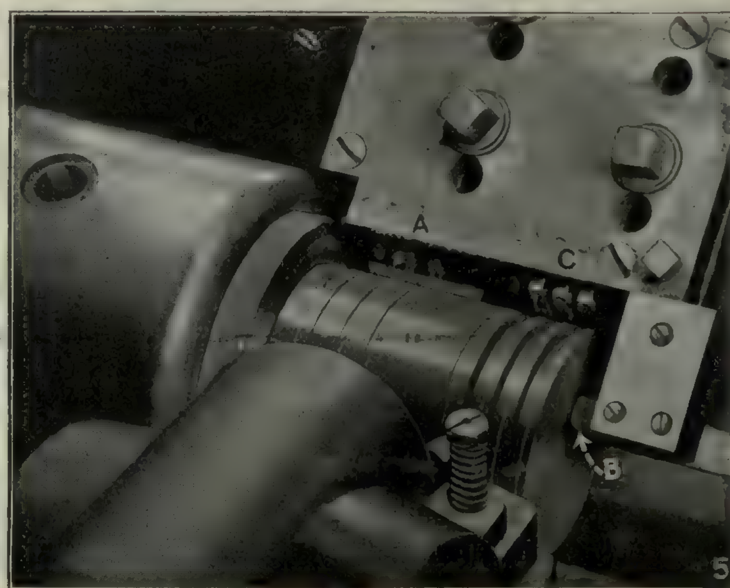


FIG. 5. GROOVING FOR OIL AND PISTON RINGS

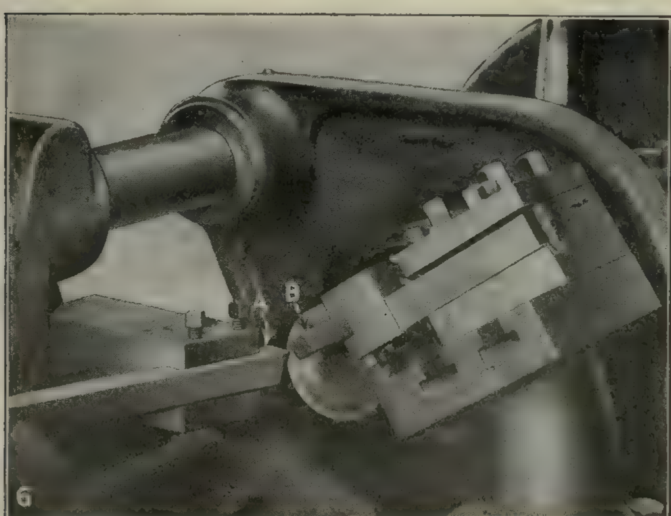


FIG. 6. THE TOOLS USED IN TURNING AND FACING

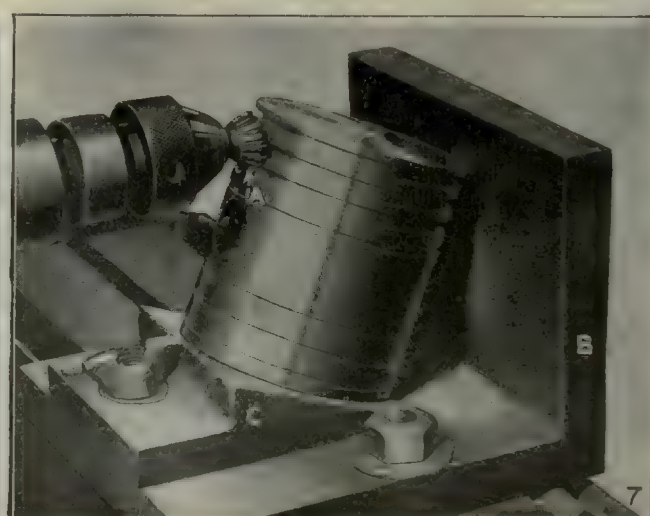


FIG. 7. MILLING OIL POCKET ON SIDE

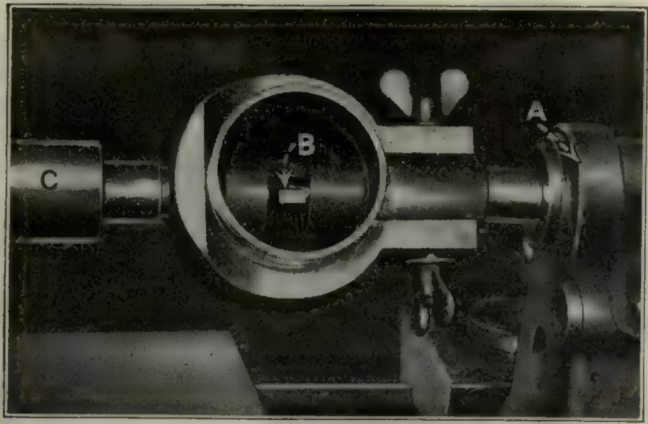


FIG. 8. FACING INNER ENDS OF PISTON-PIN HOLES

for these operations are very plainly shown in Fig. 5, while Fig. 6 gives another view of the tooling, showing the outside turning tool at *A* and the head-facing tool at *B* in a special holder. The grooving tools, shown at *A* and *C* in Fig. 5 are held in the same block as tool *B*, Fig. 6.

An Unusual Oil-Pocket

A somewhat unusual operation is shown in Fig. 7. This is the cutting of an oil-pocket at *A* with an angular end-mill, this pocket connecting with the oil groove below. The eccentric relief on the outside of the piston-pin hole, which is done by a cam attachment on a grinding machine, gives a direct passage for oil to the piston pin and assists in lubrication. It will also be noted that one oil pocket is between the lower ring and the piston-pin hole. The piston is held in a very simple fixture, consisting of the angle plate *B* and the inclined block *C*, which holds it at the proper angle. The wing-nut draws the inclined block down to the angle plate and holds the piston in position.

The inside faces of the bosses are finished in the fixture shown in Fig. 8, this fixture being held in the special tailstock *A*, while the bar with the inserted cutter *B* is revolved by the extension *C* of the live spindle. The fixture is clamped to the tailstock support by means of the wignut shown, the whole device being extremely simple and convenient in every way.

Next comes the drilling of the oil holes in the piston-pin boss by means of the very simple device shown in Fig. 9. The piston is simply laid on the wooden block

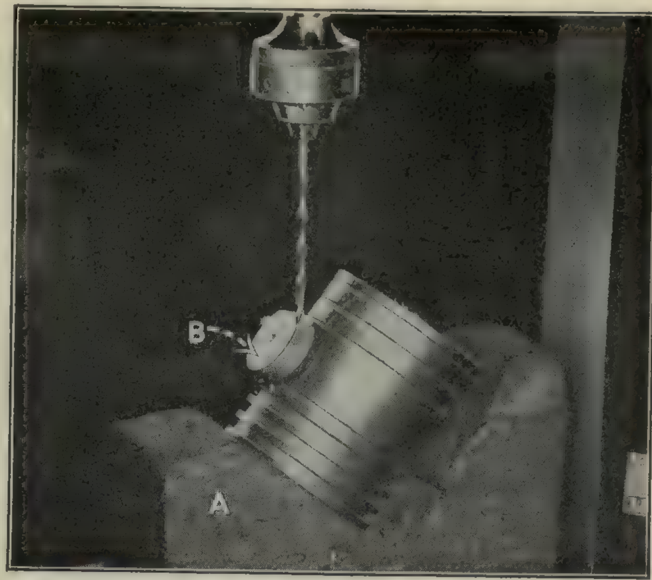


FIG. 9. DRILLING PISTON-PIN OIL HOLES

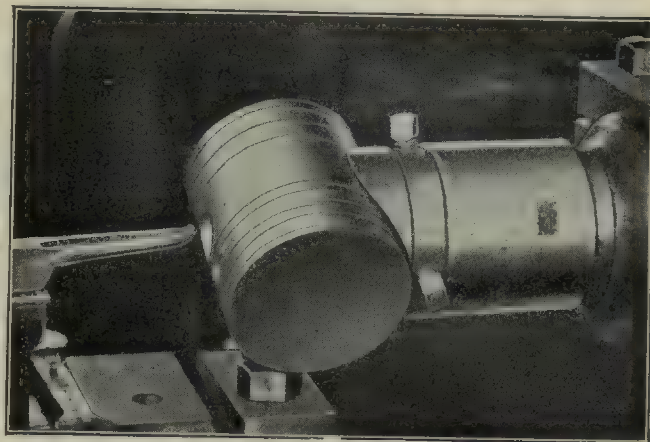


FIG. 10. FINISH-BORING PISTON-PIN HOLES

A, and the bushing *B* inserted in the piston-pin hole. The angle of the block brings the hole in the drill bushing in its proper position, and the oil hole is readily drilled. A handle on the other side of the bushing enables it to be easily removed and placed in the opposite hole, when the operation is repeated.

Before the final reaming, the piston-pin hole is finish-bored by means of the special chuck and a single-point

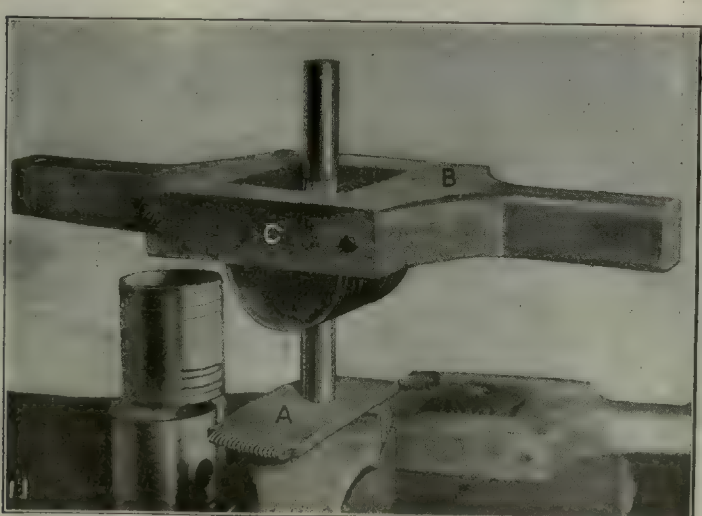


FIG. 11. HAND-REAMING PISTON-PIN HOLES

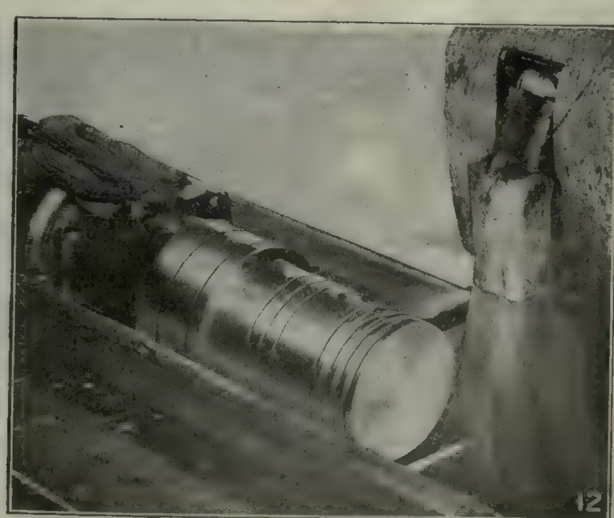


FIG. 12. FINISHING OUTSIDE ON GRINDING MACHINE

boring tool, as shown in Fig. 10. The face of the chuck fits the outside of the piston, which is drawn back in position and firmly held by means of a draw bolt through the hollow lathe spindle. The holes on both sides are bored in this way, after which they are hand-reamed in the fixture shown in Fig. 11. This is genuine hand-reaming, the squared end of the reamer being clamped in a vise, with a piece of belting surrounding it at A to prevent the piston from coming in contact with the vise jaws. The piston is held in the wooden clamp B, which consists of a sort of yoke made in two parts, each containing one handle and half the required opening. With the two halves B and C bolted together, the piston is firmly held without distortion, and the handles enable the machinist to easily place the piston over the reamer and turn it sufficiently to ream the holes in a perfectly satisfactory manner.

The last operation is to grind the outside of the piston. It is supported on a mandrel, Fig. 2, and drawn back in position by a pin through the piston-pin hole. This is in contrast with the method of grinding between centers. The relief on each side over the piston-pin boss is ground in a machine specially equipped with suitable cams for this purpose.

Machining Special Aluminum Pistons

The Franklin pistons involve several unusual problems due largely to the two facts that they are of aluminum and that air-cooled engines run at a much higher temperature than engines of the other type. This affects the expansion, which is taken care of in an ingenious manner. The oiling methods are also of special interest.

PISTONS in the Franklin motor are die-cast aluminum; after being sandblasted they are rough-turned and the wristpin hole is drilled in the regular way. Then the open end is bored and faced, after which it becomes the locating or working point for future operations. Centering the piston by the open end and using a pin in the piston-pin hole for drawing the piston solidly into position, the outside is finish-turned, the end faced, the hole drilled and center reamed in the central projection, and the piston-ring grooves cut. This operation is shown in Fig. 2, while Fig. 1 shows the sequence of operation.

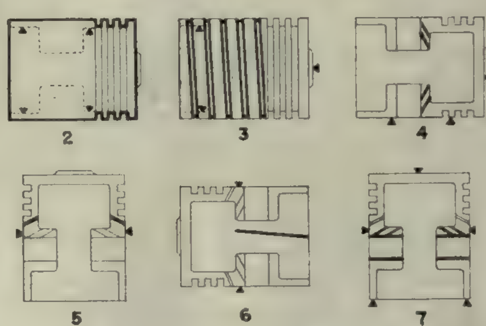


FIG. 1. TRANSFORMATION SHEET

The pistons next go to a Fox turret lathe shown in Fig. 3, where the oil grooves are cut in the form of a coarse-pitch thread, after which the pistons are tested for leakage, and the clearance holes drilled in the skirt of the piston.

Then angular oil holes are driled in the piston-pin bosses in the simple fixture shown in Fig. 4, where the piston fits over a stud A through the piston-pin hole and the head end of the piston is guided by the stops B and C. The plate which forms the base for the fixture is at quite a decided angle and has two stop pins, D and E, which control the movement of the cradle, holding the piston so that the two angular holes will be in their proper position through the upper side of the piston-pin boss. The cradle pivots around the post A, which also acts as a drill bushing and guides the point of the drill in its proper path. The nut F locks the cradle in either position.

Sixteen oil holes are drilled through the wall of the piston just below the piston-ring groove. This is done in the special drilling fixture shown in Fig. 5. The piston, with a pin slipped through the hole, is placed in the center of the machine as at A, the cap B fitting over the open end and holding it in place during the drilling operation. The piston pin serves not only to aid in holding the piston firmly but also locates the posi-

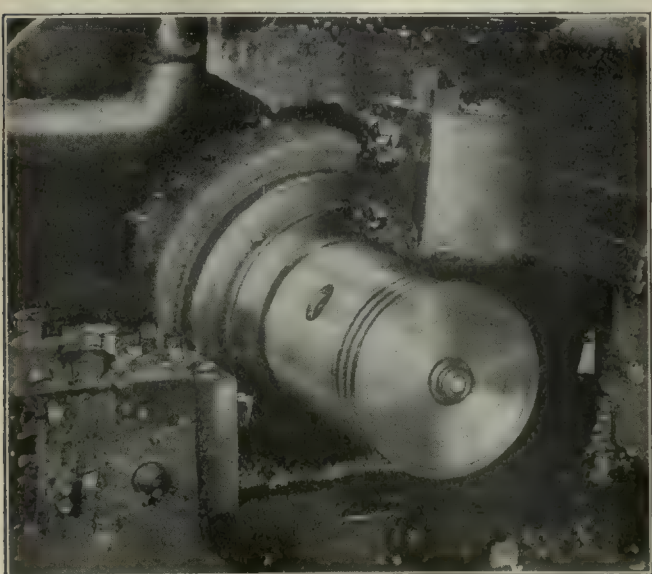


FIG. 2. FINISH-TURNING, FACING, AND GROOVING

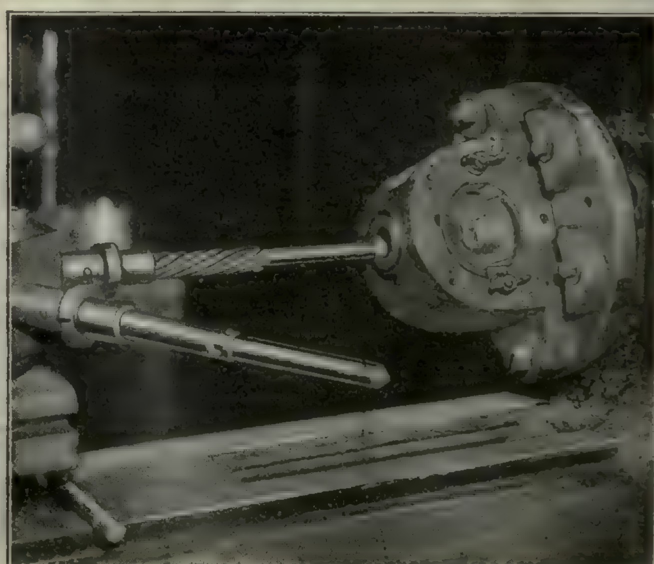


FIG. 7. FINISH-BORING PISTON-PIN HOLE

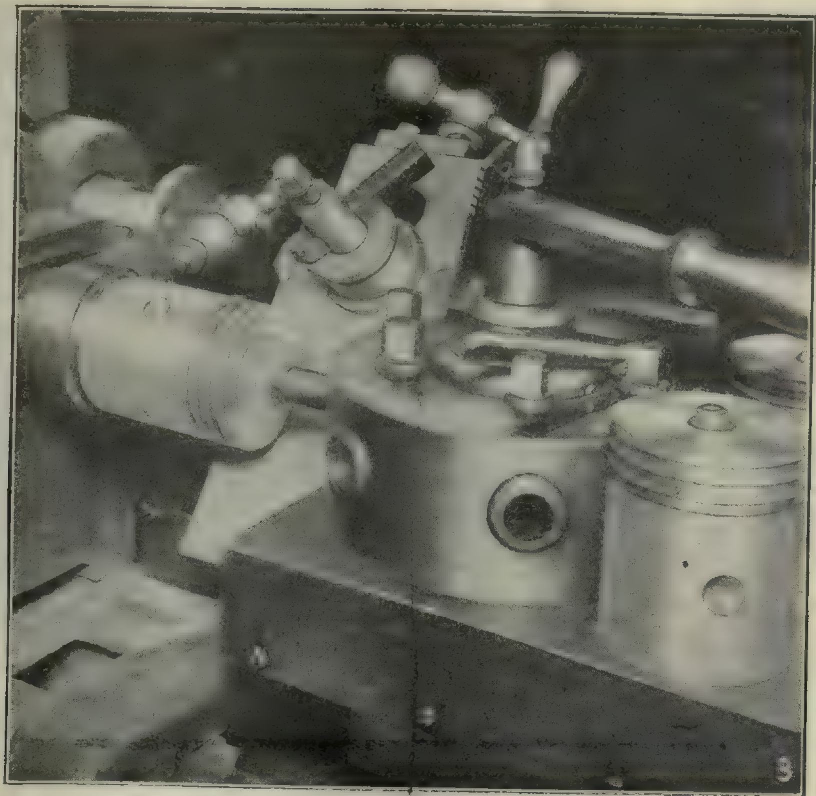


FIG. 3. CUTTING THE OIL GROOVES

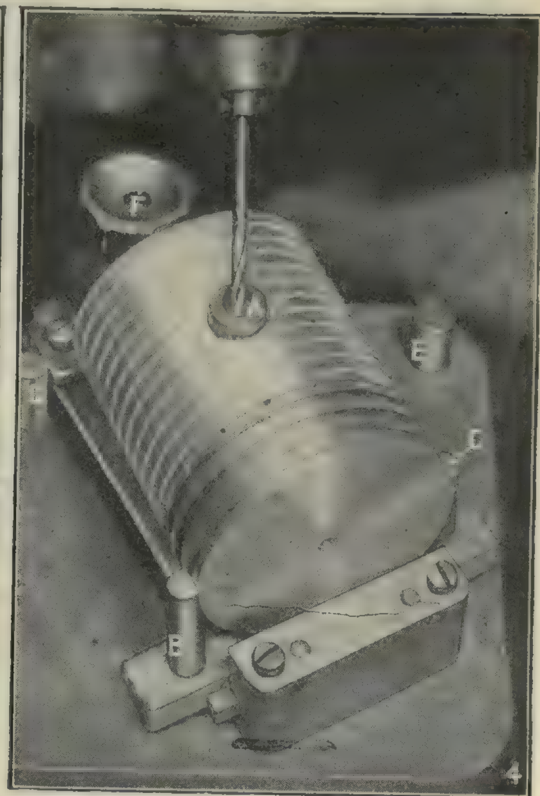


FIG. 4. DRILLING ANGULAR OIL HOLES

tion of the drill holes with relation to the solid end of the piston. Arranged radially underneath the eight-sided fixture are 16 drilling spindles, each carrying a $\frac{3}{32}$-in. drill. These are driven by the round belt shown, by means of grooved pulleys on each drilling spindle. The back ends of these spindles rest in floating bearings, one of these being shown at *C*. The 16 spindles are so arranged that a downward pressure on the lever *D* forces them all into the work and the 16 holes are drilled in less than one minute per piston.

In order to avoid piston "slap" owing to the necessity of allowing a greater clearance between the pistons and cylinders with aluminum pistons, the Franklin engineers hit upon the clever expedient of making the piston as large as necessary to prevent piston slap and then making four saw cuts in the skirt so as to allow the skirt of the piston to spring away from the cylinder wall as the pressure increases from the enlarged diameter of the piston due to the expansion of the aluminum casting.

These saw cuts are made very rapidly on a hand milling machine with the fixture shown in Fig. 6, which consists primarily of the sleeve *A* held in a suitable fixture and the pin *B* through the piston-pin hole which allows the piston to be easily and rapidly indexed. The piston is simply pushed into the sleeve past the cutter, the slot in the sleeve guiding the pistons so that they are cut on the slight angle shown. This has proved to be a very satisfactory method and has solved the difficulty of piston "slap" in the finished motor.

After this the piston is carefully recentered and the taper ground on the solid end. The ring walls are next

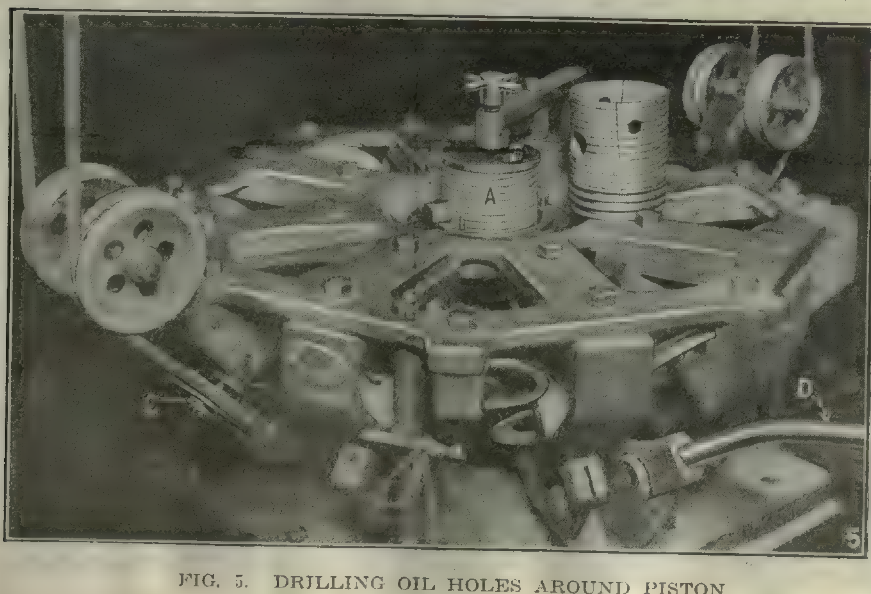


FIG. 5. DRILLING OIL HOLES AROUND PISTON

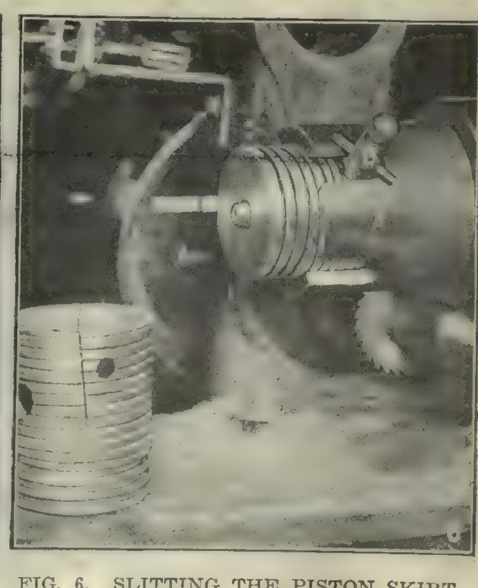


FIG. 6. SLITTING THE PISTON SKIRT

carefully ground and inspected, after which the piston-pin hole is bored and reamed in the special fixture shown in Figs. 7 and 8. This fixture is carefully made so that the piston bore is at exact right angles to the spindle of the lathe. The piston slips into the opening in the fixture as at *A*, and is held in position by the clamp under the thumb nuts *B*.

The construction of this fixture is shown in some detail in Fig. 8, and, in addition to its being of substantial design, it also has the rather unusual feature of having the inner or pilot bushing so constructed as to remain stationary with the boring and reaming tool instead of revolving with the fixture. The construction of this bushing can be seen at *A*, Fig. 8, which shows that the outside of the bushing proper, which is a snug fit on the pilot of the boring tool, is tapered where it revolves in its bearing *B*, and can, in this way, be adjusted to any degree of fit which may be desirable to secure free running and at the same time prevent shake in the bushing proper. The piston is positioned endwise by the stop *C*, being held against this by two straps and thumb nuts shown in Fig. 7.

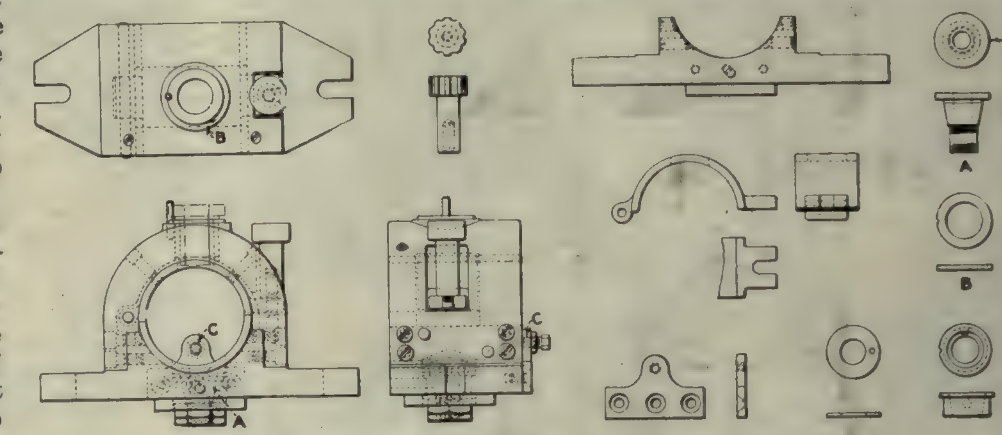


FIG. 8. DETAILS OF PISTON-PIN-BORING FIXTURE

This construction has been found satisfactory in securing a true hole through the piston and undoubtedly has many applications in other fields.

White Method of Making Pistons

> *This article describes and illustrates the method used by the White Motor Co., Cleveland, Ohio, in making pistons for its truck motors. Here the semi-automatic lathe is utilized to a greater extent than in any of the methods that have been described in this series, and is interesting on account of the tooling and holding devices used.*

THESE pistons are ribbed on the inside as can be seen in both the end views shown in Fig. 1. The first operation turns the outside and faces the end, the piston being held by the special jaws *A* and *B* in the two-jawed chuck shown.

These special jaws are so shaped as to receive the piston-pin bosses on each side, while the gripping portions of the jaws are grooved so as to clear the internal ribbing previously referred to. A projection *C* on the jaw *B* acts as a stop against the end pressure of the turning tool.

Next comes the boring and facing of the open end of the piston skirt, Fig. 2. The rough-turned piston is held in a two-jawed chuck with jaws of the special radius, the facing tool being held in the overhang at *A*, while the boring and chamfering tools are shown at *B* and *C* respectively. In future operations the bore and face of the open end become the locating points.

A somewhat unusual method of rough-drilling the piston-pin hole is shown in Fig. 3. This is a double fixture, each side holding four pistons. The pistons are centered by a raised boss at *A*, while the ears *BB* roughly locate the pin bosses. The clamps *C* are then put in place and tight-

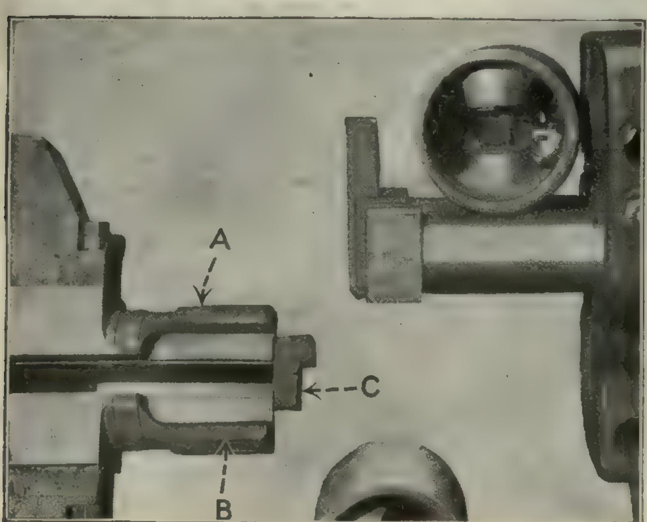


FIG. 1. CHUCK AND TOOLS FOR TURNING PISTONS

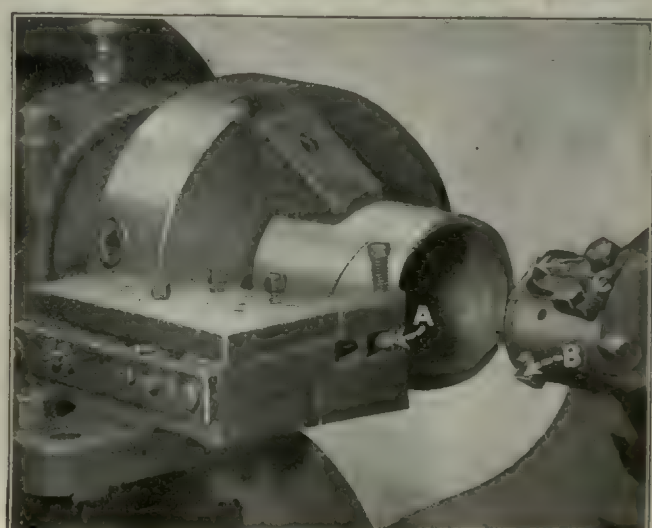


FIG. 2. BORING AND CHAMFERING OPEN END

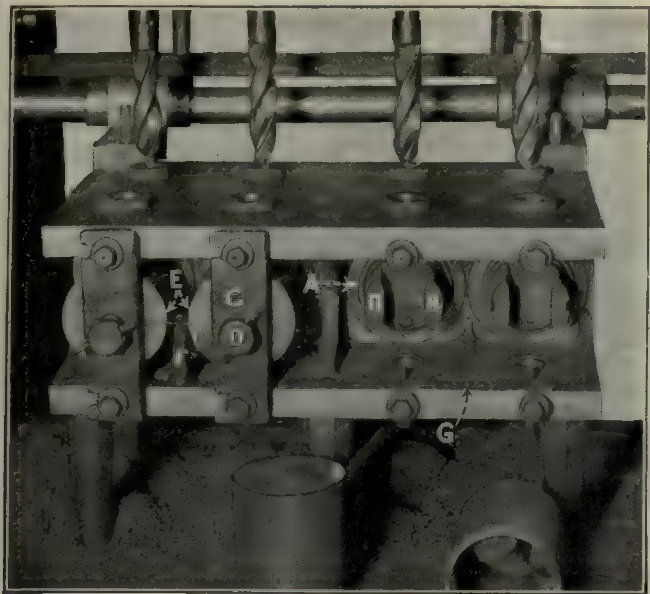


FIG. 3. SPECIAL FIXTURE FOR DRILLING PISTON-PIN HOLES

ened slightly by means of the screws *D*. The ends of the pistons are then chalked as shown at *E*, and the gage *F* is then slipped into the holes, one of which is shown at *G*.

The operator then rolls each piston to the right as far as possible until the piston-pin boss contacts with the ears *BB*, marking this position on the chalked surface of the piston head. He next turns them as far as possible in the opposite direction and repeats this marking. It is then only necessary for him to roll the pistons until the indicator shown comes half way between the marks, and he knows that the pin bosses are central with the drill bushings. Then the locking screws *D* are tightened and the supporting screws *H* screwed up by hand into contact with the lower side of the piston.

Not a Long Operation

While this sounds like a somewhat long operation, it must be remembered that the four drills are at work on the pistons in the other side of this fixture while this is being done. When these holes are drilled, the fixture is reversed and the drills set to work on the four pistons which have just been loaded into the fixture.

The operator then removes the drilled pistons and replaces them with a fresh lot in the manner described.

How Packard Pistons Are Made

In the shops of the Packard Motor Car Co. attention is paid both to quality and quantity of output. Motors with twelve cylinders require an equal number of pistons, three times as many per car as in the White, for instance. Special machines are used to advantage in this work.

THE making of motor pistons is receiving more attention than formerly; like other parts of the motor, they are being refined both in design and workmanship. The first operations on the Packard twin-six pistons are to carefully anneal, sandblast, and snag the castings ready for machining. The sequence of machine operations is shown in Fig. 1. The open end of the skirt is rough-bored in the New Britain machines shown in Fig. 1. Special chucks and jaws are provided for this purpose. At the same operation the lower side of one piston-pin boss is faced so as to be easily drilled and tapped to receive the setscrew. The pistons are then taken to the Gridley automatic shown in Fig. 3. The piston is centered by the bore of the skirt and held by an expanding chuck for rough-turning, facing, and cutting the ring grooves. It is also centered on the outside during this operation.

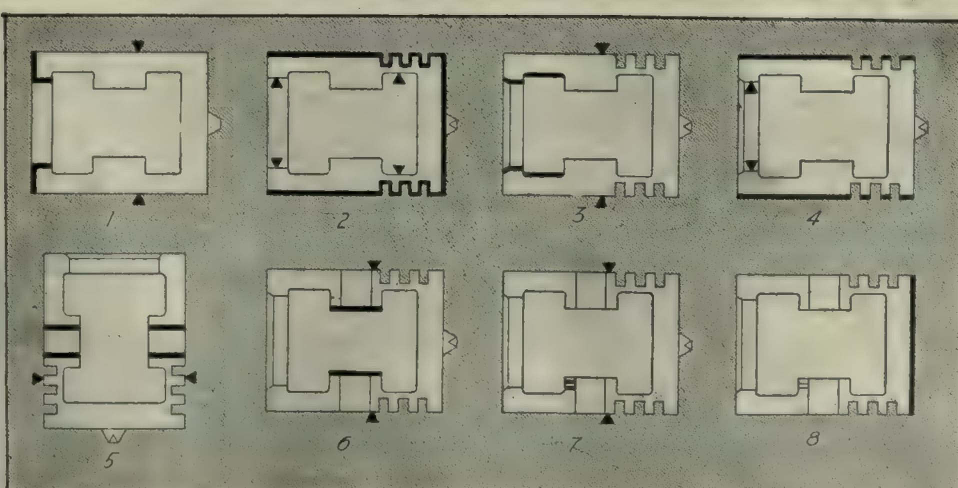


FIG. 1. TRANSFORMATION

The facing is done by the tools in the arm at the back while those in front rough-turn the body and also cut the grooves for the rings. The pistons are next finish-bored and the open end of the skirt chamfered in the hand screw machine shown in Fig. 4. The chamfering tool *A* is shown in position. The inside of the skirt is also counterbored by means of the boring tool *B* which is moved on the cross-slide until stopped by the screw *C*. Chucking the pistons again by the inside, they are finish-turned in the Porter-Cable lathe shown in Fig. 5. The piston-pin holes are drilled and reamed in the special semi-automatic machine shown in Fig. 6. The pistons are clamped in the special chucks shown, being located by means of the tool *A*. This tool has a pin at each end and a pair of V-shaped forks in the center which locate the piston so that the hole will be drilled in the center of the piston

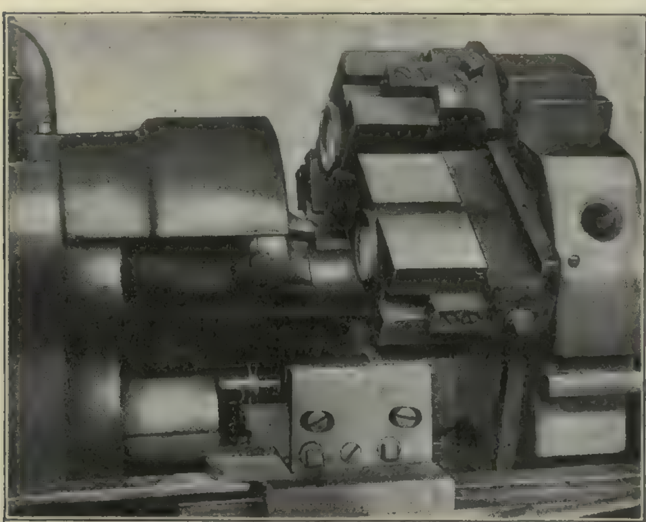


FIG. 2. ROUGH-BORING THE SKIRT

FIG. 3. ROUGH-TURNING AND GROOVING

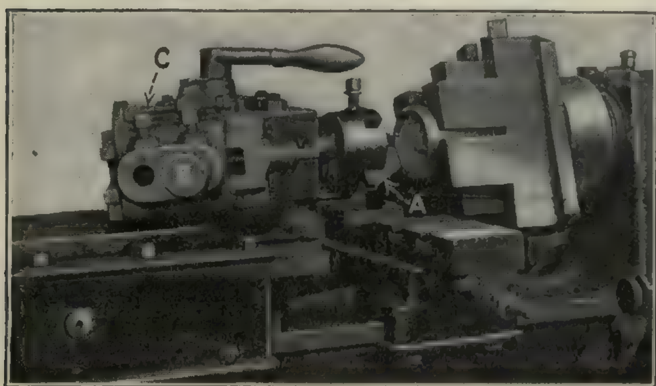


FIG. 4. FINISH-BORING AND CHAMFERING

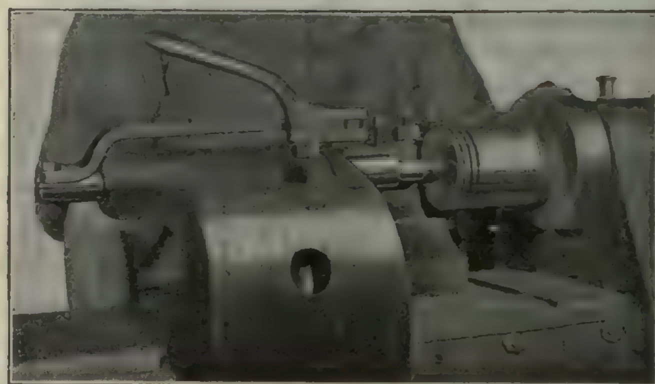


FIG. 5. FINISH-TURNING

bosses. The piston is drilled from both sides, the movement of the drilling heads being controlled by the cams shown. The inside of the piston bosses is then rough-milled by a special fixture which allows the milling cutter to reach inside the piston. The final finishing, however, is done by the double-ended back-facing cutter shown in Fig. 7. Suitable stops enable the bosses to be faced to the proper length rapidly and accurately.

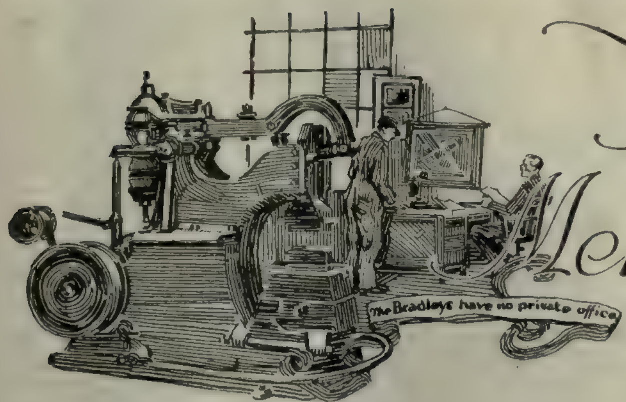
The Finishing Operations

Then the boss is drilled and tapped for the setscrew, the holes are hand-reamed, the outside of the skirt is rough- and finish-ground, and the centering boss is cut off. The solid end of the piston is then finished by grinding on a piston-ring grinding machine so as to present a smooth and perfectly finished surface.

With this brief description of the Packard factory method of machining pistons, we complete our present series of piston articles. Our intention is to follow this up in two weeks with a similar series on connecting-rod practice. According to our original plans this was to be the extent of these automotive articles but so much favorable comment has resulted from their publication that we have decided to carry them on still further. With this end in view we are gathering additional material from other machine shops.

FIG. 6. DRILLING PISTON-PIN HOLES

FIG. 7. BACK-FACING BOSSES



The Human Touch Method of Managment

by C-C-BRADLEY Jr.
President, C-C-Bradley & Son, Inc.

In these days when we are trying to get back the human touch in industry it is interesting to find a plant in which it has never been lost. It will be noted that the author does not claim that such a method will work in all places, but it is refreshing to know that it has worked for over eighty years and is still "going strong." The policy of not overexpanding in good times and of building stock in dull times is well worthy of careful consideration. It is not new but it is too often overlooked.

YOU ask us about our method? Possibly the best way to answer that question is to say that we always try to be human and treat our men with absolute fairness at all times.

This business was established here in Syracuse in 1832 by my grandfather, the original Christopher Columbus Bradley. The third Christopher Columbus Bradley is conducting it at present. The fourth, who is now eleven years old, is in training.

My grandfather was a real human being, and he regarded his men as men, not as mere tools. He personally knew all his men by their first names; he knew their entire families and where they lived. He went among them when they were at work, found out their troubles, if they had any, and adjusted them right then, if such a thing was possible.

See Men Any Time

The Bradleys never had any private offices or barriers to separate them from their men. They and their men have always worked together. Any man in our plant can see the head Bradley any time he is in the plant.

In other words, the Bradleys have taken a human interest in their men. They have always worked, at some time, in the plant with their men, and have done the same things the men have done. No Bradley has ever asked a man to do anything about the plant that he would not do himself. The Bradleys have never been afraid to get their hands or faces dirty. Overalls look just as good to them as a dress suit, and the writer prefers the former. They circulate through the plant, talk to their men face to face, and in a friendly man-to-man sort of way try to get at the bottom of things and thereby help the man as well as the firm.

Quite often we raise the men's pay without their asking for it. If we think that a man is earning more than he is getting we don't wait for him to come to us, we go to him. We never liked the idea of keeping a man at the same pay just as long as he would stand it. That policy is a strike breeder. If a man thinks he is not earning as much as he is worth we want to talk it over with him. If we think he is getting all he is worth we frankly tell him so and at the same time we tell him that if he can make himself worth any more to us we will gladly pay him more. That puts it squarely up to the man.

Training Men, Not Breaking Them

We try to train our men, not break them. There is a big difference. We don't believe in calling down our men. If a man makes a mistake we try to show him how to avoid a similar mistake in the future. Men are human and sensitive. We find that we can get more out of them by kindness than we can by curses. We never allow our foremen to curse or bawl out our men. If a man does not think he is getting a square deal from the man over him, we want to know it, so that we can get the men together and settle the matter right away, so that no one will carry around a grudge or a grouch.

We invite suggestions from our men. If they are good we adopt them. If we do not think that they are worth while, we tell them why. The confidence of our men is a valuable asset. We try in every way to make our men so happy and contented here that they will give us the best that is in them and not think of working elsewhere. Our men are not all perfect. A few of them do not appear on Mondays and the day after a holiday. We talk it over with them and give them a fair chance. If they don't make good we get others who will.

We never talk politics or religion with our men, or even suggest that they vote for anyone. When the War Saving Stamp and Liberty and Victory Loan drives were on we tried to make it as easy as possible for our men to subscribe. We kept all the accounts, so that they did not have to do any banking. Our plant went 100 per cent on every Liberty and Victory Loan. We tried to set the men an example by the firm's subscribing to these loans an amount equal to the amount of the entire capital stock of the firm. (We have been told that this firm was one of the very few in the United States which had this record.)

During the war Uncle Sam wanted three Bradley hammers quick. The best delivery we could figure on was ten days. The writer put the matter up to the men. Practically all of them were past the draft age, or could not go to war, or be accepted for duty. The men said, "if we can't fight over there we can here," and in just three days the three hammers were on the cars.

We try in every way to make our men as comfortable as possible. We have a well lighted and heated plant and most everything that goes with a modern factory. The plant operates fifty hours a week, nine hours five days and five hours Saturdays. The men elected to take half an hour instead of an hour for lunch, so that they are off at 4: 30 p.m., and at noon Saturdays. When the Red Cross membership drive was on a short time ago, the firm paid for a membership for 1920 for every employee. The firm pays for $1,000 worth of life insurance for every employee who is insurable; $150 is paid immediately upon death and the balance in twelve monthly installments. For Christmas this year every employee received a full extra week's pay.

We do not feel that we are running a charitable institution, but a business along liberal human lines. As a result we have twenty-one men who have been here over fifteen years, seven more than forty years. We have a father and three sons, three brothers and two brothers all working here. One veteran, "Billy," after having worked here fifty-one and one-half years, is taking his first vacation, but expects to come back. Some of our men never worked for anyone but the Bradleys. I have tried to give you all the details but they say, "Only results count." Anyone can come here any working day and see the results.

No Hard and Fast Rules

We run this plant like a fairly large family. We have no hard and fast rules. Every man is on his honor. Our bosses are not bosses in the ordinary sense of the word. We have head men but they are used more as instructors than anything else, not as drivers.

Every man knows that if he abuses any other man in our plant the abuser's job is vacant. Our method might be absolutely worthless in a large plant. We purposely keep our plant comparatively small and well in hand. This is a personal business to a large extent.

I am somewhat like a friend up in Exeter, N. H., who said, "I have no ambition to become wealthy, for if I did I might become dissipated, and that's a thing I have fought against all my life."

We get lots of advice to expand and build more buildings and put in more machinery and hire more men. That is all right, but we have seen the time when this plant was very much too large and we were running forty hours a week, or less, and borrowing money to pay the men with rather than close the plant and turn the men out in the street. We find that we can't prosper unless the other fellow does.

The fellow with bristles on his back doesn't often make good in the long run. No doubt some people say, "Chris Bradley is a nut," but I would rather have them say that, than that I was a crab or a lemon.

Some years ago when orders were few and far between and we were having what was called bad times, there were a lot of good men idle and many plants closed. We ran on short time and only let out a few men that we could readily replace. For some weeks we had to borrow money to pay the men with. Some of our friends, and some bankers, told us that what we were doing was suicidal, and that it was foolish to work on stock with no orders in sight.

That was their honest opinion, but it wasn't mine. I said, "We will work on stock and pay our men every week just as long as we can stand it. We have the best crew of men in captivity and I am going all the way with them. Bradley hammers on hand are just as good to me as money in the bank, and I'm going to play this string out, make or break."

You can call it nerve or anything you like. I figured that some day someone would want some Bradley hammers and we were going to be right on the job. Things can't go one way all the time. The result was that we didn't go broke, and when the tide turned we had Bradley hammers for quick delivery. Our stock melted like a snowball in a hot oven, and we had all our best men, which was the main thing.

Then our friends and the bankers said, "Chris Bradley is a smart fellow," which was bunk. We just kept right on making and selling Bradley hammers. They couldn't say anything bad about us and tell the truth so we didn't care what else they said.

My principal job is seeing that Bradley hammers are made, made right, and delivered. This has kept me busy and I like the sensation. As a result of my chosen profession I have had to neglect a great many of my out-of-town friends unless they trail me to my lair. Our mutual friend, the late Prof. John Edson Sweet, had cut in the stone arch over his office door, Visitors Always Welcome. He had it cut in so that it could not be rubbed out. It is there today, although he has joined the great majority. Those are our sentiments, but we haven't any stone arch to cut them into.

I guess you will wonder where the "method" is. I don't know. Perhaps it got lost in the shuffle. Anyhow, what we have done since 1832 can be seen in the human results now on exhibition at our shop in Syracuse, N. Y.

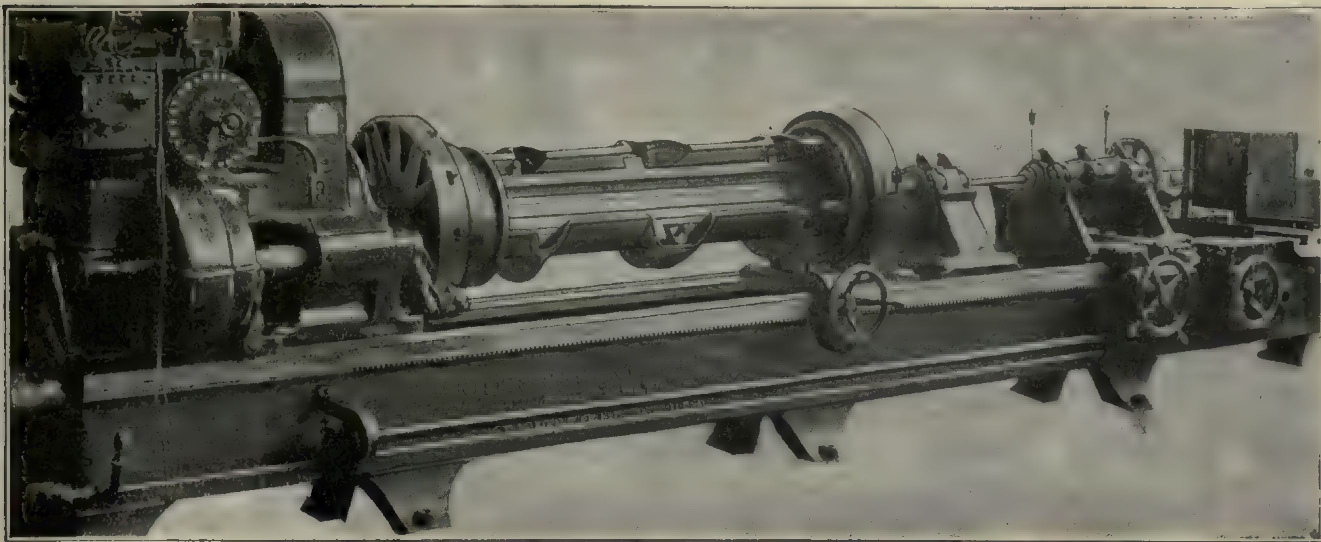
Remember that I am a hammer manufacturer, not an author, and just one of the common people.

A Heavy Cut in a Small Lathe

By Henry F. Colvin

The illustration shows a chip which was cut from the end of a ⅜-in. rod of cold-rolled steel in a Stark Bench Lathe. The rod was held in the collet in the usual way and the tool ground with considerable top rake to provide a clean shearing cut so as to leave the central stem shown on the bar. After turning the rod was removed from the lathe with the chip still in place as shown. This was done by E. H. Goldsborough of the Pioneer Instrument Co., New York.

THE CHIPS AS DESCRIBED ABOVE



Unusual Methods of Securing Extreme Accuracy—II

By A. L. DE LEEUW, M. E.
Consulting Engineer

In this installment the very important operations of drilling and boring the two main holes in the cradle forging are taken up in detail. The methods used, the types of tools and the working limits are all discussed.

(Part I appeared in our March 18 issue.)

THE machining operations which are the most important in the schedule of operations on the cradle forging are the drilling and boring of the two main holes. The entire success of the mechanism depends on the accuracy with which these holes are bored. These holes are 63 in. long, one is $1\frac{5}{16}$ in. in diameter, and the other about $2\frac{1}{2}$ in. The variation permissible in any one hole is 0.0008 in., though the permissible variation between the holes of various pieces is as much as 0.002 in. However, this allowance was of no assistance as the pieces were supposed to be interchangeable. There was nothing in the mechanism which required the two holes to be parallel, but, as very close limits were set on the walls surrounding both holes and as the metal between the two holes was rather thin and had to be submitted to a hydraulic pressure test of 5,700 lb. to the square inch, it was thought best to make the holes parallel whether they were required to be so or not.

In addition, the holes were to have a very smooth and mirror-like finish and were to be entirely free from tool marks and even the smallest surface scratches. The result of the following operations was that the variation in individual holes did not exceed 0.00025 in., that the roundness of the holes did not in any place show a measurable variation and that the surface was sufficiently good to withstand the very severe tests to which the pieces were subjected, of which there were more later on.

The boring operations took place in the following sequence: Drill small hole; drill large hole; first bore small hole; second bore small hole; first ream small hole; second ream small hole; first bore large hole; second bore large hole; first ream large hole; second ream large hole.

It was the original intention to drill the holes on special 30-in. boring lathes. These lathes had a 10-hp. motor mounted on the carriage for turning the drill and a revolving steadyrest for the work or fixture to revolve in. Delayed delivery of these machines made it necessary to rig up other lathes, originally designed for boring, to do this operation.

The 30-in. lathes, however, were very well designed for this class of drilling and would have been especially superior for drilling the large hole. With both the work and the drill revolving, proper drill speeds could be secured and the time of operation shortened. In drilling the large hole only the work was revolved.

Drilling the $1\frac{5}{16}$-In. Hole

A general view of the 24-in. heavy boring lathe with revolving steadyrest, with the fixture and recoil body in place and the drill in working position, is shown in the headpiece (Fig. 18). The spindle is driven by a 3-hp. d.c. motor with pushbutton control and dynamic brake for stopping and starting and a field rheostat for speed regulation. The switch and the starting rheostat for the oil pump are shown mounted at the right.

Fig. 19 shows the recoil held in the revolving fixture *A* which is clamped to the faceplate by the clamp *B*, while the other end revolves in the steadyrest *C*. The fixture is turned to the same diameter at both ends. The hole is first drilled half way through from one end, then the fixture is turned end for end in the lathe without unclamping the recoil body and the other half of the hole drilled from the opposite end. The tools met within 1/64 in. and often within a few thousandths.

The fixture is revolved at 70 r.p.m. in a counterclockwise direction, viewed from the carriage. The recoil body is held by the clamps shown in Fig. 19. The revolving steadyrest *C* and the end of the fixture *A*

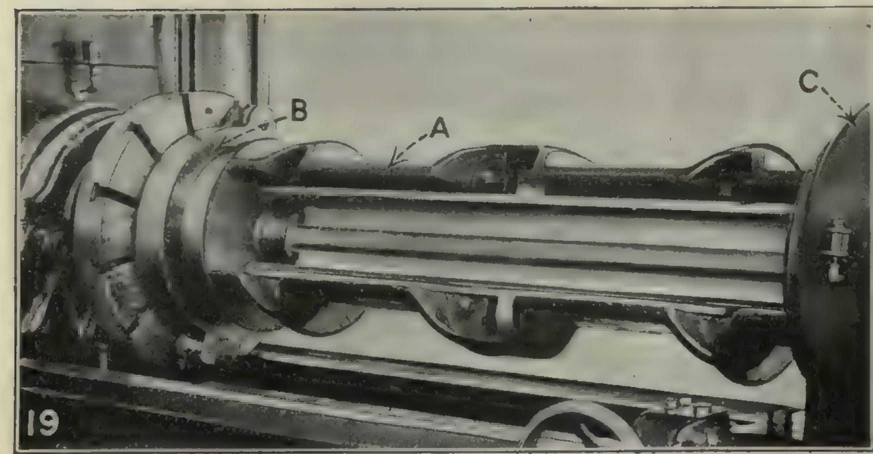


FIG. 19. DETAILS OF HOLDING FIXTURE

are seen in detail in Fig. 20. The bushing *F* is held tightly against the end of the recoil body by the two screws shown. The oil-tube drill *G* is fastened to the hollow drill tube *H* and revolved in a clockwise direction viewed from the carriage. The drill is guided in the guide bushing *E* and in the stuffing-box *J*.

Oil Outside the Drill

Oil under pressure enters the stuffing-box *J* as shown and passes through the drill tube in the guide bushing *E*. The drill tube is smaller than the cutting diameter of the drill. This allows the oil to pass into the drilled hole and around the tube and thence along the oil clearance and over the end of the drill. As the chips are produced they are carried back through the drill tube by this oil.

The drills are shown in Fig. 21 and were made of Rex AA high-speed steel. The shank section was left soft and the land above hard. If the drill is not hard at the land, it will seize in the hole and twist off in use. It is necessary to give the oil clearance *L* the shape shown in order to prevent the wedging of fine chips along the edges.

Another important point is the shape of the grooves for chip breaking shown at *N*. These grooves must have square sharp corners to properly split the chip into three parts. The shape and finish of the throat of the drill where the chips enter the hollow interior must be as shown and must be polished to prevent any clogging of the chips. The short drill shown at *A* is ready to be scrapped; it has drilled 102 holes. Figs. 22 and 23 show the method of revolving the drill tube *H*. The unit *O* is connected to the regular carriage by a forced bar and is fed forward along the bed by a feed screw inside the shears. This drags the carriage on which is mounted the 3-hp. motor, controller and gearing as shown. The gearing is 10 to 1; the motor speed, 1,750, giving a drill speed of 175 r.p.m. This, added to the speed of the work, gives a total speed of 225 r.p.m. The maximum cutting speed of the drill is 80 ft. per minute. This drive was installed as a temporary expedient but proved entirely satisfactory. A cast-iron shearing pin, $\frac{5}{16}$ in. in diameter by $1\frac{1}{2}$ in. long, drives the drill tube. This pin is reduced in diameter to $\frac{1}{4}$ in. by a neck 1 in. from the end and is easily sheared off in case the drill sticks.

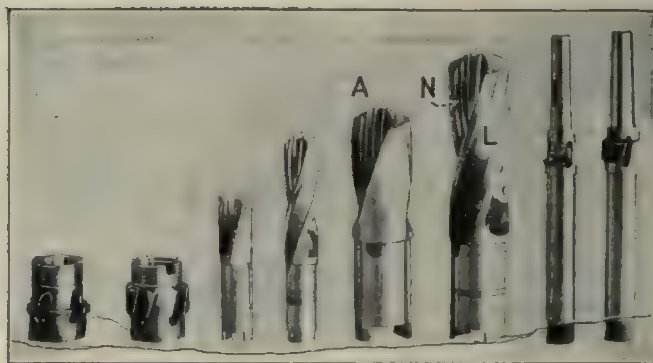


FIG. 21. SOME OF THE DRILLS USED

The three-cylinder pump, shown in Fig. 23, driven by a 3-hp. motor, supplies the oil. The tank conections to the pump contain fine meshed screens to filter out the fine chips. This shows the arrangement of troughs and the way in which the outlet *A* must always discharge into *B*, no matter where the carriage may be. The oil used was Houghtons' refrigerant base, 7 gal.; paraffin oil, 50 gallons.

The drilling data may be summed up as follows:

Drill size	1.3594 in.
Drilling speed (total)	225 r.p.m.
Cutting speed	80
Feed per revolution of spindle	0.0035 in.
Feed per minute	0.787 in.
Idle time, loading, turning around, etc.	1 hr. 10 min.
Cutting time	2 hr. 50 min.
Total time	4 hr.
Number of operators required per machine	1
Holes per drill average	48.3

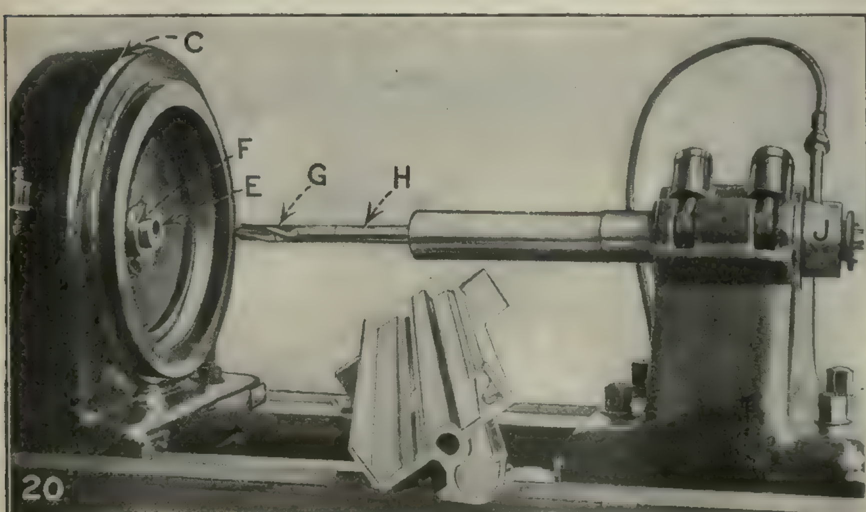


FIG. 20. HOW DRILL IS DRIVEN AND LUBRICATED

In drilling 726 holes, six drills were broken. Four of these breakages were before the adoption of the aforementioned cast-iron safety pin and the other two were due to the drills being worn so short that they had insufficient taper clearance at the shoulder end.

The large hole in the recoil body is drilled from both ends and the operation is very much the same as with the $1\frac{5}{16}$-in. hole, the main difference being

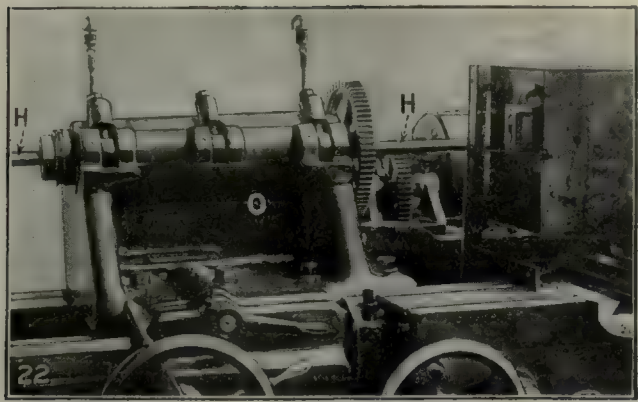


FIG. 22. DRIVING THE DRILL

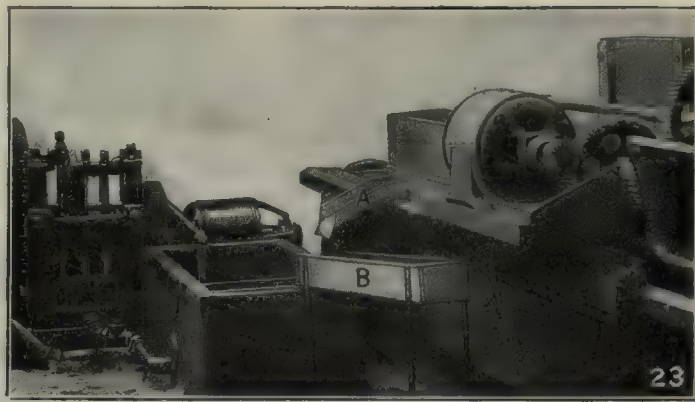


FIG. 23. HANDLING THE DRILLING LUBRICANT

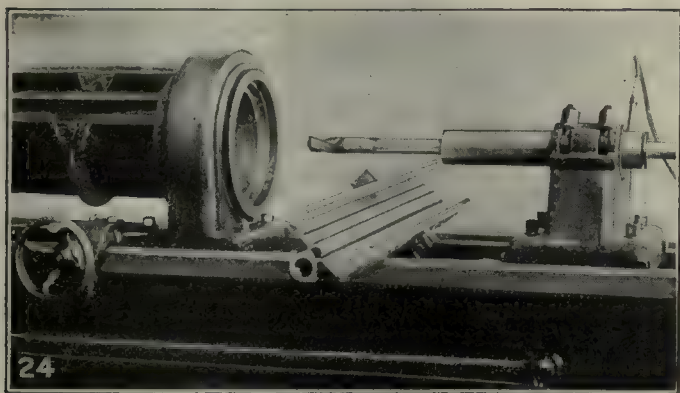


FIG. 24. DRILLING THE LARGE HOLE

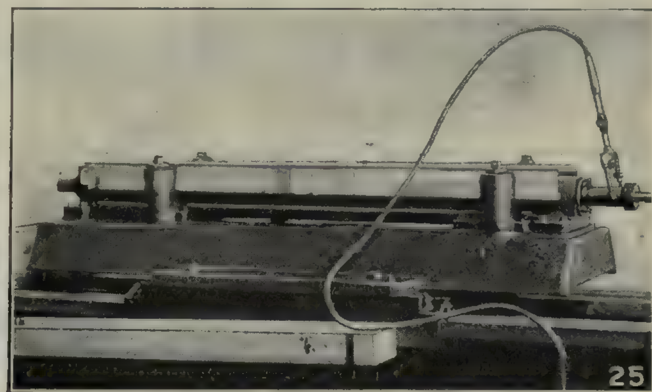


FIG. 25. THE DRILLING FIXTURE USED

that the work only revolves. Fig. 24 shows the drill and the work. The same type and size of machine is used as for the small hole. The fixture is the same type and the function and design of the drill, stuffing-box and bushings, size and type of pump and the oil used, are the same in both cases.

The same points must be observed in making this drill as in making the small one. The details follow:

Drill size	2.3906 in.
Drilling speed	80 r.p.m.
Cutting speed	50
Feed per revolution	0.0014 in.
Feed per minute	112
Idle time, loading, turning, etc	1 hr. 10 min.
Cutting time	9 hr. 10 min.
Total time	10 hr. 20 min.
Operators per machine	1

Boring and Reaming the Two Holes in the Recoil Body

Both the boring and reaming of each hole are accomplished in one setting of the piece. The boring brings the holes parallel and in the correct position, and the reaming sizes give the holes the proper surface for lapping.

A modified French type of tool was used for boring, while for finish-reaming, a wood-packed reamer was developed by the Singer engineers for this purpose. Both these tools have the same bar and are pulled through the holes, one after the other. Two boring tools are first pulled through, each removing part of

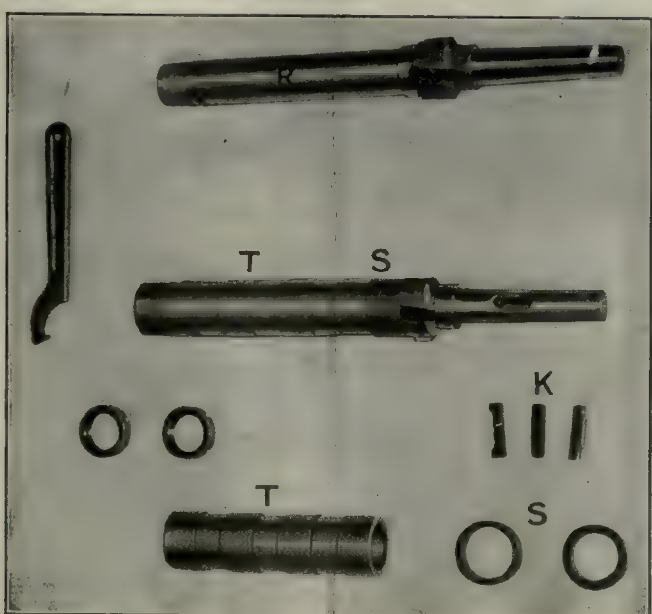


FIG. 26. SOME OF THE DRILLING TOOLS

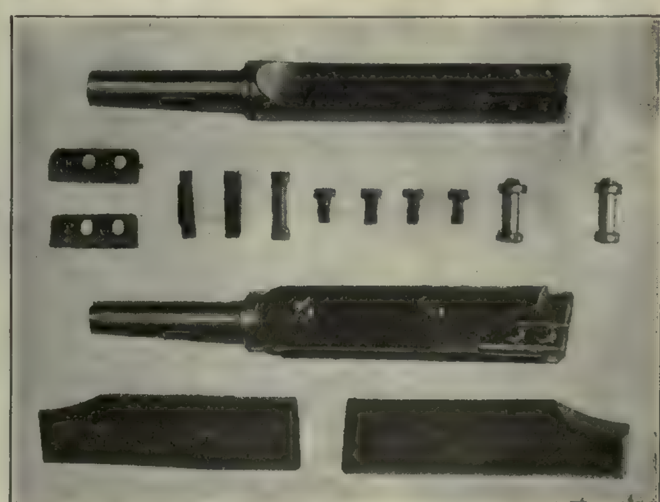


FIG. 29. THE BORING TOOL

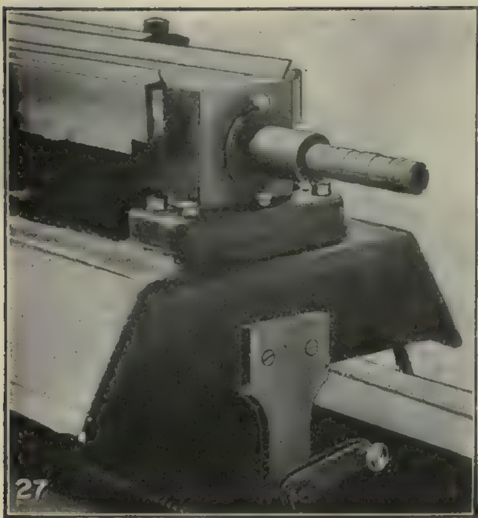


FIG. 27. PULLING THE BORING BAR INTO THE WORK

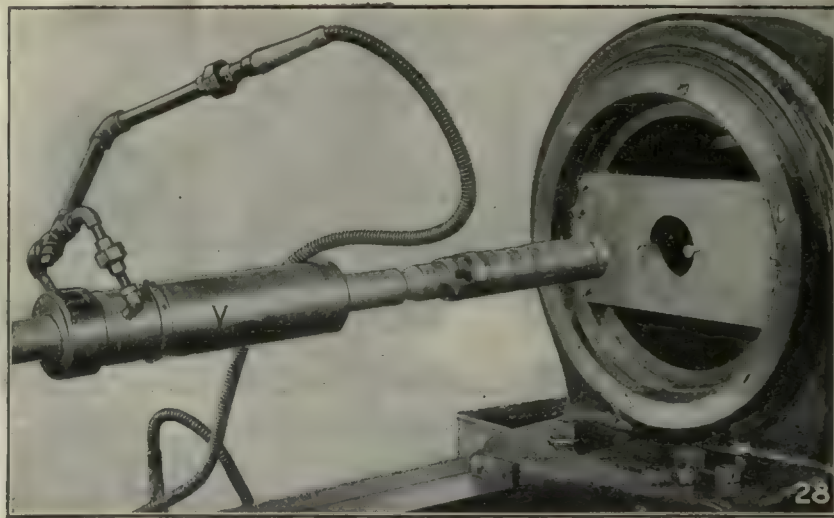


FIG. 28. BORING BAR JUST LEAVING THE WORK

the stock left from drilling. The last boring tool drawn through leaves the hole straight and in the position required. The finish-reamer is then pulled through and the hole sized and left smooth. About 0.002 in. is left for lapping and this amount is all that is required to remove the reamer marks.

Fig. 25 shows the small-hole boring and reaming fixture mounted on the stripped carriage of a 24-in. heavy-duty lathe. The recoil body is clamped in position by four brackets. The spindle nose driving the bar is screwed to the spindle and the tapered end of the bar is drawn in by two tapered keys.

Boring the Small Hole

Fig. 26 shows the modified French boring tool for pull-boring. The body *R* is made of Rex AA high-speed tool steel. The chip is produced at the cutting edge and washed by the oil flow through the slot in front of the cutting edge and out through the interior of the hollow body. The fiber washers *S* are fitted to prevent the chips reaching the bronze bushing *T*. The bushing *T* is ground about 0.0005 to 0.0007 in. smaller than the cutting diameter of the reamer and is free to turn on the body *R*. When the tool is revolved and pulled through by the bar, the body *R* revolves within the bushing. The fiber bushings *S* are ground the same diameter as the cutting tool.

The bushing *T* is made of forged bronze. The tool is fastened to the solid boring bar by the keys shown at *K*. This tool differs from the French cutter which is fastened to the boring bar by a female instead of a male taper. This was expensive to grind inside and not easily removed from the bar. The French tool is also without relief on the outside, back of the cutting edges, and also in the space which in the Singer reamer is occupied by the fiber collar. This caused the reamer to seize in the hole and break off. The Singer tool is backed off to a line as is any reamer and breakage entirely ceased after this type was introduced. The life of this reamer averaged 32 holes. Two of these tools are pulled through to straighten and position the hole.

Fig. 27 shows the small reamer entered in the starting bushing at the beginning of its travel through the recoil body. The steel starting bushing is 0.0005 in. above the size of the bronze bushing in the reamer and gives it a straight start. While working, the oil and chips come out of this bushing. In case the reamer is reduced in diameter by grinding, smaller bushings are furnished below the maximum size, in steps of 0.002 in. Fig. 28 shows the coming-out end of the fixture. Bushing *V* is bronze. The oil is pumped in at this bushing as shown and the bushing is held tightly against the end of the recoil body. Details of the reaming operations are:

First tool size	1.457 in.
Second tool size	1.552 in.
Revolutions per minute	90
Feed per revolution	0.014 in.
Reaming time	1 hr. 50 min.
Loading, changing, etc.	25 min.
Total time	2 hr. 15 min.

The fixture-reaming is done in the same fixture as the boring, without removing the recoil body. The last boring tool is removed from the bar and the bar pushed

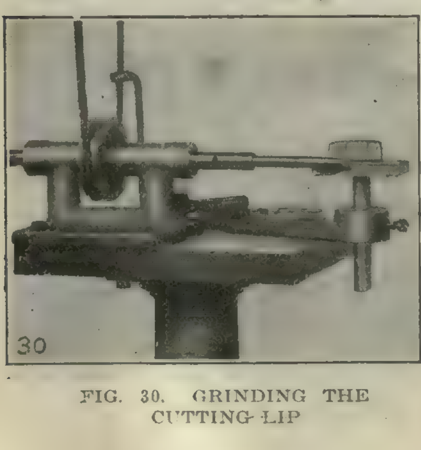


FIG. 30. GRINDING THE CUTTING LIP

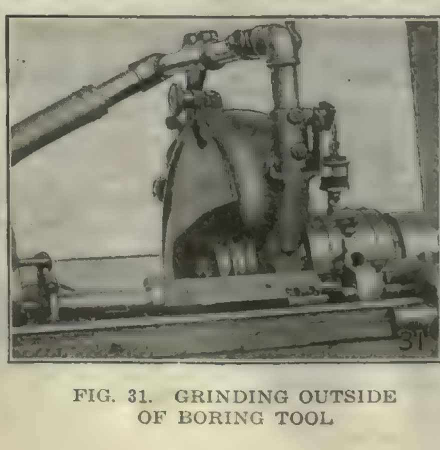


FIG. 31. GRINDING OUTSIDE OF BORING TOOL

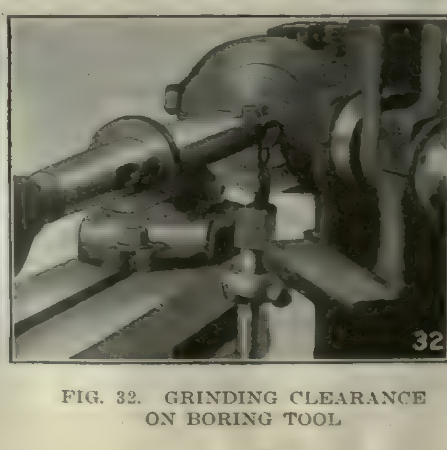


FIG. 32. GRINDING CLEARANCE ON BORING TOOL

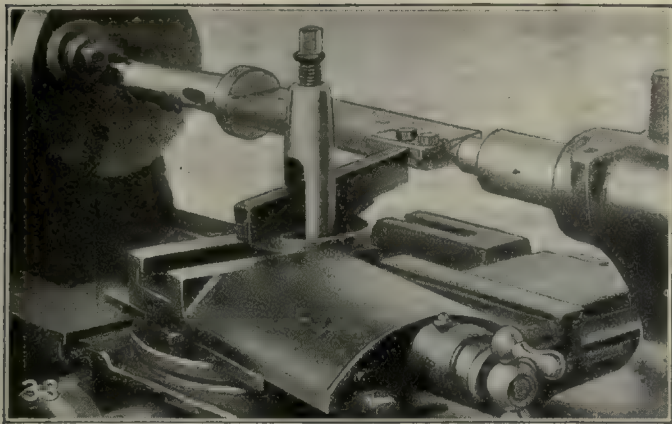


FIG. 33. HONING AND TESTING BORING TOOL

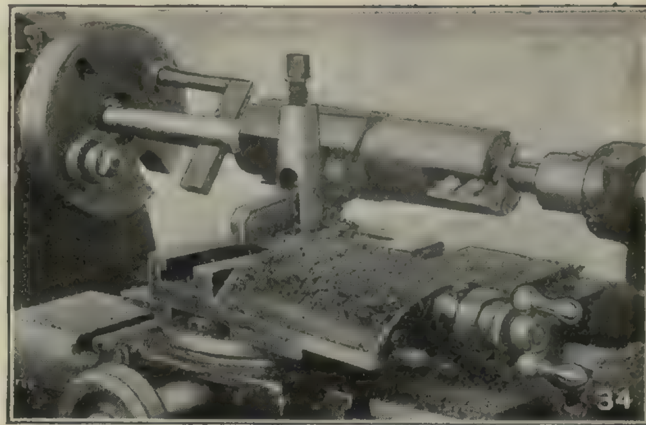


FIG. 34. TURNING THE WOOD PACKING

through the hole until it protrudes from the rear. The wood finishing reamer is then keyed to the end of the bar and pulled through. No starting bushing is used, as the wood follows the bored hole, this wood being turned 0.007 in. larger than the hole is bored.

The finishing-reamer is shown in Fig. 29. The body is made of chrome-nickel steel and the blades of a fine carbon finishing steel. Colonial No. 7 and Bohlers Gold Label proved well adapted for this purpose. After being machined and hardened the blades are lipped as shown in Fig. 30. The blades are then fastened to the bodies and packed out to allow for grinding to the correct diameter.

Fig. 31 shows the blades in position, being circular-ground to correct diameter and tapered. The angle of this taper is 3 deg., followed by a short taper of 1½ deg., ⅛ in. long. As the reamer is pulled shank first through the hole, the taper occurs on the end of the blade toward the shank. Fig. 32 shows a reamer being backed off on a Cincinnati cutter grinding machine No. 1½. The edge is backed up to the circular grinding line. Fig. 33 shows the reamer being stoned. The soft copper bar in the toolpost is used as an indicator and the two blades stoned until they both register exactly. The point where the taper meets the straight part of the blade is very carefully stoned.

In Fig. 34 is shown the wood packing being turned. The wood is hard maple, soaked in hot cutting oil until the oil has permeated the wood thoroughly. It is left in the oil until shortly before the reamer is to be used and the turning is done just before using. That part of the wood which extends back along the blades is turned 0.007 in. larger than the blade and is tapered at the shank to facilitate entry. This supports the blades as the wood leaves the hole on finishing. The oil flows back around the bar and washes the chips away as they are produced, as with the boring tools. The wood is shimmed out several times with veneer and returned. The blades are set out and re-ground for every cradle.

DETAILS OF REAMING

Size of first finish-reamer	1.565 in.
Revolutions per minute	55
Feed per revolution	0.0685 in.
Size of second reamer	1.572 in.
Revolutions per minute	55
Feed per revolution	0.050 in.
Time changing from French tool to first finish-reamer, including gear changing	20 min.
Reaming time	17 min.
Change to finish-reamer	12 min.
Reaming time	45 min.
Removing work	15 min.
Total time two reamers	109 min.

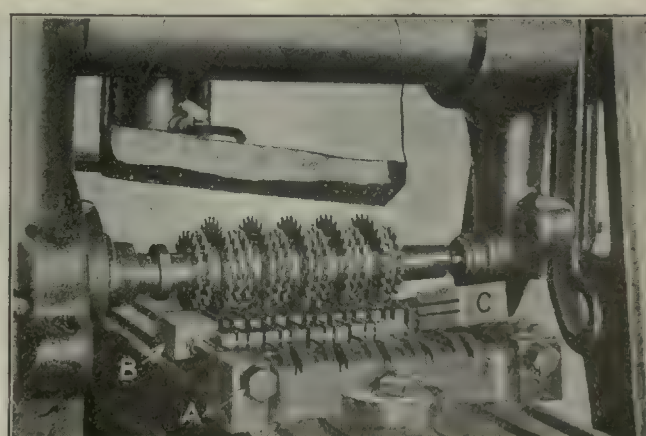
After some experimenting it was found advisable to pull two finishing reamers through the holes. This was mainly to counteract a tendency to taper the hole as the reamer finished cutting and the wood got away from the supporting walls of the hole in the cradle. Care must be taken to break the corners of the entering end of the hole to prevent shearing of the wood. When the wood is about right, a squealing noise is often heard as it revolves.

The details of this reaming are shown in the accompanying table.

A Gang-Slitting Operation for Knife-Switch Bases

By John Vincent

A rapid method of producing the bases which hold the clips of knife switches is employed in the shops of the Delta Star Electric Co., Chicago, Ill. The fixture and the slitting cutters shown in the accompanying illustration are used. The copper bar used for the bases is previously sawed into sections of the same length as the fixture. A section is clamped into place by drawing up the bolts *A*, thus pulling forward the block *B* in the manner of a vise jaw. Seventeen slitting cutters are carried in a gang on the arbor, five serve for separating the pieces and the remainder cut the slots in which the spring clips that engage the switch blades are afterward brazed. Six pieces similar to the one shown at *C* are produced in the one operation.



SLITTING CUTTERS AND FIXTURE FOR PRODUCING SWITCH PARTS

A Tribute to Chordal

BY W. D. FORBES

Into this, our world, there come lives that affect our own existence even though we never have been thrown in personal contact with them. The incident I am about to relate illustrates this and I do not doubt that there are others who could tell a like story of James W. See, or Chordal.

I was in charge of quite a large works that like many others had special tools built outside its own machine shop. A Mr. X did this class of work very well. His shop was not large, working only from fifteen to twenty men, according to the job work obtainable. I went over to his office one afternoon with instructions to contract for six special machines of a pattern we had had built several times before, and I found him seated at his desk in his little office with a copy of the *American Machinist* in his hand.

He did not seem to hear me when I spoke and just then his son came in from the shop. I said to the young man that I could give them an order if we could agree on a price.

Then Mr. X looked up and answered, "No, young man, we will not take any more job work." His son was startled and remonstrated, but there was no moving Mr. X who said, "Yes, I have been thinking that the job work we take paid, but it has not, and what is worse it has made all my other work run behind and I shall stop it. Here," he said, pointing to an open page of the *American Machinist*, "This fellow Chordal has set me straight and shown me where I have been blind, and what is more, he points out the way to get over my blindness; see that picture of a fellow in a stove pipe hat standing in a machine shop? He does not know a lathe from a screw machine, yet he took hold of a money-losing shop and made it pay. I am going to do just what he did and right now is the time to start, I can make money on my presses if I stick to making them and make them the right way."

The story told by Chordal and referred to by Mr. X away back in the "eighties" was of a man who understood the value of tools, jigs and fixtures, and also the value of manufacturing. He hired brains, trained them in the right direction and got ready to make things in multiple and he pulled a broken-down concern out of a hole and made it a profitable business.

CHORDAL GLAD TO BE OF HELP

Mr. X never saw Chordal, but he wrote the *American Machinist* telling what the article had done for him some three years later, and it was either Lycurgus Moore or Horace Miller who told me that Chordal was more pleased at knowing that he had been a help to somebody than if he had been sent a check for a thousand dollars; he was just that kind of a real man.

Chordals style was so very holding, when he started to tell anything you wanted to continue reading, for, besides the information, there was a delightful sense of humor which ran all through what he wrote and you felt that he was not talking of anything he had been taught but something he knew of his own knowledge.

The real value of what a man either writes or says lies in having it remembered. Chordal had a way of making all he wrote stay with you. Chordal's book is one on my "three-foot length of book shelves" and even with the lapse of time since it came out, I feel refreshed when I again take it down to con over its pages.

Smiling over the described shop work, I can fairly see the two young men with the ring gage behind the door and almost catch the smell of the oily waste used by them in cleaning out the ring as they examined it.

I remember a large concern up East where I saw a scrap yard with a padlock on the gate and the super told me that many years before he came there the president of the company had put a fence around the scrap pile, saying that Chordal had taught him how much money could be lost by hunting over a scrap pile. And up in the office there was a picture of an old gray-haired man, with his specks pushed up on his forehead, hunting for some piece in a scrap pile.

What made Chordal inimitable was the fact that he knew his subject through and through and knew the men of whom he wrote, coupled to this was his great ability to inject humor into all he wrote, and humor is a lubricant which makes the human machine run more smoothly.

[We will be pleased to have other readers contribute their recollections of Chordal and his influence on shop methods.—Editor.]

Stay in the Ranks

BY W. G. DAMM, M. E.

Establish an incentive for which the employees in your organization may strive and you will have taken the first and most important step toward averting a continuation of industrial unrest and excessive labor turnover that is one of the biggest problems confronting the employer.

Every progressive employer should train his men for his work, adopting the policy of promotion within the ranks for every man who realizes and accepts his responsibility.

Each employee should keep in mind that no chain is stronger than its weakest link, that he is a link in the chain, and that he should by study and application become a thorough master of his job and strive to make himself efficient therein. He should have a thirst for knowledge not only of his own work but the other fellow's as well, as it is only in this way that he can reasonably expect advancement.

How often it has been stated that when a foreman or superintendent was needed it was necessary to go outside the organization for him because there was not a single man inside that was qualified for the position.

If the plan as above outlined is followed out the result will be greater contentment among the workers and consequent greater efficiency and increased production, with a minimum of labor turnover. One of the biggest and most successful employers in the world early adopted this policy and as a result has never had to go outside his organization for a man for any position.

The effect of the promotions that are made by him among his own workers has a wonderful psychological effect upon the men with the result that they are constantly striving to become more efficient in their work and to qualify for the bigger jobs they know will be theirs when opportunity affords.

Manufacturing a Farm Pump Engine

By J. V. HUNTER
Western Editor, *American Machinist*

The gas engine has been working for the farmer for a number of years, and is increasing in popularity as its operation and maintenance are better understood. The manufacturing methods which have enabled its production at so low a cost that it may be sold at an attractive price have done much toward making the farmer feel that he can use power for relieving his back of the labor of pumping water.

SOME years ago a small gasoline pumping engine was brought out which has proved itself of great service to many farmers; others of similar type have appeared since but the original as made by the Fuller & Johnson Co., Madison, Wis., is in such demand that it is made in great quantities. It is so designed that it can be simply and easily attached to any pump standard and will operate either in place of, or as auxiliary to, the windmill without in any way interfering with the latter where conditions permit its use, thus assuring the farmer of a certain supply of fresh water at all times.

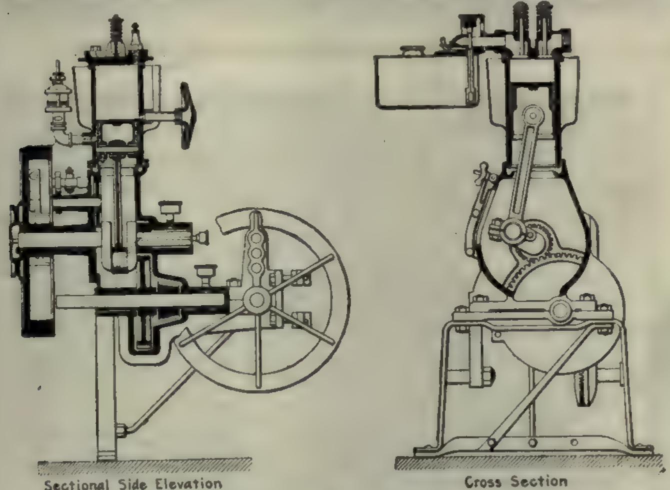


FIG. 1. CONSTRUCTION OF FARM PUMP ENGINE

The manufacturer has developed an interesting line of tools and fixtures for producing these engines, and with his lately enlarged factory facilities, is in better condition to take care of the post-war business. Machining fixtures and jigs and gages have been made for all of the parts of this engine so that every piece will be interchangeable on all engines.

The machining on the crankcase, whose general form may be determined from the engine outline shown in Fig. 1, is done for the most part on turret lathes. An example of this work, Fig. 2, shows a Gisholt lathe with the remarkably large housing fixture *A* which is used to carry the casting. The tools carried in the turret head turn, bore and face the interior and finish the bearing, while the tools in the toolpost finish the surface for the gear-case cover.

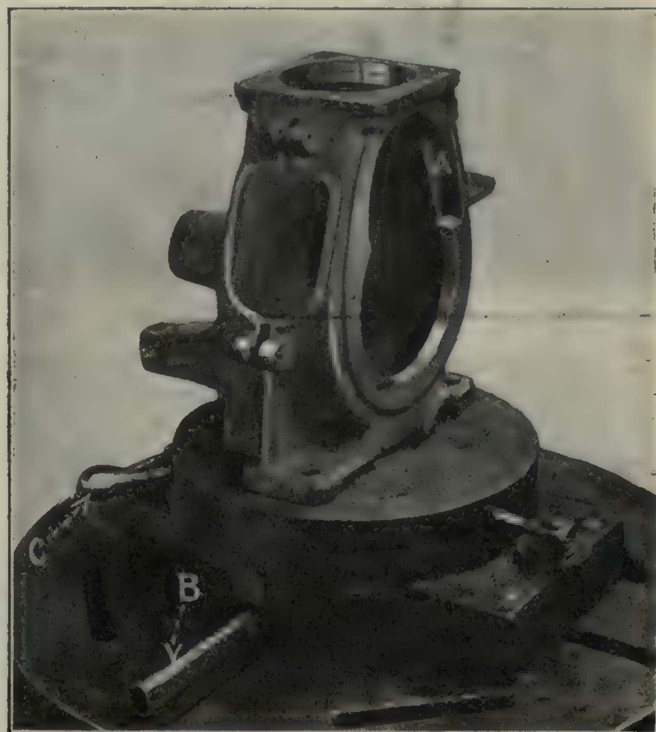


FIG. 3. INDEXING JIG FOR DRILLING AND TAPPING

A revolving and indexing jig, Fig. 3, is used for drilling and tapping the holes for bolting on the cylin-


FIG. 2. TURRET-LATHE OPERATION ON CRANKCASE

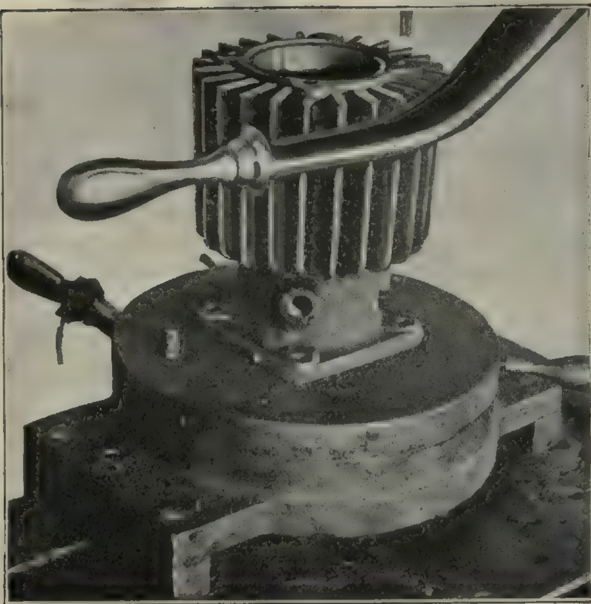


FIG. 4. INDEXING JIG FOR CYLINDER

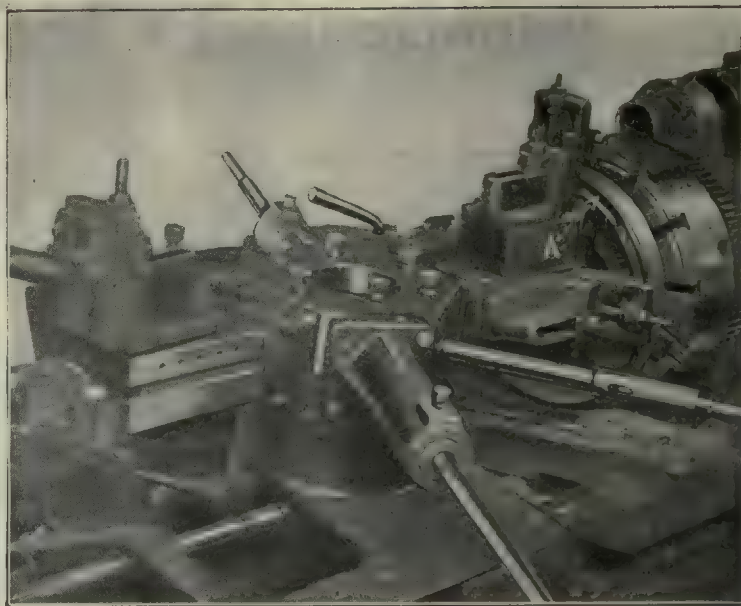


FIG. 5. TURRET-LATHE OPERATIONS ON FLYWHEEL

der. During the drilling operation a jig plate is used which fits on the machined top and clamps to the side of the casting, but is removed before the tapping operation shown. The casting *A* is held in line on the fixture by dowel pins which fit the holes drilled into its base. The lever *B* operates the indexing movement while the operator is swinging the top revolving plate by means of the small handle *C*.

The cylinders have the crankcase surface rough-bored and faced in a Gisholt turret lathe, and are then reversed for finish-boring and facing the other end. Afterward they are drilled and tapped under a radial drilling machine, Fig. 4, using an indexing fixture very similar to the one employed for the crank cases.

The flywheels are finished complete in a Gisholt turret lathe in one setting, Fig. 5, while the wheel is gripped by the chuck jaws on the inside of the rim. The turret tools turn, bore and ream the hub. The rim-turning tools are carried in the toolpost. The flywheel has a slot or pocket cast in its rim *A* in which a small handle is pivoted for cranking the engine. When the engine has attained sufficient speed the crank is thrown back into the recess to prevent it from striking the operator.

A special Gisholt machine has been built for machining the combination gear case and engine base *A*, Fig. 6. The casting is held in a vertical position in the fixture *B*, which is mounted on the cross-slide of the carriage. In service this starts at the forward position and the crossfeed carries it against the large built-up milling cutter *C* which is mounted directly on the main spindle of the machine. Behind the spindle head has been attached a special frame which carries a set of gear-driven drill spindles arranged in the proper relationship for the holes in the engine casting. The carriage cross-slide of the machine carries the fixture with the casting back until it reaches a positive stop which aligns it in the correct position for drilling the holes. It is fed against the drills by the regular carriage longitudinal feed. Thus both the milling and drilling operations are accomplished with a single setting of the casting in the fixture and considerable time is saved.

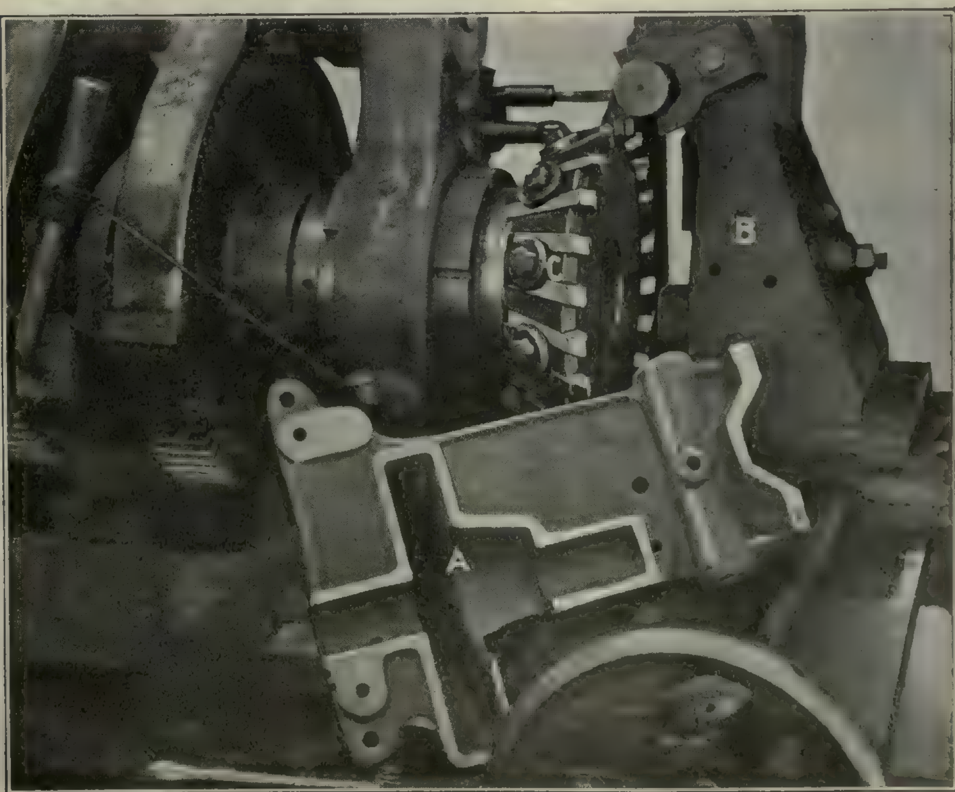


FIG. 6. SPECIAL MACHINE FOR MILLING AND DRILLING BASE

All cylinders made in the shop are subjected to a hydraulic test under a pressure of 100 lb. to detect leakage. The small cylinders for

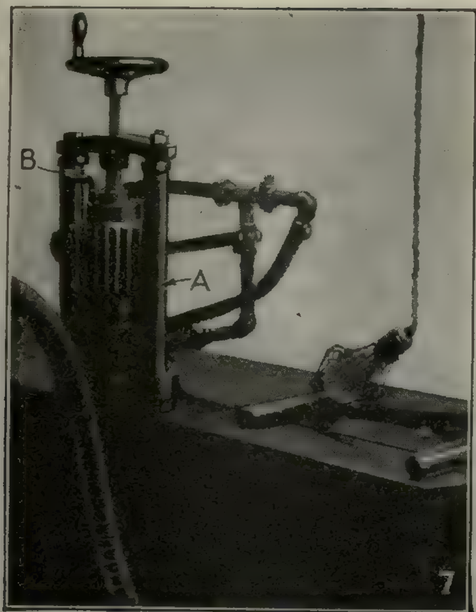


FIG. 7. TESTING CYLINDER FOR LEAKAGE

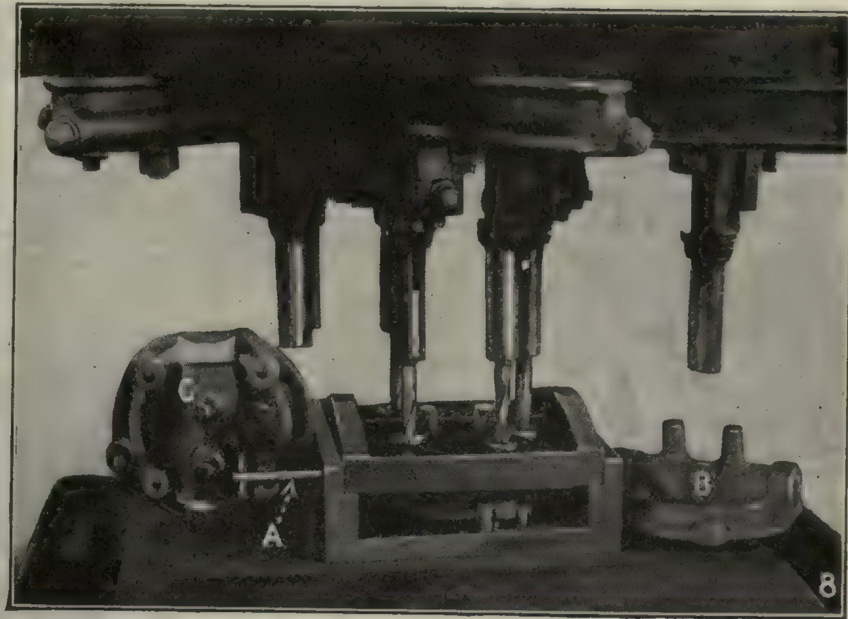


FIG. 8. MULTIPLE DRILLING ON CYLINDER HEAD

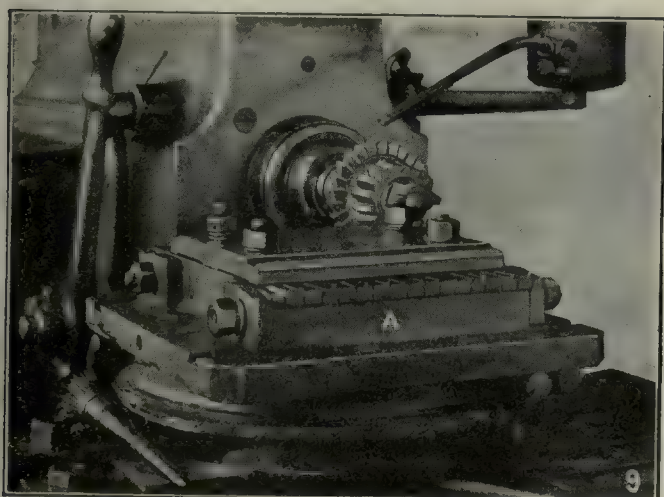


FIG. 9. INDEXING FIXTURE FOR MILLING LATCH KEY

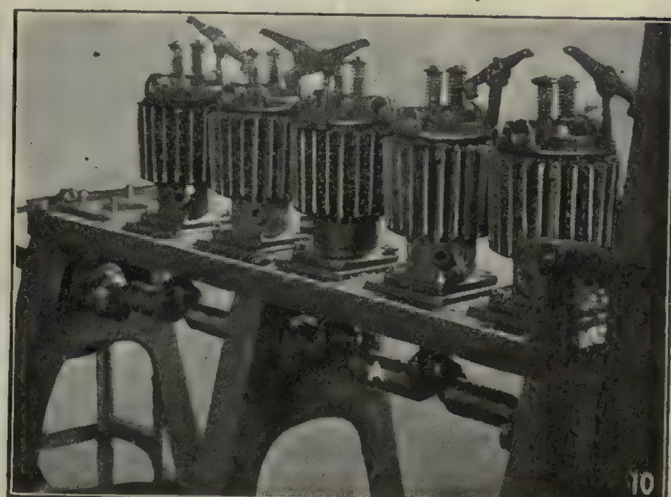


FIG. 10. SPECIAL MACHINE FOR RUNNING IN BEARINGS

this engine are clamped in the frame *A*, Fig. 7, between top and bottom heads which carry water-tight gaskets. The water enters the cylinder through an opening in the bottom plug, while an opening in the top cover leads to the vent pipe *B* through which the air may be permitted to escape.

The major holes in the cylinder head are drilled in one setting, under a Fox multiple drilling machine, Fig. 8. The jig used for this operation has its top-plate hinged at the back so that it may be quickly swung open for the insertion of the casting, and when closed the two side flanges insure its correct position while the pin *A* is used to lock it down. The casting before and after is shown at *B* and *C*.

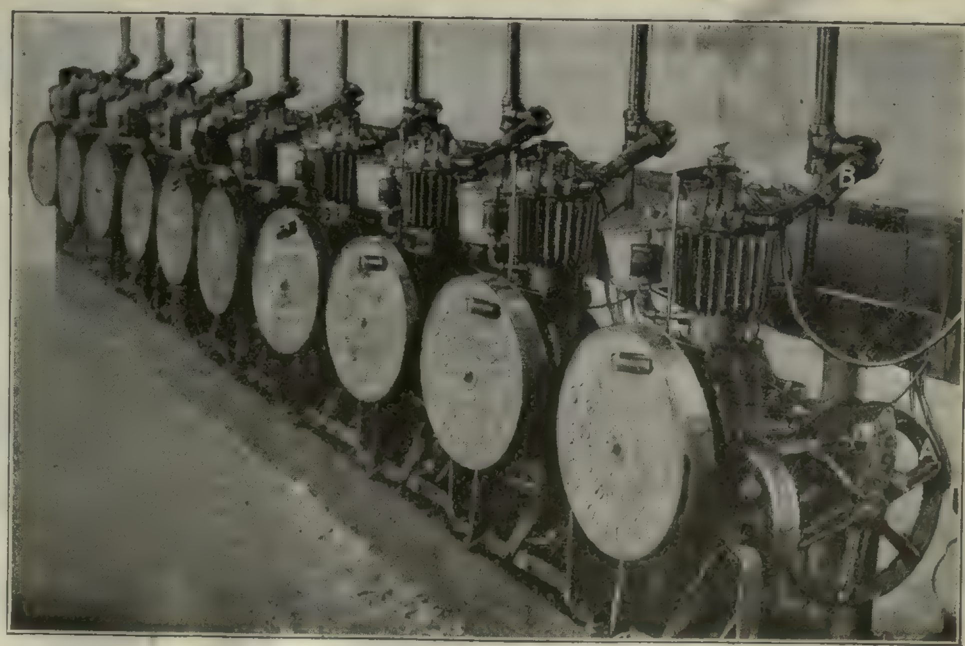


FIG. 11. METHOD OF TESTING GROUPS OF ENGINES

A milling operation on one of the small tripping parts of the timing device is shown in Fig. 9 as handled on a Cincinnati milling machine. A double-row holding fixture *A* is used so that the operator may be filling one side while a cut is being taken across the other.

After assembly of the cylinders, heads, pistons and rods the unit is taken to the running-in machine, Fig. 10, upon which six cylinder units may be mounted at one time. The connecting rods are connected to the power-driven crankshaft *A*, and several hours of running are devoted to limbering up these parts.

A line of the engines on final test, Fig. 11, shows them mounted on a frame in the position which they will occupy when bolted to the framework of a farm pump. The bevel bull-gear *A* which operates the pump plunger, is mounted on a small stud shaft that has a bearing in an extension bracket of the crankcase casting. A system of exhaust pipes is used to carry away the fumes from the engine exhaust. These hang from a large overhead main and the engine exhaust conections may be seen extending to them at *B*.

An Accurate Squaring Device for the Planing Machine

By E. A. Dixie

Lately I have had quite a lot to do with the planing department of a shop where high-grade work is done, and have mentally contrasted its practice in this respect with the methods used in shops where this class of work is the exception and not the rule. In this shop "square" means as near 90 deg. as it is humanly possible to attain on a planing machine. In other shops square means as nearly square as the operator can get by setting and squaring the work with a beam square.

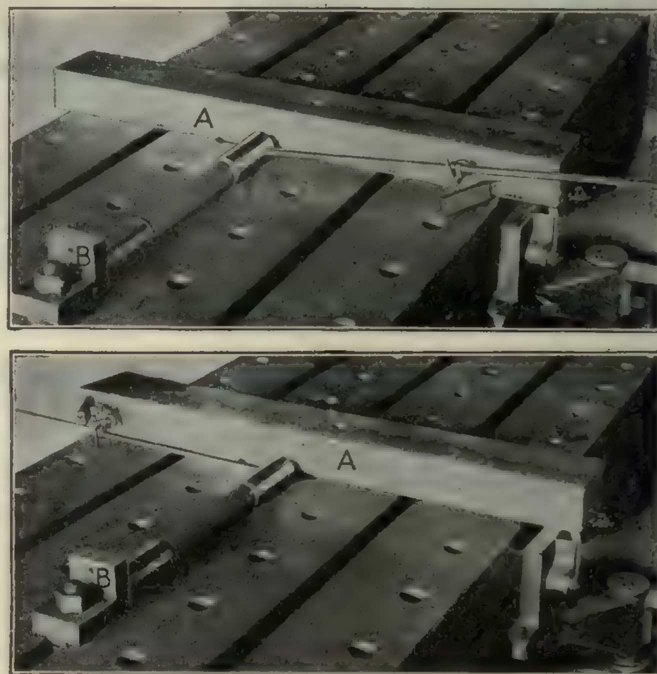
At best a beam square is a poor tool to use for squaring work on a planing machine. The stock is usually applied to the edge of the table and, of all the table surface, the edge is the most exposed to abrasion. The edges of the T-slots are not so much exposed, but T-slots are so narrow that the stock of a large square cannot be used in them. Even if it could, accurate squares are not common, and squares, the accuracy of which is permanent, do not exist.

Figs. 1 and 2 show a squaring device used in this shop. Not only is its accuracy permanent but it is used in conjunction with the center T-slot, the edges of which the operator keeps beveled and in good condition. The tool can be made of any desired size, but in this one the cylindrical ends are each $1\frac{1}{4}$ in. in diameter by 3 in. long, while the central portion is turned to about $\frac{7}{8}$ in. in diameter by 6 in. long and heavily knurled. A $\frac{5}{16}$-in. cross-hole is drilled and reamed through one end. After hardening, the two cylindrical ends are ground to diameter; the ends ground square, and the corners chamfered.

The cross-hole takes the $\frac{5}{16}$-in. rod from a standard surface gage and for preliminary squaring the regular needle can be used or as shown in the illustration, an indicator can be substituted for accurate work.

The application is as follows (assuming that the parallel *A* is to be set square with the travel of the table): Its general location on the table is determined and the stop *B* secured with a bolt in the central T-slot at a distance from the parallel that will admit the body of the tool lengthwise as shown in the illustration. The parallel is now located approximately square with the table and clamped lightly. The rod and indicator having been adjusted to the body of the device the indicator is swung first to one end of the parallel, as shown in Fig. 1, and then to the other as shown in Fig. 2, the operator being careful to keep the back end of the tool in contact with the stop *B*.

If the parallel is not square with the center T-slot (and consequently with the travel of the table) the error will show double on the indicator, thus with a difference of 0.001 in. in the reading of the indicator at the two extremes, the actual variation from square



FIGS. 1 AND 2. AN ACCURATE SQUARING DEVICE

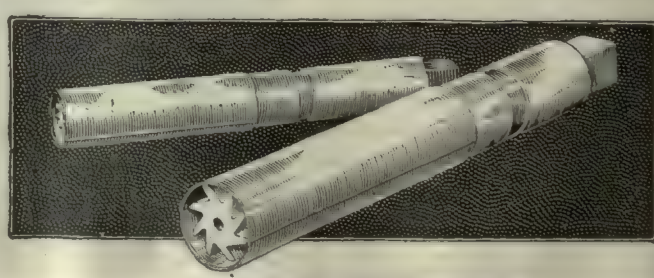
would be but 0.0005 in. With a good indicator a reading of a quarter-thousandth is readily discernible.

In the same manner work which has been planed on one or more edges is set square with the travel of the planing machine so that the second cut may be made at right angles to the finished surface.

Paper Protectors for Reamer

By H. H. Parker

Sets of reamers are usually sent out in a wooden case and are placed in shallow grooves side by side. If the box is moved around much, the tools are so close together that their edges soon become nicked. To prevent this, protectors may be made of heavy paper wrapped around several times and glued all the way around to provide extra stiffness. These containers should slip snugly over the reamers and not be loose enough to slip off easily.



A PROTECTOR FOR REAMERS

Self-Aligning Disk Bearings

BY DR. ALFRED GRADENWITZ

The advantages afforded by the use of ball-bearings are too well known to need comment, though in certain cases and especially at very high loads and small numbers of turns, roller bearings have been found to be preferable. From a theoretical point of view the latter should be able to stand greater radial stresses, though they present some serious drawbacks, such as greater friction and inability to stand axial loads.

TESTS have for some time past been carried on at the scientific department of Messrs. Nordiska, Kullager, Aktiebolaget, at Gothenburg, Sweden, with a view to devising a new type of bearing. The results of these tests are seen in what is called the NKA-Disk Bearing—a combination of the ball and roller bearings—in the design of which an attempt has been made to incorporate the good points of both types while avoiding their individual drawbacks.

Bearing Comprises Two Races and Disks

The disk bearing, like the ball bearing, comprises two races fitted with tracks, the balls being displaced by disks. The disks (Fig. 1), are self-aligning, and in order to understand their mode of working, we may imagine each disk to be cut out of an ellipsoid of rotation and to be arranged between two plane surfaces, according to Fig. 2. As long as the ellipsoid is running on the smaller of the great circles, the contact surfaces lie symmetrically in the points *A* and *B*. When, however, the disk develops a tendency to turn, for example, to the left in a plane lying at right angles to the plane of the paper, and when the bearing goes on rotating, thus imparting to the disk a rotation in the plane of the paper, the section of the ellipsoid will


FIG. 1

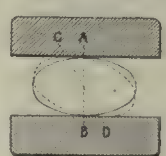


FIG. 2

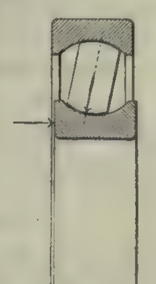


FIG. 3

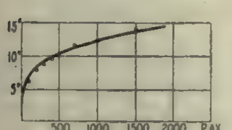


FIG. 4

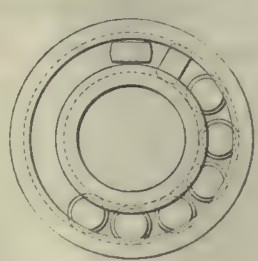


FIG. 5

FIGS. 1 TO 5. GRAPHICAL ILLUSTRATION OF THE THEORY OF CONSTRUCTION

Fig. 1—One of the disks. Fig. 2—A rotating ellipsoid. Fig. 3—Behavior under axial load. Fig. 4—Curve showing theoretical connection between axial load and angle of reaction. Fig. 5—How the disks, by reason of their shape, can be assembled in place.

look like the curve drawn in dash line, the points of contact being shifted to *C* and *D*. Since the latter do not lie opposite one another, there will be produced a moment, turning the disk to the right in the plane of the paper, thus returning it to its normal position.

This statical self-aligning is, however, insufficient to insure uniform running of the disks. When an NKA-disk bearing is exposed to radial load, all the disks on the back half of the bearing will be unloaded, the same as in a ball bearing, thus giving rise to no statical self-aligning. On account of the small width of the disks, the moment of inertia round the normal axis of rotation will be greater than the moment of inertia round any other axis passing through the center of the disk, so that the disk becomes dynamically self-aligning.

From the above it will be seen that the disks adjust themselves in accordance with the resultant thrust acting upon them. If the disk bearing be only exposed to

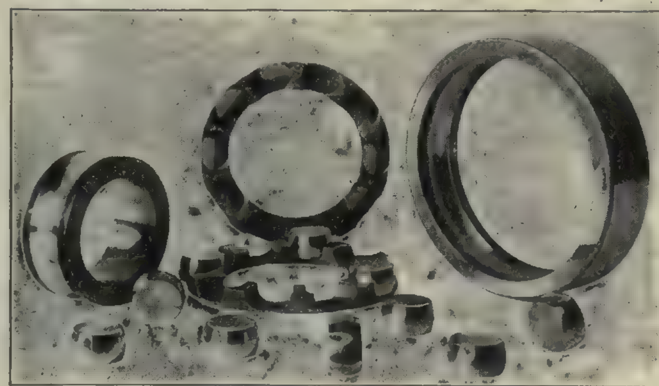


FIG. 6. COMPONENTS OF THE DISK BEARING

an axial load, the resulting thrust on each disk will form with the axis of rotation of the bearing an angle less than 90 deg., the disks adjusting themselves according to Fig. 3, so as to react against the axial thrust. If the bearing has to stand both an axial and radial load, the disks will in various positions have various angles of rotation, depending on the actual resulting thrust.

Characteristics Brought Out by Test

These characteristics have been brought out by actual tests on NKA-disk bearings without holders, the theoretically determined angles of reaction fully agreeing with those actually measured. Under a purely axial load the connection between the angle of reaction and the axial thrust will be inferred from Fig. 4, the curve drawn in full showing the theoretical connection. The points marked correspond to the figures actually measured, there being satisfactory agreement up to axial thrusts as high as 150 per cent of the radial thrust.

On account of the form of the disks they can, without any special arrangement in full numbers, be introduced between the races, after which they are by rotation, according to Fig. 5, fitted into the tracks.

As the disks comprise plane side surfaces, every disk in a disk bearing can be tested at will; whereas, in the case of ball bearings, only a small fraction of the balls in a given lot can be tested as to their physical characteristics, any balls submitted to the test becoming unsuitable for use in the bearing.

Disk bearings are made of the same high-class steels as ball bearings. They are not intended to supplant, but to supplement the latter, the choice of the proper type of bearing in each case depending on working conditions

Pipe Dreams of a Tramp Machinist—An Apprenticeship of Auld Lang Syne

By Glenn Quharity

Charlie Pratt was a machinist of the old school. If he had lived in these stirring times when any man who knows a lathe from a wheelbarrow is a machinist, and when any machinist who wears a white apron is a toolmaker, Charlie would have been some kind of an engineer.

I don't mean one of those engineers who blows in at 9:05 a.m., dictates a few letters to his stenographer and then goes out to play golf; he wasn't that kind of a fellow. If he had lived to become a famous engineer he would still have gotten to work by 6:30, or earlier, and would most likely have been the last man out of the place at night, just as he was in the old days of the Brookdell Co. when he was the "boss machinist."

I cannot imagine him immaculately clothed, sitting on a swivel chair with his feet on a mahogany desk and smoking a cigarette. Though he frequently wore "boiled" shirts he would not remain in the shop an hour without getting a trademark on bosom or collar; he sat, if at all, on a pine stool that one of the boys had made in the pattern shop, before a pine desk from the same furniture emporium, and he smoked—after working hours—a corn-cob pipe.

Charlie's Specialty

Charlie's specialty was getting things done. He never pleaded lack of experience; never intimated that "he wasn't hired to do such kind of work;" never complained about the "perfectly rotten material we get to work with now-a-days;" and, so far as I know, never went on a strike for more pay or shorter hours.

When the company wanted a steam engine to help drive its north shop, which was on a tributary stream in which there wasn't water enough to keep up with the increasing demand for power, Charlie and the "boys" built it. When the big breast wheel at the main shop showed signs of decrepitude, Charlie made drawings for a new one; the patternmaker "got out the stuff," and the boys erected it while Charlie bossed the job. When the dam went out on a spring freshet, Charlie, with the aid of some extra laborers, a yoke of oxen and a hoisting engine, constructed a new one.

Charlie's job was to keep things moving in the Brookdell shop, and he never fell down on it. He and the "old man" were frequently in consultation as to ways and means, but the former had unlimited and completely justified confidence in Charlie's judgment so that there were no strings upon the latter's operations, save those pulled by the laws of nature and the condition of the company's exchequer.

It required quite a number of millwrights, repair men and toolmakers (we called 'em all machinists then) to take care of the mechanical details of the Brookdell shop; and as one of the functions of the aforesaid laws of nature appears to be making men a little older each day it follows that Charlie's job of keeping things moving involved in the long run the training of mechanics to take the place of the superannuated and of those that left for other reasons.

While the defections from the combined causes were not serious, there were always one or two "cubs" undergoing a "course of sprouts" in the machine room, and Charlie rightly considered the training of these boys as the most important part of his job.

The raw material, from which mechanics were made in the Brookdell shops, was just ordinary country boys of the kind that was quite commonly raised at that period. Not just any boy; for Charlie selected all his material, human or otherwise, with care and deliberation, but any boy that was fortunate enough to be chosen to spend four years under his benevolently despotic sway was pretty sure to develop into a mechanic of rather above ordinary ability.

(To shield myself—and him—from possible criticism let me say right here that I was not one of Charlie's boys. Though I knew him well, it was not until after he had retired from active service.)

Charlie Had No "System"

I don't believe Charlie had any system in educating apprentices, at least not a system that could be reduced to a set of rules, for he considered each boy a separate problem to be handled according to his individual needs and qualifications. He considered, too, that the principal object in educating boys was to make them into competent and faithful workmen instead of using them during their period of apprenticeship as so many instruments for earning money for the company, realizing that the company's interests were far better served in the end by good journeymen than by time-serving and dissatisfied juniors.

There were no "sanitation engineers," "lubrication engineers," etc., in the old days. There was no need for them, for about the first tools with which Charlie's boys became thoroughly familiar were the Oil Can, the Broom, and the Bunch of Waste.

This does not mean that a cub spent all of his time wielding these tools; a half hour on Monday mornings in oiling the overhead works and a half hour's attention each night to the floor sufficed to keep both in proper shape and the boy in practice; while an extra half hour on Wednesday and Saturday nights, devoted to wiping up machinery, gave him a sense of responsibility for the appearance of the machine room.

This latter duty was not particularly onerous, for every man in the shop knew that if he did not leave a machine ship-shape when he got through with it there would be trouble.

The first job, therefore, that the new boy ran against was "oiling up," and his instructor was his apprentice mate who, at that time, was usually entering upon his third year of instruction and who had thus had the responsibility for the condition of line and countershafting upon his shoulders for two years and was therefore competent to teach his successor. Having finished the oiling, the boy would most likely be assigned to one of the journeymen as helper, and would be employed in getting out stock, cleaning off castings, and making ready various parts for the machining operations that were to follow. He would be taught how to handle a hacksaw—there were no power hacksaws—a file, a chisel and hammer, threading dies, taps, etc., and there was always some competent mechanic watching his every movement, instructing him in the right way to use such tools and correcting at the start any error due to lack of comprehension.

Boy Not Expected to "Know How"

A boy was not expected to know how to do even the simplest operation until he had been thoroughly instructed at least once, and his knowledge even then was not taken for granted until he had conclusively demonstrated his ability and understanding.

Each machinist forged the tools that he used and the cub was required to build the fire, "blow the bellows" and swing the sledge when necessary; and, as he was allowed to try his hand on the simpler operations at first, it was not long before he became an adept at forging small tools. Larger forgings, up to a hundred pounds or so, were sent out to a neighboring forge shop, and the boy would usually be delegated to trundle them over in the two-wheeled cart, or on a sled, according to season, and see how the work was done. While he was not expected to do any of the work in the other shop, a live boy, interested in his work and having the advantage of living in a town where everybody knew everybody else and where any workman took a human interest in an apprentice, it would have been a very dull boy indeed who would not find ways to make himself useful and to acquire information concerning the work in hand.

Parenthetically, I would like to inquire how many machinists and toolmakers of the present day could step up to a thousand-pound steam hammer and handle the valves in a way to inspire the confidence of the man who was holding the work, striking light or heavy blows with skill and precision in response to a nod or a movement of the hand of the hammersman?

Though Charlie apparently paid no attention to what a cub was doing when the latter was under the instruction of a journeyman, there was really little that escaped his attention, and rarely was an operation performed or a job completed but what he, by adroit questioning or by apparently irrelevant comment, would find out what the boy had learned.

All special patterns were made in the shop and the boy early received instruction in laying them out; learned the qualities and characteristics of various kinds of lumber; was taught to run circular and band saws, buzz planers, etc., and above all was painstakingly warned of the dangerous possibilities inherent in these and other machines. Though the only guard in use at that time was the guard of common sense, I can recall but one serious accident, and that was when a boy lost part of one forefinger through doing something that he had repeatedly been told *not* to do.

The boy soon learned what "draft" on a pattern was for, and how much there should be; how much "shrinkage" to allow; knew what could be molded easily and what not at all; knew the difference between a "drag" and a "cope" and could explain just why some patterns didn't look much like the castings made from them.

What He Was Taught

He was taught to figure the speeds of pulleys and gears; taught how to figure the power delivered by a belt; how to lace an ordinary belt or to cement an endless one; how to determine safe belt tensions and to figure safe bearing loads. He knew how fast an emery wheel ought to run and under what conditions such a wheel was unsafe. He could figure the change gears to put on a lathe for a given thread or set a dividing head to cut the requisite number of divisions, even if there wasn't a chart within a hundred miles. He not only knew what size a tap drill should be for a given diameter and pitch of threads, but if there wasn't a twist drill of that size at hand—not infrequently the case—he could make a flat chill to do the work.

If trouble developed on a job, either before or after completion, the boy or boys who had a hand in the work were called into the consultation and given an equal chance to find out what was wrong and to express their opinions as to how to make it right.

Whatever the boy's activities, whether patternmaking, blacksmithing, tempering, machine or millwright work, Charlie was always an ardent seeker after

information. He wanted to be told *why* a job was done, *how* it was done and why it wasn't done some other way; and he was just as earnest in seeking this information as if he didn't know all about it beforehand. But the only one that could tell him these things was the boy; he wasn't at all anxious to find out from the journeyman, who was bossing the job.

In addition to the work in the shop, there were lessons and examinations in mathematics, and the use of drawing instruments—in which Charlie himself was the preceptor, the schoolroom his old-fashioned kitchen and the time that which present-day apprentices usually devote to the movies. There were also practical night demonstrations in millwrighting in the shop at

Developed a fuzz on his upper lip.

the company's expense, some of which I have already told you about, for the boys were not exempt from night work on a breakdown or alteration job. It was a by no means unheard-of thing for the boys to work all night, but they usually got more consideration than their elders the next day.

The Brookdell shop was not a paradise for apprentices. There were hard spots and hard words a-plenty, but the latter were seldom, if ever, unmerited. There was then, as now, more or less roughness and horseplay in which the boy was usually the "goat." Many an unsuspecting apprentice has hunted hours for something that never existed, and has tried long and faithfully to do something that couldn't be done. Charlie looked askance at these doings generally but tolerated them when there was a lesson at the other end.

Charlie was a competent instructor of youth, not because he was better than other people, nor because of a vaster fund of mechanical information that is possessed by the ordinary boss machinist, but because he took a human interest in his boys, saw to it that they always got a square deal and considered that the real object in teaching a boy the trade was to make a mechanic of him. Many of the finer points of a later day would be Greek to him, but no boy ever got away from him without being firmly grounded in the fundamentals of his trade.

He furnished the foundation. When a boy reached the age where he developed an interest in the color of his neckties, and a solicitude for the state of the fuzz on his upper lip, it was up to *him* to rear the superstructure.

The Application and Maintenance of Rawhide Gearing

By Orville N. Stone
Assistant Chief Engineer, the Van Dorn & Dutton Co., Cleveland, Ohio

The large-scale commercial production of non-metallic gearing of the present day is the result of a vast amount of experimental work which has been done in the past by the foremost gear manufacturers in attempting to produce high-speed gearing for use where quietness is a prime consideration. The initial material placed on the market for this class of work was rawhide. In recent years, numerous other fiber materials, such as bakelite, fabroil, Egyptian fiber, celeron, and many others have been placed on the market as a substitute for rawhide; and, although these fiber materials ordinarily are not as strong as rawhide, still from the standpoint of economy and for many purposes where the gears are subjected to small stresses, fiber is considered by many manufacturers an ideal material.

Rawhide gear material consists of the green packer hides cured separately, followed by a special treatment which eliminates much of the animal material, leaving the fiber and reducing the thickness of the hide to about $\frac{1}{8}$ in. Hides treated in this manner are then blanked to the desired size, ranging from 2 to 40 in. in diameter, depending on the size of the gear wanted. These disks are dipped in high quality glue and are then piled up to make blanks of the required thickness; hydraulic pressure is then applied to squeeze out glue.

Rawhide, while not quite as durable as steel, is used in preference for peripheral velocities of from 1,700 to 2,000 ft. per minute and more. This material, although weak in comparison in a static test, is as strong as cast iron at high speeds, inasmuch as the impact is absorbed by the cushioning effect of the rawhide teeth. Gears and pinions made of rawhide are in general practice furnished with side plates of bronze having the teeth cut through them, thus increasing the load capacity from 10 to 25 per cent, the amount depending on the grade of bronze and the thickness of the plates. Gearing made of rawhide should not be subjected to a temperature greater than 225 deg. F. Higher temperatures dry out the material, so proper storage must be maintained, because dried-out rawhide cannot be revived. When not in use rawhide gearing should be coated with shellac and stored in a cool place. When in use the life of such gearing is increased by the application of a lubricant consisting of a thin mixture of lard oil and graphite, which coats the tooth face with a metallic film.

In the application of rawhide gears general practice is to make the smaller member of the mating pair of rawhide. The number of teeth should be fifteen to eighteen wherever possible. Excessive wear is caused by a lack of consideration being given to the machine supports, insufficient bearings and the dis-alignment of the meshing teeth. Under proper working conditions the life of gearing made from rawhide has been satisfactory in a large variety of applications, such as main-drive gears for punch presses, boring mills, engines, lathes, pressure pumps, crane motors, etc.

Thread Forms for Worms and Hobs*

BY B. F. WATERMAN

The use of worm gearing is steadily increasing, and accompanying this increase, perhaps the cause of it, is a corresponding increase in efficiency and durability which is the result of a better understanding of both the theoretical and mechanical problems. This paper points out some of the problems involved and some of the mechanical difficulties in the use of worm gearing, for failure to take these problems and difficulties into consideration in the past has often led to the discrediting of this form of drive. It also suggests methods for bringing about a uniform and satisfactory practice in worm gearing.

IT IS only recently that engineers have considered a worm gear in any other light than that of a necessary evil, and this is probably due to the fact that heretofore the finer points of manufacture were not appreciated and were not obtained except in those places where this type of gear has received more than the usual amount of study. It has been known for a long time that the efficiency of worm gearing depends largely on the angle of thread or helix angle of the worm, and literature on the subject emphasizes this point. The actual manufacture of the worm and gear, however, presents certain mechanical difficulties and inaccuracies which are not apparent in any theoretical discussion of the subject. These difficulties appear in making the worms and hobs, especially with multiple threads; in fact, it might be said they appear in making worms or hobs whose helix angle is greater than 18 deg., and, although no attempt has been made to show these difficulties mathematically, enough models have been made to clearly indicate them. It might also be said that these uncertainties are due to the differences in the thread forms produced by the different methods of cutting the worms: First, with an axial tool, the use of which is limited to a rather low helix angle; second, with a normal tool which has no limit for angle, and third, with a rotary cutter. Also the difference in helix angle at the top and bottom of the thread affects the method of cutting and the form of thread.

The most common worm has a single thread. This is usually made with the sides of the threads on the axis forming an included angle of 29 deg. and it can be cut with a lathe tool of 29 deg., the cutting edge of which is set parallel either to the axis or to the normal section. It can also be cut with a rotary cutter of the same included angle in a thread-milling machine. and the results in shape of thread will not differ enough to affect the working of it in any way. In other words, the hob, which must be backed off with a tool set either to the normal or on the axis, can be made either way and the wheel produced will mesh properly with the worm made in either of the three ways just mentioned. Any general statement, however, has its exceptions. For instance, in making worms for index wheels the very slight error or difference in shape produced by the three methods just mentioned may be too great to be allowable; also, the size of the thread or pitch will affect the degree of error, the error varying with the pitch; and the effect produced by any number of threads will depend on the thread angle. The preceding statements as to a single-threaded worm apply to a double-threaded worm, except that in the case of the latter the difference between the normal and axial sections begins to be noticeable.

To demonstrate the difference mentioned above, 13 worms were made to the dimensions given in Table I, which with Table II gives all the necessary working information for producing them. It should be noted that the pitch diameter and axial pitch are the same for all.

In the case of worm No. 8, Table I, which is a double-threaded worm and was cut with a straight-sided milling cutter, it was noticed that when the thread is held to the light, with the cutter or fly tool set in the space, the thread is perceptibly convex. This difference is shown in Fig. 1, where the dimensions of the cutter which cut worm No. 8 are shown at *A*, with the dimensions of tools fitted to the normal and axial sections

*A paper presented at the annual meeting, December, 1919, of the American Society of Mechanical Engineers, New York.

TABLE I. DATA FOR WORMS

No. of Worm	No. of Threads	Outside Diam.	Angle of Thread with Axis, Deg., Min.	90°—a = δ, Deg. Min.	Cutting Tool Used	Included Angle of Tool Used, Deg.	Tool Cut on Axis or Normal	Diam. Cutter	Addendum S	$D + f$	Normal Thickness t	Lead	Bottom Diam.
1	Single	3.50	83–39	6–21	Lathe tool	29 on axis	Axis	Same tool as No. 2	0.3183	0.6866	0.497	1.00	2.127
2	Double	3.50	77–28	12–32	Lathe tool	29 on axis	Axis	Same tool as No. 1	0.3183	0.6866	0.488	2.00	2.127
3	Triple	3.467	71–33	18–27	Lathe tool	29 on axis	Axis	Same tool as No. 1	0.302	0.651	0.475	3.00	2.165
4	Five	3.420	60–56	29–4	Lathe tool	29 on axis	Axis	Same tool as No. 1	0.278	0.600	0.437	5.00	2.220
5	Five	3.50	60–56	29–4	Lathe tool	29 on axis	Axis	....	0.3183	0.6866	0.437	5.00	2.127
6	......	.....	.....	.....	.....	......	......	....	......			...	...
7	Single	3.50	83–39	6–21	Cutter	29	Normal	3½	0.3183	0.6866	0.497	1.00	2.127
8	Double	3.50	77–28	12–32	Cutter	29	Normal	3½	0.3183	0.6866	0.488	2.00	2.127
9	Triple	3.467	71–33	18–27	Cutter	29	Normal	3½	0.302	0.651	0.475	3.00	2.165
10	Five	3.420	60–56	29–4	Cutter	29	Normal	3½	0.278	0.600	0.437	5.00	2.220
11	Five	3.420	60–56	29–4	Cutter	50	Normal	3½	0.278	0.600	0.437	5.00	2.220
12	Single	3.500	83–39	6–21	Cutter	29	Normal	6	0.3183	[illegible].687	0.497	1.00	2.127
13	Five	3.420	60–56	29–4	Cutter	50	Normal	6	0.278	0.600	0.437	5.00	2.220
14	Five	3.420	60–56	29–4	Hob	29	Normal	....	0.278	0.600	0.437	5.00	2.220

All dimensions in inches. Worms are in every case 2.8634 in. pitch diameter and 1 inch in axial pitch.

a = Angle of thread with axis
δ = Helix angle

S = Addemdum = top of thread to pitch line
t = Thickness of thread at pitch line
$D + f$ = Whole depth of thread

TABLE II. TOOTH PARTS FOR DIFFERENT WORMS
(All dimensions in inches)

No. of Threads	Applies to Worms Nos.	Thread Angle, 90—α=δ, Deg., Min.	Top Angle, Deg., Min.	Bottom Angle, Deg., Min.	Addendum, Axial	Addendum, Normal	t Axial	t Normal	$D+f$ Axial	$D+f$ Normal	Lead
Single	1–7–12	6–21	5–12	8–31	0.3183	.....	0.500	0.497	0.6866	.....	1.00
Double	2–8	12–32	10–18	16–40	0.3183	.....	0.500	0.488	0.6866	.....	2.00
Triple	3–9	18–27	15–24	23–48	......	0.302	0.500	0.475	......	0.651	3.00
Five	4–10–11–13–14	29–4	24–57	35–38	......	0.278	.....	0.437	.....	0.600	5.00
Five	5	29–4	24–27	36–48	0.3183	.....	0.500	0.437	0.6866	.....	5.00

at *B* and *C*. In all the references to the normal or axial sections it is to be understood that the space section is meant. This method of analysis permits a visual inspection of any difference in shape of thread, as the model or dummy worm can be held to the light and the difference readily seen. The figures show in thousandths of an inch what the difference is, the dotted lines showing divergence of the sides of the teeth from the straight in an exaggerated way.

When a triple-threaded worm is considered, the method of cutting becomes of greater importance, since the difference in form between the axial and normal sections (which results from the different methods of

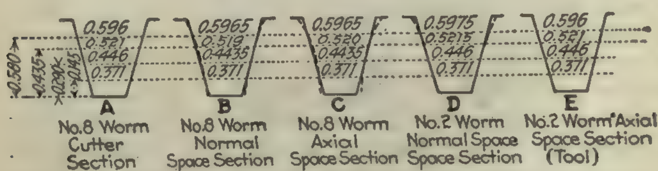


FIG. 1. DOUBLE-THREADED WORM

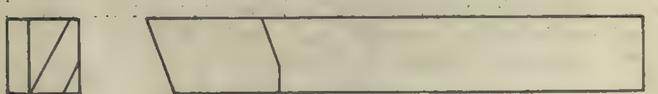


FIG. 2. AXIAL LATHE TOOL FOR WORM NO. 3, TABLE I, SHOWING UNSUITABLE CUTTING EDGES

cutting) is great enough to require that the hob-teeth shape be made exactly like that of the worm. This appears to be a superfluous statement, but it is the exception for a purchaser of a hob to state how he intends to cut the worm, no matter how many threads it has. Worms No. 3 and No. 9 are triple-threaded, No. 3 being cut with an axial tool in a lathe and No. 9 with a rotary cutter. The unfavorable cutting edges on this lathe tool will be noted in Fig. 2. There is a very weak cutting edge with an acute side clearance on one side; the other side has a very unsatisfactory cutting edge and clearance. Here a tool made on the normal would be better. The differences in the normal and axial sections of worms No. 3 and No. 9 are shown in Fig. 3. The difficulty just mentioned as to cutting clearance on the axial lathe tool may also be experienced with a hob that has axial grooves as shown in Fig. 4, so that when the angle becomes 18 deg. or greater it is well to use spiral grooves, as the hob, unless it has ample radial clearance, may drag on one side. The hob shown is correct in size for worm No. 3.

A more extreme case, but now a very common one, is a five-threaded worm where the helix angle for the diameter of the model here shown is approximately 30 deg. Here it will be noticed that an axial tool, Fig. 5, is almost impossible, although worms No. 4 and No. 5 were cut with it. The angle of the thread at the root governs the clearance angle on the tool and in the case of worm No. 4 the bottom helix angle is 35 deg. 39 min., and in worm No. 5 the helix angle at the bottom is 36 deg. 48 min. The depth of worm No. 4 is based on the normal pitch, while the depth of No. 5 is based on the axial pitch. The shallower tooth, of course, eliminates some of the difficulties experienced with these extreme helix angles and it is good practice to use the normal depth as soon as an 18-deg. angle is reached, or when spiral grooves are used in the hob. In fact, with a helix angle of 45 deg., which is quite common with axial depth, and 20-deg. thread, either axial or normal, it is very difficult to make the hob, as the tool must have such excessive clearance at the point that it may not be possible to make the hob with

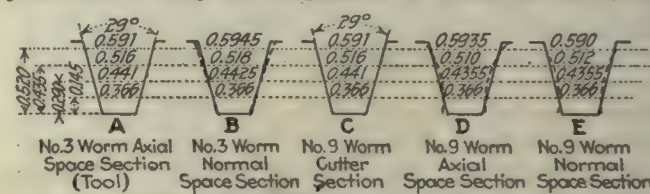


FIG. 3. TRIPLE-THREADED WORM

FIG. 5. AXIAL LATHE TOOL FOR WORMS NOS. 4 AND 5, TABLE I

a tool that can be sharpened without changing its thickness. Also, the hob tends to drag on the side and any distortion in the hob or in the worm, due to hardening, interferes very much with the meshing of the worm and wheel. The differences in the shape of the various sections of a five-threaded worm as made with the straight-sided tool shown in Fig. 5 are shown in Fig. 6.

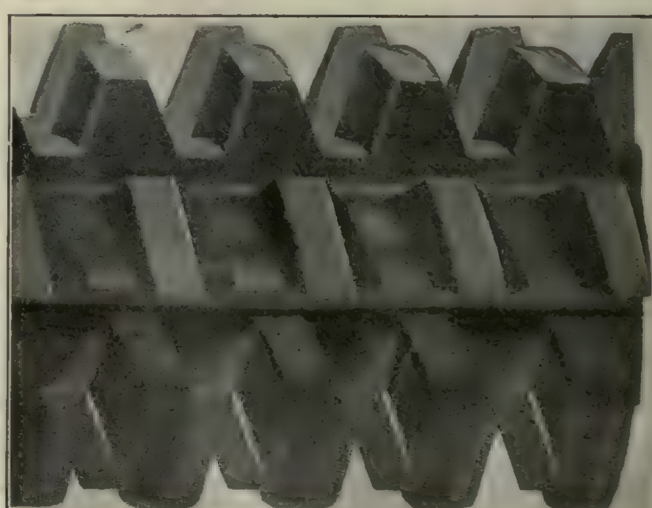


FIG. 4. CUTTER FOR CUTTING WORMWHEEL TO BE USED WITH WORM NO. 3, TABLE I

Worm No. 10 has five threads and was cut with a 29-deg. included-angle cutter 3½ in. in diameter, and the differences in shape between tools fitted to the normal and axial sections of No. 10 worm may be compared with the normal and axial sections of worm No. 4.

When the helix angle is greater than 18 deg., it is well to consider using a greater pressure angle. To illustrate, worms Nos. 11 and 13 were made and cut with a cutter whose sides formed an included angle of 50 deg. No. 11 was cut with a cutter of 3½-in. diameter and No. 13 with one 6 in. in diameter. This change

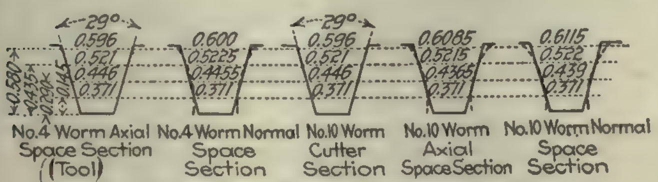


FIG. 6. FIVE-THREADED WORMS

in size of cutter was made to show the difference in shape produced by two cutters of different diameters.

The most durable pair of worm gears, other things being equal, is that with a hardened and ground worm. If the worm is to be ground, the shape of the worm thread must be such that the thread surface can be readily reached, and when the wide-angle cutter is used this is possible. The best cutter to use is the one that will give ample working space. This angle, however, should be no greater than is necessary to obtain such results, as the smaller the angle the better, because the pressure on the bearings varies about as the tangent of the angle of pressure.

Worm No. 13 might be considered as having been ground with a wheel 6 in. in diameter and the difference in the shape on the axial and normal sections between Nos. 11 and 13 is shown in Fig. 7. A worm might be cut as No. 11 with a cutter 3½ in. in diameter and ground readily with a wheel 6 in. in diameter. The error, or difference, is principally at the outside of the worm thread, since there is a decided rounding off at this point. The hob made to conform to the finished worm would produce a shape to suit the ground worm.

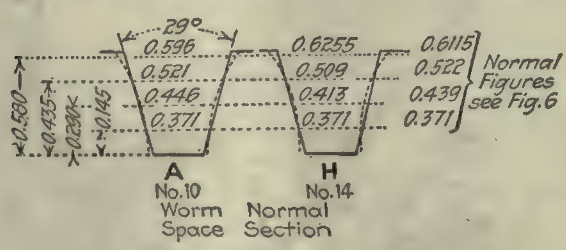


FIG. 8. FIVE-THREADED WORMS

Fig. 7 shows, at *F* and *G*, how nearly straight the sides of the teeth are on both No. 11 and No. 13, a tool fitted to the axial section being compared with a straight-sided tool. This is also interesting as it forestalls the fear that there may be a loss in efficiency due to the lack of straight-sided teeth on the axial section. Another advantage of this cutter is that it has straight sides, which as a starting point to make a worm or hob is most simple. This cutter can also be made as an ordinary milling cutter, which cuts more freely than a formed cutter which must be used if the section is other than that produced with a straight cutter.

If it is known that a given included angle is the basis for the cutter it can be produced by any one, even if its diameter is not known, as quite a difference in cutter diameters can be used without any serious difference in shape if it is borne in mind that the greater the angle of the cutter the less the variation in shape due to the diameter of cutter.

Another method of producing worms with five threads would be to hob them. Worm No. 14 was cut with a single-threaded 14½-deg. pressure-angle hob (29-deg. included angle) and the shape of the space on the normal is shown by dotted lines in Fig. 8, at *H*; this is compared with the normal section of worm No. 10, Fig. 6, and is reproduced at *A*, Fig. 8. It is apparent that this method produces something quite different and a shape that cannot be readily ground. If a hob of 25-deg. pressure angle or 50-deg. included angle on the axis was used, the shape produced would be much nearer that of worms Nos. 11 and 13.

That there is a general lack of knowledge of the foregoing facts is apparent to any one who is familiar with the manufacture of worm gears and the tools for producing them. It would be desirable to establish and follow a standard line of procedure as the use of worm gears is increasing rapidly. Any method adopted, how-

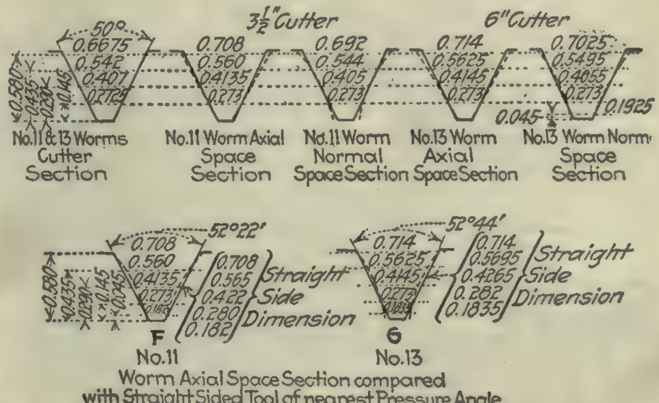


FIG. 7. FIVE-THREADED WORMS

ever, should be based on simple principles, such as straight-sided cutters with a change in pressure angle at some stated angle of helix and a change from axial to normal depth at the same point, and the desirability of this latter method is due to its mechanical advantages and not to any theoretical ones.

Sag Paste for Burns

During the war large quantities of sag paste were purchased by the Government, principally for the treatment of gas burns. The paste was prepared by a large number of manufacturers according to the following formulas:

FORMULA 66

	Parts by Wt.
Zinc oxide, 100 mesh, U. S. P.	40
Benzoinated lard	20
Refined raw linseed oil	20
Adeps Lanæ, U. S. P.	20
Coloring matter	1

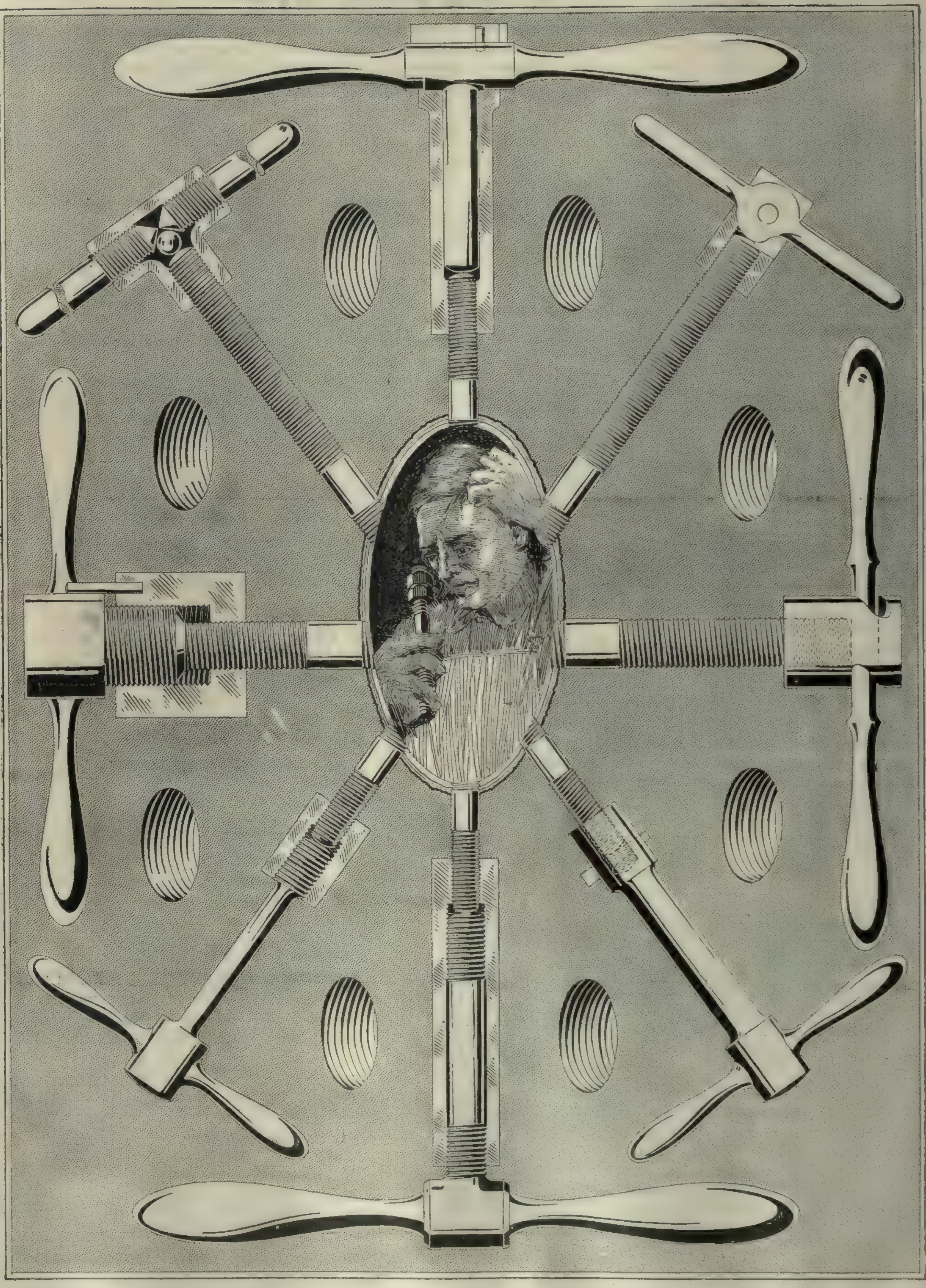
FORMULA 146

	Parts by Wt.
Zinc oxide, 100 mesh, U. S. P.	45
Benzoinated lard	10
Raw refined linseed oil	30
Adeps lanæ, U. S. P.	15

FORMULA XII-A

	Per Cent
Soya bean oil	62
Zinc stearate	38

This paste was put up in collapsible metal tubes in several sizes.



Adapting a Machine To a Special Job

BY AMOS FERBER

At the shops of the Schickel Motors Co. there was an order for a large number of pieces like that shown in Fig. 1. The job was wanted in a hurry and the contract was conditional upon delivery at a stipulated date.

With the exception of the notches in the collar the job was one for the automatic screw machine, milling, and drilling machines, and presented no unusual problems. Notching the collar was, however, another matter and in casting about for methods of doing this with the least possible loss of time in making tools, Mr. Schickel decided to use the Fellows gear-shaping machine in the manner shown in Fig. 2, and the indexing device there shown was made.

The material of which the pieces were to be made was very tough, and the clearance groove allowable between the body of the screw and the collar quite small, thus rendering press tools or rotary cutters out of the question. Further, because of this lack of clearance space, it was necessary to take at least three cuts to each notch, else the chip would wedge under the tool and break off the point.

Neither work spindle nor cutter spindle was revolved during the operation. The work was rotated upon its own axis, one step to each stroke of the machine, by means of a lever and pawl, the latter engaging the notches in the indexing wheel. The free end of the pawl lever was attached by a wire to the upper end of the cutter spindle so that the work was stepped forward on the upstroke of the machine. A weight carried the lever down. The L-shaped piece at the top of the device is a locking lever, the short end of which, when thrown forward, engages a notch in the index wheel. It was expected that it would be necessary to lock the spindle of the device during the cutting stroke and the latch was put on for that purpose; it is connected to the head of the machine in such a way that it lifted from the index wheel just as the pawl engaged the latter to move it forward, and seated in the next notch on completion of the upstroke.

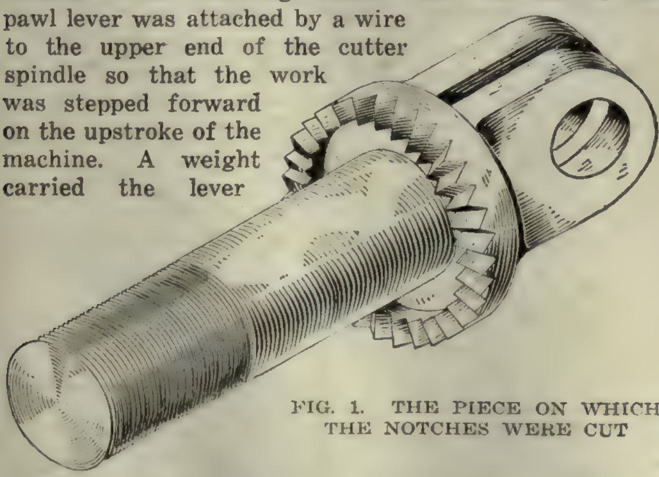


FIG. 1. THE PIECE ON WHICH THE NOTCHES WERE CUT

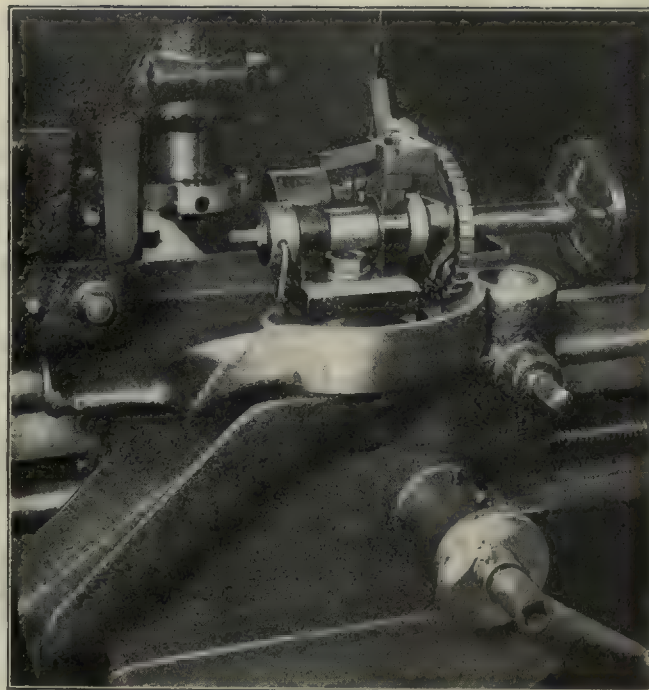


FIG. 2. THE MACHINE AND THE SET-UP

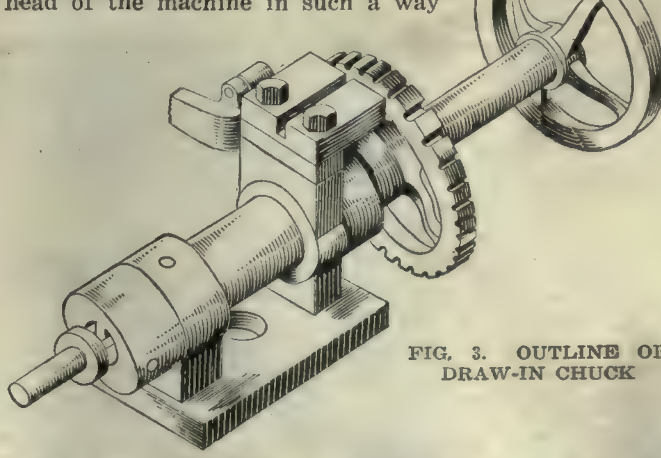


FIG. 3. OUTLINE OF DRAW-IN CHUCK

It was found, however, that the friction of the indexing spindle was sufficient to hold it stationary under the cut, and the latch was soon disconnected and thrown back out of service as seen in the picture.

The cutting was done by a high-speed toolbit held in a fly-cutter holder attached to the cutter spindle of the machine. The work was held in a special draw-in chuck made as shown in Fig. 3 and operated by the handwheel on the outer end of the spindle. With a piece in the chuck, the machine was started, the feed thrown in and the machine left to take care of itself.

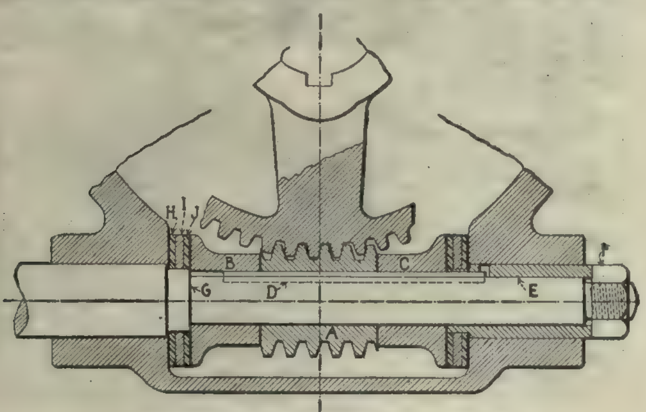
Three revolutions of the work were required before the cutter reached its full depth, after which the machine continued to run idle until the operator found time from his other work to stop it and substitute another piece. The device was designed and built under the supervision of Mr. Schickel.

Method of Mounting a Worm

By A. J. Dexter

The accompanying sketch illustrates a method I have devised for mounting a worm on its shaft. I have used this method on several occasions but do not remember having seen it elsewhere.

As may be seen, the worm *A* and the two collars *B* and *C* are all held by the key *D*, and a bronze sleeve



METHOD OF MOUNTING A WORM

E, slipped over the end of the shaft, is also held by the key *D*. When the nut *F* is tightened all the parts are forced against the shoulder on the shaft at *G*. Thrust washers *H*, *I* and *J* are provided at each end of the worm, those at the left riding on the shaft and those at the right on the sleeve *E*.

This construction allows both bearings to be bored the same size.

Cutting the Teeth of a Pinion up to a Shoulder

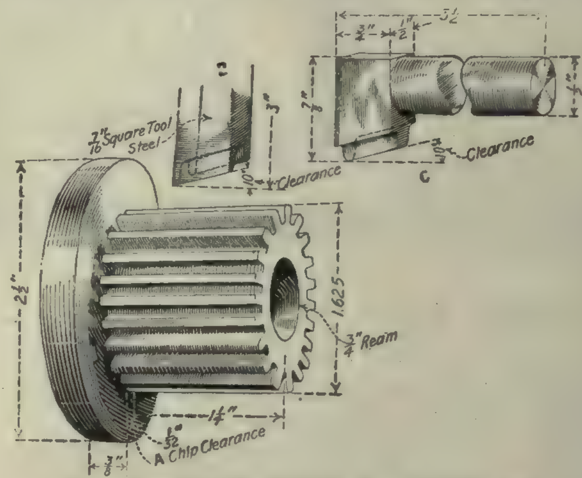
By Ray B. Miga

A little while ago I had the job of cutting a 24-tooth, 16-pitch pinion in which the teeth must run back to a shoulder, less a very small amount for chip clearance. The illustration shows the job and the tools.

I cut a groove at *A* 1/32 in. wide and as deep as the gear tooth. Then with a No. 5, 16-pitch B. & S. cutter I cut a tooth-space in the end of a piece of 7/8-in. square tool steel as shown at *B*. Hardening this and using it in a fly-cutter holder in the milling machine I formed the cutting portion of a small broaching tool *C* to go in the slotting attachment for our No. 2 Brown & Sharpe milling machine.

Next, mounting the blank in the machine I roughed out the teeth with a 1/16-in. wide broaching tool, and finished them with the forming tool I had made.

By doing the work in this manner I cut the teeth clear up to the shoulder in one setting, thereby saving



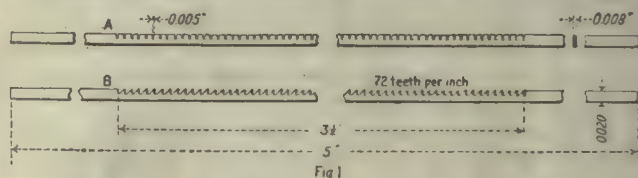
CUTTING PINION TEETH TO A SHOULDER

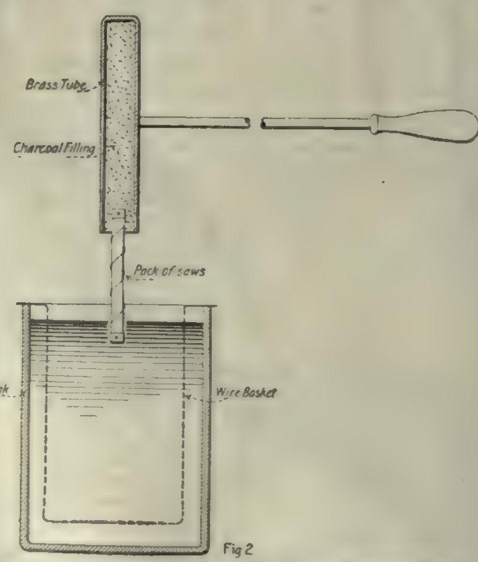
much time. I have seen similar jobs done by cutting in the regular way as far as the cutter would allow and then finishing the balance of the way by chipping and filing.

Making Jewelers' Saws in an Emergency

By T. W. R. McCabe

During the war, among the many supplies which were hard to obtain were jewelers' fine saws, and as we were entirely out of them during one period of the fracas we were compelled to make a supply.





FIGS. 1 AND 2. MAKING AND HARDENING JEWELERS' SAWS

Fig. 1—Milling the teeth. Fig. 2—The method of hardening

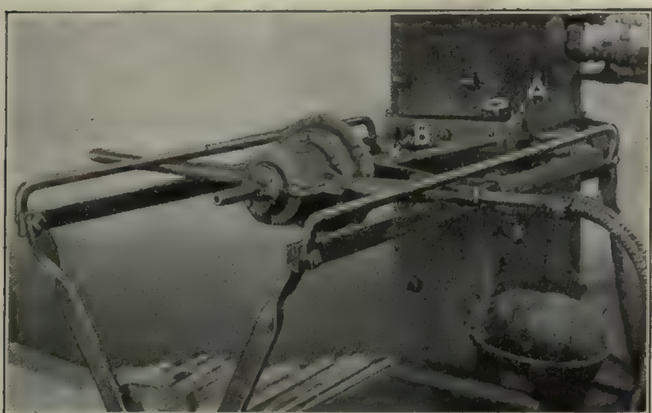
These saws are made of round wire rolled to a flat about 0.008 in. thick and 0.020 in. wide, with 72 teeth per inch. When cut, they are about 5 in. long and have teeth for 3½ in. of their length.

Owing to the angle mills refusing to hold their extreme sharpness at the fine cutting edge we were, for a while, stumped as how to cut the teeth. The solution was first to block out the spaces with a fine slitting saw as shown at *A*, Fig. 1, and then finish with an angle mill as shown at *B*. The same method applies to extremely fine-tooth ratchet wheels. We did the hardening by tying the saws in bundles, packing in a charcoal-filled tube, and quenching in oil as shown in Fig. 2.

Device for Re-Chasing Threads on Bolts

By J. V. Hunter

The threads on staybolts and other parts used in boiler assembly are apt to get bruised and damaged by being dropped on the shop floor or by other accidents. In the boiler shop of the Minneapolis Threshing Machine Co., Hopkins, Minn., the special device shown in the illustration has been rigged up for quickly clearing up these damaged threads by running the bolts through the proper size of die. A light steel frame has been constructed and bolted to one of the timber columns of the shop. This frame has flat horizontal bars which act as ways and on which the handles of an air motor slide forward and back. Additional rods are provided over these so that the air-motor cannot throw itself from the frame.



DEVICE FOR RE-THREADING BOLTS

At the point *A* is placed an open-top socket, into which standard square die-blocks can be dropped. These die-blocks are provided with eye-bolts to facilitate their removal, as can be seen in the accompanying illustration.

The socket is far enough to one side of the post so that bolts, after passing through the die, will clear the timber.

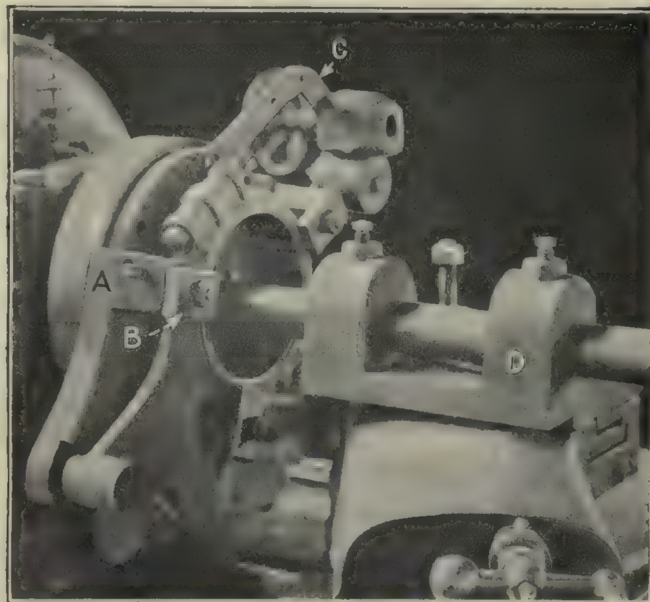
The air-motor is provided with sockets *B* suitable for holding the various bolts which are handled.

To operate the device the workman drops the right size of die into the holder, starts the bolt into the die and then pushes the motor forward so that its socket holds the bolt head. The motor is then started in the correct direction of rotation and the thread re-chased as far as desired, the motor being pushed forward by hand. At the proper point the motor is reversed and the bolt is backed out of the die.

Boring a Large Yoke Bearing

By J. H. Vincent

The illustration shows the method employed for boring a yoke used on a large steam threshing engine. The fixture used is simple and consists of little more than an arm which extends in support of the small end of the yoke, together with brackets *A* on its sides with the clamps *B* which serve to hold the yoke in place. The yoke arm is balanced by the arm *C* which carries counterweights.



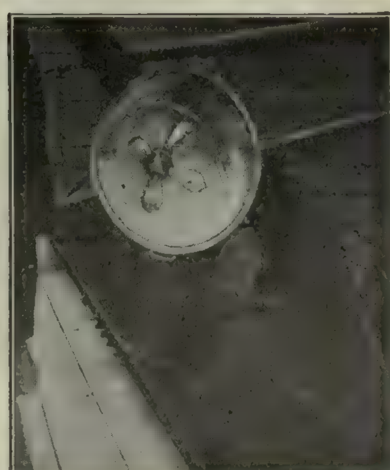
BORING A YOKE FOR A STEAM THRESHING ENGINE

The bracket *D* for carrying the boring bar was also locally made, and it is bolted to the tool slide of the carriage in place of the regular toolpost.

A Dishpan Reflector

By Henry F. Colvin

When the need for more ships became so urgent, back in 1918, and the shipyards were compelled to work night and day to produce them, the supply of electrical equipment for floodlight illumination became extremely low. Reflectors for the electric lamps were both scarce and expensive and many unique contrivances were substituted for them. A shipyard in Mobile, Ala., conceived the idea of using porcelain-lined or tin dishpans, as illustrated. By puncturing them in the middle and inserting a cluster lamp socket they were easily converted into an efficient reflector, the handles being used as a means by which to suspend them.



A DISHPAN REFLECTOR

Our Shop Equipment News Record

GIVING our readers the latest news of shop equipment in a clear, quickly readable form is our constant effort.

Every maker of machine tools and equipment is rightly anxious to obtain the greatest possible publicity for his product.

With this in mind we want to give our readers a few figures that will plainly show what we are doing for the benefit of our field.

During the last six months of 1919 and the first three months of 1920, we had 407 regular *illustrated* descriptions of new shop equipment. The greatest number of illustrated descriptions of such new equipment published by ANY OTHER PAPER in the same period, was 199.

This means that we published over twice the number of regular illustrated new equipment descriptions published by *any other* paper.

Put in another way the figures show an average of a fraction over five illustrated new-tool descriptions per week, or twenty-three per month, more than the number published by *any one paper* in the field.

In *addition* to these regular illustrated descriptions of shop equipment, the same equipment was again illustrated and described a few weeks later in our Condensed Clipping Index of Shop Equipment, which appears in both our American and English editions several weeks apart. This index is also translated into French, so that in reality each piece of equipment receives *three* separate illustrated descriptions—one regular and two condensed. On this basis we published 1,221 *illustrated* descriptions of shop equipment for the nine-month period just passed. This counts the French translations as separate descriptions, but does *not* include the regular *reprints* used in our English edition.

In view of these facts, is it any wonder that in the same period various manufacturers gave us enough prior descriptions of large machines to make fourteen leading articles and twelve major editorial articles in the body of the paper?

A considerable number of machine-tool builders continue to give us all their big developments exclusively year after year. The reason is plain—they obtain such overwhelmingly good results that they consider no other course, since on articles of this kind we can spend time and pains impossible on rush articles.

Our aim is to publish as *complete* a list of new tools and equipment as possible and to get it to our readers quicker than they can obtain it in any other way.

The figures we have given tell the tale.

Ethan Viall

Gray Thread-Milling Machines of Improved Design

BY E. L. DUNN, Associate Editor, *American Machinist*

BEFORE the war, thread-milling machines were generally considered as special machines for precision work, but when the big demand came to "do it now," these machines found instan favor with production engineers. They were used extensively on a large variety of work and are now recognized as production machines of the first order. During the war the Gray Machine Tool Co., Inc., Buffalo, N. Y., manufactured a great number of thread-milling machines that were used in the manufacture of shells and other war material. After the signing of the armistice, the company's engineers completely redesigned the machines making them universal in type and suitable for use on either toolroom or standard production work. The design combines, in a compact and simple machine, ample strength, efficiency and a capacity to handle a wide range of work.

NEW DESIGNS TESTED IN REGULAR USE BEFORE ADOPTION

The first machines of the new design were, before adoption, installed in large manufacturing plants and subjected to the severe tests of daily use in regular production work. The machines, shown in Figs. 1 and 2, will handle bar work, regular chucking work or work held between centers. On work held in a chuck, internal threads can be cut as well as external. Where a hob is to be used a plain cutter head is employed, but when the machine is required to use a single cutter, it is equipped with a swivel cutter head, so that the cutter may be swiveled to the same helix angle as that of the work. The work spindle, which is hollow to accommodate bar work, is driven through gearing by a three-step cone pulley at the back of the machine, allowing for three different speeds. The best method of chucking is by means of a draw-in collet chuck, with false jaws for various diameters of work and operated either by means of a handwheel or by an air cylinder, although the design of the work spindle is such that any standard method of chucking can be used. The carriage is supported upon exceptionally wide ways and is moved by the shaft at the front of the machine. An automatic stop for hobbing work and an adjustable automatic trip for milling long threads with a single cutter, can be supplied when required.

CONSTRUCTIONAL FEATURES OF TYPE A MACHINE

In the type A machine, shown in Figs. 1 and 2, the lead is acquired through the threaded sleeve and nut on the lead-screw shaft, which is directly geared to the work spindle. The threaded sleeve can be set at any point on its shaft, permitting the setting and adjusting of the carriage. This is accomplished by an adjusting screw operated by the handwheel shown at the right-hand end of the machine. The cross-slide has a micrometer dial to gage the depth of cut and moves on wide, flat bearing surfaces. It carries the swivel cutter head that is held in a round housing securely bolted in place. The cutter head is substantially constructed and is provided with ball thrust bearings. The cutter spindle is made of high-carbon steel, hardened and ground and is carried in bronze taper bearings, which allow all wear to be taken up. Power is transmitted to the cutter spindle through spiral, bevel and spur gears by a three-step cone pulley at the back of the machine. The gears are of nickel steel, hardened and ground, the spiral gears running in oil. The shaft on which the cone pulley is mounted ex-

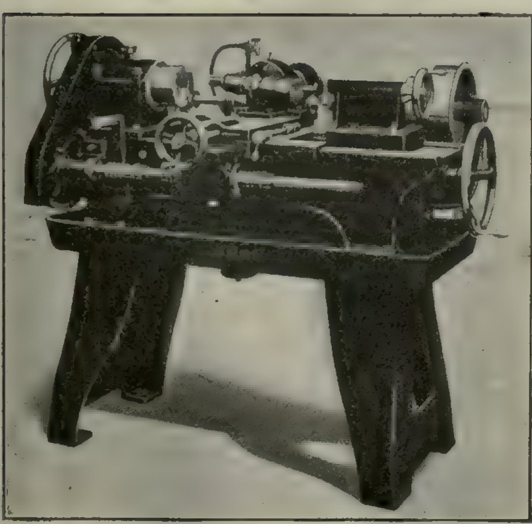


FIG. 1. SIZE "A" STANDARD SWIVEL HEAD (EQUIPPED FOR BAR AND CHUCK WORK)

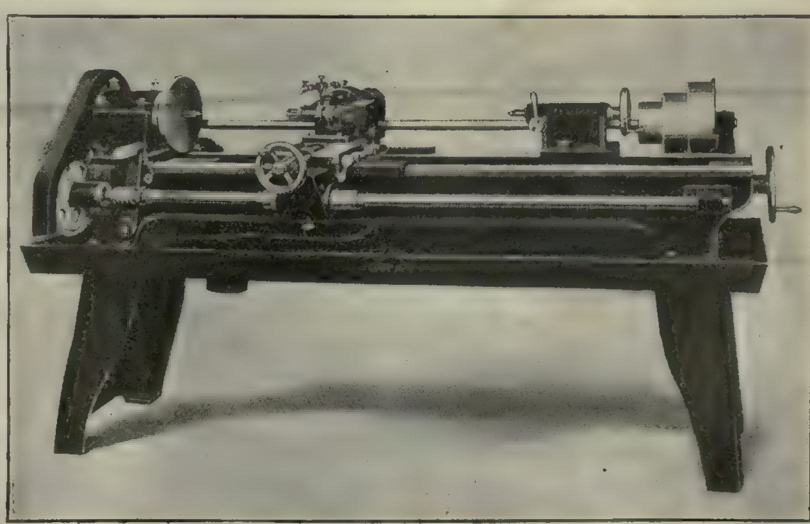


FIG. 2. SIZE "A" SWIVEL HEAD WITH LONG BED (EQUIPPED FOR MILLING WORK ON CENTERS)

tends the full length of the machine and is splined, allowing the head to be moved to any position along the bed without disturbing the belt.

When milling threads with a hob, the threading operation is completed with one revolution of the work, plus a slight overtravel, the hob being first set to the proper depth by means of the micrometer dial on the cutter-head cross-slide. The feed is started by throwing the handle in front of the headstock to the right, and when the work has made one revolution the feed is automatically stopped. An adjustable stop is provided for use when duplicate parts are being milled. The handle referred to is then thrown to the left, causing a quick return of the carriage to the starting point. When milling lead screws or other work of considerable length with the single cutter, where more than one revolution is required for doing the work, a tripping device may be attached. The tailstock is furnished for milling work on centers. For cutting multiple threads on worms, a special indexing plate is provided.

Lubrication for the cut is taken care of by a geared pump driven from the cone-pulley shaft. Every machine is built with a heavy, deep cast-iron oil pan between the bed and the legs, and the lubricant, after being used, drains through a strainer into a receiver which is connected to the pump.

A very efficient oiling system is provided for all bearings. A countershaft complete with tight and loose pulleys, a cone pulley, hangers with ring oiler bearings, etc., are furnished with each standard machine. The larger size, type B, machine is of the same construction as the A-type machine, with the exception that the various leads of threads are obtained by means of change gears, in place of the threaded sleeve and nut, and the machine is mounted on a box-type bed of ample strength and proportion for the work it is designed for. The machines are arranged for belt drive, but a direct-motor drive can be furnished when required. and beds of any reasonable length are supplied to suit requirements.

SPECIFICATIONS

Size of machine	A	B
Distance between centers	18 in.	30 in.
Hole through spindle	2 in.	3 in.
Swing over carriage	6 in.	12 in.
Swing over ways	12 in.	20 in.
Diameter of external threads, max	7 in.	9 in.
Diameter of internal threads, max	6 in.	9 in.
Spindle diameter, for multiple cutter	¾ in.	1 in. and 1¼ in.
Spindle diameter, for single cutter	1¼ in.	1¼ in.
Floor space	36x54 in.	40x88 in.
Net weight	1,600 lb.	3,100 lb.

A Banker's View of the Foreign Trade Outlook*

The year 1919 was one of great industrial and commercial activity in the United States. It was, however, a year which disappointed many of the hopes and also many of the fears that were commonly entertained at its inception. Twelve months ago it was generally hoped that the war-stricken countries of Europe would swiftly turn their energies to the activities of peace. The principle fear was that the process of transition would bring with it a large and sudden reduction of prices and a temporary disturbance of industry with unemployment of labor. But it was hoped that this would quickly give place to a resumption of production.

Without going into the reasons why things did not turn out in this way, it is sufficient to note that in 1919 the continent of Europe did not resume production on a self-supporting scale but continued to draw largely on the American continent and the Far East for supplies of food, raw material and machinery. Moreover, most of the principal European nations continued to create debt both by loans and by further emission of paper money. The United States last year sent to Europe almost four and one-half billion dollars' worth of goods over and above the amount imported from Europe. A small proportion of these four and one-half billions has been settled by the sale of our own securities held abroad but the largest part has been met by borrowing in various forms. Probably one-third of the amount is represented by current credits. In these facts we have, in large measure, the explanation of the stringent money market in the United States, and the collapse of the rates for exchange on European countries together with the continuance of high prices for commodities both here and abroad.

Conditions of this sort bring in the end their own cure. The larger European countries—especially Great Britain which took nearly 45 per cent of the 1919 exports above referred to—realize that the time has come to stop the creation of new debt and further dilution of paper currencies, and to make national budgets that will balance. While the central and eastern nations will for some time to come require food and material to an extent much in excess of their capacity to produce, it seems clear that from now on the larger nations will tend to rely less upon the outside world and more upon their own resources for all commodities other than those food supplies and raw materials which they must have and cannot at present produce for themselves. It is also clear that the volume of their manufactured exports will tend to increase largely. In this respect, Great Britain has already shown a remarkable capacity of recuperation and one which is increasing rapidly, as indicated by her monthly trade returns. This is a very satisfactory sign not merely as regards Great Britain herself but as regards Europe as a whole, for despite her own difficulties with exchange she is aiding, by means of credits, the smaller nations.

Once the European continent is fairly started in economic convalescence by means of balanced budgets and sound currency policies, the United States may look with confidence to the future as full of opportunity for American capital and American initiative in foreign fields. It is true that trade currents may be changed in some respects for a while. Europe will probably buy from us in smaller amounts and sell to us in larger amounts than in former times, for only in this way can she pay the interest due to us on what she owes. But new markets are opening. Silver is the monetary standard for a group of nations in the Far East whose aggregate population is probably one-half the total population of the globe. The rise in silver has enormously increased the purchasing power of these peoples so far as the rest of the world is concerned. The South American nations have been materially enriched by the war which gave them a wide and profitable market for their natural products and enabled them to put their exchange rates with the outside world on a satisfactory basis, to the great benefit of their purchasing power. All this spells opportunity for the United States which, alone among the great nations in the world, possesses not merely enormous natural resources but also, under normal conditions, a large available capital.

*Excerpt from the report of the president of the American International Corp.

Shop Courses in Metallurgy at the Michigan Agricultural College

By H. B. DIRKS
Professor of Mechanical Engineering, Michigan Agricultural College

This article gives an idea of what is being done to train men for practical work in metallurgy, especially in the heat treatment of steels for automobile use. To supply the demand for men so trained, the special courses which are here described have been established at the Michigan Agricultural College.

TO MEET the demand for technically trained men in the foundries, heat-treating plants and laboratories of the automotive and other industries, the Michigan Agricultural College provides for its students in Mechanical Engineering, courses in foundry and steel treating based upon the metallurgical aspects of the subjects.

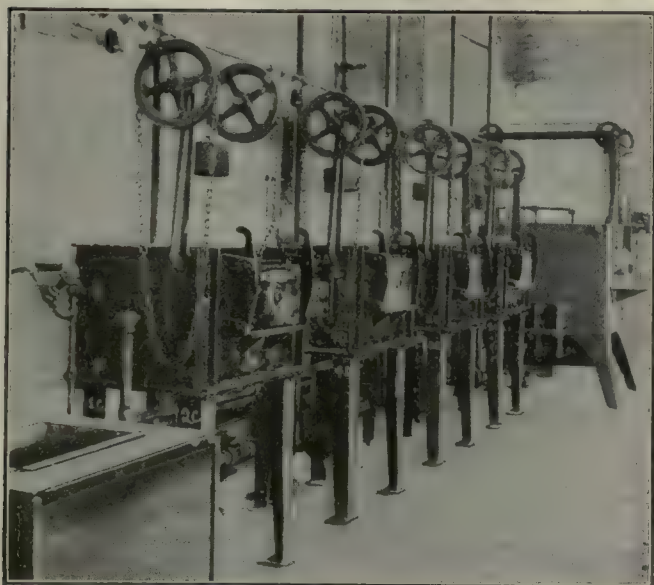


FIG. 1. A PART OF THE FURNACE EQUIPMENT. THE SIGNAL LIGHTS CAN ALSO BE SEEN

In the sophomore year, which is divided into three terms of about twelve weeks each, the students receive instruction as follows:

Fall Term—Four hours per week in the foundry and four hours per week in the forge shop are required. The foundry work is practical work in hand and machine molding, melting, pouring, cleaning and trimming castings in iron, brass, bronze and aluminum and in core making. The forge work is practical work in forging and welding iron and steel, and in hardening and tempering steel for hand tools and machine tools. Both of these courses are in charge of competent instructors who have thoroughly learned their respective trades.

Winter Term—This course comprises four hours per week in the foundry and two recitations per week in the class room. The foundry work emphasizes commercial methods and gives special attention to mixtures, especially for cast iron. The students learn by experiment and by study of the cupola, pig iron, scrap, flux, and alloys to make a melt which will produce a predetermined analysis or grade of castings. The recitations cover the manufacture of pig iron and the principles of founding. Lectures set forth the special problems of brass and aluminum and direct the attention of the student to the practical applications of theory and accumulated knowledge. Moldenke's "Principles of Iron Founding" is used as a text and visits of inspection to the foundries of Lansing tie all instruction work to the real thing.

Spring Term—The work of this term is devoted to the heat treatment of plain carbon steel, and the instruction is given in four hours of laboratory and two recitations per week. The student experiments in hardening, tempering, annealing and casehardening and gets experience in hardness testing and temperature measurement. Recitations and lectures cover the manufacture of steel and the heat treatment of plain carbon steel. Visits of inspection to the auto factories of Lansing supplement the above, and Bullens' "Steel and Its Heat Treatment" is the text. Electrical engineering students also take these same courses, but the practical and classroom work is given a "slant" toward the materials used in electrical practice.

The classroom and other technical instruction of the above courses, as well as the supervision of the practical work, is in the hands of a technically trained man who has been "through the mill" of the practical side of the subjects.

Study in the Senior Year

In the senior year, mechanical engineering students who are especially interested in automotive and industrial engineering are given advanced work as follows:

Fall Term—This advanced course in the heat treatment of steel, supplementing the work of the sophomore year, is a study of the heat treatment of alloy steels, including high-speed steel, by means of one recitation and four hours of laboratory per week. Specifications of physical properties, chemical analysis and heat treatment are made for every metal part of the automobile. Forgings of all the important parts of the auto are heat treated and test pieces cut and tested to

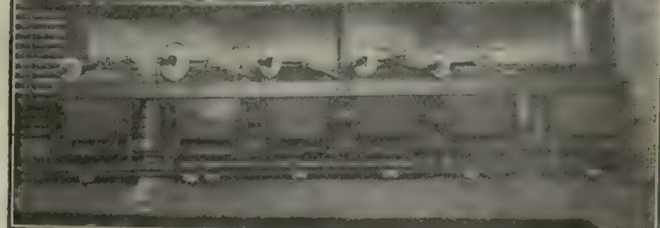


FIG. 2. CYANIDE POTS, LEAD POTS AND TEMPERING BATHS

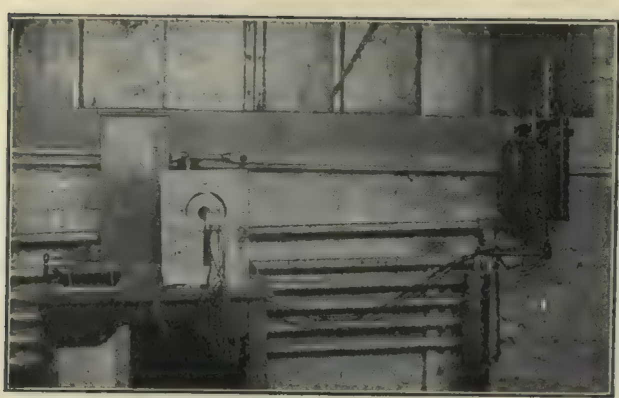


FIG. 3. LEEDS AND NORTHRUP TRANSFORMATION-POINT APPARATUS

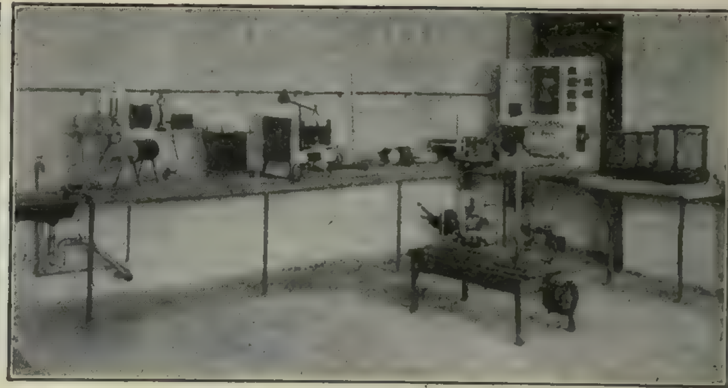


FIG. 4. A CORNER OF THE METALLOGRAPHY LABORATORY

check the physical properties. The machining properties as affected by heat treatment are indicated. The forging and heat treating of high-speed steels are practiced, and the results of their use in the shop are observed under various conditions. Bullens' "Steel and Its Heat Treatment," collateral reading and inspection trips are used to supplement the instruction.

Winter Term—Four hours per week in the laboratory and one recitation per week in metallography, or the study of the micro-structure of metals is given. Studies are made of annealed steel of various carbon contents, of hardened and tempered steel and of the impurities occurring therein, as well as of the technique of metallography as applied in practical work. Sauveur's "Metallography and Heat Treatment of Iron and Steel" is the text and inspection trips to factory laboratories are utilized.

Spring Term—Ten to sixteen hours per week may be devoted by the interested student to the study of problems of current interest to manufactures of steel products, the aim being by proper direction and correlation of the work of the student to contribute something to the solution of those problems.

The equipment for carrying on this work is very similar to that used in actual practice except that, since the shops are operated as laboratories, they contain more laboratory apparatus than an ordinary shop or foundry.

The equipment of the forge shop consists of forty down-draft forges, shears, grinding wheels, buffing wheels and a complete set of tools for each student.

For heat treating there are eleven furnaces of various sizes, some being shown in Fig. 1, and several lead pots, cyanide pots and tempering baths, as shown in Fig. 2. The Leeds and Northrup pyrometer equipment includes a transformation-point apparatus, shown in Fig. 3. There are several makes of pyrometers and the equipment necessary to accurately calibrate them. For hardness testing several scleroscopes and a Brinell machine are used.

In the metallography laboratory, shown in Fig. 4, Bausch and Lomb microscopes and cameras are used. In addition to them there are several polishing stands, electrical furnaces with pyrometer equipment and a dark room.

The foundry equipment consists of one cupola, two gas-fired crucible furnaces for brass and aluminum, a core oven, several molding machines, flasks and a complete set of molding tools for each student.

Credit is due Prof. J. A. Polson, formerly head of the Mechanical Engineering Department, for suggesting the above courses. The development of this work has been due to Prof. W. G. Hildorf, who is at present in charge of all the work except that in metallography, which is in direct charge of Prof. H. L. Publow of the Chemical Engineering Department.

Relation of Bearing Construction to Chattering

By Martin H. Ball

In studying the causes of chattering in machine tools it has occurred to the writer that much of this trouble may be due to the impairment of the bearing between moving parts by reason of unequal expansion from varying temperatures, springing of the parts by clamping work to or upon them, and similar causes.

Some observations, taken recently of a lathe carriage to which had been bolted a piece of work for boring with a bar between centers, leads me to believe that not only this but other classes of tools might be improved by making the bearings of sliding members of such shape that they will be subject to the least possible distortion from any condition likely to prevail in ordinary usage.

A machine that is provided with a V-shaped slide on one side and a flat one on the other will automatically adjust itself to changes caused by varying temperatures between the moving part and the bed of the machine, and it would seem that such construction might be adopted to advantage in many places.

When the double V-bearing is used and for any reason one or other of the members becomes distorted, the bearing surface is reduced. Instead of having a bearing on both sides of both V's the bearing will be only on the inside or the outside faces of each V according to the direction of the distortion, and will therefore be deprived of its proper support. In fact, the distorted member may be tilted to the extent of the misfit in whichever direction pressure may happen to be applied.

Of course the difference in temperature of two parts of the same machine is usually small, but little as it is, it would seem to be worth while to make a study of conditions with a view to eliminating its possibilities for evil; especially in consideration of the fact that the combined V and flat bearing is much more easily fitted, and, other things being equal, the job that is easiest to do is generally the best done.

It would be interesting to hear from some of the machine-tool builders on this subject and get the reasons, if any exist, why this construction should not be applied to planer platens.

Knowing Your Insurance Policy

BY CHESLA C. SHERLOCK

You will probably admit that there are a great many legal points pertaining to insurance with which you are not familiar in regard both to your own personal policy and to those which your firm holds. This article, which is the beginning of a series, treats of insurance in general as viewed from the standpoint of the law, and it defines the principal kinds of insurance with special emphasis on those types which are encountered in industry.

I. General Terms and Definitions

INSURANCE has come to be one of the most important elements in our present business life; in fact, many who are in a position to know claim that modern business as we know it would never have been possible but for the advantages offered by insurance in some form or other.

In the field of the law, insurance has assumed a constantly growing importance until today it is one of the most important branches of our jurisprudence. Its importance in the field of the law is no less great than it is in the field of business. In fact, the growth of insurance in both fields has been practically the same.

It would be impossible for us to more than point out the general principles of the law governing so important a subject. The insurance cases decided by the courts are legion; and the number is constantly growing. One of the textbook writers has brought together five large volumes on the subject; there are numerous other works upon the law of insurance, all showing that there is much to be said upon the subject.

In arranging this discussion, we have tried to leave out all considerations that do not intimately relate themselves to insurance law as it applies to business conditions generally over the country, particularly to industrial business conditions. At the same time, we have tried to leave out nothing that should be said. In short, our purpose has been to give to the busy business man and industrial leader a short, concise, readable discussion of the things he ought to know about his insurance, whatever its form.

DEFINITIONS OF INSURANCE

In the first place, what is insurance? Joyce, a leading authority, defines it as follows: "Insurance, strictly defined, is a contract whereby one for a consideration agrees to indemnify another for liability, damage or loss by certain perils to which the subject may be exposed, but the contracts of life insurance and accident insurance are not strictly contracts of indemnity."

Emerigon, an early authority, defined it as "a contract by which one promises indemnity for things transported by sea, deducting a price agreed upon between the assured, who makes or causes to be made the transport, and the insurer, who takes upon himself the risk and burdens himself with the event."

This definition relates, of course, to marine insurance, but that is due to the fact that in the time of Emerigon it was the only form of insurance known in the business world. Most early discussions and definitions relate entirely to marine insurance.

In a Minnesota case, it was held that "the word 'insurance' in common speech and with propriety is used quite as often in the sense of contract of insurance or act of insuring, as in that expressing the abstract idea of indemnity or security against loss."

In Illinois, the court said: "Insurance is an agreement by which the insurer, for a consideration, agrees to indemnify the assured against loss, damage or prejudice to certain property described in the agreement, for a specified period, by reason of specified perils."

In New York, the court defined it: "A contract of insurance is intended as an indemnity against an uncertain event, which, if it occurs, will cause loss to the assured."

In Delaware, the court said: "An insurance in relation to property is a contract whereby the insurer becomes bound for a definite consideration, to indemnify the insured against loss or damage to certain property named in the policy, by reason of certain perils to which it may be exposed."

In another case, it was said: "Insurance is a contract by which the one party, in consideration of a price paid to him adequate to the risk, becomes security to the other that he shall not suffer loss, damage or prejudice by the happening of the perils specified to the certain things which may be exposed to them. If this be the general nature of the contract of insurance, it follows that it is applicable to protect men against uncertain events which may in any way be of disadvantage to them; not only those persons to whom positive loss may arise by such events occasioning the deprivation of that which they may possess, but those also who in consequence of such events may have intercepted from them the advantage or profits, which but for such events they would acquire according to the ordinary and probable course of things."

The Pennsylvania court defines the matter in a little different way: "Insurance is a contract of indemnity, in which the parties may stipulate for the time and the manner in which the indemnity shall be made, and the law will enforce such contract."

MORE DEFINITIONS NOT NECESSARY

It is not necessary for us to repeat any more of the definitions which have been handed down upon the general subject of insurance. The above are complete enough to give anyone a correct idea as to what the legal definition is. These definitions all have a reason and it will be noted that while they vary slightly, they express common requisites which we will discover later are very necessary to the insurance contract if it is to stand the test of the courts.

Sharpe defined fire insurance as "a contract to indemnify, in whole or in part, one having an insurable interest in property from loss or damage caused by fire to the property insured."

The Earl of Halsbury's Laws defined it: "A contract

of fire insurance is a contract by which the insurer agrees, for a valuable consideration (usually called a premium), to indemnify the assured, up to a certain amount and subject to certain terms and conditions, against loss or injury by fire which may happen to the property insured during a specified period."

Another English authority said: "Fire insurance is a contract whereby, in consideration of the payment of an agreed premium, the insurer undertakes to make good to the assured any loss or damage which may happen to specified property during a stipulated period. Fire policies—in this respect differing from marine policies—are usually for a specified sum, which bears no necessary relation to the value of the property insured. The amount payable in case of loss, therefore, is not determined by the value of the property insured and injured, but simply by the amount of the damage. The sum payable can in no case exceed the amount named in the policy; but as the contract is a contract of indemnity, if the loss is less the amount for which the insurer is liable will also be less."

The California statutes provide that fire insurance includes "insurance against loss or damage by fire, lightning, windstorm, tornadoes or earthquakes."

Industrial Insurance

Joyce defines industrial insurance: "Industrial insurance is, except where otherwise defined by statute, an insurance upon life, for a small or limited amount in consideration of a premium payable in small installments and collectable weekly, or at some other short periodical interval." He later adds that it amounts, in fact, to "burial insurance."

"Industrial insurance," as it is used in this connection, is not to be confused with workmen's compensation insurance, for the latter form is generally a risk entirely under state control and authority. It is seldom permitted to be a voluntary risk under existing laws, so that we will not treat it in this connection, but by casual reference later in the discussion.

Industrial insurance usually relates to that form of insurance which is carried by employee's organizations and from premiums paid out of the pay checks of the workers at stated regular intervals. It usually relates to sick insurance, disability and burial benefits, payable out of a common fund created by the premium payments of the members of the fund.

Burial insurance is a valid form of life insurance. Usually it is for the purpose of providing a burial worth a certain specified sum for the members upon death. Payment is usually made by means of regular contributions into the common fund each pay day. It has been held, however, that a contract of such insurance was void and against public policy where it specified that a certain undertaker, designated as an official undertaker, should perform all of the services and that all burials should be through him.

Workmen's Compensation Insurance is largely compulsory. Says one authority: "It is only by the loose use of language that the term 'insurance' can be applied to the system. It is in reality an elaborate system of poor relief, and its success or failure has little significance for the question of practicability of the public management of insurance on scientific principles. It is also said that compulsory insurance, where and in so far as it is at the expense of the employers, is in effect simply a liability to pay compensation for accidental injuries to employees, with a legal obligation added to insure its payment," and "the principles of the compensation law are developments of the negligence law."

An English case has said of the English Compensation Act: "That act has rendered it practically necessary for all who desire to avoid the risk of bankruptcy, and who cannot afford to be their own insurers, to insure. Tens of thousands of small shopkeepers with one assistant, lodging-house keepers and others with one 'general,' small farmers, tenants of small buildings, and the like with one man, are driven to insure."

While the English act may, in effect, require this action, it may be said, in passing, that most of the American acts do not apply in this narrow, limited way to the man with only one employee, although, in some jurisdictions they may. In the majority of instances they apply to workmen numbering three to five. What has been said of the smaller number in England, however, is fairly representative of what takes place here where the employer is covered according to the terms of the law.

Workmen's compensation insurance is, therefore, not properly a true contract of insurance in the sense that other forms of insurance are, for it is compulsory in a large measure and applies to a purpose which does not ordinarily exist in other forms of insurance. For that reason, we will omit any large discussion of it in these remarks.

Accident and Casualty Insurance

Accident insurance, as it is known in the insurance world, is a contract whereby one party agrees to indemnify another against accidental personal injury, or to pay a certain sum of money in case death is caused by the accident. The contract is very similar to that in the case of life insurance for it seeks to indemnify one against bodily hurt by accident, or to pay a certain sum in case the accidental injury causes death. In this latter respect it is similar to a life insurance contract.

Since the words "accident" and "casualty" have a very similar meaning in many respects, people often arrive at the conclusion that accident insurance and casualty insurance are one and the same thing. They may be, but usually they are not.

The following distinction was drawn in Massachusetts, it being said that the "distinguishing feature of what is known in our legislation as 'accident insurance' is that it indemnifies against the effects of accidents resulting in bodily injury or death. Its field is not to insure against loss or damage to property, although occasioned by accident. So far as that class of insurance has been developed it has been with reference to boilers, plate-glass, and injuries to property by street cars, etc., and perhaps injury to domestic animals, and is known as 'casualty insurance.'"

In an Iowa case, Justice Weaver said: "It cannot be said that their definition has been very accurately settled by the courts. Strictly and literally 'casualty' is perhaps to be limited to injuries which arise solely from accident without any element of conscious human design or intentional human agency; or, as it is sometimes expressed, inevitable accident, something not to be foreseen or guarded against. But in ordinary usage 'casualty,' like 'accident,' is quite commonly applied to losses and injuries which happen suddenly, unex-

pectedly, not in the usual course of events, and without any design on the part of the person suffering from the injury. Nor does the fact that the conscious or intended act of some other person producing it, take from such injury its character of an accident or casualty."

In Kentucky, the court said that employer's liability "is insurance taken out by an employer to protect him against loss on account of injury to his employees while engaged in his service. It is recognized as a distinct class of accident insurance business, and yet it is common knowledge that most accident insurance companies carry a line of employer's liability."

"Under a policy of this description the insurance company undertakes to indemnify the assured against his liability to pay damages and costs, in case any person may sustain injury by accident, and claim compensation against the assured," is the definition placed by an English authority. It is to be distinguished from workmen's compensation, in that the employer's liability can extend to almost any form of accident, while in the case of workmen's compensation only those accidents arising out of and in the course of the employment would be covered. There are various other forms of insurance which the business man will want to be familiar with. Because life insurance is largely a personal matter with the business man, it has not been treated herewith, except in a casual manner, although what is said subsequently in other discussions will apply equally well to it.

According to Joyce, "guaranty insurance is a contract whereby one for a consideration agrees to indemnify another against loss arising from the want of integrity, fidelity or insolvency of employees and persons holding positions of trust, against insolvency of debtors, losses in trade, losses from non-payment of notes and other evidences of indebtedness, or against other breaches of contract."

Title Guaranty Insurance

Title guaranty insurance is that type of insurance in which one for a consideration agrees to protect another's title to property (real estate), or "which insures against all loss or damage, not in excess of a specified sum, which assured may sustain by reason of existing defects or unmarketableness of a title to a described estate, mortgage or interest, or because of liens and encumbrances changing the same, as of the date of the policy, with certain exceptions; or by reason of defects in the title of the mortgagor in the mortgaged estate, or mortgage interests."

In a Connecticut case, it was said that "strike insurance may be defined as a contract whereby, for a consideration, the insurer agrees to indemnify and guarantee firms, corporations or other persons carrying on manufacturing against damage or loss, directly or indirectly, resulting from any interference with, or suspension of business or the use or operation, wholly or partly of a manufacturing establishment by reason of an employees' strike."

Rent insurance is that form of insurance which guarantees against loss of rents to a lessor, resulting from rendering the property untenantable; or against loss to the tenant by reason of obligation on his part to pay the rent, as the result of fire or other damage."

The nature of a contract of insurance is something at once confusing and hard to understand on the part of many people. In the very first instance, an agreement of insurance, or an insurance policy, is a contract, first, last and always. As a contract, it is subject to all the elements of an ordinary contract, and a number of other elements peculiar to it as a contract of insurance.

There must be competent parties, a valid subject-matter, a proper consideration, and it must be in writing, although the contract of insurance may be in force as soon as the meeting of the minds takes place. Indeed the difficulty of proof makes it imperative that the contract be in writing, aside from any statutory regulation that may be imposed upon the subject. The most important essential additional element in the contract of insurance is the necessity of risk. Risk is an essential element and there must be risk, if the contract of insurance is to be valid. Indeed, one authority says that "it is of the very essence of insurance and forms the principal foundation of the contract."

The very existence of the contract implies that the subject-matter thereof is to be exposed to some risk or danger, but it must be a danger which neither side has the power to hasten or avert.

If it is a risk over which either one has any control, it is not properly the subject matter of a contract of insurance.

Another Important Consideration

Another important consideration is that the insurance contract is aleatory, in that it depends upon the happening of some other event to bring it into force and being, such as loss from fire, theft, strike, or the like. The loss must occur before the contract requiring indemnity is to be enforced.

It has long been held that insurance is a personal contract, regardless of what the subject matter of it may be. Chancellor King has said: "These policies are not insurances on the specific things mentioned to be insured, nor do such insurances attach on the reality or in any manner go with the same as incident thereto by any conveyance or assignment, but they are only special agreements with the persons insuring against such loss or damage as they may sustain. The party insured must have a property at the time of the loss, or he can sustain no loss, and consequently can be entitled to no satisfaction."

Railway Master Mechanics' Resolution

WHEREAS, A bill for the adoption of the metric system in the departments of the Federal Government has been reported favorably to the House of Representatives;

WHEREAS, We consider that the only effect of such a law will be the creation of a government metric system and the continuation of the existing system in ordinary commerce and industry;

WHEREAS, It is evident that the confusion resulting from such a condition of things would be intolerable;

WHEREAS, We believe a change in the system of weights and measures used by the people at large to be impossible; therefore be it

RESOLVED, By the American Railway Master Mechanics' Association, in convention assembled, that we condemn all legislation intended to promote the adoption of the metric system in this country.

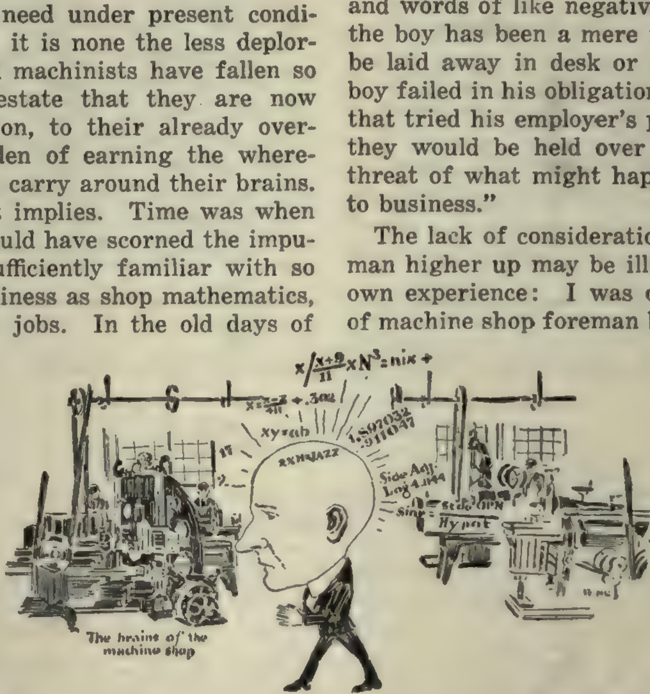
Why Is a Shop Mathematician?

By Harry Senior

I note on page 481 of the *American Machinist* the advent of a new factor in our business; the "Shop Mathematician."

Admitting the undoubted need under present conditions for such a functionary, it is none the less deplorable that our toolmakers and machinists have fallen so far from their once high estate that they are now obliged to assume, in addition, to their already overwhelming expenses, the burden of earning the wherewithal to hire another man to carry around their brains.

For this is exactly what it implies. Time was when self-respecting machinists would have scorned the imputation that they were not sufficiently familiar with so important a part of their business as shop mathematics, to be trusted to handle their jobs. In the old days of not so long ago every boy who desired to "learn the machinist's trade" knew that unless his school record in arithmetic was above the average he had about as much chance of standing in with the "old man" of a machine shop as a Standard Oil magnate has of getting past St. Peter. Not only was a boy expected to know thoroughly the fundamental principles of mathematics but he was daily required to put them to practice. He was taught to memorize conversion tables in common use just as at school he was taught to memorize the multiplication table; he was taught to figure speeds of pulleys and shafting, gear ratios, relative proportions of threads, etc., and if he was so fortunate as to secure an opportunity to learn the trade in a place where there was no recognized dividing line between "millwrighting" machine work and "toolmaking," he was taught to compute strength of materials, safe loads on beams, and many of the minor details that the present day "engineer by education" thinks can be acquired only in a college.



The brains of the machine shop

Shop trigonometry was far from being an occult science to the boy who received his training in the "machine shop" of thirty years ago, and although he did not learn to use a sine-bar it was because the sine-bar had not been developed and not because he did not understand the principles that underlie it.

The trouble with our educational system in so far as it relates to the training of machinists is, in my belief, due largely to the greed or the indifference of the shop proprietors who will allow a boy to be taken in to work for small wages for a longer or shorter term of years during which time, in consideration of his services for practically nothing, the boy is to be taught those things which will make his services really valuable. A definite obligation is assumed by both parties; the boy to work for his employers interests; the employer to teach.

How often has it been the case in later years that the employer knew or cared whether or not he had a foreman who was capable of delivering to the boy the goods for which he (the boy) was paying? How often has the foreman, in assigning a job to the boy, questioned in his own mind whether or not the job was one from which the boy could learn a lesson? or if the journeyman to whose assistance the boy was sent was a fitting instructor? When a shop proprietor or his agent hires a foreman, or when a foreman hires a machinist, what weight does the hirer attach to the competence of the "hiree" as a teacher of youth?

The answers to these questions are: never, nix, none, and words of like negative import. The indenturing of the boy has been a mere matter of form; the papers to be laid away in desk or safe and forgotten unless the boy failed in his obligation or indulged in some escapade that tried his employer's patience too far, in which case they would be held over the head of the culprit as a threat of what might happen to him if he didn't "tend to business."

The lack of consideration or interest displayed by the man higher up may be illustrated by an incident of my own experience: I was once employed in the capacity of machine shop foreman by a firm that had a local reputation for frequent and sudden changes in its personnel. This firm always carried on its pay-roll several apprentice boys regularly indentured by the formal "know all men by these premises, etc., etc.," and signed on the dotted lines by the president of the company and the guardian of the more or less fortunate boy. I considered myself bound in my employer's interests to instruct these boys and during my somewhat brief tenure did so to the best of my ability. I found, however, that the boys, though bright and willing, were strangely ignorant of the principles of their trade.

On one occasion one of the boys, an exceptionally bright kid in the fourth year of his apprenticeship, made some particularly egregious mistake on a simple job to which I had set him without (contrary to my usual practice) first making sure that he understood the principles and methods involved. I asked him somewhat impatiently if he wasn't ashamed of himself? to which he slowly replied, "Mr. Senior, I have worked for four foremen since I came here, and you are the first one that ever told me how to do anything before I done it, and about all they told me afterwards was cuss words."

The president of the company, whose name was at the foot of the contract by which the boy was held, was a prominent and respected member of society and was chairman of the local board of education, but he had entered into a legal agreement and accepted payment, in the shape of the boy's work, for services that he had no thought of rendering himself, nor had he assured himself was being rendered by his agents.

This man was not deliberately dishonest. He was simply playing the great national game of "Let George Do It" and because of his passivity (and that of a few hundred thousand others who, like him, had forgotten their sense of personal responsibility for anything that did not pay them real money) employers of skilled labor in the year of grace 1920 must pay skilled employee's wages to men who do not know, or but partially know, their business, and must then hire other men to supply them with the knowledge that has already been bought and paid for by every man who has served an apprenticeship.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Electric Reversing Control of Colburn Drilling Machines

The illustrations show two motor-driven Colburn heavy-duty drilling machines, one equipped with a Cutler hammer alternating current electric control, the other with Electric Controller and Manufacturing Co.'s direct control for reversing the spindle for tapping operations.

These machines have been arranged for reversing the spindle with direct-current motors for some time but it is only recently that any equipment has been available which would accomplish this with alternating-current motors.

The alternating-current equipment, Fig. 1, consists of an automatic motor starter and a reverse switch. The automatic starter is contained in a metal box which may be mounted directly on the machine or fastened to the wall as illustrated.

The reversing switch is mounted on the column of the machine directly above the feed gear box, and is connected to the operating lever by sprockets and chain. It has three positions: forward, neutral and reverse.

The operator when tapping a hole, simply throws the lever to the forward position and when the tap reaches the desired depth, throws it to the extreme opposite (reverse) position which reverses the spindle instantly and withdraws the tap. To stop the machine the lever is thrown to the neutral position.

The direct-current equipment, Fig. 2, also consists of an automatic motor starter and reverse switch but differs somewhat in mechanical detail from the alternating-current equipment.

In the illustration the starter and reverse switch are shown mounted directly on the column of the machine.

This reverse switch also has three positions: forward, neutral and reverse and control is carried to the operating lever at the front by means of a lever and link.

In operation this mechanism acts similar to the a.c. control, throwing lever to forward position starts the spindle; throwing it to the extreme opposite position reverses the spindle and throwing it to neutral, stops spindle immediately.

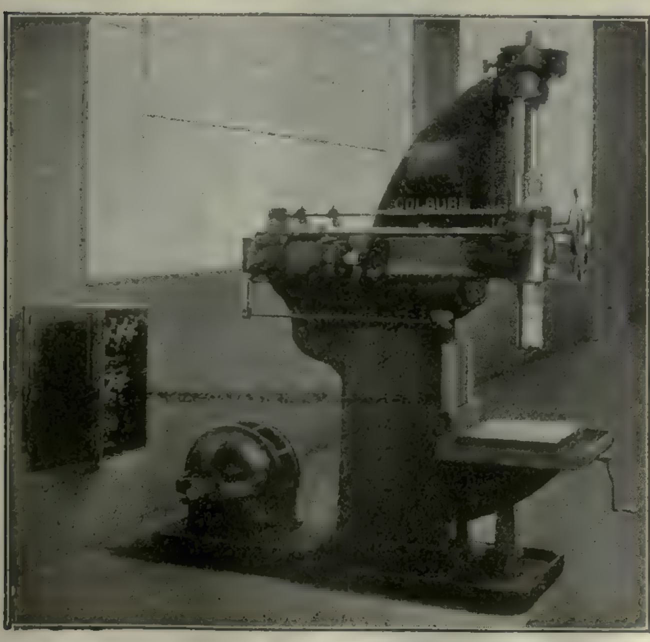


FIG. 1. DRILLING MACHINE WITH ALTERNATING-CURRENT EQUIPMENT

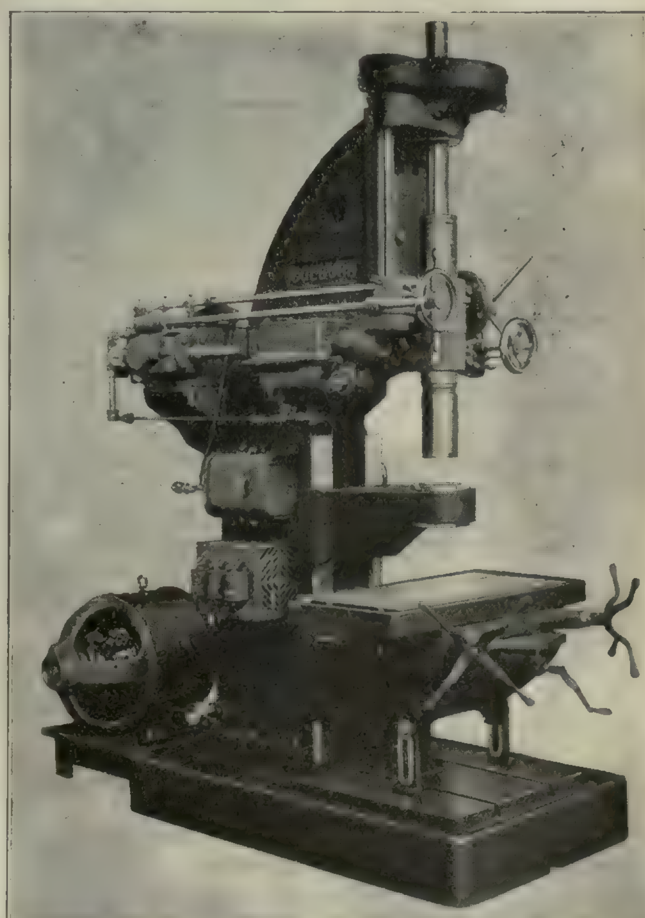


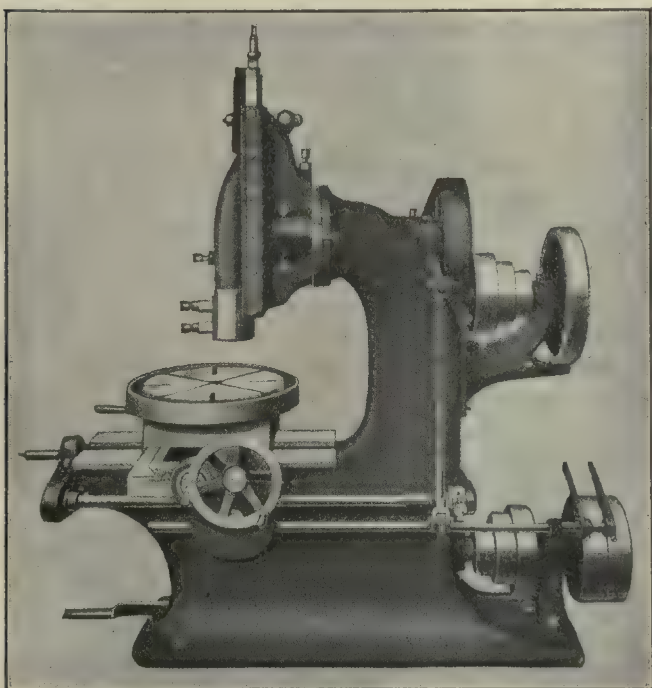
FIG. 2. DRILLING MACHINE WITH DIRECT-CURRENT EQUIPMENT

Colburn heavy-duty drilling machines are built in three styles and several sizes, and although the illustrations show reversing a.c. and d.c. motor control as applied to the larger machines, either style of control is readily adaptable to the smaller machines.

The use of electrical control for reversing the spindle of either an alternating or direct-current motor-driven drilling machine eliminates all shock and jar. Moreover, it reduces the wear and tear on the machine and increases its term of service.

Atkins Slotting Machine

Among the English-built machines introduced by Alfred Herbert, Ltd., 54 Dey St., New York City, is the 6½-in. slotting machine illustrated. It is manufac-



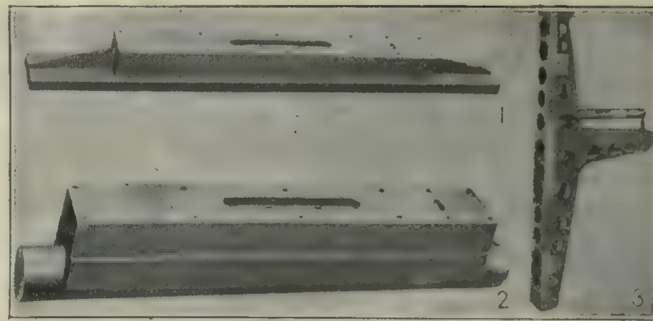
ATKINS SLOTTING MACHINE

Specifications: Stroke of ram, 6 in. Height of work admitted, 7½ in. Diameter of work admitted, 30 in. Working surface of table 16 in. Outside diameter 20 in. Longitudinal feed 12 in. Cross Feed 12 in. Strokes per min., 26 to 77. Largest cone step, 10 in. Belt, 2 in. Countershaft pulley, 12 in. Belt, 2½ in. Net weight, 2,050 lb. Gross weight, 2,500 lb. Cu. ft., 94.

tured by Harry F. Atkins, Old-Fletten, Peterborough, England. The machine is equipped with automatic feeds to both slides and circular table. The table is graduated in degrees and has a locking device with twelve divisions. The clapper-type toolholder is universal in movement and the ram is arranged to swivel. All gears are inclosed. A treadle brake is provided and the countershaft is self-contained.

Rieker Precision Levels

A line of precision levels for machine-shop use has been brought out by the Rieker Instrument Co., 1919-21 Fairmount Ave., Philadelphia. Referring to the illustrations, Fig. 1 is a machinist's level, Fig. 2 is an instrument for levelling shafting, while Fig. 3 is a plumb level designed for use in plumbing planer uprights and other vertical surfaces. The vials of these levels are ground and graduated and it is claimed for them that



FIGS. 1 TO 3. RIEKER PRECISION LEVELS
Fig. 1—Machinist's level. Fig. 2—Shafting level. Fig. 3—Plumb level.

the bubbles will be deflected 0.10 in. for every 0.001 in. the work is out of level in one foot.

The cases are put through a heat-treating process to prevent them from warping.

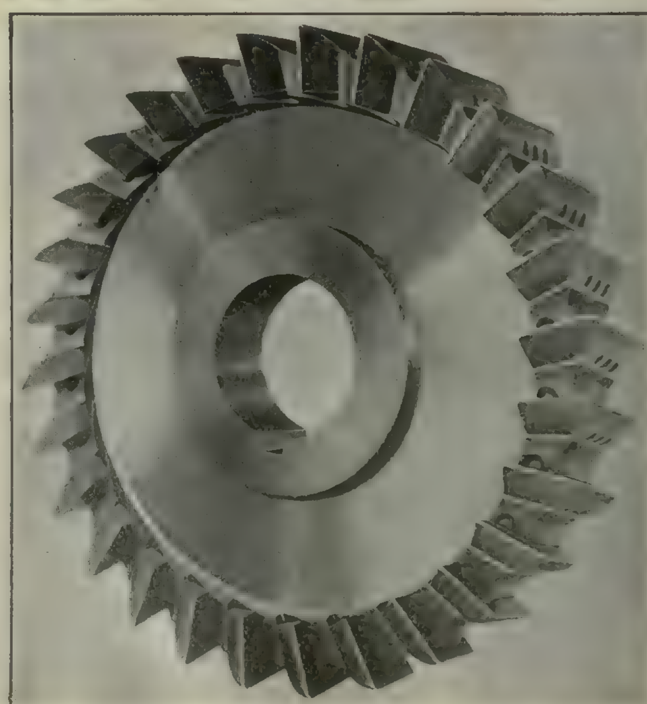
Goddard & Goddard Inserted-Tooth Milling Cutter

The inserted-tooth milling cutter illustrated herewith is made by Goddard & Goddard Co., Detroit, Mich.

The body is made of heat-treated alloy steel and has an elastic limit of about 105,000 lb.

The high-speed steel blades are set so as to have a slight undercut or hook and are held in place by the well-known wedge-pin method. They are positioned laterally by dowel pins in the periphery. The blades have multiple notches cut in them so that when worn they can be taken out and reset, moving them laterally the distance from one notch to another thus providing long life for them.

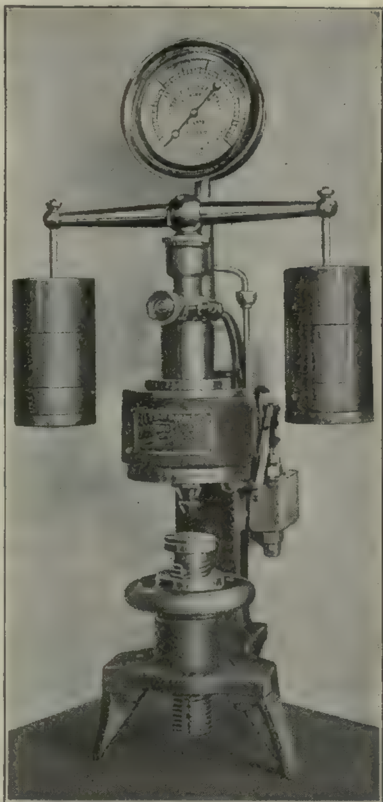
The cutters are made to be used in gangs—right and left—on arbors or arranged to be bolted to flanged spindles such as are used on milling machines of various makes. They are recommended for work requiring cutters of 10 in. in diameter or larger.



GODDARD INSERTED-TOOTH MILLING CUTTER

Ideal Brinell Testing Machine

Since the Brinell method of testing the hardness of metals has been adopted in many countries, various sizes of Brinell machines have been put on the market in order to conform to the different sizes of test pieces. To meet the demand for a Brinell tester that will suit the requirements of the laboratory and toolroom, the Pittsburgh Instrument and Machine Co., 101 Water St., Pittsburgh, Pa., has developed a style C machine as illustrated. There is a slight difference in the construction of this machine from the standard type, inasmuch as the oil reservoir is attached to the side of the supporting frame, and so arranged that the overflow of oil from the cylinder will always circulate back to the reservoir. The maximum distance between the 10-mm. steel ball and the press table of this machine is 3 in. The procedure of making tests is the same as with that of the standard machine, style A.

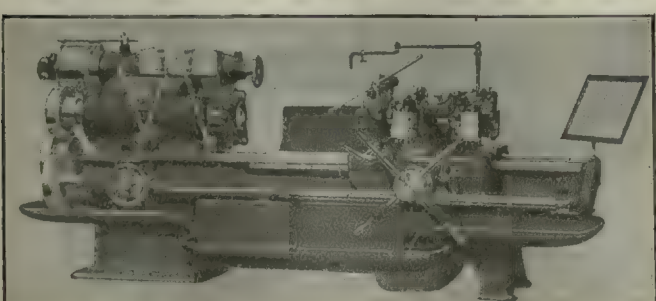


IDEAL BRINELL TESTING MACHINE, STYLE "C"

Herbert Hexagon Turret Lathe

The turret lathe illustrated is made in three sizes by Alfred Herbert, Ltd., Coventry, England; New York address, 54 Dey St. The lathe in its three sizes produces work up to 42 in. in length and $3\frac{1}{2}$ in. in diameter from the rough bar. The single pulley runs at constant speed on ball bearings and does not require a countershaft. All spindle speeds are obtainable in either direction.

The gears run in oil and the bearings are either lubricated automatically or by continuous feed lubricators. The speed variator is interlocked to prevent possible damage by incorrect manipulation. A quick power traverse is provided for the turret slide and the Nos. 4 and 13 lathes have power rotated turrets. The No. 1 machine is fitted with a geared draw-in chuck, the other two having double toggle chucks that may be operated while in motion.



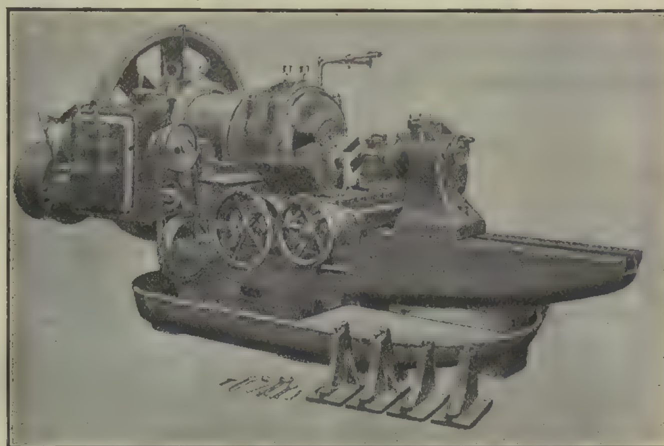
HERBERT HEXAGON TURRET LATHE

Specifications. Bar capacities, $1\frac{5}{8}$ in., $2\frac{3}{8}$ in., $3\frac{1}{2}$ in. Greatest length turned 27 in., 36 in., 42 in. Diameter of pulleys, 8 in., 10 in., 14 in. Belts, 4 in., 5 in., $5\frac{1}{2}$ in. Spindle speeds 8, 8, 16. Feeds 6, 12, 9. Horsepower requirements, 5, 7, 10. Net weights, 3,376 lb., 5,550 lb., 8,400 lb.

A roller steady-rest is provided for the turning tools that is said to allow cutting speeds and feeds to be increased to the limit of the cutters.

Gardner Crankpin Turning Machine

The machine shown is of English manufacture, the American agent being Alfred Herbert, Ltd., 54 Dey St., New York City. It is designed for the rapid and accurate machining of crankpins and is said to be of exceptionally rigid construction, the bed and headstock being made from a single casting, strongly ribbed. A chief feature is the chucking arrangement. A special chuck to suit the required throw is mounted inside the drum or spindle and so arranged that the crank may be rigidly supported and driven through the web nearest to the pin being turned. There is an additional steady support inside the spindle for preventing whip in the previously turned part of the crankshaft, and the web is further held by clamping screws in the face of the chuck, thus eliminating all torsional vibration of the crank itself. The gear box provides eight speed changes in geometric progression and extra long cross-slides carry the front and rear tool rests. The crowning rest may be used to crown the end of the crank webs.



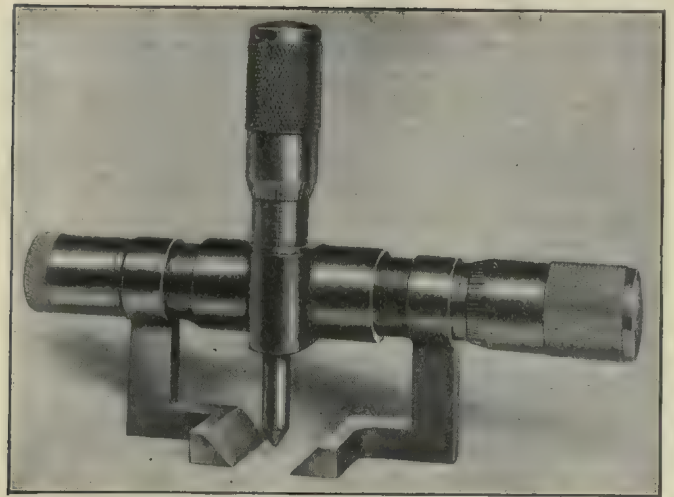
GARDNER CRANKPIN TURNING MACHINE

The machine is made in three sizes with spindle bores 16 in., 22 in. and 31 in. respectively. The drive pulleys are 16 x $4\frac{1}{2}$ in., 20 x $4\frac{1}{2}$ in. and 18 x $6\frac{1}{2}$ in. Horsepower requirements are 8, 14 and 20. Net weights, 8,000 lb., 14,672 lb. and 29,385 lb.

Brinell Indentation Micrometer

A micrometer for measuring the diameter and depth of the indentation made in applying the Brinell test has been introduced by the Pittsburgh Instrument and Machine Co., 101 Water Street, Pittsburgh, Pa.

As may be noted from the illustration the instrument will register both horizontal and vertical meas-



BRINELL INDENTATION MICROMETER

urements as separate graduations are provided. The dimensions of the impression can be read to 0.01 mm. and the hardness value quickly determined by reference to tabulated data.

The Need of Internal Auditing

By F. S. Nelson

The annual audit, as made in most plants, does not go into an investigation of the foundation of the subject data, but simply of totals. To thoroughly audit a plant it is necessary to check and to audit continually and to have accountants who are familiar with the concern do the work. The purpose of this article is to show the advantages of the internal-audit system, which provides for the employment of a staff of accountants in the plant who ascertain the correctness of all charges at the time that they are made to the various departments.

In many cases cost computations are not correct, this being true in all sorts of firms. The reason is that the work of posting the data is usually left to a minor clerk who has no judgment as to whether or not a particular class of material is necessary to produce a certain product. The clerk, who is more or less a machine, cannot be blamed, and his duty is discharged when he has done what he is ordered to do. He may take a bunch of requisitions or other papers and post them to the respective plant orders or shop orders which are designated on them, but in all cases this will not be the correct procedure. The trouble lies not in the fact that the actual numerical work of the accounting department is wrong, but in the fact that there are probably errors in the handling of the records before they reach the accounting department.

Plant orders and shop orders are used as a basis for the computation of costs and overhead charges, hence it is important that they be correct. If an internal-auditing department will assure this, it will more than pay for its own upkeep. By doing this it will enable the firm to bid more closely and intelligently against its competitors and hence to receive a greater number of orders, with an increased net profit.

The figures compiled by the cost department are usually correct and properly assembled in so far as the information given that department is concerned, but often there are slips in the routine work leading up to the data given the cost department. To prevent this common source of trouble there should be a central point between the stores, office and the cost department through which all requisitions and data must pass for audit as to the correctness of the charging to the respective accounts. In this way an error would be stopped before it went too far, and the charge would be rerouted to its proper channel. This organization, which we have already called the internal-auditing department, would be furnished with copies of all classifications and material lists for reference in deciding as to the proper account to which any certain item should be charged. The use of such a department should insure correct and dependable cost data.

In most concerns items of an asset nature are frequently allowed to be charged to burden, and vice versa. In a large establishment this condition may not exert itself very forcibly, but in a smaller concern the inevitable result, when depreciating the assets, would be an incorrect overhead charge, reflecting directly upon the cost of the product. Comparative statements of figures often give the impression that a business is being conducted upon a profitable basis, and then it will be discovered that a loop hole has been left open and that the profits have leaked out. Sometimes it is too late to recuperate the losses and failure is the result.

It seems from the above that figures often do lie, although not intentionally. To make the cost figures correct it is necessary to rectify the defects of the accounting department. The addition of the internal-auditing system should make the costs and charges correct, and should enable the establishment of any business upon a firmer basis. This is of especial importance now, because keener competition is to be expected immediately following the present economic reorganization of industry.

Soldering With Zinc

By S. E. Frew

Zinc may be used for joining metals together in the same manner as solder and well-made zinc joints will be stronger than a corresponding soldered one, though not as strong as a brazed joint.

Zinc melts at about 800 deg. F. and if a good strong heat can be applied it flows more readily than solder, especially over iron surfaces.

The same flux should be used as with solder; that is zinc dissolved in hydrochloric acid to the point of saturation. The zinc can be readily granulated for dissolving by melting and pouring it into water from a ladle, at a height of two or three feet.

To join parts of sheet iron, galvanized iron, sheet copper, or brass, when the parts are too large to be directly heated, a soldering iron made of iron should be used and it should be heated to a dull red.

To insure having the metal run thoroughly through the joints they should be heated with a blow torch, the flux liberally applied and the heating continued. Pieces of granulated zinc or small cast bars should now be applied to the joint and the work tapped lightly with a small hammer, which will cause the zinc to spread and flow through the joint in the same manner as spelter in the brazing process.

Soft solder often appears to adhere to iron surfaces only in small spots while zinc, if the flux be thoroughly applied, spreads and flows evenly over iron surfaces and adheres strongly.

WHAT *to* READ
—for the man in a hurry

Suggested by the Managing Editor

AFTER a week's let-up we are at you again with the automotives. This time it is the wind-up of the piston series with the methods in vogue at the Winton, Franklin, White and Packard shops. The next big job like this to be tackled is the connecting-rod series and Fred Colvin has gathered so much material on this subject that it begins to look as though we would have to run three sections. But this isn't all. We have been so cheered on by the kind criticisms of some of our readers that we are going to use a lot more of the same sort of thing with the idea that if a little is good, more ought to be better. Incidentally, if there is any particular phase of this subject that you are especially anxious for us to cover now is the time to write in and let us know while we are still doing the preliminary work.

Nobody who is holding down a man's job has time to read all of the "American Machinist." On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials—they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.

An old friend who has recently graduated into a fair-sized executive job said to us the other day, "Oh, I used to read the *American Machinist* until I got into this work but I haven't time now, I have to keep up with the management papers." We leave it to any average reader of the *American Machinist*—are we so far behind on management articles? There is Basset's big series which is just getting started; there were the Heald articles last year which took up planning details; there is the article which began last week and will be finished soon, on the sensible system at the White factory; and this week there is Christopher Columbus Bradley's article, on page 935, on the old-fashioned but result-producing "Human Touch Method" employed in making Bradley hammers for three generations, to mention just a few. There are many others to follow which will take up every phase of management and bring it in line with the requirements of the men of our field.

We are printing in this issue the results of a little investigation Ethan Viall has been making into the matter of "new tool" information. He covers it so completely on page 958 that we will say nothing more here as we dislike to lay ourselves open to a charge of being conceited.

The second part to Mr. De Leeuw's article "Unusual Methods of Securing Extreme Accuracy" begins on page 937. This is a real manufacturing article as it gives in detail the solutions of the problems overcome in boring long holes to close limits of accuracy. The remaining parts of this series will appear in early issues.

Quantity production of an entirely different type of product is described by J. V. Hunter on page 943.

Designers and engineers will be interested in the description of a new type of anti-friction bearing which originated in Sweden. See page 947. They will also find valuable data on worms and hobs in the article by Mr. B. F. Waterman, of Brown and Sharpe, which appears on page 951. This article is rather technical and presents the views of an expert in his line.

Our old friend Glenn Quharity has burst into print once more and rather more volubly than usual this time. He starts on page 948 to give an account of a real apprentice school of the old days and as this is a subject near to his heart he treats it with less of levity than is usual with him. Breul of the illustration department contributes several of his inimitable sketches to illustrate "Charlie Pratt's" methods of instruction. If instruction of just this type had been by any means universal in those days we would many of us sigh for their return, but the world has never had enough "Charlie Pratts" to supply the demand for them.

On page 963 Professor Sherlock commences a five-article series on insurance. We are free to admit that insurance policies have always been to us about as intelligible as a court decision and that we have looked upon the insurance business in general as a sort of legalized lottery. Of course this isn't true, but the results you get when you have overlooked some apparently insignificant clause in your policy lead you to believe that the cards are stacked. Professor Sherlock goes into the matter in his usual thorough manner and points out many of the pitfalls for the unwary in clear language.

We would also call the attention of engineers to the description of the practical shop courses in metallurgy given at the Michigan Agricultural College. Page 961.

SPARKS FROM THE WOR

Valentine Francis

The National Marine Exhibit Held at New York

Many Features Included That Merit Consideration from Engineers and Mechanics in General

The National Marine Show, which occupied three floors of the Grand Central Palace during the week of April 12 to 17, was not only of interest to those whose business or pleasure bring them into contact with ships, but it also included many features that merited the serious consideration of mechanics and engineers whose field is more remote from the sea.

Among the things of direct interest to the mechanical man, perhaps the most noticeable was a model thrust-bearing in which the only lubricant is air.

The Kingsbury thrust-bearing is probably too well known to warrant description here; suffice it to say that the stationary member is made in sections mounted upon floating points of support which in turn rest upon an equalizing ring so that they may adjust themselves to a full bearing upon the revolving member. The bearing runs in oil, each segment of the stationary member being entirely surrounded by the lubricant. The theory of the bearing is that the movement of the rotating member will draw a film of oil between the opposed surfaces, thereby preventing a metal to metal contact.

To demonstrate the correctness of this theory Mr. Kingsbury has built a small model vertical thrust-bearing, to be operated by hand, in which the lubricating medium is nothing more nor less than free air.

The stationary member of the model is built of six floating, or self-adjusting, segments of cast iron. The rotating member is a solid disk of soft steel weighing perhaps 15 lb. and turning upon a central stud that is set into, but electrically insulated from, the base which contains the stationary member. A dry battery and a small glow lamp, together with the necessary connecting wires, complete the model.

The steel disk may be spun between the hands by means of a knurled stem. When at rest, the full weight of the disk bears upon the stationary segments and there is considerable friction; the disk starts hard. As the speed increases, air is drawn in by the revolving disk between itself and the units of the stationary member, until the disk is lifted out of contact with the latter and floats upon a film of air.

To prove that the thrust surfaces are out of contact the battery and lamp are used. One wire of the circuit through the battery and lamp is attached to the base, and the other may be held by the experimenter against the revolving disk. As long as the latter is revolving at a speed above, say, 75 to 100 r.p.m. no current will flow, but as the speed decreases the little lamp will begin to glow, first intermittently, as the disk touches the minute high-spots of the segments, increasing in frequency and brilliancy until it reaches a full steady glow as the disk comes to rest.

Of course, an air lubricated bearing is not recommended for practical uses, but the little model serves perfectly to demonstrate the principle upon which the Kingsbury bearing operates.

The exhibit includes a full-size Kingsbury bearing running in oil, and a water-jacketed ring thrust bearing of standard design mounted upon the same motor-driven shaft, subjected to a spring-loaded thrust of 12,500 lb. Both bearings are mounted on dynamometer frames and the torque is weighed upon platform scales.

While the exhibit of the Sperry Gyroscope Co. is confined strictly to marine apparatus it was none the less interesting from a mechanical point of view.

The ship stabilizer attracted popular attention for the reason that its actions were so obvious and the causes of them so obscure. A model of the midship section of a ship was mounted to swing in trunnions so as to give a close counterpart of the rolling motion of a ship at sea; this motion being imparted by a motor-operated weight rolling upon a track across the deck. The movement of the weight was from a point entirely outside the model, therefore the latter was not subjected to any forces other than the depression of first one side and then the other, due to the changing position of the weight. The weight was rolled back and forth in synchronism with the pendulum-like movement of the model and served to impart a "roll" of about 60 deg. to the ship.

A framework bolted to the "deck" carried two gyroscopes, each of which swung upon vertically disposed trunnions so that they could turn about an axis perpendicular to the deck. The gyroscope wheels themselves turned upon horizontal axes, or rather, upon axes that were held rigidly parallel to the deck.

The gyros, however, could be, and were, turned about their vertical axes through an arc of 30 deg. either side of the normal athwartship position, this movement being accomplished by a small reversing motor and suitable gearing; the motor was under the control of a third and much smaller gyroscope similarly mounted near the rail of the ship.

The controlling gyroscope—the "brains" of the system—was allowed but a very limited movement about its vertical axis, being stopped in either direction by rigid posts that carried the electric contacts in the circuit of the reversing motor above referred to. Thus the direction of rotation of the latter depended upon which one of the stops was in contact with the swinging frame of the gyroscope. The oscillation of the controlling gyroscope was in direct response to the rolling movement of the ship.

With the current cut off from the motor, the ship would be allowed to acquire its maximum roll. Upon closing the switch in the motor circuit the main gyroscopes would begin to swing about their vertical axes, first through the full amplitude of their movement and in unison with the roll of the ship, then gradually lessening their movement as the ship was steadied until within thirty seconds from the time of closing the switch both the vessel and the gyroscopes would be practically stationary, notwithstanding the fact that the heavy weight which produced the motion continued to roll back and forth across the deck.

After the ship had become steady the gyroscopes remained practically stationary; moving but slightly at intervals in response to a contact, one side or the other, of the controller, which seemed almost to anticipate each movement of the ship.

Among the other notable exhibits along mechanical lines were: Steam and electro-hydraulic steering apparatus, by the Hyde Ship Windlass Co. Engine room and bridge revolution counters, direction indicators and fog-signalling apparatus, by the McNab Engineering Co. and turbine reduction gearing by the Poole Engineering Co.

Washington Navy Yard to Auction Machine Tools

Announcement is made by the Navy Department that it will sell by sealed proposals to be opened at 10 a. m., May 24, 1920, by the Disbursing Officer, Senior Member Board of Sale, Navy Yard, Washington, D. C., a considerable quantity of machine tools consisting of various kinds of milling and boring machines, lathes, grinding machines, drilling machines, planers, trimmers, saws and shaping machines.

These machines were manufactured by some of the leading firms in the country and are still in such condition as to render satisfactory service. However, owing to the Navy's decreased need of this material, subsequent to the cessation of hostilities and a return to more normal conditions, this machinery is being offered for sale at prices far below the cost of production at the present time, and is a bargain for anyone interested in securing such material.

Those desiring further information relative to the disposition of these machines may obtain it from the Disbursing Officer, Senior Member Board of Sale, Navy Yard, Washington, D. C.

Electricity in the Production of Iron and Steel

At the April meeting of the New York Electrical Society on April 21, 1920, Max Albert Whiting of the power and mining engineering department of the General Electric Co., at Schenectady, New York, talked on "Electricity in the Production of Iron and Steel."

In this talk the course of the ore from the crude state in which it enters the mills to the principal finished products was described.

Mr. Whiting discussed steel-mill machinery and told how electric drive is used in the operation of various types of machines.

Seek Trade With Russia

Resolutions calling upon the Administration to permit American business men to open trade with Russia have been forwarded to the Secretary of State on behalf of 60 American firms and corporations. The resolutions were drawn up by a special committee selected at a meeting of business men held at the Hotel Astor last Wednesday under the auspices of the American Commercial Association to Promote Trade with Russia.

Annual Brooklyn Industrial Exhibition

Architectural, Mechanical, Electrical and General Exhibit—Machine-tool Field Well Represented

The Annual Brooklyn Industrial Exhibition was held at the Twenty-Third Regiment Armory at Atlantic and Bedford Aves., from April 10 to 17. It was an architectural, mechanical, electrical and general exhibition, and everything from a baby scale to a casket was exhibited.

The machine-tool field was well in evidence; these exhibitions were mainly by local manufacturers. Grinding machines, small lathes, furnaces, chucks, small tools of all kinds, jigs and fixtures, castings, saws, belts, pumps, etc., were shown. The Ludlum Steel Co., of Watervliet N. Y., attracted considerable attention with its demonstration of chisel steel. The demonstrator drove a small punch through a 1-in. block of 20-point carbon steel with a light hammer in less time than it takes to tell about it. In the Ludlum booth the Fairbanks Co. exhibited its Radbore head for drilling square holes. The head was attached to a Cleveland milling machine and a Ludlum steel bit was used. The drilling of a blind square hole leaving a flat bottom kept an interested crowd around.

The Forbes metal body forming machine is another mechanical device that was interesting to watch. This machine produces a 10-in. piping at the rate of 2 ft. per minute. It will turn out a pipe of any length. At the exhibit of the company making the machine was the longest piece of piping produced at one operation. It is a little over 30 ft. in length.

The Greenpoint Fire Brick Works and the Brooklyn Fire Brick Works had interesting exhibits of good versus bad in fire brick; what to get and what to avoid.

Other exhibitors of the field were: Acme Foundry Co., Adriance Machine Works, H. W. Cotton, Inc., E. W. Bliss Co., Bay Ridge Sheet Metal Works, Burr and Houston, Doehler Die Casting Co., Eastern Tube and Tool Co., Erie Metal Products Co., Fortuna Machine Co., Fulton Foundry and Machine Co., Foster Pump Works, General Electric Co., R. Hamilton and Sons, Charles A. Hones, Inc., Hay-Budden Manufacturing Co., Improved Appliance Co., Merrill Bros., Manning Abrasive Co., Inc., Maxon-Premix Barnes Co., Oldham Saw Works, V. & O. Press Co., Wahlstrom Tool Co., J. H. Williams Co.

Bureau of Standards Get \$40,000 Appropriation

Congress has just authorized an appropriation of \$40,000 to be used by the Bureau of Standards in work looking to the standardization and testing of standard gages, screw threads, and standards required in manufacturing. The fund is also to be used to calibrate and test standard gages and screw threads. The sum of \$15,000 is made available for developing methods of testing and standardizing machines, motors, tools, measuring instruments and other apparatus and devices used in mechanical, hydraulic and aeronautic engineering.

Goodyear Industrial University for Employees

It is announced that the Goodyear Industrial University, the first of its kind, was opened at Akron, Ohio, April 17, with an enrollment of 5,700 persons. The classes, which are free, offer 33,000 employees courses ranging from Americanization work to post-graduate studies for college men and women.

Program of the Taylor Society

A tentative program has been announced for the meeting of the Taylor Society, which will be held at Rochester, N. Y., on May 6, 7 and 8. The meeting will be held under the auspices of the Industrial Management Council and the Manufacturers' Council of the Rochester Chamber of Commerce.

The program opens with a reception at the Rochester Club. A series of lectures, visits of inspection to several factories in Rochester and addresses by prominent manufacturers and engineers will form the main features.

LD'S INDUSTRIAL FORGE
News Editor

America in Position to Hold Her Own in Foreign Markets

American Export Manufacturers' Association Expresses Views at Round-Table Discussions

America is in a position to hold her own in the markets of the world, and no further serious curtailment in exports is looked for, according to the consensus at a commodity group luncheon held on April 21 at the Hotel Pennsylvania by the American Export Manufacturers' Association. The subject of discussion was "Present-Day Foreign Exchange Conditions." The opinion of leaders in the discussion was that conditions in the export field were beginning to improve, and that, while severe competition and the erection of tariffs could be expected, the abnormal and unusual conditions now surrounding export trade would gradually disappear.

W. L. Saunders, president of the American Manufacturers' Export Association, presided.

During the luncheon-conference, which was in the nature of an experiment, leaders of the group tables presented the views of the textile, food-stuffs, machinery, leather, iron and steel, drugs, hardware, oils and coal, automobile, typewriter and specialty export interests of the country. Some of the views expressed follow:

Textile exporting interests hold competition abroad and political conditions chiefly responsible for the curtailment in exports, rather than credits.

Steel interests cannot meet the foreign demand for their products.

Machinery people are in the same position as the steel interests.

Coal exporters are ready to ship coal abroad on their own terms, otherwise the foreign customer can leave the coal in this country.

Hardware exporters welcome the present period of temporary curtailment as a breathing spell to catch up with their orders.

Foodstuffs interests predict higher prices unless production is increased.

Specialty people want foreign trade and are considering allocating a certain percentage of their output for export.

The following suggested questions were submitted to be used by leaders of discussion on obtaining the consensus of opinion on the subject of the day among each of the various commodity groups:

1. Have the foreign exports in your line been absolutely stopped or materially curtailed by present foreign exchange conditions?
2. If not, do you anticipate that they will be stopped or materially reduced in the next six months?
3. In what countries do you find evidence of financial recuperation among your customers?
4. Do you think it advisable to accept deposits abroad against invoices?
5. Do you require, or are you advising your foreign customers to purchase futures of exchange?
6. Do you anticipate any general increase on duties or embargoes against your products in foreign countries?
7. Is your company allocating for its foreign business a definite percentage of its total estimated products?

Machinery Men Vary As To Status of Trade

Two speakers reported on the subject of machinery. The first one, C. E. Wilson, export manager of the Worthington Pump and Machinery Co., said for ten firms at his table:

"On the first question two say that there has been no let-up in their business. Six claim that there is considerable curtailment. One claims that it is absolutely stopped. The other says about 80 per cent of normal.

"On the second question eight claim they feel there will be no further reduction. Two claim that it is getting worse and will continue so until exchange materially improves.

"On the third question, it is interesting to note that they vote on the countries as follows in recuperating: Great Britain, 6; Belgium, 8; Scandinavian countries, 2, and the following have one: Holland, Spain, Switzerland, Chile, France, Brazil, South America and Argentina.

"On the fourth question, two of them say 'yes,' and five of them say 'no.' Apparently the difference of opinion here is due to the different conditions that prevail in Europe, the Latin-American countries and the Far East.

"On the fifth question, two of them say 'yes' and eight of them say 'no.' One claims that if our banks would be more liberal on Latin-American credits and not restrict loans to six months, but encourage loans along for about a year at reasonable rates, it would help things in the Latin-American countries.

"On No. 6, three of them say 'yes' and six of them say 'no.' That is, do you anticipate any general increase on duties or embargoes against your products in foreign countries? One says Europe; one says England and France.

"On the seventh question two say 'yes' and seven claim 'no.' One claims that if Russia is encouraged and opened up that will materially help everybody."

L. D. Alvin said for nine concerns represented at his table:

"One concern states that there has actually been an increase in their foreign business, and that the exchange rate has therefore not affectd them seriously. There are three concerns who say there has been no stoppage of their business. The rest say that their business has been materially curtailed.

"There is only one at this table who expects further curtailment of business, due to this cause.

"With reference to the evidence of financial recuperation, the responses are on the basis of financial recuperation in the countries involved, rather than on the part of the customers. Nearly every country outside of our own is mentioned in some way or other as showing financial recuperation.

"Answer to question No. 4, with reference to deposits abroad against invoices, is almost universally 'no.' On No. 5, we agree with the other tables, that we do not advise our customers to purchase futures in exchange.

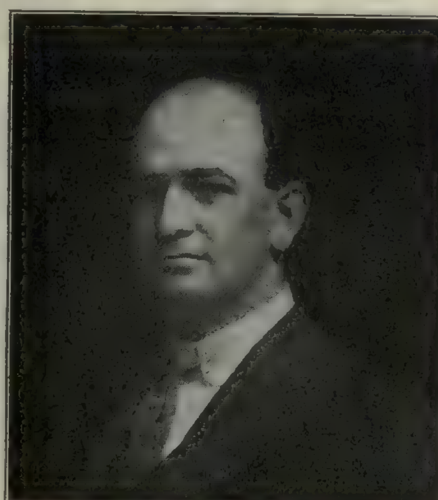
"Part of our members at this table were silent on No. 6. Four of them say that they do not expect duties or embargoes against our products in foreign countries, and one or two suggest that they do expect increases in these duties or embargoes in Australia and in England. Three are allocating a definite percentage of their product to foreign business. Four are making no such allocation, and the rest say they are giving the foreign business the same right of way that domestic business gets with regard to the time their business is received."

New President of the National Metal Trades Association

The members of the National Metal Trades Association are to be congratulated in their choice of Albert E. Newton for president. Mr. Newton is also president of the National Machine Tool Builders' Association and vice president and general manager of the Reed-Prentice Co, Worcester, Mass.

At the meeting of the association in the Hotel Astor in New York on April 22, 1920, at which Mr. Newton was elected president, other officers were also elected as follows:

First vice president, George O. Rockwood, Rockwood Manufacturing Co., Indianapolis; second vice president, W. W. Coleman, Bucyrus Co., South Milwaukee; treasurer, F. C. Caldwell, H. W. Caldwell & Sons, Chicago. The following councilors were elected for two years: Albert J. Ford, Fuchs & Lang Manufacturing Co., New York; A. W. Foote, Foote-Burt Co., Cleveland; J. B. Doan, American Tool Works, Cincinnati; F. E. McKee, Manning, Maxwell & Moore, New York; D. M. Wright, Henry & Wright Manufacturing Co., Hartford; J. W. O'Leary, Arthur J. O'Leary & Sons Co., Chicago; and Paul C. De Wolf, Brown & Sharpe, for the unexpired term of George O. Rockwood.



ALBERT E. NEWTON

Mr. Newton was born in 1878 in Worcester, Mass. To judge from his characteristics, he is a direct descendant of one of the minute men. The fact that he was born in Worcester and not in Lexington does not make any difference. He is a fighter. If it is a scrap in the right cause, Bert Newton is always there. From present indication his new job will be an enjoyable one.

He received most of his education in Lynn, Mass., spending his vacations in the General Electric Works. When he completed the public school work his family moved to Worcester, and Bert began to run a lathe for the Prentice Bros. Co.

When the Spanish war broke out in 1898, he volunteered and was there at the finish. He was spared an untimely death from poisoned-meat microbes, and saw active service in the battles of El Caney, San Juan Hill, and the capture of Santiago. When the war was over he returned to Worcester, again entered the employ of Prentice Bros. Co., working on various machines until 1900, when he shifted to the drafting room.

Yes, he has been an automobile enthusiast since the old "one-lunger" days. He is one of the few men alive who can coax a balky motor back to life, even a Ford on a cold morning, and not brag about it for the next month. And that's some rare accomplishment.

Another National Association Joins Engineering Council

American Railway Engineering Association Joins Council—Harry R. Safford Made Representative

The American Railway Engineering Association has accepted an invitation from the United Engineering Society to become a member society of the Engineering Council. The association has about 1,650 members and its headquarters is at 431 South Dearborn Street, Chicago, Ill. Its president is Harry R. Safford, and its secretary, E. H. Fritch. The excellent technical work done by the committees of this association in many branches of railroad construction and maintenance is well known.

The association has named as its representative on the Engineering Council, its president, Mr. Safford, who is a member of the American Society of Civil Engineers and Engineering Institute of Canada. He was recently appointed assistant to President Hale Holden, of the Chicago, Burlington & Quincy Railroad Co., the Colorado & Southern Railway Co., the Fort Worth & Denver City Railway Co. and the Wichita Valley Railway Co. He was formerly chief engineer of the Grand Trunk Railway, and is well known in Canada, as well as in the United States. Following the severance of connection with the Grand Trunk, he became assistant to the regional Director, U. S. Railroad Administration, Chicago.

The societies now represented in Engineering Council have an aggregate membership of 45,000.

Baker R & L Receives Citation

The Baker R & L Co., Cleveland, manufacturer of Baker electric industrial tractors and trucks, has received official notification of citation by the U. S. War Department for "special effort in rendering valuable service by prompt execution of orders and intelligent cooperation." The citation is given on the recommendation of the Chief of Construction Division and the notice of citation is signed by Major General George W. Burr, Assistant Chief of Staff, Director of Purchase, Storage and Traffic.

Director of Sales Office Appropriation Before Senate

The activities of the Director of Sales promise to be handicapped seriously by the failure of the House Committee on Military Affairs to appropriate more than $100,000 for the conduct of his office. An appropriation of $400,000 has been asked. While it is possible that the Senate may increase the amount, the chances are against any substantial addition.

Trade Currents from New York and Chicago

New York Letter

Little change is apparent in the volume of business reported by the machine-tool trade for the past week over the week previous. Orders continue steady in all lines with woodworking machinery showing the largest gain.

Shipments have improved slightly. New England plants have succeeded in getting some tools through to their local agents by water, and motor truck deliveries have had much to do with relieving the shortage.

Western shipments are weeks overdue with little sign of improvement.

There has been some falling off in inquiries by the manufacturers due to coal and raw material shortages at their plants, but on the whole, business is steady with a satisfactory balance of orders against inquiries being maintained.

It is reported that several large railroad lists originating in the Eastern district are being held in abeyance pending the settlement of labor troubles. The B. & O. has inquiries out for several engine lathes, but the large list expected has not as yet materialized. A number of the roads have purchased some small tools recently. The International Railways of Central America has issued a list through its purchasing agency at 17 Battery Place.

The Long Island Repair and Supply Co., of Brooklyn, has incorporated for $20,000. It will conduct a general machine and repair shop. F. Schippers, and F. C. Kramer, of 3819 Ave. A., are the incorporators.

The Peerless Surfacing Machine Co., of Troy, N. Y., has incorporated for $50,000. L. S. Greenleaf, P. S. Bridgeman, and F. E. Gallagher, of Troy, are the principals.

The Strong Machinery and Supply Co. of New York City, advises an increase of its capital from $60,000 to $75,000.

The Arcadia Trailer Co. of Wilmington, Del., has organized for the production of auto trucks with a capital of $6,400,000. T. L. Croteau, M. A. Bruce, and S. E. Dill of Wilmington are mentioned as principals.

Chicago Letter

Trade conditions remain fairly quiet, though not nearly so much so as was anticipated in view of the railroad troubles with the resultant fuel shortage. It was reasonable to expect that with manufacturers facing the possibility of a forced suspension of operation, due to a lack of coal, they would not be in a buying mood. If local dealers' business was restricted to their own fields it would have been pretty flat for the past three weeks, but the wide range of territory supplied left a large stretch unaffected by the strike. With these troubles being rapidly ironed out, it looks as though April's sales record will be very satisfactory.

The strike has proved to be little more than an annoyance to the trade. Manufacturers all had sufficient raw materials on hand to tide them over the period when no goods were being received and all were able to secure sufficient coal to keep going. The ones worst affected were the dealers, in that the increased time required in shipping goods from factory to customer materially increased the length of time elapsing between billing and receiving remittances. The effect has been to multiply the amount of money necessary for the conduct of business. Recent prosperity seems to have been universally enjoyed, for all dealers have been able to meet the increased demands of their business without trouble.

An indirect effect of all this has been to cause dealers to be a little more exacting in the matter of credit requirements and more careful in seeing that credit obligations are rigidly met. Thus the tendency to tighten credit conditions, which has made itself felt in many other lines in the past sixty days, is making its appearance in the machinery trade.

An event of moment is the recently announced consolidation of the Whitman & Barnes Co. and the J. H. Williams Co., under the presidency of J. H. Williams. The general offices of the new concern will be located in Buffalo, N. Y. With their plants in Brooklyn, N. Y., Buffalo, N. Y., St. Catherines, Ont., and Chicago, Ill., they will have the largest capacity for drop-forgings of any concern in the country. No change in their output of tools is announced.

Mobile Machine-Shop Units to Be Used for Road Building

The Secretary of War is directed, in a bill just introduced by Representative Reavis of Nebraska, to turn over to the Department of Agriculture for distribution among the states, for use in road building purposes, 200 mobile machine-shop units, as well as shop machinery and machine tools suitable for repairing and rebuilding motor-propelled vehicles. The Bureau of Public Roads is particularly anxious to gain possession of the mobile machine shops. It is thought that these plants, which were constructed for war purposes, will be of particular service in the road-building campaign.

Waterloo Gasoline Engine Co. to Erect Four Buildings

The Waterloo Gasoline Engine Co., Waterloo, Ia., has completed its plans for the erection of four new buildings with a total area of 90,000 sq.ft. There will be a foundry building 120 x 200 ft., of structural steel construction, steel sash, wire glass and cement tile roofing. This building will add a capacity of 40 tons per day to the present output. Other buildings will be a cupola building, a service and core room building, and a casting cleaning or mill building. The cupola building will centralize all melting and will be of reinforced concrete construction 40 x 40 ft. three stories in height. There will be four cupolas, each with a capacity for melting 15 tons of iron per hour, and the building will be fully equipped with mechanical means for handling of the pig iron and other raw materials which go into these cupolas. The service and core room building will be 100 x 200 ft., three stories in height, reinforced concrete construction, with steel sash and an abundance of glass. The first story will be used for storage and mixing of core sand and storage of finished cores. The second story will be used for a pattern shop and pattern storage, and the third story will be used exclusively for the making and baking of cores. Full equipment of core ovens and modern machinery for proper handling of material and finished cores will be installed. The fourth building, the casting cleaning, or mill building, mill be 80 x 180 ft., one story high, steel construction. This will be fully equipped with modern machinery for handling and cleaning of castings economically and efficiently. In addition to these buildings there will be added a larger foundry storage yard for storing sufficient material to run the foundry for several months. Railway tracks, cranes and handling material are included in the plans.

The company's faith in the growth of the tractor and farm-power business in the near future and its steady and healthy growth as well as the desirability of a distributing center in a vast farming area has impelled it to make these extensive improvements toward bui ing up one of the most modern plants in the tractor industry. The cost of the improvements will be over half a million dollars.

Silver Jubilee of Manufacturers' Association

With a diverse program, featuring numerous public problems with which industry is corelated, the National Association of Manufacturers will hold its "Silver Jubilee" Convention in New York City on May 17, 18 and 19. Headquarters will be established at the Waldorf-Astoria. International problems, immigration, labor and financial conditions will be among the subjects under discussion.

Farmers and their problems will come in for a great deal of consideration and discussion. The manufacturers are desirous of hearing from the farmers at this time because it will be an excellent opportunity to present "the common problems of the farmers and the manufacturers." The manufacturers want to obtain the farmers' viewpoint on matters of interest to both.

Second Annual Convention of Industrial Relations Association

Beginning on Wednesday, May 21, and continuing for two days thereafter, the Industrial Relations Association will hold its annual convention at Chicago, Ill. The auditorium theater will be the scene of the gathering, which will include representatives of all the important manufacturing and mercantile establishments in the country. Several prominent speakers have been secured and a list of subjects has been prepared covering a wide range of thought. Labor and wage conditions and the ways and means of creating a better understanding between the employer and the employee are some of the most important subjects to be considered. Philip J. Reilly, of the Retail Research Association of New York, and president of the National Organization, will preside at the main sessions of the convention.

New Washington Gun Factory Assistant Superintendent Appointed

Orders have been issued at the Navy Department assigning Captain J. J. Raby, U. S. N., now in charge of the office of ship-movement operations, Navy Department, to succeed Captain McVay as assistant superintendent of the Gun Factory, Navy Yard, Washington D. C. and Captain of the Yard. Captain McVay succeeded Rear Admiral A. W. Grant, who was retired recently.

Captain Raby was born in Michigan in 1874 and graduated from the Naval Academy in 1895. During the war Captain Raby was in charge of the escort of 142 ships bound for Europe and while in command of the "U. S. S. Albany" he commanded the first mercantile convoy to cross the Atlantic under American escort. Later in command of the "U. S. S. Georgia," Captain Raby brought home the first load of our soldiers to be transported from France on a battleship.

Obituary

Roger C. Sullivan, chairman of the Board of Directors of the Independent Pneumatic Tool Co., Chicago, Ill., died April 14.

William H. Farrell, president of the Bridgeport Screw Co., Bridgeport, Conn., died at his home in Sound Beach, Conn., on Sunday, April 18, from heart disease. Mr. Farrell was 56 years old. He was a brother of James A. Farrell, the steel magnate of Philadelphia. Previous to establishing the Bridgeport Screw Co. in 1911, Mr. Farrell was president of the Dominion Wire Manufacturing Co., of Montreal, Can. A wife and a son, Ralph G., general manager of the Screw Co., survive him.

Daniel W. Sisson, New York manager of the Phoenix Iron Works, died recently in Asbury Park, N. J., from heart disease. Mr. Sisson was in his sixty-fifth year.

Theodore Newton Vail, chairman of the board of directors of the American Telephone and Telegraph Co., died on April 16 in the Johns Hopkins Hospital. He had for some time been in ill health and came to the hospital two weeks ago from his winter home on Jekyl Island for a slight operation, which was expected to give him relief and restore his health.

Personals

Seymour de B. Keim, manager of the New York branch of the Locomobile Co., of Bridgeport, Conn., has resigned, and will become general sales and advertising manager for the Rolls-Royce, Ltd., of England, maker of the famous Rolls-Royce cars, and will be stationed at the new plant at Springfield, Mass. Mr. Keim has been with the Locomobile Co. for the past twenty years.

Charles E. Nystrom, master-mechanic of the Wright Works, of the Wickwire Spencer Steel Corporation, Worcester, Mass., has been appointed assistant superintendent of the Hammond St. plant of that company. Mr. Nystrom will perform both duties from now on.

F. A. Bennett, secretary of the Manufacturers' Association, of Bridgeport, Conn., has resigned this position, which he has held for the last twelve years. Mr. Bennett has entered into partnership with E. E. Seeley in the businss of foundry and electroplate supplies, with a plant at 823 Railroad Ave., Bridgeport, under the firm name Bennett & Seeley.

Philip James, formerly assistant sales manager of the National Manufacturing Co., of Worcester, Mass., subsidiary of the Wickwire Spencer Steel Corporation, is now with the Hobbs Manufacturing Co. of Worcester, Mass.

Frederick C. Hill has been chosen as secretary of the Bridgeport, Conn., Manufacturers' Association, replacing F. A. Bennett, resigned.

T. P. Cunningham, formerly sales manager of the transmission department of the Hyatt Roller Bearing Co., Newark, N. J., is now president of a newly formed corporation, the Lincoln Products Corporation, Newark, N. J.

William V. Lowe, for several years sales engineer with the Hess Bright Co. and recently with Manning, Maxwell and Moore, Inc., at the Putnam Machine Works has entered the employ of the Easton Machine Co., South Easton, Mass., as sales engineer.

Otto A. Yingling, formerly with the Washington Steel and Ordnance Co., is now connected with the Ward Tool and Forging Co., Latrobe, Pa., as general superintendent, having taken charge of his new position April 1, 1920.

A. F. Orcutt, at a recent meeting of the directors of the Rivett Lathe and Grinder Co., Brighton District, Boston, Mass., was elected president and general manager. Prior to his election he served as vice president and general manager.

Henry P. Blumenauer, formerly sales manager of the Eastern Malleable Iron Co., Naugatuck, Conn., has become president and general manager of the Arcade Malleable Iron Co., Worcester, Mass. Previous to his position with the Eastern Malleable Iron Co., Mr. Blumenauer was for a time with the Standard Oil Co., as manager at Calcutta, India.

The Fafnir Bearing Co., of New Britain, Conn., manufacturer of ball bearings, has recently completed an addition to its plant which will give an additional 7,000 sq.ft. of floor space for manufacturing purposes.

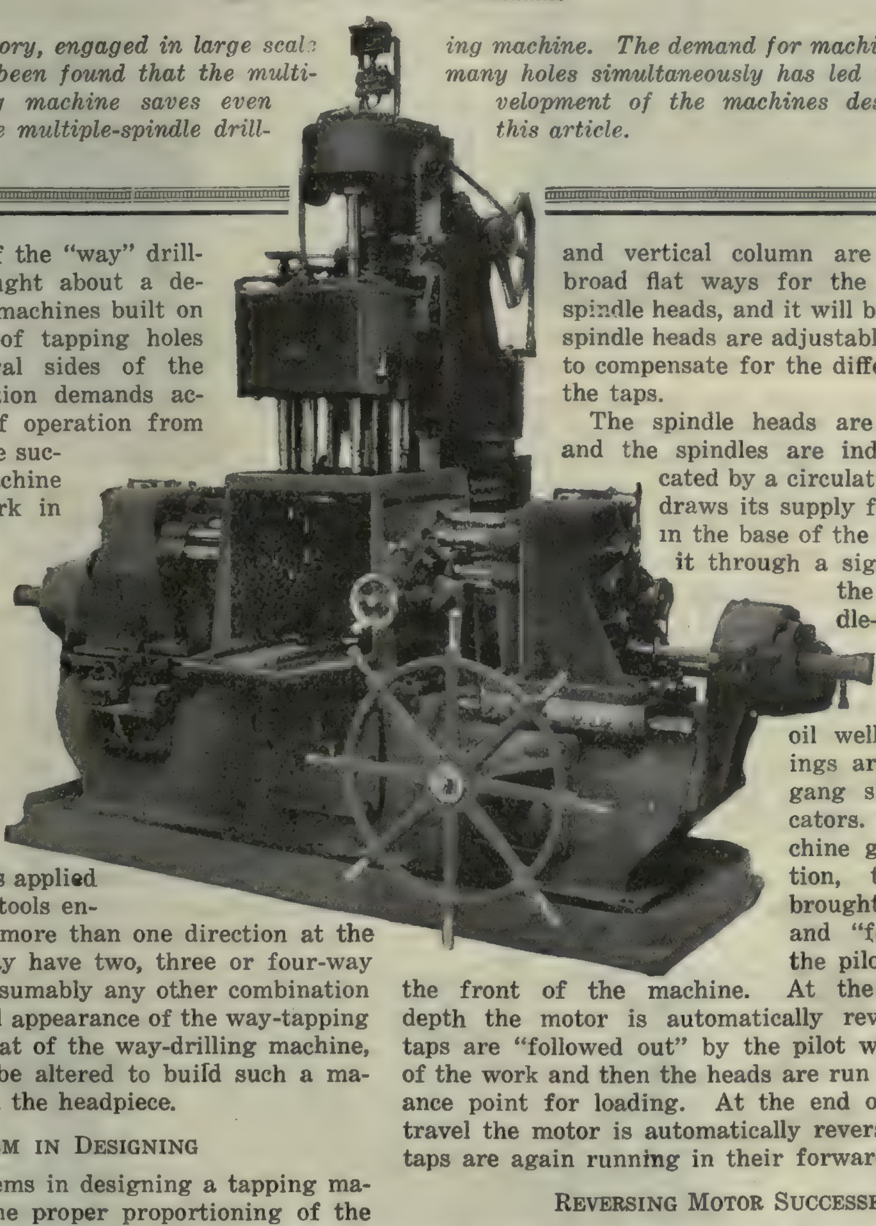
Frank Metcalf, of the production department of the Wright Wire Co. division, of the Wickwire Spencer Steel Co., of Worcester, Mass., has been promoted to chief clerk of the company.

May 6, 1920 — American Machinist — Vol. 52, No. 19

Foote-Burt "Way" Tapping Machines

By J. V. HUNTER
Western Editor, *American Machinist*

In the modern factory, engaged in large scale production, it has been found that the multiple-spindle tapping machine saves even more time than the multiple-spindle drilling machine. The demand for machines to tap many holes simultaneously has led to the development of the machines described in this article.



The development of the "way" drilling machines brought about a demand for tapping machines built on a similar plan capable of tapping holes simultaneously in several sides of the work. Quantity production demands accuracy and reliability of operation from all machine tools, and the successful way-tapping machine must be up to the mark in these requirements. It has been necessary to design each type of machine as an individual engineering problem, and the machine which the Foote-Burt Co., Cleveland, Ohio, has built for this service typifies the individual character of the construction required. The designation "way" is applied only to machines whose tools enter a piece of work in more than one direction at the same time; thus we may have two, three or four-way tapping machines or presumably any other combination if required. The general appearance of the way-tapping machine is similar to that of the way-drilling machine, but many details must be altered to build such a machine as is illustrated in the headpiece.

A Problem in Designing

One of the real problems in designing a tapping machine of this class is the proper proportioning of the gears so that a large number of holes of different sizes and pitches of thread may be tapped at the same time.

The sizes tapped by the same spindle head may range from as large as a $1\frac{1}{8}$ in. down to a $\frac{1}{4}$ in. hole. It is stated as an interesting feature of this class of work that the use of a large size tap in a spindle head adds to the success of the results obtained from the smaller taps that may be in use at the same time, since the larger tap tends to pull the smaller ones more uniformly into the work.

The drive for the spindles is carried through a main shaft to a separate reduction gear in a housing on the frame at the rear of each spindle head. Both the bed and vertical column are provided with broad flat ways for the saddles of the spindle heads, and it will be noted that the spindle heads are adjustable on the saddles to compensate for the different lengths of the taps.

The spindle heads are fully inclosed, and the spindles are individually lubricated by a circulating pump which draws its supply from a reservoir in the base of the head and forces it through a sight-feed oiler to the top of the spindle-head body. Oil-level indicators are provided for all oil wells. Other bearings are lubricated by gang sight-feed lubricators. When this machine goes into operation, the taps are brought up to the work and "followed in" by the pilot handwheel on the front of the machine. At the predetermined depth the motor is automatically reversed, and the taps are "followed out" by the pilot wheel until clear of the work and then the heads are run back to a clearance point for loading. At the end of the clearance travel the motor is automatically reversed, so that the taps are again running in their forward direction.

Reversing Motor Successful

The reversing motor has been found particularly adapted for this machine, and has been used with marked success. However, the usual switch control methods for reversing the motor were not found sufficiently positive in operation, and on request a special electrical reversing mechanism was developed by the Electric Controller & Manufacturing Co., Cleveland, Ohio, which eliminates mechanical and depends entirely upon electrical control and is very positive in its action. A view of one of these controllers, Fig. 1, shows the two contact boxes *A* and *B* which provide for the forward and reverse motion of the motor. Adjustable stops *C* and *D* sliding in a T-slot on the base of one of the spindle heads, make suitable contact with the control arms of these switches, pushing

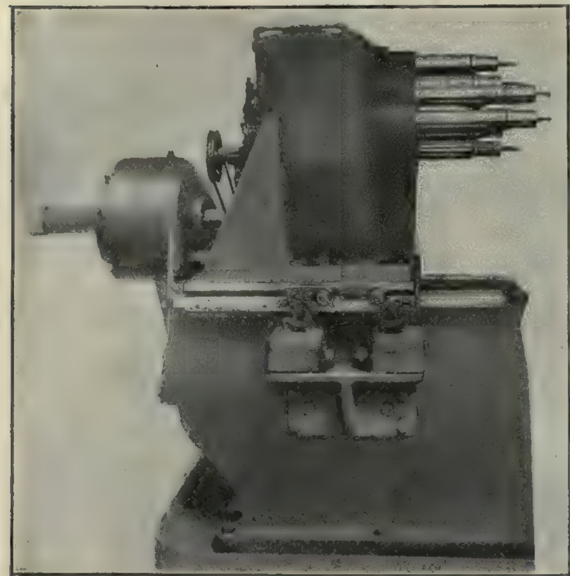


FIG. 1. AUTOMATIC ELECTRIC CONTROL FOR REVERSING MOTOR

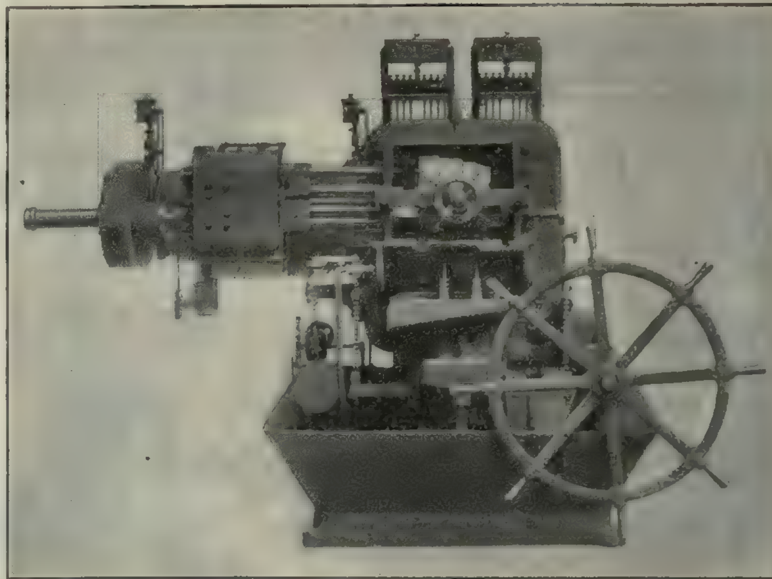


FIG. 2. TWO-WAY TAPPING MACHINE WITH INVERTED HEAD

them down as the spindle head moves forward and back.

The drive motor can be stopped at any point whether going forward or back by a push-button control. This is only used for stopping or starting the machine, or stopping it quicklv in case of accident.

A Two-Way Machine

In Fig. 2 is shown a two-way tapping machine which is provided with an inverted spindle head, so that the casting shown in place in the jig may be tapped without inversion, thus making it easier to handle. It is not always advisable to tap from underneath and in another tapping machine, Fig. 3, the cylinder block casting is inverted before being placed in the machine. The use of either of these systems depends upon the judgment of the production engineers who are planning the routing of the work through the shop.

For belt-driven machines mechanical control is provided for the reversing motion and Fig. 4 shows the side of a machine of this type with its forward and reverse belt pulleys, together with a portion of the mechanical shift that is employed. The spindle-reversing motion is controlled by a special lever connected with the clutch which is automatically tripped when the taps have reached their proper depth. These are again automatically reversed into the forward direction upon the return of the head slides to the clearance position.

Power for Reversing

While the head slides are returning to the work they draw up the lower weight shown, and its fall when tripped at the proper instant by a dog, furnishes the necessary power for reversing the clutches. This reversing motion is rapid and permits tapping very close to the bottoms of the holes.

The tapping machines so far described have their spindle heads in the vertical or horizontal planes, but in Fig. 5 we see a machine in which both spindle heads are inclined at an angle of 45 deg. Both spindle heads are counterbalanced by weights.

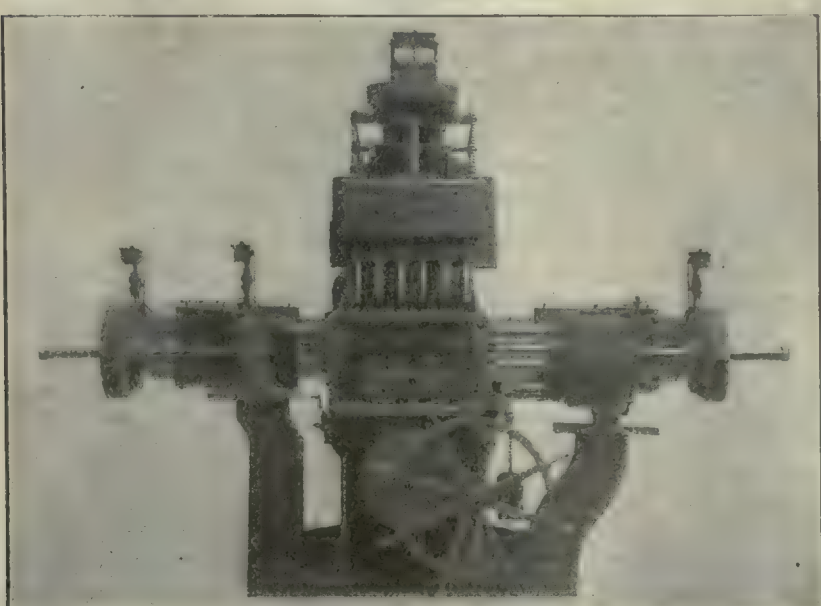


FIG. 3. A THREE-WAY TAPPING MACHINE

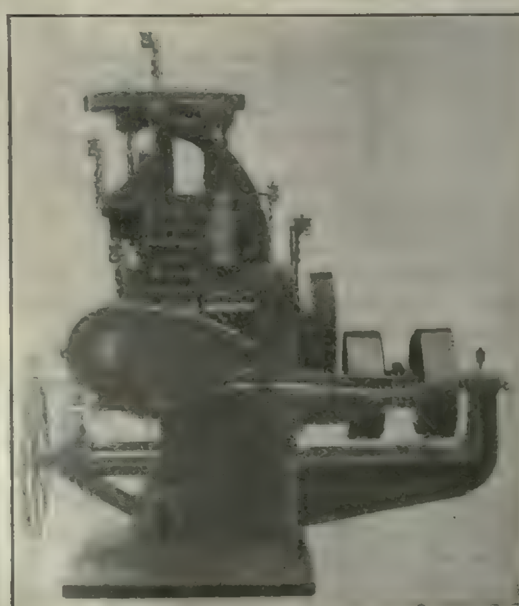


FIG. 4. MECHANICAL CONTROL OF BELT-DRIVEN MACHINE

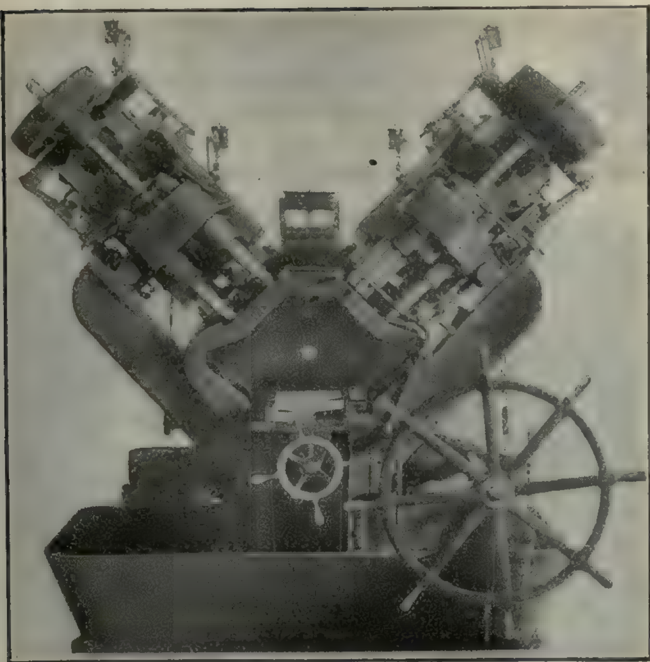


FIG. 5. MACHINE WITH TWO INCLINED SPINDLE HEADS

A three-way tapping machine with one similarly inclined spindle head is shown in Fig. 6, and a cylinder block lying in the fixture reveals the job upon which the machine is employed. The reader will note the guide bar which fits in the crankshaft bearings and aligns the cylinder block. In the last mentioned models it will be noted that the inclined spindle heads are each equipped with a roller running on a guide plate. This supports the out-board weight of the spindle head.

Broaching the Recoil Cylinder of the 4.7-In. Gun

By M. E. Infiorati

One of the problems that presented itself as a broaching possibility during the war was the finishing of the recoil cylinder of the 4.7-in. field and anti-aircraft guns. The length of this cylinder for the field gun is 86 in. and this fact alone seemed discouraging when it was considered as a broaching proposition.

The ordinary method of machining by planing on a special automatic indexing fixture would have been very difficult as at no time could the tool be seen in operation, and the degree of accuracy required was such that a few thousandths deflection of the bar which held the tool would result in a rejected cylinder which might sometimes have had seventy hours of labor expended upon it.

Then, too, resetting would be almost impossible if it were undersize, while if oversize it would have to be scrapped anyway. Regardless of the cost of production, time was the most vital element, as the guns were needed and any delay would be serious.

After making arrangements with the Government arsenal for experimental work, we proceeded as follows: It was first made sure that the 3¼-in. hole was reamed to exact size, within plus or minus limits of 0.001 in. the entire length of the cylinder; this was necessary as the broaches were designed to guide with a very snug fit in this hole to avoid drifting.

A special machine with a stroke of 106 in. and of

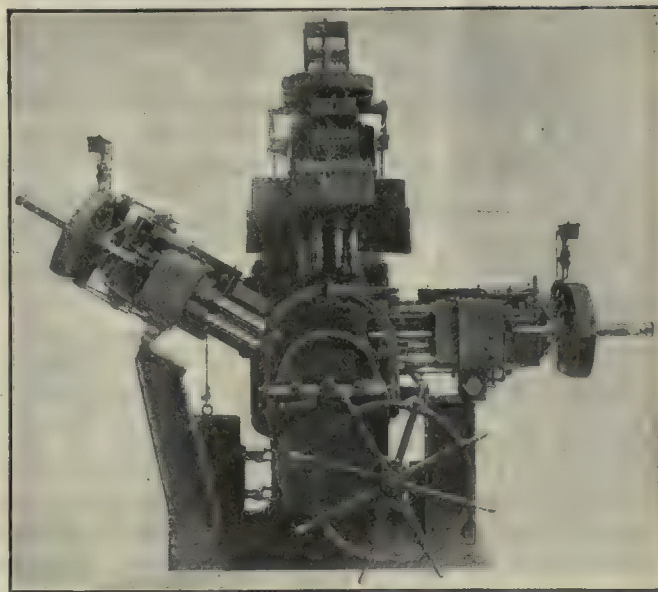


FIG. 6. THREE-WAY MACHINE WITH INCLINED SPINDLES

sufficient pulling capacity was fitted with a suitable fixture for holding the cylinder in alignment, and provision made to get proper lubrication to the broach while cutting. This latter was obtained by inclosing the broach in a pipe at the end of the fixture, and was arranged to be disconnected from the fixture by a quarter turn. The set-up, together with section of the cylinder, is shown in Fig. 1.

With the pipe removed, the broach was connected to the pull shank and pushed in place up to its first cutting tooth. The pipe was then connected to the fixture and the lubricant turned on through the pipe at *A*.

After unsuccessfully trying several lubricating compounds, a first-class grade of lard oil was settled upon. It was supplied from a pump which was directly connected to the countershaft and filled the entire tube

FIG. 1. LINE DRAWING OF CYLINDER SET-UP FOR BROACHING

surrounding the broach. It will be apparent that at all times the broach teeth were completely flooded both at the top and bottom with lubricant—an unusual condition in broaching. To this ideal lubrication we attribute the finish obtained.

The broaches were designed with a groove the entire length of the body to allow the lubricant to flow through while cutting, forcing the warm lubricant out through the front end and keeping the broach supplied with fresh, cool oil. The lubricant was supplied at a temperature of 48 deg. F. and the outflow registered 59 deg. The feed was approximately 5 gal. per minute.

The design of broaches offered several problems such as pitch of teeth, undercut, cut per tooth, chip clearance, etc. The pitch and depth of teeth were designed after figuring the amount of solid material to be removed by each tooth. The thickness of chip per tooth and undercut were governed entirely by past experience on the broaching of similar material. It was decided that a set of forty-eight broaches would be necessary to complete the total depth, which was ½ in., the width across the bottom of each flute being about 2½ in. Approximately 320 cu.in. of metal had to be removed.

Impossible to Determine Pull for Broach

There was no possible way in which we could determine the pull required for each broach, but it was very apparent, knowing the behavior of the machine, that it was pulling close to 95,000 lb.

The cylinder remained very cool while broaching, and the chips were rolled very smoothly, many in lengths exceeding 18 in. x ½ in. wide. The finishing broaches cut the entire width of splines as shown, sizing the hole to proper diameter and burnishing.

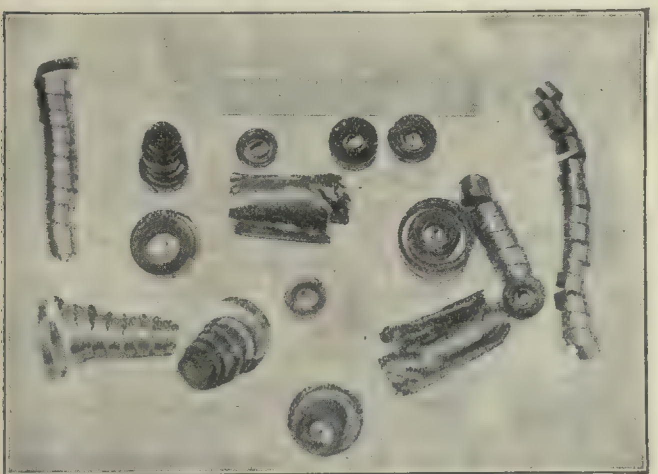


FIG. 2. CHIPS PRODUCED BY THE BROACHES

Upon the final inspection by the Government inspectors it was found, by the use of the star gage, that the outside diameter of splines were plus 0.0005 in. in some spots and to size in others, which was within the tolerance allowed.

It was thought that because of the work being so long the broaches would not retain their size for many cylinders, but reports show that 300 cylinders were broached by one company using this method and the broaches showed less than 0.0005 in. wear on the outside diameter.

The Time Required for Broaching

The time required for broaching the complete cylinder was 6½ hr. and assured interchangeable product; while the time required for machining by other methods was 67 hr. without any assurance of interchangeability. It was not necessary that the men who handled the broaching be first-class mechanics.

Some of the chips removed by the broaches are shown in Fig. 2.

"Notice that the first part of manager spells 'man'."
—*Forbes Magazine* (N. Y.).

Arc Heating in Ship Repairs

By I. B. Rich

The growth of the use of the electric arc in shipbuilding and repair work is quite a surprise to those who have not kept pace with it. As an example, the electric welding barge of the Alabama Drydock and Shipbuilding Co., of Mobile, Ala., shows to what an extent this has become a part of shipyard equipment. This barge contains a whole power plant, consisting of an internal combustion engine and a large generator and can be towed to any part of the yard so as to have the power readily available.

FIG. 1. ARC WELDING POWER PLANT

Fig 2 shows the bow of a ship which is having a number of plates replaced, and here the electric arc plays an important part in cutting out rivets and in other ways, taking the place of the hammer, chisel and punch of the older methods.

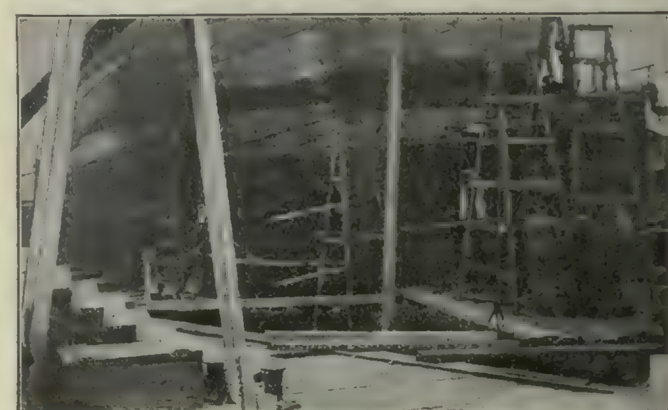


FIG. 2. THE ARC IN REPLACING PLATES

A booklet entitled "Public Utilities, City of Nitro, West Virginia," has been issued by the Charleston Industrial Corporation, which is operating the city of Nitro at the present time. The booklet gives a technical description of the public utilities of Nitro, which were planned for a city of 35,000 before the city was actually built. Besides numerous illustrations of the power equipment and the public utilities, maps showing the layouts of the water, electric, fire alarm, sewer and railroad systems are given.

A Comparative Test of High-Speed Steels—I

BY A. J. LANGHAMMER, M.E.
Industrial engineer, Thompson & Black, engineers and accountants, New York and Detroit.

In the last sixteen years the use of high-speed steel has grown from practically a metallurgical and manufacturing experiment to what is today one of our most important economic and industrial factors. The principal reason for its wide application is the rapid growth of quantity production methods as applied particularly to the automobile, machine tool and allied industries, and the introduction of scientific management in these works.

TODAY there are dozens of brands of American-made high-speed steel on the market, and in the last eight months some of the famous English brands have again made their appearance. British-American brands too are very much in evidence, particularly in the crucible mills. Both electric-furnace and crucible steels are well represented, though the latter are still very much in preponderance.

High-speed steel selling methods of today leave very much to be desired. In general, the steel is sold by voluble salesmen who know nothing of their wares, have never been in a steel mill, and have never graced the floor of a machine shop. Fortunately, there are always some saving exceptions. It is indeed astonishing how little the average steel salesman knows of his product. If an interview is granted him, he begins by nonchalantly announcing that his brand is the best in the market, and that he can increase your production anywhere from 50 to 100 per cent, or more. When pressed for supporting data, he refers you to a local machine shop or some large manufacturer out of the city. During the war, Government plants and arsenals were quoted elaborately as using solely his steel. If you took the trouble to investigate, it would invariably develop that the particular brand in question had never been used, or that a small sample had been left gratis by the salesman for test purposes. Usually the test disclosed a mediocre or even a poor steel. The damage done to the steel company by such misrepresentation is almost immeasurable, for though it may later improve its product or even bring forth a superior brand, you still retain that bad taste from the interview and are suspicious, if not antagonistic.

SPECIAL SAMPLES PREPARED FOR TESTS

Sometimes you meet in steel salesmen a canny old-time mechanic who has forced his way into the selling business and who is wiliness personified. If such a man is permitted to have a hand in directing the test, and the man in charge of the test is not himself an expert, then the result is never in doubt. The steel that the "old-timer" represents will win out.

High-speed steel salesmen often have access to a supply of specially-prepared steel for test purposes. At the mills a heat may be prepared which has the best possible composition and subsequent workings and heat treatments are very carefully performed. When this practice is not followed, a batch of "regular run" steel that has shown exceptional performance under test is retained for test purposes only. Obviously, when the steel company begins to fill orders, it will ship from the regular run of stock, which is inferior in quality to the "special" bar submitted for test purposes. In justice to the steel manufacturers it must be said that such practices seldom or never reflect the true policy of the companies represented (or misrepresented).

Most steel companies, too, manufacture several grades of high-speed steel. One of the grades is usually superior to all of the others and is the best steel that experience and careful manufacture can produce. This steel is then used for test purposes and should it win a place when the final selection is made, great care must be exercised to see that the "best grade" is received on subsequent shipments and not specimens of the poorer grades.

HIGH COST OF CHEAP TOOL STEEL

Much is found wanting in the average buyer or specifier. In most plants the purchasing agent decides on the brands, and he is naturally gullible on this subject. His decision is usually based on price, which to him is all important, while in reality it constitutes practically a negligible item. Then, too, if market conditions seem to warrant, as they do in recurring stress periods, he will buy as much high-speed steel as he can and of every available brand. In this way his errors are multiplied, for not only does he get steel which is primarily poor, but also such rejected stock as has been accumulated by the steel salesmen.

Under modern manufacturing conditions it is of utmost importance to know the comparative capabilities of the various brands of high-speed steel on the market. This applies to the small machine shop as well as the giant works. As stated above, the first cost of the raw material in a high-speed tool is practically negligible. This is true because the labor cost for the machining of such a tool is usually several times that of the raw material. Also, when a tool is made up of an inferior grade of steel, it may be scrapped after an attempt at hardening before it ever gets into the shop, thus producing an immediate combined loss of indirect material, labor and overhead. If the tool should successfully pass through the hardening room and subsequent inspection into the machine shop, trouble at once begins. Production is decreased, more work is incurred for the machine operator and tool grinder due to the increased tool changes, and costs increase accordingly. Spoilage or scrap also takes a jump and the costs increase again.

When the capabilities of certain brands of high-speed steel are to be determined, it is imperative that the test be conducted under the constant supervision of a competent observer. This man need not be a technical graduate, but he should be a good mechanic and in addition he must possess the mental and moral qualities that permit him to follow instructions explicitly. The man in charge of the test, however, must be familiar with all the variables that affect the life of a cutting tool. He can then correctly plan the complete details of the test which will be executed by his subordinates. One of the reasons that large quantities of relatively poor high-speed steel are used annually is that such tests are conducted by incompetent men.

In addition to the objection to the use of a large num-

ber of miscellaneous brands of high-speed steel noted two or three paragraphs back, there is that of difficulty in heat treatment. A standard method of heat treatment is all-essential for uniformly good results. Mediocre or poor grades of steel do not in general permit high heats and must be treated accordingly. If the next tool is made of a good steel which must be subjected to a high heat for best results, the chances are very much against its proper hardening, and the result is confusion, increased difficulties, more work, and finally a general run of poor tools. When quantity production methods are employed, as for example in a cutter or twist drill plant, these bad conditions are considerably augmented.

With a selection of brands that permit a uniform heat treatment, the tool hardener has an ideal condition and his work will show results.

Carbon Steels

Carbon tool steel, which was the earliest form of cutting steel used in machine shops, is now used only in relatively small quantities except in cutting non-ferrous metals and non-metallic materials. It has a wide and universal application, however, for hand tools such as chisels, punches, dies, shear blades, cutlery, broaches, hand taps and reamers, etc. Large quantities of plain carbon steel are also used for forging dies, hammer dies and machinery parts, though in these instances elements that promote toughening, resistance to wear and shrinkage are usually added to the alloy. As a cutting tool it fails because of the low duty that can only be exacted and the premature dulling of the cutting edges.

Self-Hardening Steels

Mushet, or self-hardening, tool steel (so called from the name of its inventor) was the immediate successor of carbon tool steel. This steel usually contained from 6 to 9 per cent of tungsten, 2 per cent of manganese, and a high percentage (about 2) of carbon. With the introduction of Mushet steel, cutting speeds were increased about 60 per cent, and this record stands out as one of the most notable achievements of that time, though not fully exploited. Today this steel is obsolete, but it was of extreme usefulness in that it formed an indispensable link in the development of modern high-speed tool steel. It is an obsolescent product because practice today demands a cutting speed far in excess of its capabilities.

High-Speed Steel

Self-hardening tool steel was the immediate predecessor of high-speed tool steel. The composition of the average high-speed tool steel (by actual analysis of sixteen different brands) is as follows: carbon, 0.60 to 0.70 per cent; tungsten, 16 to 18 per cent (although one or two brands go as high as 22 per cent); vanadium, 0.75 to 1.05 per cent; chromium, 3 to 4 per cent. In addition to these "standard" elements, some brands contain also uranium, cobalt, manganese and molybdenum. Sulphur and phosphorus average from 0.02 to 0.04 per cent and the same minimum amount of silicon is generally present.

High-speed steel enabled an increase of about 400 per cent in cutting speed over Mushet or self-hardening steel. The feature wherein the tools made from this steel differ from and exceed in performance the tools made from the preceding steels is their ability to maintain a sharp, strong cutting edge while heated to a temperature far above that which would cause "failure" or "breaking down" of the cutting edges on tools made of the simple steels. As a matter of fact, the sharp cutting edge is maintained until just a short time before failure occurs. Carbon steel tools, on the other hand, show wear or dullness of the cutting edge as soon as they are put to work. The heat generated by the friction of the chips on the tool when cutting steel, plus the pressure, is great enough to weld small bits of the chip to the tool at some distance (depending principally on the depth of cut) back of the cutting edge proper and to wear a groove into the lip surface. The property of being able to retain hardness and cutting ability at a red heat is termed "red hardness." In the early days, the principal objection to high-speed steel was the apparent inability to produce a good finish. This handicap was largely imaginary and not well founded, for in the general run of work no such difficulty is experienced.

Stellite

As self-hardening tool steel was supplanted by high-speed tool steel, so the latter will in some cases give way to stellite where this alloy is applicable. Stellite is made up of approximately 65 per cent cobalt, 25 per cent chromium and 10 per cent molybdenum. It is extremely hard, quite brittle and possesses the quality of red hardness to a very marked degree. On cast iron, stellite has a cutting speed of 100 per cent above high-speed steel, while on bronze it may run as high as 700 per cent faster. On soft steel, honors are about even, depending on conditions. Stellite, however, is not adaptable even to cast iron or bronze when the tool is subjected to sudden shocks, on account of its brittleness.

Much work is being done in developing both stellite and similar alloys, but to date none of the rival products tested by the writer have equalled stellite in performance or adaptability. The range of utility of stellite is greatly increased, due to the fact that small rectangular or square sections can be readily welded in an electrical welder to large steel shanks, which arrangement gives a high-duty tool of low cost. The same procedure, of course, is applicable to high-speed steel.

Cast Tool Steels

Within the last two years several very promising brands of "cast high-speed steel," both air- and oil-hardening, have been produced in this country. In some cases the alloy has a composition very similar to that of a good brand of high-speed steel, while in others no tungsten is used. Distinct advantages are claimed which greatly reduce factory costs. Thus it can be cast readily into almost any intricate shape such as dies for presses, milling cutters, core drills, form cutters and other special high-duty working and cutting tools. These castings, which usually anneal readily and machine easily, require but a small percentage of machining as compared with the tool made from a solid bar, whereby the labor cost is reduced very appreciably.

When placed in actual operation, some of these tools have produced as high as ten and twenty times as many parts as a regular high-speed steel tool on the same task, with the consequent saving in costs. Milling cutters made of such cast high-speed steel have been seen by the writer in use, and their performance appeared to be excellent. In this case, however, the duty was not very heavy, though the cutting speed was high, so that

too much importance could not be attached to the one demonstration. Cutters of such material and of intricate design were at once ordered by the author's firm, but to date they have not been tested. In view of the recorded successes of "cast" high-speed steel and the large amount of experimental work that is being done with it, developments of extreme importance can be expected in the near future. This is the more interesting because the idea of casting high-speed steel is diametrically opposed to one of the fundamental requisites of a good high-speed steel, which is that the ingots must be of sufficient size that the proper reduction in area occurs in the working, with the resultant refined structure and hardy constitution.

English Brands

English steel makers are doing a great deal of work on high-speed steel, supposedly in an effort to produce a superior grade. As their efforts are chiefly confined to securing a substitute for tungsten, their object is probably to produce a cheaper steel. Molybdenum (already exploited by American metallurgists and discarded) is understood to be the principal element that is receiving their attention. Cobalt, too, is being thoroughly investigated, although both these elements are at the present time more expensive than tungsten. One English manufacturer has actually brought out a so-called "tungsten-less" high-speed steel that is being offered at an unusually attractive figure. In an actual cutting test, when run against a good brand of high-speed steel, it proved a failure. There may be quite a market for such a product, however, where a cheap cutting steel is desired for limited performance, or even for general work on aluminum, brass, or such easily machined metals. Again, this steel may be vastly improved, thereby increasing its usefulness.

Influence of Chemical Composition

It has been the writer's experience that the analysis of a particular brand of tool steel is but an indicator as to its ultimate capabilities. By this is meant that just because a high-speed steel has 18 per cent tungsten and other elements in proportion, it cannot be classed as a good steel on this basis alone. If, on the other hand, the analysis shows the presence of but 10 to 12 per cent tungsten, and no other substituting element, then one can readily assume that it would be a waste of time and money to investigate further such a steel. Since, broadly speaking, analysis does not in any way guarantee the performance of a tool, it is a grave mistake to order or purchase high-speed steel on the basis of specified composition only, which unfortunately is practiced by some large manufacturing industries. During an efficiency test, one of which is later described, it was always our policy to impress carefully upon the steel men that to us, chemical analysis as such meant nothing except as an indicator; the final requisite was that subsequent shipments of high-speed steel duplicated or closely approximated the performance of the test specimen. This usually served a good purpose, for not only would the salesman instruct the mill to inspect rigidly the first large shipment that was sent, but he would emphasize this point from time to time, because he knew that the steel would be subjected to a "check" test and the performance would have to be good.

The qualities ascribed to the various elements contained in high-speed steel are as follows, it being understood when discussing one that the other requisite elements are present in proper proportion:

Tungsten

Tungsten has long been credited as being the most valuable element in high-speed steel. The principal characteristic is that with a moderately rapid rate of cooling from high temperatures, tungsten steels are exceptionally hard, and this hardness is retained even when the steel is again heated to a high temperature, because it offers a strong obstruction to the various changes from austenite to pearlite. This element, too, is very heavy, its specific gravity being about 19.3, it apparently diffuses very slowly, and in addition it is the most infusible element in steel with the exception of carbon. It is these three factors that may cause considerable trouble, especially in the crucible process, if in charging the tungsten is not placed at the top of the mixture so as to counteract in a measure its tendency to settle. If this tendency were not counteracted, an ingot of irregular composition would result. Tungsten raises the strength of the steel and also the temperature of fusion.

Vanadium

The effect of vanadium is to increase the hardness or red-hardness of cutting tools and also the resistance to wear. It has a strong affinity for oxygen and therefore probably acts to good advantage as a purifier. Vanadium greatly increases the strength of steel up to a certain percentage, though this limit is usually exceeded considerably in high-speed steel to get the effect of red-hardness.

Chromium

The effect of chromium in high-speed steel is to increase the hardness or red-hardness and also the life of the cutting edge. It also adds strength and especially toughness, thereby increasing the ability of the tool to withstand shocks and sudden strains. European steels, due presumably to their relative cheapness, use as high as 10 per cent of chromium.

Molybdenum

The use of molybdenum as a major constituent has in general been discontinued. High-speed steel with a goodly proportion of molybdenum is generally characterized by irregular performance, which is said to be due to the ease with which it is volatilized. Such tools too often exhibit a tendency to crack in quenching. In general, molybdenum possesses the same quality of producing red-hardness as tungsten, though in a greater magnitude—possibly two or three times as great. This advantage is apparently lost almost entirely by reason of its instability, especially after re-hardening. However, European makers are now advocating the use of a relatively high percentage of molybdenum as a substitute for tungsten.

Uranium

To uranium is generally attributed the quality of increasing the red-hardness, ability to withstand shock and resistance to wear. It is also a powerful agent for removing gases, principally oxygen, nitrogen and their compounds. This element, however, apparently exhibits characteristics which call for careful mixing and expert handling at the steel mill. It appears, too, that the elec-

tric furnace is most adaptable for the manufacture of this steel.

COBALT

To cobalt is usually attributed the quality of being able to cut extremely hard steel. It is generally conceded that an excess of cobalt produces a premature deadening or softening of the cutting edge. American manufacturers are apparently using little or no cobalt at present, probably due somewhat to its high cost.

MANGANESE

The effect of manganese in high-speed steel is to strengthen or toughen the body, at the same time allowing it to be worked readily. Apparently the effective range is very close, and when this is exceeded, excessive breakage results. It is believed that chromium is in general substituted for manganese.

CARBON

Carbon is the element which forms the basis for all steel hardening and is a requisite constituent. In high-speed steel it is usually present in smaller amounts than would produce satisfactory results in the hardening of simple steels. This element in high-speed steel acts in a somewhat different way from what it does in the simple steels. In high-speed steel some of the carbon unites with the tungsten and chromium to form carbides of these two elements. The carbides in high-speed steel, especially tungsten carbide, are more insoluble than the cementite of the carbon steels and therefore, for hardening, a much higher temperature must be resorted to. The effect of carbon in connection with the various elements discussed above is beyond the scope of this work and will therefore be omitted.[1]

The uncertainty of heat treatments recommended by steel makers is responsible for a great amount of cutting tool troubles and very much more accurate data should be forthcoming at an early date. This is especially true of the better steels. Precise information as to the proper time-temperature factor required for forging, pre-heating, heating and hardening, and drawing, at least, should be given. Variations for tools of different duties should be provided. Quenching mediums, "drawing mediums" and the time required for these operations should be given careful consideration.

To illustrate this point, the specifications of about twenty leading makers of steel (the majority of whom were represented in a test to be described later) are listed in Table I, and attention is invited to the apparent uncertainty in a large number of directions. For the sake of simplicity only the pre-heating, hardening and drawing temperatures plus the quenching mediums specified for "lathe and planer" tools are given.

TABLE I. MAKER'S RECOMMENDATIONS FOR TREATING LATHE AND PLANER TOOLS

Brands	Pre-Heating Temperature, Deg. F.	Hardening Temperature, Deg. F.	Quenching Medium	Drawing Temperature, Deg. F.
1	1600–1650	2250–2300	Oil until black, then cool in air	800–1000
2	No mention	Heat nose until it sweats, then quench quickly	No mention	No mention
3	No mention	About 2300	Cool in air blast until nose is cold	No mention
4	Bright red	2250	Tempering oil	1000–1100
5	1700	2300	Lard-linseed or fish oil	400–600
6	1500–1700	2150–2400	Oil or air blast	No mention
7	No mention	About 2200	Air blast or oil	Draw when necessary
8	Red heat	2200–2250	Air blast or oil	500–600 1100–1100 for toughness
9	1400	2200–2300	Air blast or thin oil	700–750
10	Red heat	About 2300	Air blast or oil	No mention
11	1400	2200–2300	Thin oil or air blast	700–750
12	1375–1450	2250	Oil or air blast	500–750
13	1400	2300	Oil	1065
14	1500	2200–2300	Cottonseed oil	No mention
15	1400–1500	2250–2300	Oil or lead	1050
16	1400	2200–2250	Oil or air blast	No mention
17	1450–1550	2150–2250	Oil or lead	When necessary
18	No mention	About 2300	Fish or tempering oil	650–1130
19	Cherry red	White heat	Oil	No mention
20	Bright red	Melting or running point	Air blast	No mention
21	1750–1850	2250–2300	No mention	No mention
22	Cherry red	White sweating heat	Oil	No mention
23	About 1400	2200–2300	Air blast or thin oil	700–750 in lead
24	No mention	Slowly to 2100	Air blast	No mention
25	No mention	2300	Air blast or oil	None required

[1] For more detailed information concerning the influence of the various chemical elements in high-speed steel, the reader is referred to the works of Messrs. Arnold, E. T. Edwards, Carpenter, C. A. Edwards, Read, etc., in the *Journal* of the Iron and Steel Institute.

Hollow-Spindle Dividing Head

By W. C. STEUART

The hollow-spindle dividing head, shown in Figs. 1 and 2, will be found a convenient adjunct to the milling machine. It is intended for use in milling squares, keyways, etc., on work too long to be held between the centers on the ordinary machine.

FIG. 1. HOLLOW-SPINDLE DIVIDING HEAD

The spindle has a 2 11/16-in. hole and is fitted with taper draw-in chucks at both ends. The chucks are operated by threaded collars and a spanner wrench. The split bushings shown in Fig. 1 are provided for work of varying diameter.

For dividing, a notched index plate and a hardened index pin are used.

The work for which this head was designed does not usually call for finer divisions than are provided, though a worm-gear indexing device could be substituted if the work required it.

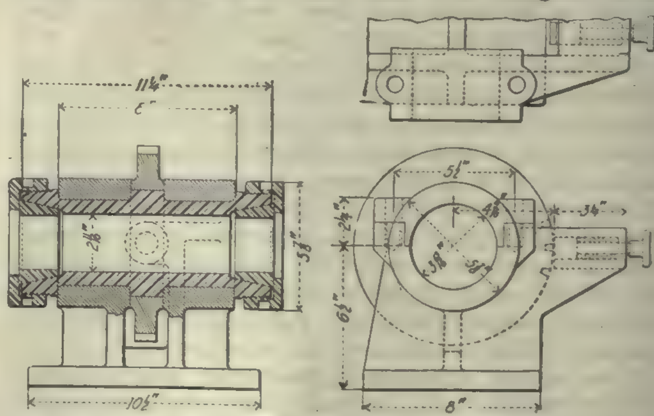


FIG. 2. DETAILS OF HOLLOW-SPINDLE DIVIDING HEAD

The tailstock is of the usual type.

Making Employees Interested in Their Work

BY HARRY DEXTER KITSON, PH.D.

Psychology in business is as old as the hills, but only recently have we come to recognize it by that name. Here is a pertinent suggestion that may well be given careful consideration by any man whose job it is to get production.

IN THE course of a recent conversation, the office manager of a manufacturing concern complained: "One of my chief difficulties is to get the employees to take an interest in the affairs of the firm." "How do you mean, take an interest in the affairs of the firm?" I inquired. "Why, to look upon it as theirs—to identify themselves with it—to throw themselves into their work, heart and soul. I can't describe what I mean but I can give you an example of it. Look at those two fellows," and he indicated through a glass partition two young men sitting at adjacent desks. "Bill, there, has it. He treats the company's business as though it was the most important thing on earth. Any time there is a rush of orders demanding immediate attention he stays on the job till it is finished. Many's the night I've found him here working till nine or ten o'clock. He is responsible for the motto on our letter-head, 'Every letter answered the day it is received—every rush order filled the same day.' He has bought some stock in the company and has been promoted twice in the past year.

"– a dandyish floor-walker"

"Now George illustrates what I mean by lack of interest. He is just as bright as Bill—brainier, I think—but he isn't worth half as much to us. Oh, he does all that is asked of him in an honest routine manner, but he never becomes enthusiastic and he never goes a step beyond. At the first tinkle of the closing gong he dashes to his coat locker, rams on his hat and rushes to the news-stand to see how the ball-game came out. He's a nice cub with a pleasing personality. We could use him to good advantage higher up, but he doesn't take interest enough in the business to warrant burdening him with weighty responsibilities. We've got a lot like him in the office and factory and if we could get them really interested in things around here we could increase the efficiency of the plant a hundred per cent."

This executive voiced a complaint universally made by the heads of big business. True, they find it difficult to express, usually using terms like "morale," "esprit de corps" and other words of subtle French origin which everybody throws off glibly but refrains carefully from amplifying.

The reason for this vagueness is not hard to see. Interest is an elusive thing. Nobody ever saw a particle of interest; analyzed "morale" into its chemical constituents; or weighed a morsel of "esprit de corps." All our physical measures fail us in dealing with this thing. We know, however, that it exists; we have felt it in varying degrees of intensity; but the feeling is not a physical thing—it is psychical. This being the case, we must go to the science of psychology.

A description in terms of technical psychology, however, will not help us greatly in answering the plaint of the business man. What we want is a practical exposition of the thing and a translation of it into terms of everyday life. This we shall find in the writings of Professor James, who, were he living in these days of business psychologizing, would undoubtedly be one of the most sought-after of business consultants. He would respond, too, with the best psychological technique at his command for his zeal for adapting great truths to the needs of the practical man amounted almost to a passion. We shall find Professor James talking much about the relation of interest to mental efficiency, and knowing his delightful faculty for expressing important principles in everyday language, we shall not be surprised to see him use a racy figure of speech. Thinking of the lowly crap game he likens a good mind to a "high" die: "The performances of a 'high' brain are like dice thrown forever on a table. Unless they be loaded, what chance is there that the highest number will turn up oftener than the lowest?" "Can consciousness increase its efficiency by loading its dice?" That is, by applying the pressure of certain interests unto the mind of our workers can we increase their output?

The psychologist answers this question in a decided affirmative. He says that the mind is bound to have some interests. Men cannot think without taking an interest in something. Even the fluffy pate of Geraldine being fastidiously coiffed between customers at the basement glove counter, holds interest in something—a dandyish floor-walker, a marcelled movie hero, the semi-weekly dance at Dreamland.

Some interests are accidents of the environment; some, assertions of will. Sometimes the interest is foisted upon the individual by another person and sedulously fostered, as when the female of the species definitely sets out to win the interest of a mate.

Since interest can be thus cultivated an employer has only to set out determinedly to follow the laws of mental action and he can direct the interest of his employees into the desired channels.

We might profitably pause to consider this point. For there is a mistaken idea abroad that interests are altogether innate things; that a man is interested in a thing because he was created with predispositions in that direction. We constantly hear such expressions as: "I can't get interested in golf, or French music, or tariff problems; I was born with an interest in the violin; or the Republican party, or cabbage."

Such ideas are fallacious. Every one of these interests is acquired. Professor James goes so far as to assert: "An adult man's interests are almost every one of them artificial; they have been slowly built up. The objects of professional interest are most of them in their original nature, repulsive; but by their connection with such natively exciting objects as one's personal fortune, one's social responsibilities and especially by the force of inveterate habit, they grow to be the only things for which in middle life a man profoundly cares." Not only does the psychologist affirm that our occupational interests are acquired, he goes further and declares that they might have been cultivated in widely different fields. "Any object not interesting in itself may become interesting." A golf enthusiast might have become just as deeply interested in horseback riding; a specialist in early Victorian literature might just as readily have developed an interest in chess; a manufacturer of saw-mill machinery might just as easily have cultivated an interest in diamond smuggling. He need only to have been subjected at the proper time to the appropriate stimulations.

So the business executive may take heart. Geraldine, if properly aroused, may be made just as thoroughly interested in the manufacture and sale of gloves as she is in the latest modes of hairdressing. George, poring over the sporting-page when he should be posting remittances, may be so transformed that he will be equally interested in bucking up the collections of the firm.

The course for the employer to pursue is to start a campaign toward the development of interest on the part of the force. This may seem contrary to the doctrine of responsibility as commonly stated. The employer insists: "It is up to the man himself to develop interest in my line." This is, however, not exactly a fair demand. It is incumbent upon the employer to offer stimulants to this interest. As business executives become aware of the magnificent human material just awaiting the dynamic touch of a motive, they will begin to select certain bright young people and definitely cultivate their interests. The fact that transformations such as those just indicated are possible should challenge the will-power of every employer.

How accomplish the transformation? There's the problem. Let us consult our psychologist again. He gives this simple formula for appealing to the employee: "Begin with the line of his native interest, and offer objects that have some immediate connection with these."

One such interest that will always serve for a starting-point is the money-interest. It is present in every individual and can easily be shown to be connected with the interests of the firm. The task of the employer is to show the employee that as he works to increase the profits of the concern, he is augmenting his own earnings. The demonstration of this will have to be apparent, concrete—in terms of the pay envelope—and immediate. Its form will depend upon the wage scale and system of bonus or profit-sharing in operation. Indeed, the practice of giving bonuses and shares in profits is in itself an application of our formula. Corporation baseball teams, bowling leagues, musical organizations, benefit associations, and the like have the same basis, and the adoption of these devices mark an important step in the identification of the interests of the employee with those of the firm.

To search out the interests of the employee and offer them expression is only the beginning. The new bookkeeper may be most zealous in playing on the departmental bowling team and still lack interest in the firm's product. Our psychological mentor gives further advice: "Next, step by step, connect with these first objects and experiences the later objects and ideas which you wish to instill. Associate the new with the old in some natural and telling way, so that the interest being shed from point to point, finally suffuses the entire system of objects of thought." This means that effort must be unremitting and cumulative. The institution must be so organized that a continuous stream of ideas will pour into the mind of each worker and mingle with the ideas already there.

This fact might be stated as a general law: In order to make a man interested in a thing, give him information about it. Our baseball fan furnishes an excellent example of this. What is the secret of his interest in the game? The fact that he knows so much about it. His mind is crammed full of facts—the standing of each team in the league; the batting average of each player; the intimate details about the game at Cleveland last week. All this information extending back several years is catalogued in his mind, ready to be compared with today's results. That is why he awaits the news of the afternoon game with such keen interest and haunts the desk of the bookkeeper, talking baseball incessantly.

Now this psychological principle should be utilized by the employer. He should tell his employees many things about the business, saturating them with facts. For example, in a cotton mill every workman should know the facts about the invention of the cotton gin; the life

of Eli Whitney; the different stages in the invention of textile machinery and the struggles of some of the early inventors. Such facts are powerful stimulants to observation and inventiveness.

The practical executive who reads these lines may interject: "We have already installed a library stacked with technical and historical books, but it is hard to make the employees read them."

The same executive must realize that the dissemination of such information must not be a haphazard and sporadic matter. It must be provided for by some definite agency within the organization. If a corporation school is maintained for giving instructions in spelling, history and the like, it may well give courses in industrial history and industrial biography.

Or the dissemination of this information may be delegated to some department like welfare, research or house organ. Its head will be a "morale" executive, with duties frankly those of a press-agent—to propagate information about the firm and its affairs among the employees. He must work through all departments and agencies: library, house organ, corporation school, directorates of employee associations, athletic clubs, etc.

Another Psychological Principle

This is not all. There is another psychological principle that we must employ: In order to make a man interested in a thing, arouse his motor activity in its behalf. The more one does for an enterprise the more deeply does he become interested in it. This principle is habitually employed by clubs, churches, colleges and philanthropic institutions which choose as members of the board of directors those whose interest they wish to enlist. When Forbilt College desires to obtain support from Millionaire X, it first elects him a trustee. Then it constrains him to attend a board meeting and puts him on an important committee. In trying to solve the problems of the ways and means committee, he becomes so deeply interested that he opens up his exchequer and makes a substantial gift to the annually deficient budget. One step of motor activity leads to another, finally culminating in the donation of the long-prayed-for physics building.

A wish frequently voiced by the heads of big business is that every employee may have a deep affection for the firm. To attain this end we have simply to apply our twofold formula: disseminate information, and start motor activity on behalf of the firm. One firm has carried this out by preparing a history of the house, including biographical sketches of the founders and of employees of long standing. This first appeared in consecutive issues of the house organ circulating among the employees, and was so effective that it was later made into a booklet which is presented to every employee on his first day of employment. Another firm has made its history still more impressive by presenting it dramatically at one of the regular "get togethers" of the personnel.

Developing Loyalty

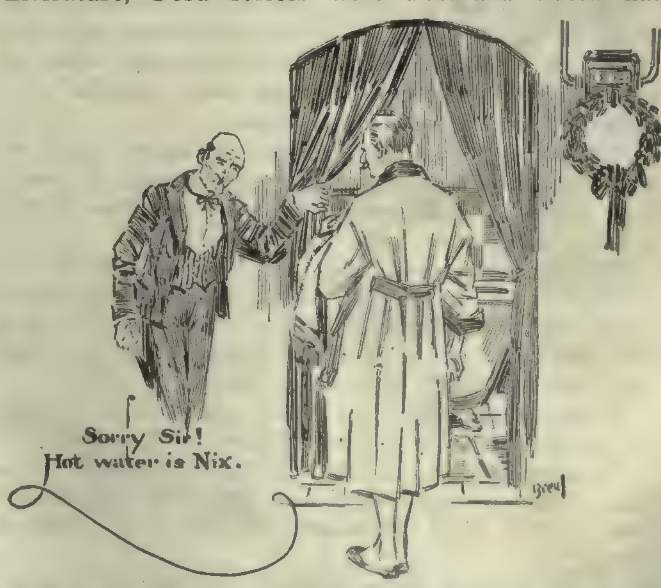
The following incident shows how one manager proceeds to develop loyalty within a certain type of man: Job Grimson was a dapper youngster of considerable mother-wit but so inordinately fond of himself that he never became very much interested in the affairs of the firm. The manager was sure Job could be very useful if he could transfer that self-interest to the company's product. One day, noticing how Job strutted past the stenographer's cage, he got an idea. Calling him from his preening he asked him how he would like to be reception executive, his duties being to take visitors over the establishment and explain the product. Job expanded to the idea. He gladly undertook a course of instruction which would fit him for the job and nosed into odd corners collecting information with great avidity. When he had absorbed a sufficient amount he was permitted to take his first visitors through the plant. He did it gracefully and effectively as the manager had anticipated, and the desired result followed. For as he dilated upon the economical methods of handling raw material, the efficient routing system, the new machines that did the work of three men, the number of cars loaded daily, he began to act as though it were his personal property he was exhibiting. Indeed, he developed the habit of looking upon the entire plant as his. This was the very attitude the manager wished to encourage, and it resulted in boosting Job up to a responsible managerial position. The device proved so valuable in Job's case that it was permanently adopted and has raised the work of many a young fellow from a level of mediocrity to one of enthusiastic co-operation.

Such is the mental attitude in which the interested workman will perform his task, and in the beneficent results both employer and employee will share. To secure them you need only "Load Your Dice."

A Metric Nightmare

By Raymond F. Fletcher

Once upon a time a Business Man awoke at Morn in the far-famed city of Winds. 'Twas a historical morning, for it marked the advent of a long-heralded El Dorado, and men that day were to become Metric Brothers everywhere. From the land of California Oranges, and Mack Sennett Bathing Blossoms had come this wonderful idea. All Measurements were to be reduced to Delightful Simplicity. In wondrous Sunset Literature, Ford stories were Preached which had



resulted in the Banishment of the Yardstick, the Tape-Measure, and the Milestone to the land of Things That Were.

So it was the First day of this Metric Paradise, as the T. B. M. marched in Dignity to the Lavatory.

"Sorry, Sir," said the Slave who guarded the Portal. "The Hot water is Not, also the Gas and Electricity.

No more service from the Central Station until new Volume Meters can be made. None can be made because all the Lead Screws and Screw Cutting Gears for every Factory Lathe in the country must be changed. All the Small Tools and Fixtures have been scrapped, Sir. No new Patterns, Tools and Jigs can be made because the men do not understand the new system."

Unlaved and unshaved, the Victim went down to breakfast.

"Very sorry, Sir," he heard again, "there is no Food, Sir. The Grocer and the Butcher have Suspended until they can replace their Scales and Weight-Beams. Anyway, there are no legal Baskets in which to deliver goods and the Cook left when they destroyed her Cook-Book and Recipes."

Unfed, our Friend sought the Porch and the Milkman. But, Milk-Bottles too were out of date, and a Litre

Bottle had not been thought of by the Geniuses of the World Fade Klub.

Very much out of humor, our Hero started for his Place of Toil. "Sorry, Sir," the taxi-driver told him, "Our new Damages will be $10 a Kilometer, when we get Kilo-meters; no cabs running today, though."

Trains presented the same excuse.

"No trains," said the Megaphone Tosser, "until we reset 100,000 Mile-Stones, pardon me, I mean 'One-and-Six-Tenths of a Kilometer' Stones. No time Tables either, for the same reason."

The Tailor was mournful too. "No cloth at all," he advised. "All the old Yard-Wide Rolls at the Woolen Mills must be remade. Collars? Sure, but it is a 406 Millimeter not a 16 inch one now. And you must call your hat a 187 Millimeter, instead of a 7⅜."

In desperation, the Poor Chap sought to sell all that he had and move to Peaceful Fiume or Shantung.

"You own no Acres," objected the Real Estate Autocrat. "We can re-survey it next year, but your present deed is Nix, until Translated into the New Order of Units."

In a Hardware Store, he sought to buy an End-All-Here, but again he Failed.

"No guns left, Gentlemen," said the Weary Merchant to the Throng before the Counter. "No more guns until the new Bore can be adjusted. Plenty of Carbolic-Acid across the street; that is the one thing that was ready for this Metric-Foolishness."

Our Hero Drank, Staggered, and Awoke. It was not yet Day. He reached for the Button and Soft Light flooded the room. He stole quietly down to his Six-Best-Cellar.

"It is only a few Yards from my Acres down to the Office," he chuckled. "I will drink a Quart of Milk; then a Mile walk will do me good. I can live without Sugar, Cocktails, and Complaints, but this Metric Nonsense must be killed."

Spread out on the table at his Office lay the Wonderful Sunset Literature of the World Fade Klub. Without stirring more than 0.3048 of a meter, he threw the Trash into the Grate and watched with Satisfaction while it burned.

Never again would he fall for the Short Change

Artists, who promised a Metric Heaven and produced a Business Chaos.

MORAL: Give some folks "2.54 Centimeters" and they will take "1.6093 Kilometers." It is high time to voice your Protest to your Congressman regarding this Metric Bill now under consideration. A miss is as good as "1.6093 Kilometers" any day.

Spoiled Work and Its Prevention

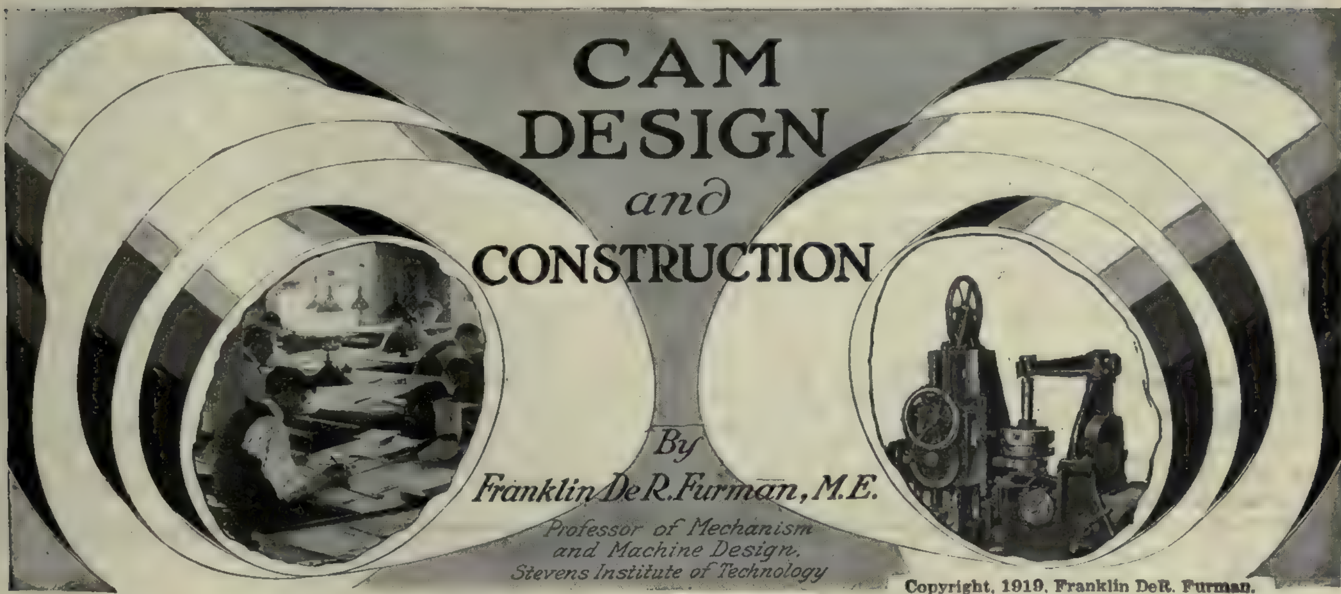
Herewith is a second table of percentages on defects in workmanship and material, and engineering. Upon investigation, we find that the percentage runs a little higher after deducting the assembling, painting and scraping hours.

Month 1919	Def. Workmanship	Def. Material	Eng. Errors
July	0.012	0.026	0.007
August	0.014	0.017	0.003
September	0.020	0.024	0.008
October	0.022	0.027	0.003
November	0.026	0.035	0.008
December	0.022	0.032	0.007

We thought this additional table might be of interest to you, as the table given you in our letter of Jan. 22, therefore, includes assembling, painting and scraping time.

JOHN GOETZ, Works Manager,
The Kempsmith Manufacturing Co.,
Milwaukee, Wis.

[The first table was published on page 637 of the current volume.—Editor.]



XI. Elliptical Arcs for Rolling Cams

The subject of pure rolling cam surfaces is further considered in this article. The simplicity of elliptical arcs for pure rolling cam arms is pointed out and the path of action, the angles of action for the two arms and the pressure angles are discussed. The same points are treated for parabolic and hyperbolic cam surfaces having pure rolling action, and in addition the adaptability of the parabola where the follower has rectilinear motion, and of the hyperbola where the camshafts are very close together, is explained. The true representation of cylindrical cam grooves is shown and the characteristic results obtained from using cylindrical, conical and hyperbolic follower pins in cylindrical cam grooves are pointed out. The involute cam is discussed and its special adaptability for some cases where the follower is offset and where there is sliding action between cam and follower surfaces is illustrated.

(*Part X was published in our April 8 issue.*)

CAM arms having pure rolling action may be constructed from arcs of ellipses as well as from the logarithmic curve, as described in the last installment. In constructing elliptical cam arms use is made of the characteristic of the ellipse that the sum of the two lines drawn from any point on the perimeter to the foci will be constant and will be equal to the length of the major axis. Briefly, then, it is only necessary as a first step to take two identical ellipses and center them on one pair of their foci at a distance apart equal to their major axis. Such a pair of ellipses, illustrated at AC and BD in Fig. 147, may be made to turn through 360 deg. respectively, and they will be in pure rolling contact all the time. If the shaft B is turning with uniform angular velocity the shaft A will turn with variable angular velocity and will go through 180 deg. while the shaft B turns through the angle $B'BB''$. Oscillating rolling arms may be obtained from the ellipses by simply taking equal and symmetrically placed arcs from each as shown at EF and GH, Fig. 147. The following problem will illustrate the method of construction.

Problem 32. Pure rolling elliptical cam arcs, angles of action equal.—Construct a pair of oscillating rolling cam arms whose working surfaces are arcs of ellipses. Take the distance between centers 24 units; make the angle of action of the driver and follower shafts the same, and find the pressure angle at any point.

In constructing problem 32, first lay down the assigned distances between centers, 24 units, as at A and

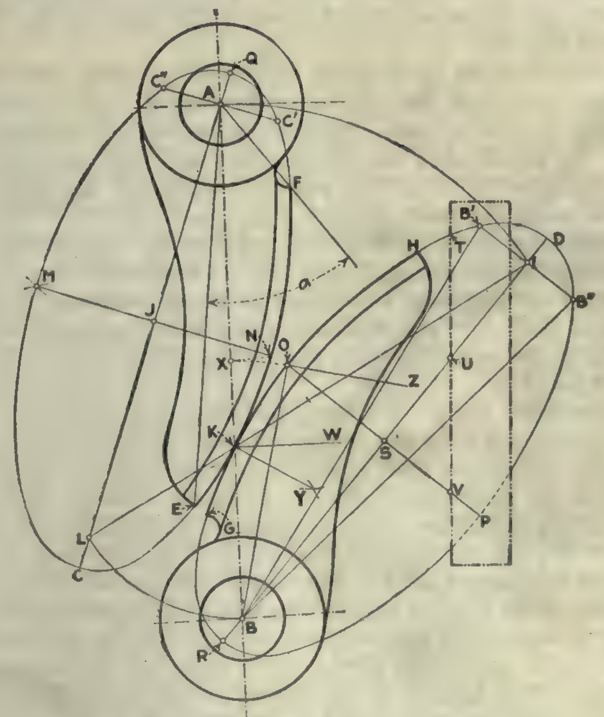


FIG. 147. BASIC ELLIPSES FOR PURE ROLLING CAM ARMS

B in Fig. 147. These points will lie at the fixed focus of each ellipse. Take any point, such as K, on the line of centers between A and B. The nearer K is taken to one of the foci the smaller will be the pressure angles between the rolling cam surfaces according to this construction, other data being the same. With K as a center and KB as a radius, draw an arc BL of any de-

sired length, thus obtaining the angle *BKL* which may be any value. The smaller it is taken the flatter will be the resulting working surface *GH* of the cam and the smaller will be the pressure angles. Had *K* been taken midway between *A* and *B* and had the angle *BKL* been made 90 deg. a limiting case would have resulted in which the ellipses from which the cam arms are taken would have had a minimum eccentricity and the cam arms would have had the largest angle of action, but the pressure angles would have been larger. With *K* as a center draw the arc *AI*, making angle *AKI* equal to *BKL*. Then *L* and *I* are the free foci of the basic ellipses.

To find the major and minor axes of the ellipses take *L* and *A*, Fig. 147, as centers and one-half of *AB* as a radius and draw short arcs intersecting at *M* and at *N*, as shown at *M*. Also use *B* and *I* as centers in the same way, thus obtaining *O* and *P*. *M* and *N* will then be the extremities of the minor axis of one ellipse and *O* and *P* the extremities of the other. From *J*, which is midway between *A* and *L*, lay off distances *JQ* and *JC* equal also to one-half of *AB*. *Q* and *C* are then the extremities of the major axis of one ellipse, and similarly *D* and *R* are the extremities for the other ellipse.

To find points of the ellipse take a piece of paper or a thin card having a perfectly straight edge as indicated by the dash and double-dot lines in Fig. 147. Mark the points *T* and *U* on the edge of the paper a distance apart equal to the semiminor axis *OS* and also mark the points *T* and *V* a distance apart equal to the semimajor axis *DS*. Then move the paper so as to keep the point *U* always on the major axis and *V* always on the minor axis, and the point *T* will move in the path of the desired ellipse.

To obtain an equal angle of action for both elliptical cams, as called for in the statement of the problem, equal lengths of arcs symmetrical about the extremity of the minor axis are taken from each ellipse. Thus *NE* equals *NF*, Fig. 147, and *OG* equals *OH* equals *NF*. The angle for each cam is then equal to *EAF*. This angle may be made larger or smaller by increasing or decreasing the arcs *NF* and *NE*. These arcs, however, should not approach too closely to the extremities of the major axis, for the pressure angle then increases rapidly, as for example when the contact point moves from *F* toward *Q*.

Pressure angle in rolling elliptical cam arms.—The pressure angle is the angle between the perpendicular to the radial line at the point of contact and the normal to the curve at that point. It varies at different phases and is a minimum when the extremities of the minor axes are in contact; that is when *N* and *O*, Fig. 147, come in contact at *X*. The angle *SOZ* is the pressure angle when *O* is in action. The line *OZ* is perpendicular to the radial line *BO*, and the line *OS* is normal to the curve at *O*. At *K* the angle *WKY* is the pressure angle. The normal to the ellipse at any point, such as *KY*, may be readily found by making use of the property of the ellipse that the normal to the curve at any point is the bisector of the angle formed by the focal lines from that point. For example, *KB* and *KI* are focal lines from *K*, and *KY* bisects the angle *BKI*.

Problem 33. Elliptical rolling cam arcs, angles of action unequal.—Construct a pair of oscillating rolling cam arms whose working surfaces are composed of an arc of an ellipse. Take the distance between centers 24 units, make the angle of action of the driver 2.9 times that of the follower and find the maximum pressure angle.

In the solution of this particular problem any ellipse may be used whose major axis is 24 units long. The shorter the minor axis is taken the less will be the pressure angle, and the smaller also will be the actual practical angles through which the cam arms will swing. In laying down the problem take *QC*, Fig. 148, equal 24 units, as the major axis of the ellipse. Bisect *QC* at *X* and assume *XM* and *XN* as the semiminor axes. With *M* and *N* as centers and a radius equal to *QX* draw short arcs intersecting the major axis at *A* and at *L*. These points will be the foci of the ellipse. Construct the ellipse as directed in the previous problem. Select an arc of such length and position on the ellipse that it will subtend focal angles, *i.e.*, angles whose vertices are at the foci, which are to each other as 1 is to 2.9. Such an arc is shown at *FE* and it subtends an

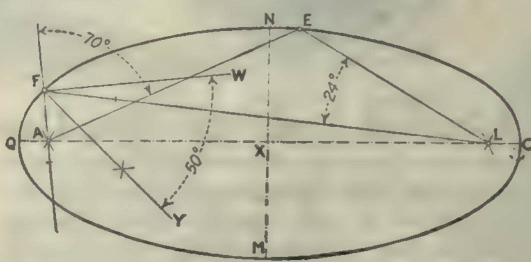


FIG. 148

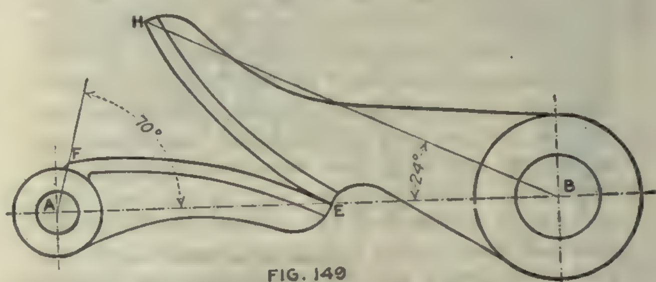


FIG. 149

FIG. 148. ANGLES OF ACTION FOR ELLIPTICAL CAM ARMS
FIG. 149. PURE ROLLING ELLIPTICAL CAM ARMS

angle of 24 deg. from the vertex at *L*, and an angle of 70 deg. from the vertex at *A*. The value of 2.9 given in the data is now provided for because 70 divided by 24 equals 2.9. The arc *FE* is used for the form of the working surface of the two cam arms, as directed in the following paragraph:

To construct the cam arms for problem 33 lay down the shaft centers by marking the points *A* and *B*, Fig. 149, 24 units apart. On a piece of tracing paper draw the arc *FE* of Fig. 148 and mark the point *A*. Lay the tracing paper down in Fig. 149 with *A* of the tracing at *A* of the figure and with *E* of the tracing on the center line *AB*. Redraw the traced curve in Fig. 149, giving *EF*. Again on the tracing paper draw the curve *FE* of Fig. 148 and mark the point *L*. Lay the tracing paper down in Fig. 149 with *L* of the tracing at *B*, and *E* of tracing on the center line *AB*. Redraw the traced curve in Fig. 149, giving *EH*. *EF* and *EH* should be tangent at *E* if the work is correctly done. The forms of the arms and the hubs are now drawn and the angles of 70 deg. and 24 deg. are indicated as shown in Fig. 149, thus giving a ratio of turning angles of 2.9 to 1 as required. The maximum pressure angle will be at the point on the working curve that is nearest to the extremity of the major axis of the

original ellipse, and it will be equal to 50 deg. as shown at *WFY*, Fig. 148.

Rolling parabolic cam surfaces for a reciprocating motion.—The parabola lends itself to pure rolling action in cam work, but it can be used only when either the driver or the follower has rectilinear motion, and then the rectilinear motion must be in a direction perpendicular to the line of axes of the two parabolas when they are in contact at their vertices.

Problem in rolling parabolas.—Required a parabolic oscillating cam to give rectilinear motion to the follower with pure rolling action. Assume the length of contact and find (a) angle of action of driver, (b) range of motion of follower and (c) the maximum and minimum pressure angles.

Construct a parabola by making use of the property that a point on the curve is equidistant from the focus and the directrix. To do this assume a point *A*, Fig. 150, as the focus of the parabola on the line *XX* as an axis. Assume the directrix *YY* at right angles to the axis and at any desired distance *AB* from the focus.

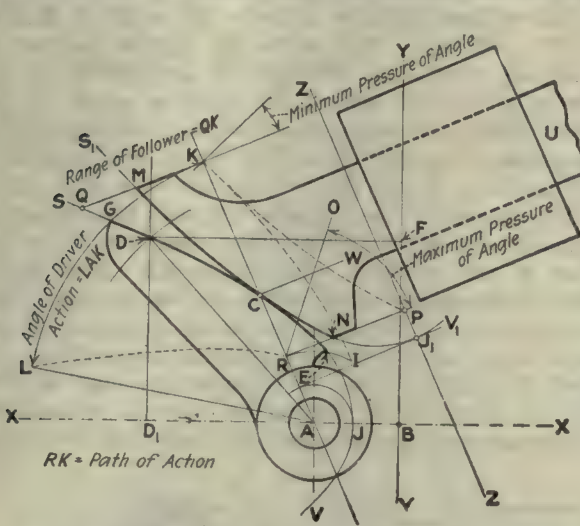


FIG. 150. PARABOLIC CAM SURFACES FOR PURE ROLLING RECIPROCATING MOTION

The larger *AB* is taken the larger will be the oscillating cam for a given motion and the smaller will be the pressure angles. The vertex of the parabola will be at *J* midway between *A* and *B*. A point on the curve may be found by assuming any radius, such as *AD*, and drawing a short arc as shown at *D*, using *A* as a center; then laying off this radial distance on the axis starting from the directrix as at BD_1 and drawing a perpendicular line D_1D until it meets the arc at *D*. The point *D* thus obtained will then be a point on the parabola and other points may be found in the same way and the curve *SJV* drawn. Draw a radial line *AK* perpendicular to the desired direction of motion of the follower, which direction in this problem is *CW*. On this radial line assume any distance *RK* as the path of action; then arcs of circles through *R* and *K* having *A* for a center will limit the part *GE* of the parabolic curve which will form the driver-cam surface. The entire oscillating cam *GEA* may now be drawn.

The surface *MN* on the follower arm, Fig. 150, will be identical with *GE*, already constructed, and may be readily found by drawing the lines *SJV* and *XX* on a piece of tracing cloth or paper, turning the paper on the reverse side and then adjusting it, always keeping *XX* of the tracing parallel to *AK*, until the two curves come tangent as shown at *C*. The axis *XX* of the tracing will then be in the position *ZZ*. The follower cam surface and rod *MNU* may now be drawn. The angle of action, range of action and pressure angles may now be found as indicated in Fig. 150. The two parabolic surfaces *GE* and *MN*, Fig. 150, will be in pure rolling action on the path *KR*, the driving cam turning about *A* and the follower cam moving in a direction perpendicular to *KA*.

Rolling hyperbolic cams.—Two equal hyperbolas will give pure rolling action to two oscillating cam arms, the essential features of construction being that the hyperbolas should turn about one pair of foci as fixed centers and that the distance between these centers should equal the distance between the vertices of the hyperbolas. In Fig. 151 *A* and *B* are the foci of one hyperbola and *CO* and *DU* its two branches, while *H* and *S* are the foci of the other hyperbola and *VW* one of its branches.

Problem in rolling hyperbolas.—As a problem illustrating the application of hyperbolas to rolling-cam work let it be required to construct two cam arms and shafts and determine the angle of action of each and the maximum and minimum pressure angles.

Construct the hyperbolas by making use of the property that the distances from any point on the curve to two fixed points, called the foci, have a common difference. Therefore, assuming *A* and *B* as foci, Fig. 151, and *C* as a vertex the common difference to be used throughout will be *CB* minus *CA*, equals *CD*. By assuming different distances between *A* and *B*, and *A* and *C*, different angles of action and different pressure angles will be obtained.

A point on the hyperbola, such as *E*, Fig. 151, is found by taking any radius such as *BE* and striking an arc with *B* as a center. Then with *A* as a center draw another short arc with a radius equal to *BE* minus *CD*. Where the second arc crosses the first will be a point on the curve as at *E*. Other points are found in the same way.

The center of one shaft will be located at the focus *B* if it is desired, for example, to show the cam surfaces in contact on the branch *CO*. Assuming *E* as the point of tangency of the two cam surfaces, the center of the other shaft, and consequently one focus of the other hyperbola, must be on the line *EB*, for the reason that in pure rolling action the point of contact must always be on the line of centers.

The second hyperbola must be placed with respect to the first so that the distances between the fixed foci and the free foci are equal to each other and to the distance between the vertices of the hyperbola. Therefore, take the distance *CD* and lay it off at *BH;* also use it as a radius with *A* as a center to draw the short arc through *S*. With *H* as a center and *AB* as a radius draw another arc intersecting the first at *S*, thus determining the second focus *S* of the second hyperbola and its axis if it is desired. The tangent branch *VW* may now be independently constructed as explained for *CO*, or it may be traced from *CO* of which it is a duplicate.

The path of action, assuming *KG* to be the driving-cam surface, the angles of action for both camshafts and the maximum and minimum pressure angles may be obtained from a study of the illustration in Fig. 151.

Detail drawing of cylindrical cams.—A simple practical method for constructing the surface guide line for

the center of the cutting tool in cylindrical cams was explained in article VIII. A more elaborate method of construction giving a more precise mechanical action and a more complete drawing of the cam is now given.

To find the true maximum pressure angle of a cylinder cam the pitch cylinder and not the surface cylinder should be drawn first. The pitch cylinder is shown at

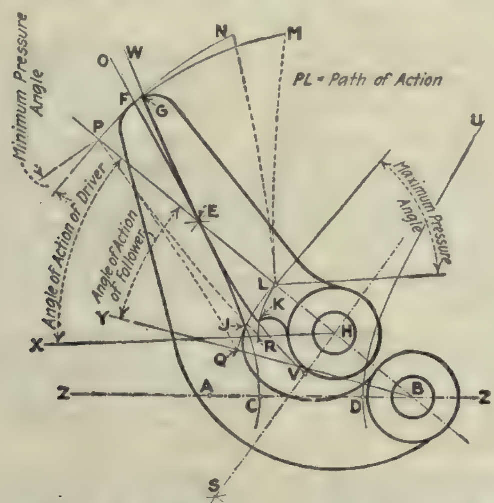


FIG. 151. HYPERBOLIC CAM SURFACES FOR SWINGING ARMS ON CLOSE CENTERS WITH PURE ROLLING ACTION

B', W', $H_3 \ldots Q_3$, etc., Fig. 152, and is drawn with a radius of 5.2, the data, excepting for pressure angle and method of construction, being the same as for problem 15. Briefly, the data are: (a) Follower to move in a straight line four units to the right on the crank curve while the cam turns 120 deg.; (b) to move to left four units on crank curve while cam turns 120 deg.; (c) to dwell while cam turns 120 deg.

The pitch curve Q_2P_3J, etc., is then obtained and the normal JG_1 is drawn as in problem 15. This normal will make an angle of 30 deg. with JD if the work is correctly done. This is the assigned maximum pressure angle and is at the bottom of the pin; the pressure angle DJG at the surface of the cylinder will be less than 30 deg. In this problem the data and layout were such that the point J of maximum pressure angle could be readily made to fall on the front element of the cylinder and the angle DJG_1 thus shown in its true size. Where the data and layout are such as not to conveniently bring the pitch point on the front element of the cylinder the pitch curve will have to be revolved if it is desired accurately to show the pressure angle in true size on the drawing.

Drawing of groove outlines for cylindrical cam.—If it is desired to draw the groove outlines of a cylindrical cam one of two methods may be used; (1) the approximate method or (2) a more exact method. The approximate method, which is simpler and quicker and which gives good-appearing results where the slope of the groove does not exceed 30 deg., is applied by laying off the points *1* and *2*, Fig. 152, at equal distances on each side of H_2 on the surface pitch curve, these points representing the extremities of a diameter of the follower pin. Similarly, the points *3-4*, *5-6*, etc., are obtained. A curve drawn through the points *S*, *1*, *3*, *5*, etc., will represent one of the surface edges of the groove. The bottom lines of the groove are found, for example, by projecting J_6 to J_4 and then laying out the diametral line *9-10*. A curve through *9* and other similarly found points will represent one of the bottom edges and the curve through *10*, etc., will represent the other.

A more exact method of drawing the outlines of the groove consists in drawing the projection of a section of the pin which is tangent to the cylinder. The section will appear in general as an ellipse in the side view and the curves representing the groove edges will be drawn tangent to these ellipses instead of through the extremities of the major axes as described in the preceding paragraph. The detail work for this is shown in Fig. 152, where the straight line *7′-8′* is the end projection of a pin section which is tangent to the cylinder. The points *7* and *8* are projected from *7′* and *8′* and are the extremities of the minor axis of the ellipse; the horizontal line *5-6* passing through J_1 is equal to the diameter of the pin and is equal to the major axis. J_1 is projected from J'. The ellipse *5, 7, 6, 8*, is now constructed as shown. Similar ellipses should be constructed at other points as at I_1, H_1, etc. At A the ellipse becomes a circle and at E it flattens to a straight line. The curve SE_1 drawn tangent to the ellipses instead of through the extremities of the major axes will be one of the surface edges of the groove. Even with this refined method of construction there remains an approximation, for it will be evident that the circle at the top of the pin lies in a plane which is tangent to the cylinder and that the projection of this circle gives an ellipse that does not lie on the surface of the cylinder. Therefore, the curve drawn tangent to the ellipse would not lie on the cylinder. The error, however, in following the above directions is too small to show in a drawing of practical proportions. If desired this slight error in construction may be corrected by rounding off the end of the pin to conform with the curve of the cylinder and projecting the curve

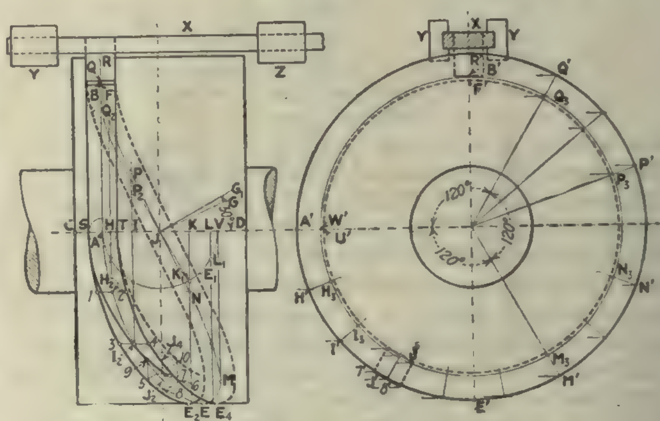


FIG. 152. CYLINDRICAL CAM, SHOWING TRUE PITCH CYLINDER AND TRUE PRESSURE ANGLE; ALSO METHODS OF CONSTRUCTING GROOVE OUTLINES

of the rounded end of the pin to the side view to give the elliptical-like curve to which the groove curve is tangent. This is illustrated in a case of exaggerated proportions in Fig. 153 where M is a true ellipse and is a projection of the end of the pin when it is flat. N is a projection of the perimeter of the pin when its end is rounded off to conform with the curve of the cylinder.

Forms of follower pins for cylindrical cams.—Cylinders, cones and hyperboloids may be used for the form of follower pins to work in the groove of cylindrical cams.

A cylindrical pin drawn to a large scale is shown at *GJ*, in Fig. 153, lying in a groove which is cut in the cam cylinder *CZ*. The cylindrical pin is advanced longitudinally the distance *EF*, Fig. 153, while the cam turns through the angle $A_1O_1A_5$, Fig. 154. The top edges of the groove are represented by the helical curves GG_4 and HH_4, Fig. 153, and the bottom lines of the working-side surface of the groove are represented by II_4 and JJ_4. The center of the follower pin is shown in its central position at A_2. The straight line A_2G_2 is a normal to the top pitch line AA_2A_4 of the groove, and it is the line of pressure between the side of the groove and the follower pin at the surface of the cylinder. The angle KA_2O is the pressure angle at the top of the pin and it is made 30 deg. in this example, as shown in Fig. 153. The straight line A_2I_2 is a normal to the helix BA_2B_4, which is the locus of the center point of the bottom of the follower pin. The line A_2I_2 then is the line of pressure between the side of the groove and the pin at the bottom of the pin, and LA_2O is the pressure angle at the bottom of the pin. The pressure angle therefore varies from the top to the bottom of the groove, being smallest at the top. From this it follows that the pitch surface of a cylindrical cam should be at the shortest radius reached by the follower pin rather than at the outer surface where it is usually taken, provided it is desired not to exceed a given maximum pressure angle on the follower pin.

When the pin is moving, the line of contact between the side of the groove and the side of a cylindrical pin is a curved line, and one phase is shown in end projection at G_2I_2, in Fig. 153, and in side projection at G_1I_1, in Fig. 154. When the pin is not working it has straight-line contact with the side of the groove, as shown at *GI* in Fig. 153. If the follower pin is fixed in the frame that carries it, it will receive wear on the forward stroke entirely within the area GG_6I_6IG, Fig. 153. G_6 is the same horizontal distance from the vertical center line through *A* as G_2 is from the vertical center line through A_2.

A rotating cylindrical pin cannot have pure rolling action against the side of the groove in a cylindrical cam, for such action requires at least that two rolling curves must measure off their lengths equally on each other. This means that if the circumference of the follower pin at the top goes a certain number of times in the curve GG_2G_4, Fig. 153, the circumference at the bottom must go the same number of times into the curve II_2I_4. This of course cannot happen with a cylindrical pin, for the circumferences of the pin are the same top and bottom, while the helical curves at the top and bottom of the groove against which they operate are totally different in length. From the above it follows that there will be considerable sliding between a cylindrical pin and cylindrical cam and that this will be greater the greater the length of the pin.

A conical follower pin for a cylindrical cam is shown at M_1R_1 in Fig. 154, and in end view in Fig. 155. In the latter view the line GG_1 is tangent to the helix which marks the center of the top of the groove, and A_2G_2 is normal to it, giving the point G_2 at which the conical pin is tangent to the side of the groove at the outer circumference. The conical pin is here taken the same size at the top as the cylindrical pin in Fig. 153 and consequently the line A_2G_2, in Fig. 155, will be parallel and equal to the line A_2G_2 in Fig. 153. Likewise I_2 Fig. 155, is the point of tangency at the inner end of the pin. These points of tangency and intermediate ones will determine the line of contact G_2I_2 between the conical pin and the side of the groove for the position shown. This line is also shown in side projection at G_3I_3 in Fig. 154. If the pin is rigidly attached to the follower framework the wear on the pin will fall on the area represented by the surface $S_1S_3I_3G_3$. If the pin is free to turn on its axis it will come nearest to having rolling action when the circumference at the bottom of the conical pin is to the circumference at the top as the length of the helix BB_4 is to the helix *AA* in Fig. 153, or, when the conical vertex of the roller is at O_1, Fig. 154, on the center line of the cylinder. Conical pins give thrust in an axial direction, and consequently there must be special pro-

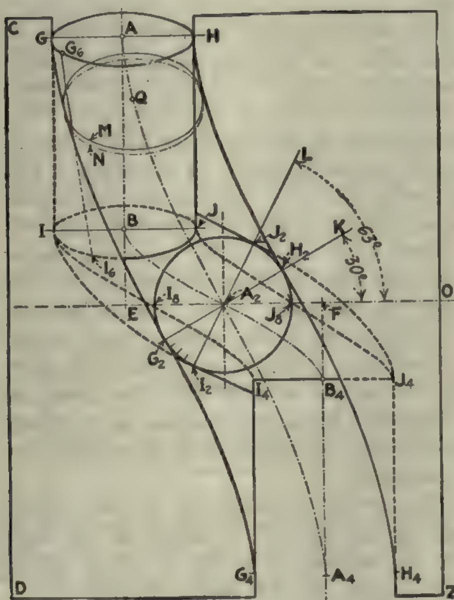


FIG. 153

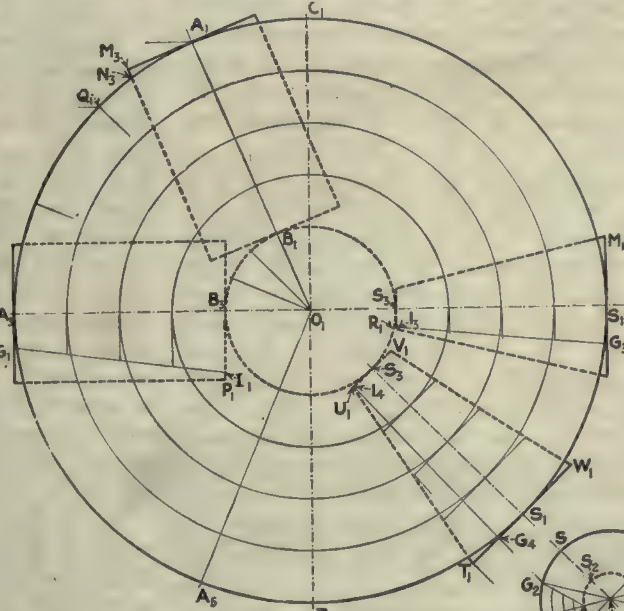


FIG. 154


FIG. 155

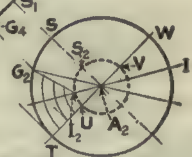


FIG. 156

FIGS. 153 TO 156. SHOWING USE OF CYLINDRICAL, CONICAL AND HYPERBOLIC FOLLOWER PINS IN CYLINDRICAL CAM GROOVES

vision in the follower framework for holding the pin in place. Conical pins have a natural advantage in that they may be designed to move in axially so as to take up wear in the pin and in the groove.

A hyperboloidal follower pin is shown at $T_1U_1V_1W_1$ Fig. 154, and in end view in Fig. 156. In the latter figure the lines A_2G_2 and A_2I_2 are perpendiculars to the top and bottom helices of the groove respectively, the same as the similarly lettered lines in Fig. 153. If the diameters T_1W_1 and U_1V_1 are taken in the same ratio to each other as the lengths of the top and bottom helices of the groove in which the pin rolls, the closest approximation to rolling action will be obtained. There cannot be pure rolling of the hyperboloidal pin, however, on the side of the groove, for even where the circular sections of a hyperboloidal pin measure themselves off equally on the corresponding helices on the surface against which they roll, there is always an inherent fundamental endwise or longitudinal component of sliding in the direction of the axis of the pin in every hyperboloidal action. The nature and amount of this characteristic is explained in some of the books on descriptive geometry.

To lay out the hyperboloidal pin the lines A_2G_2 and A_2I_2, Fig. 156, and the circles TW and UV are drawn. The straight line from G_2 to I_2 is drawn and used as the generatrix of the hyperboloid, the outline of which is the curved line T_1U_1, Fig. 154. Points on this curve are found by dividing G_2I_2, Fig. 156, into, say, four equal parts, revolving the dividing points to the line TU and then projecting them to the equally spaced lines which are drawn from S_1 to S_3, Fig. 154. The straight line G_1I_1 will be the line of contact between the pin and the groove at the maximum pressure angle, and the curved hyperboloidal line S_1S_3 the line of contact at the end of the stroke. The wear on a pin fixed in the follower frame would occur on the hyperboloidal surface between these two lines.

Involute cam.—The involute curve may be used for cam outlines. It gives characteristic motion almost identical with the cam having a straight-line base curve, but it is not so simple to construct. The involute cam will not give true motion to a roller follower unless the ends of the cam-working surface are eased off, as they are in the straight-line combination cam or the logarithmic combination cam by arcs of circles or other curves. For the same data as were taken for comparison of cams shown in Figs. 84 to 135, Article IX, the involute curve gives a slightly larger cam than does the straight-line base curve, the maximum radius in each case being 2.78 and 2.65 respectively. The method of finding the maximum radius for the involute cam will be explained in the next problem.

The involute is popularly defined as the curve that would be generated by a point on a string which is being unwound from the periphery of a circular disk, the string always being kept taut and always in the same plane.

The involute is readily constructed, according to the preceding definition, by drawing a circle of any size, as illustrated at SPR, Fig. 157, taking any point as S as the origin of the involute; laying off a series of equal angles of any desired unit, as at SOM, MON, etc.; drawing tangents to the circle at M, N, etc., and making the lengths MY, NU of the tangents equal, successively, to the lengths of the arcs MS, NS, etc. This latter operation may be done graphically by setting the small dividers to a step of $\frac{1}{8}$ in. or less, starting at S and counting the steps toward M until M is reached or passed, and then counting off the same number of steps in the reverse direction going along the tangent line, thus obtaining the point Y on the involute curve. This graphical method of stepping off distances, while accurate in theory, is apt to give an appreciable cumulative error, and therefore should be checked by a simple computation as follows: Length of tangent NU, for example, equals length of arc NS, equals $\frac{OS \times 2 \times 3.14 \times \text{angle } NOS \text{ in degrees}}{360}$. In general it is advisable to first compute and draw a long tangential line as RW at 180 deg. from S, and then if six equally spaced construction points are used as at M, N, etc., to make the tangent PV one-half of RW; the tangent at MY, one-third of PV; the tangent at NU, two-thirds of PV, etc.

Pressure angle with involute cam.—Pressure angle is defined as the angle made by the line of action of the follower and the normal to the pitch curve of the cam. Therefore if the follower moves in the direction OV, Fig. 157, and if the normal to the involute at the point V is VH the pressure angle is HVK. The angle HVK grows smaller as the point V is moved to the right toward W, and larger as it is moved to the left toward the origin of the curve at S. At S the pressure angle would be 90 deg. because the involute is tangent to the line of action OS of the follower. The line of action of the follower is a radial line in the type of cam being considered in this problem. From the above it may be seen that there are a series of points on the involute where there are definite pressure angles, and these points will be noted here, as they are necessary in solving a specific problem.

At E, Fig. 158, the pressure angle is 20 deg. The point E is obtained by laying off an angle of 88 deg. from the origin of the curve, as at SOE. The other points for pressure angles of 30 deg., 40 deg., etc., are found at A, D, etc., by using the values given in the following table. The method of finding these values will be given in a later paragraph for those who may be interested.

	Deg.	Deg.	Deg.	Deg.	Deg.
Pressure angle	20	30	40	50	60
Initial angle	88	39½	18	8	3

Problem. Required an involute cam that will move a radial follower one unit while the cam turns 60 deg. with a maximum pressure of 30 deg.—To solve this and any other similar involute cam problem it is necessary to construct first an accurate basic involute curve of any convenient size as directed in the preceding paragraphs; then to lay off the initial angle corresponding to the given pressure angle in the problem. In this problem the pressure angle is given as 30 deg. for which the initial angle is 39½ deg., as determined from the table, and this latter angle is laid off at SOA, Fig. 157, where the basic curve has been drawn. From OA lay off the given working angle of 60 deg. as at AOF. Draw the circular arc AG and measure the distance GF. Then make a proportion in which the distance GF is to the assigned follower motion as the radius OA is to the desired shortest radius of the pitch surface of the cam. In this problem GF measures 1.12 units, the assigned follower motion is 1 unit, and the radius $AO = 2.00$ units. Therefore,

$$1.12 : 1.00 :: 2.00 : x \text{ or}$$
$$x = 1.78$$

equals the shortest pitch radius of the cam. With this value known, it is a simple matter to draw the required involute cam as in Fig. 159, where *OA* equals x, as just computated, *HAK* equals the pressure angle of 30 deg., and the line *HA* extended is tangent to the base circle *EQ*, which is necessary in the drawing of the desired involute. With these items laid down the involute pitch surface from *A* to *F* is constructed in detail as described above in the paragraph devoted to the construction of the involute, and briefly, in review, as follows:

Lay off the assigned working angle of 60 deg. as at *AOF*. Make *OF* equal to *AO* plus the assigned motion of the follower, which is one unit in this problem. Draw

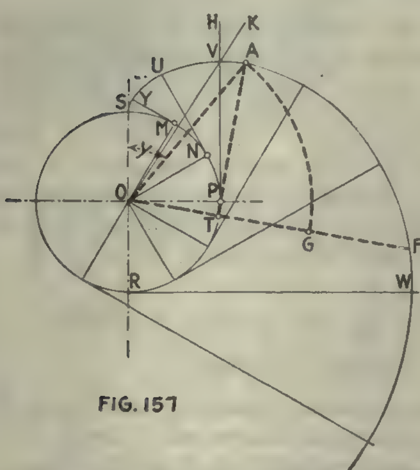


FIG. 157

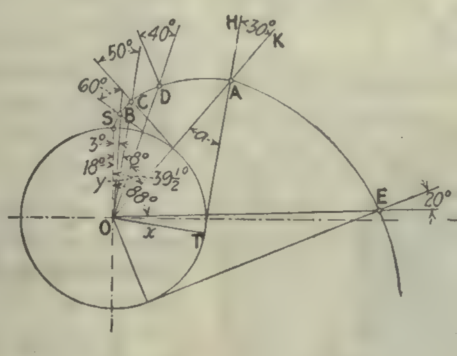


FIG. 158

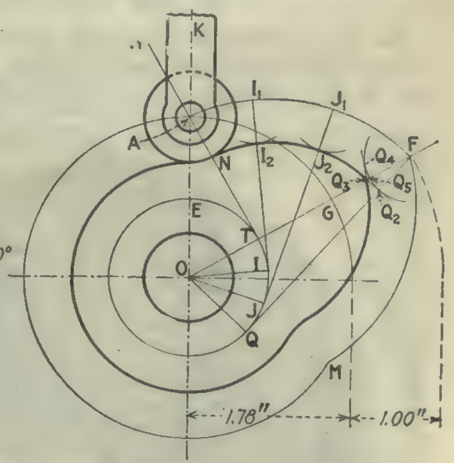


FIG. 159

FIG. 157. INVOLUTE CURVE AS USED, SPECIFICALLY IN CAM CONSTRUCTION. FIG. 158. SHOWING THAT ALL SIZES OF INVOLUTES HAVE THE SAME INITIAL ANGLE FOR EACH PRESSURE ANGLE. FIG. 159. INVOLUTE CAM FOR RADIAL FOLLOWER BASED ON THE SPECIFIC DATA IN ACCOMPANYING PROBLEM

FQ tangent to the base circle. Draw the radial line *FTO* and divide the arc *TQ* as at *I* and *J* into a convenient number of equal parts, three being taken in this illustration. Draw tangents at *I* and *J*. Step off the distance *ATI* on II_1, thus obtaining I_1, etc. Draw the involute curve through *A*, I_1, J_1, *F*, thus obtaining the involute pitch surface of the cam. The working surface, if a roller is used, is found by taking the radius of the roller and drawing a series of arcs with I_1, J_1, etc., as centers and drawing a curve tangent to them as at I_2, J_2, etc. It will be observed that a working curve so drawn will be tangent to the last construction arc at Q_2 on one side of the cam lobe and tangent at Q_4 on the other side, giving the actual tip of the working-cam surface at Q_3. This means that if the roller follower is to move with a velocity characteristic of the involute curve that its ultimate stroke will be less than the desired amount by the distance Q_3Q_5. This can only be corrected when a roller follower is used by disregarding the involute characteristics at the end of the stroke and by arbitrarily changing the true working-surface curve from J_2 to Q_3 so that the curve will run smoothly from J_2 to Q_5.

The involute curve has a fixed initial angle for each pressure angle.—For example, the initial angle *SOA*, Fig. 158, will always be 39½ deg. for a maximum pressure angle of 30 deg., no matter what size of involute is used. This may be readily shown as follows: Let y equal the angle *SOA*, which is the initial angle from the origin of the involute to the point where the pressure angle is to be shown. Let a be the assigned pressure angle as represented at *HAK*. Then the angle *SOT* $= y + (90 \text{ deg.} - a \text{ deg.})$. Let x equal *OT*, the radius of the base circle of the involute. Then

$$x \cot a = AT = \text{arc } ST = 2\,x\pi\,\frac{y + 90 - a}{360}.$$

The value of x cancels, and for a pressure angle of 30 deg. substituted for a, y is found to be 39½ deg. Similarly, the initial angle is found to be 18 deg. for a pressure angle of 40 deg., etc.

Involute specially adapted for a flat-surface follower.—The involute curve is naturally adapted for an oscillating-cam surface where a flat-surface follower is used, and in this case it gives a uniform linear velocity to the follower. The natural advantage of an involute cam for a flat-surface follower, shown in Fig. 160, is based on the property of an involute that the tangent *XY* to the base circle *RQ* is normal to the involute as at *Y*, and consequently that the perpendicular line at *TZ* is tangent to the involute. Therefore *TU* may represent the flat surface of a follower collar attached to the follower rod SS^1. T_1U is the follower in its highest

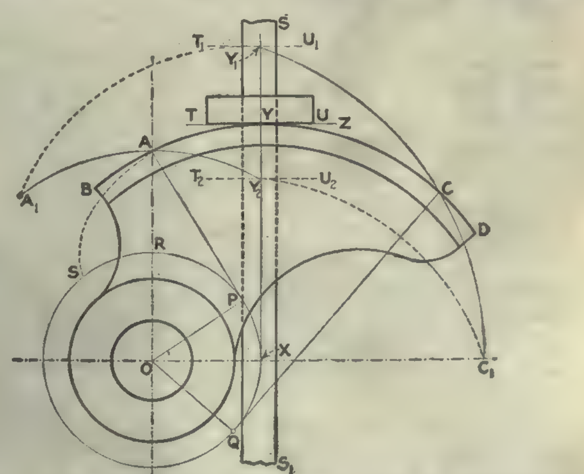


FIG. 160. SHOWING THAT THE INVOLUTE IS SPECIALLY ADAPTED FOR AN OFFSET FLAT SURFACE FOLLOWER

position and T_2U_2 in its lowest position considering that only the part *AC* of the cam surface is used. An involute curve cam as from *A* to *C* would always be tangent to the flat surface of the follower and the line of contact between cam and collar would pass

through the center of the follower rod, moving up and down between Y_2 and Y_1. This means that there is no pressure angle on the follower rod except that due to friction.

This last feature of the involute cam gives it perhaps its greatest practical importance. Where it is desired to give the follower a definite velocity and acceleration between its extreme points of travel, Y_2Y_1, the involute cannot be used.

A Heavy Hand "Forging"

By Milton Wright

As an illustration of what may be done without special equipment the large hopper, shown on the flat car in the photograph, is presented.

A LARGE HAND "FORGING"

The piece is about 12 ft. in diameter at the large end, 7 ft. high, and the smaller opening is 2½ ft. square. It is made of ⅝-in. iron plate and is all hand work for the reason that the shop where it was made in answer to a hurry call is not equipped with plate bending rolls or other devices for shaping the plates.

However, shears, punches, portable drilling machines and riveters were all available but the forming and bending was all done by hand with sledges and hammers. Fires were built on the ground wherever it was handy and sometimes inside the cone as the work progressed.

In spite of the fact that no bending rolls were to be had, the work was accomplished in a very short time. The boss blacksmith whose handiwork it is, is shown standing beside the finished cone.

Enlarging an Automobile Piston

By Walter Cantelo

On page 548 of the *American Machinist* is an article entitled "Enlarging Automobile Pistons" in which the writer apparently gives all the credit for the increased diameter of the piston to the effect of the blows of the hammer. I am of the opinion from past experience that the increased diameter resulted more from the thorough heating and cooling than it did from the hammering. In a number of instances I have had castings that were too small to clean up in machining and have saved them from the scrap heap by heating and cooling them several times until they were expanded to a sufficient amount.

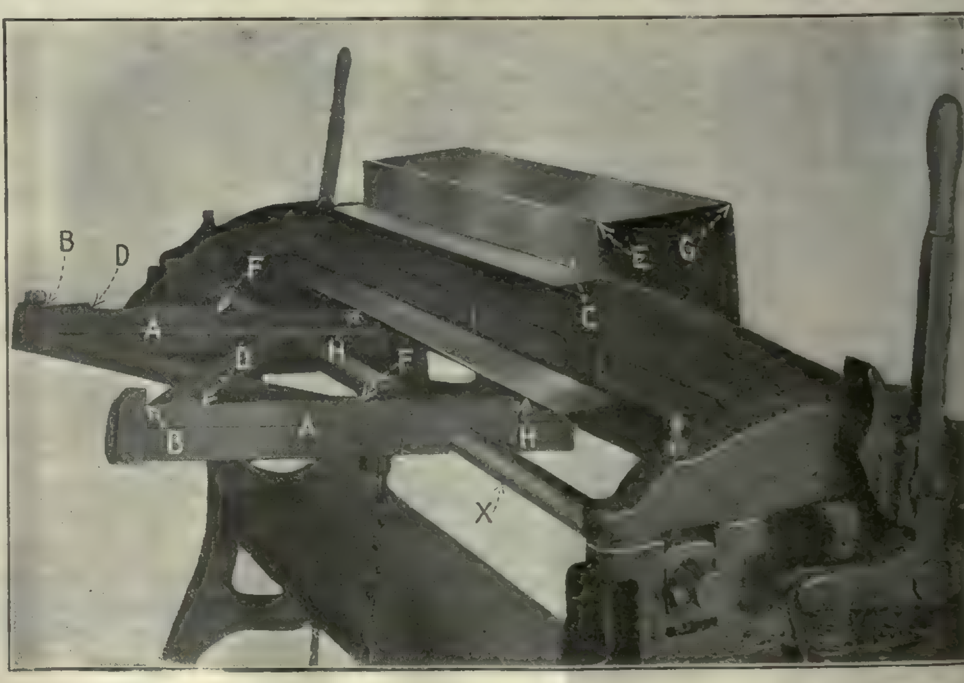
If Mr. Starr still has the old pistons I would suggest that he put them through a series of heating and cooling operations, making careful measurements of the diameter and length of each piston before commencing each heating and recording same. Also, if possible, note temperature of pistons when heated and ready to remove from furnace. I think he will be surprised at the expansions that will occur and the results of such an experiment would be interesting reading for all of us.

Forming Tanks on a Hand Brake

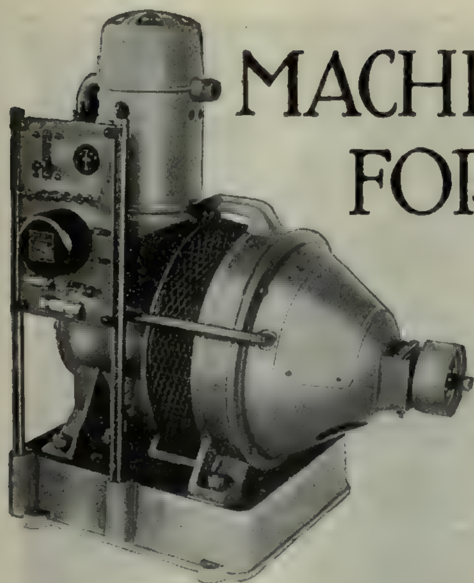
By Frank C. Hudson

The method shown enabled a standard hand brake to replace an expensive forming fixture and is much more easily operated and more satisfactory in every way.

The guides *A* hook over the rod *X* of the machine and along the guides the metal sheet is laid with its edge against the stop *BB*. In this position, the brake makes the short bend *C* at the other end of the piece. The sheet is then turned over, the straight-edge placed against the stop *DD* and the bend *E* is formed. The sheet is then held against the stops *FF* which makes the next bend *G*. The last is made with the sheet stopped at *HH* as shown, and it requires but little practice to form these tanks rapidly and accurately.



FORMING A GAS TANK



MACHINING THE GAS ENGINE FOR A LIGHTING UNIT

J. V. HUNTER
Western Editor, *American Machinist*

II. Miscellaneous Operations

Many of the miscellaneous operations in connection with the manufacture of a gas engine for a small self-contained lighting unit are covered by this article. Like the operation described in the previous article, many of these are performed on turret lathes.

(Part I was published in our April 8th issue.)

THE main foundation base casting for the lighting unit serves as a chamber for the storage of the kerosene-engine fuel. Little machine work is done on this casting other than a small amount of drilling, and the milling on the top surface of certain bosses which are left as bearing points for the motor and the generator. A heavy knee-type Ingersoll milling machine is used for this operation, Fig. 8, and is equipped with a large inserted-tooth milling cutter which is fitted with stellite blades.

The camshaft bearing is drilled and reamed under a radial drilling machine, Fig. 9, using the jig *A*, whose centering plug fits into the main bearing. Afterward the base and the feet are milled off and they are then drilled for bolting to the foundation casting.

The cylinder heads are faced and partly drilled in a Gisholt turret lathe, and Fig. 10 shows the set-up of tools required for this operation. The method of chucking the cylinder-head castings is interesting, because long extension jaws *A*, Fig. 11, are required on account of the bosses and stud projections on top of this casting. These jaws grip on the radiation flanges and care is required to avoid putting so much strain on these that they might be injured or broken. The additional supporting studs or brackets *B* and *C* will be noted extending from the face of the chuck plate.

The crank-case cover, Fig. 12, is another turret-lathe job. The hub of this is turned, bored, reamed and faced, and the outside bearing rim is faced as shown on the finished casting *A*.

The pistons are completed in two series of operations; the first of which turns about one-half of the crank end, cleans the flange and chamfers off the inside corner. For the second series of operations on this part the piston is chucked from the other end and the cylinder end of the body is turned, faced and centered while

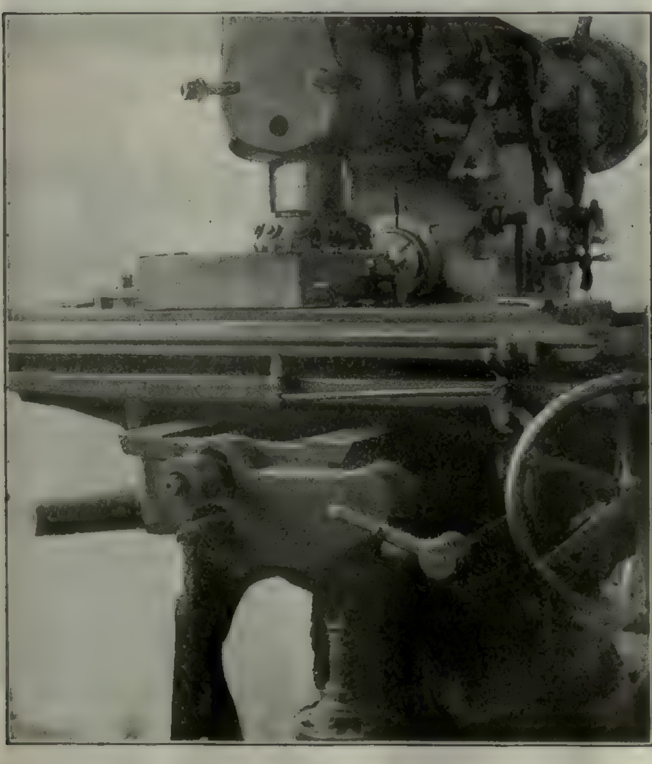


FIG. 8. MILLING TOP FACE OF FOUNDATION CASTING

FIG. 9. DRILLING CAMSHAFT BEARING IN CRANKCASE

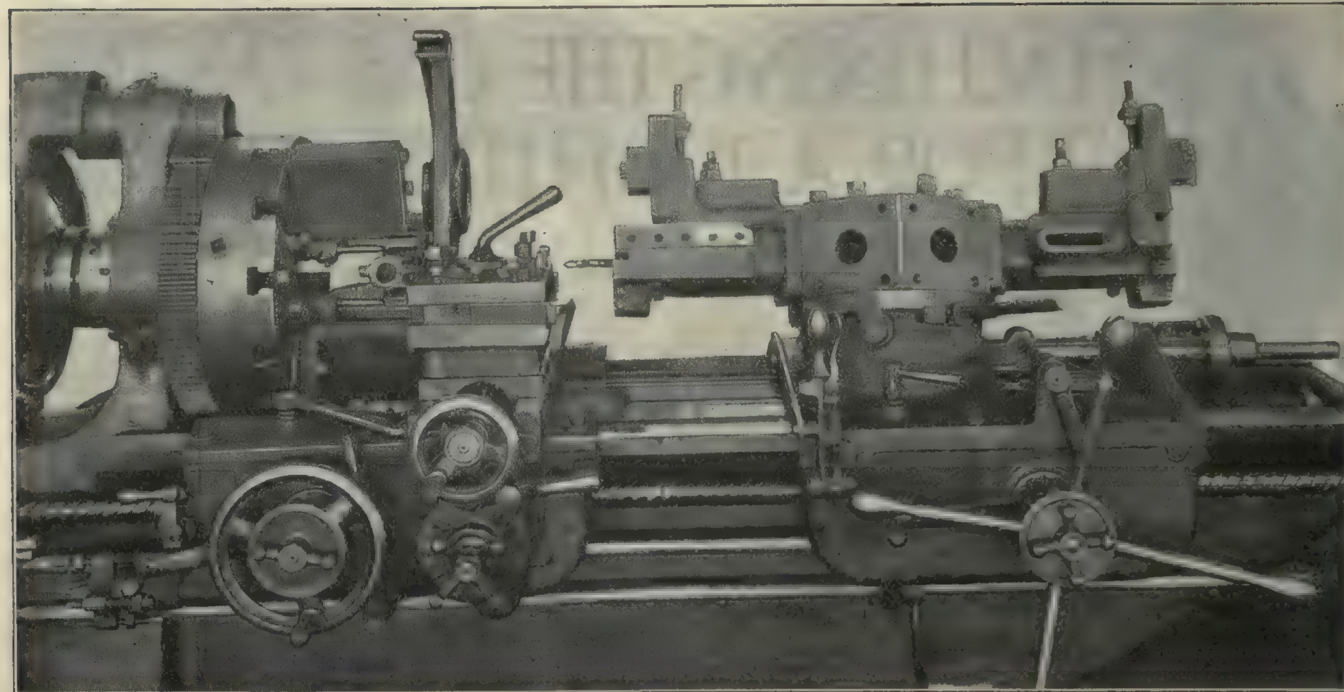


FIG. 10. TOOL SET-UP FOR FINISHING CYLINDER HEADS IN TURRET LATHE

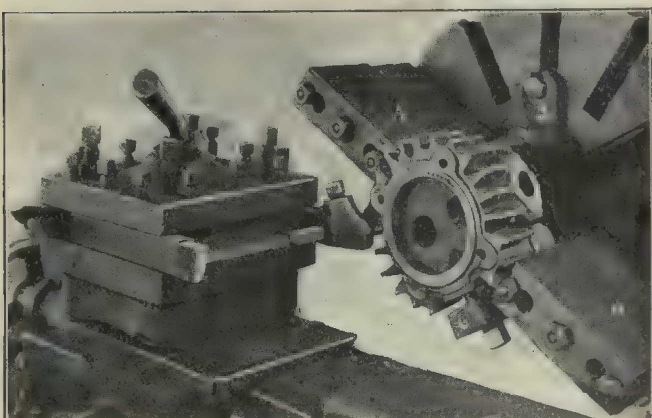


FIG. 11. HIGH JAWS REQUIRED FOR HOLDING CYLINDER HEADS

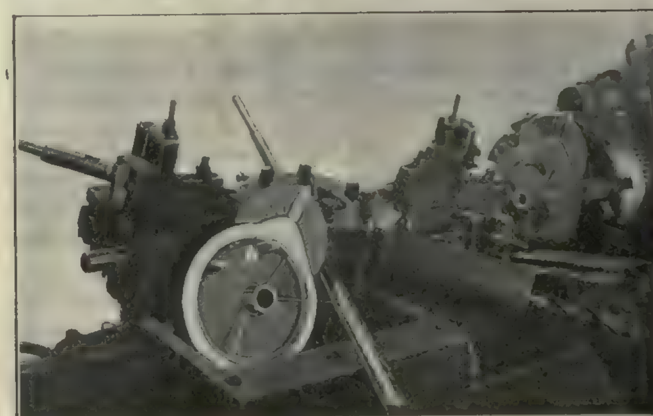


FIG. 12. LATHE MACHINING CRANKCASE COVER

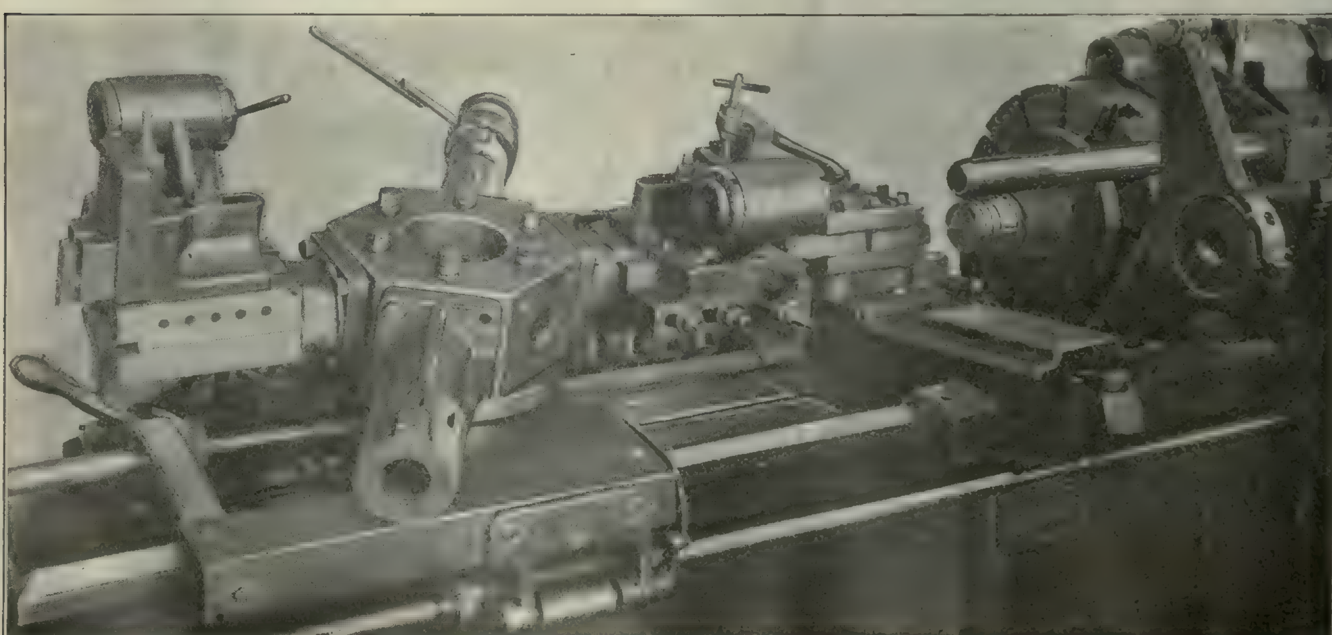


FIG. 13. SECOND LATHE OPERATION SERIES ON PISTONS

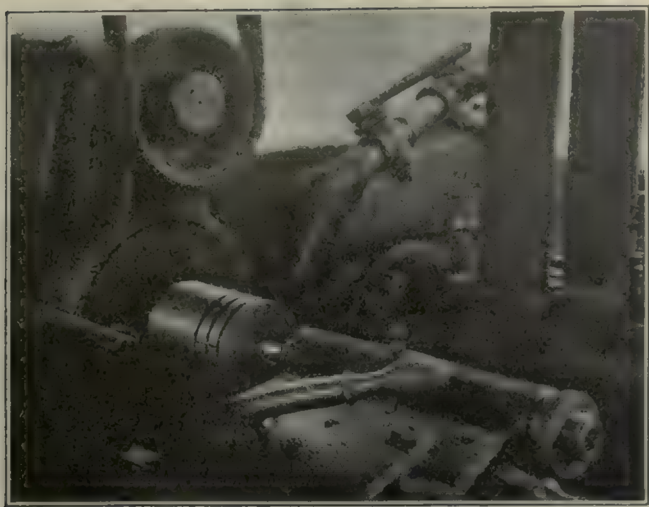


FIG. 14. GRINDING PISTONS

a profile tool, carried in the toolpost, cuts the three piston-ring grooves, Fig. 13. As mentioned in a previous article the cylinders are accurately reamed to size and not internally ground, but the pistons are finish-

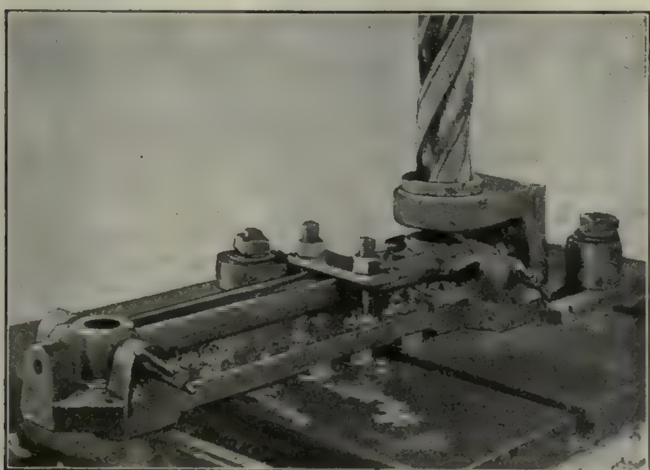


FIG. 17. DRILLING BEARINGS OF CONNECTING-RODS

ground outside to accurate diameters. The grinding operation on these pistons is shown in Fig. 14. A sal-soda mixture coolant is used.

The fuel injector or aspirator is a small elbow cast-

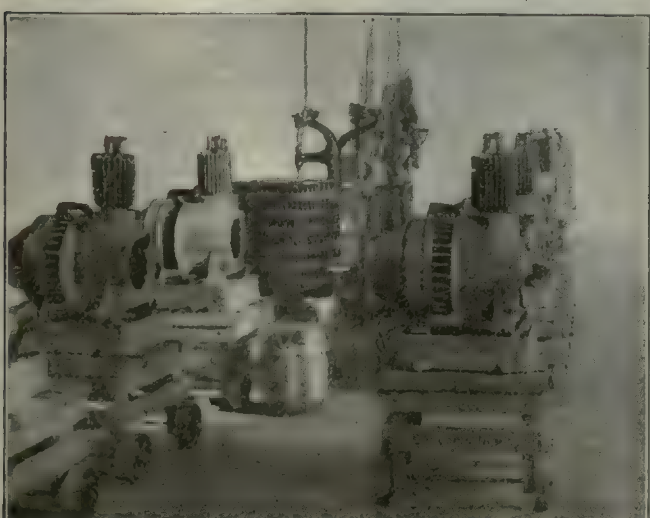


FIG. 18. ASSEMBLY FLOOR FOR LIGHTING UNITS

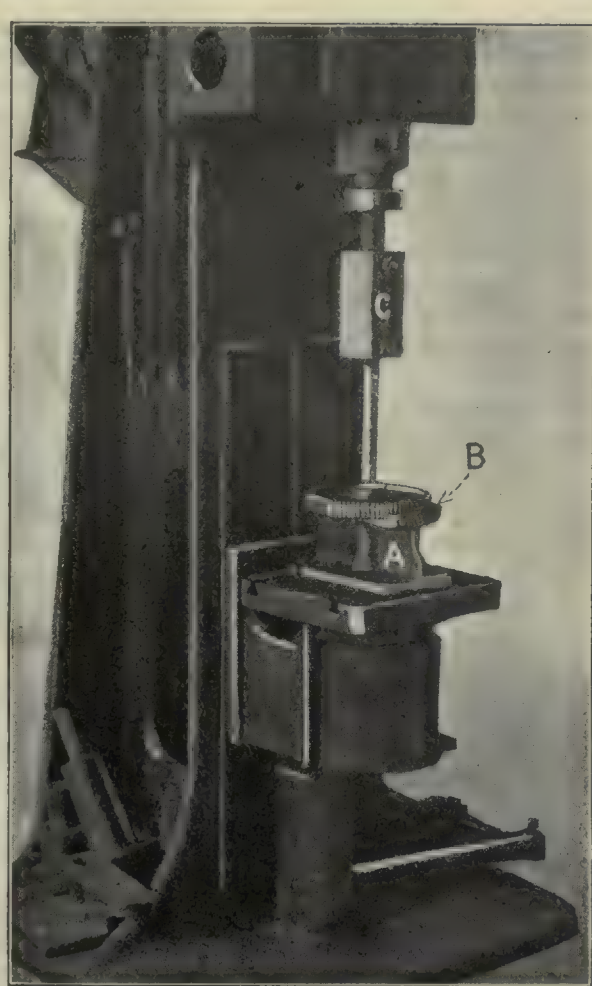


FIG. 16. DRIVING THE SHAFT INTO THE LARGE TIMING GEAR

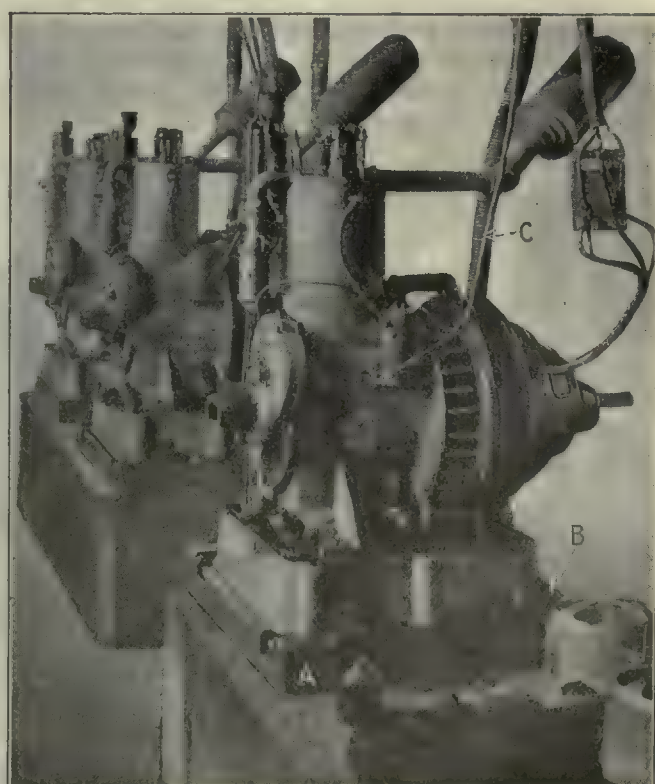


FIG. 19. LIGHTING UNITS ON TEST BURNING KEROSENE FOR FUEL

ing, both ends of which are bored, reamed and faced on a Gisholt turret lathe, Fig. 15. A special holding fixture bracket *A* is provided for this part, and the lathe as seen here is operating on the outside end of the casting. A finished casting may be seen lying at *B*. A similar bracket is used for supporting the casting during the operations on the other end.

A vertical power forcing press, Fig. 16, is used for forcing the shaft into the large timing gear. The gear is closely aligned by the fixture *A*, which holds the edge of the gear by means of the flange *B*.

The connecting-rods are held in the jig plate *A*, Fig. 17, during the drilling operations. High-speed three-lip drills are used for this work.

In starting the engine assembly in the plant of the Fuller & Johnson Manufacturing Co., the foundation castings are first placed on individual small-wheeled trucks, Fig. 18, and remain on these through all operations of assembly until the completed unit is taken to the testing floor. On these trucks the engine may be passed along to different portions of the assembly floor in progressive stages and all heavy lifting and crane work is thus avoided.

The foundation used for the engines on test consists of the cast-iron plate *A*, Fig. 19, to which they are securely bolted. This plate is mounted on a concrete base. To assist in sliding the engine unit from the assembly truck to this testing base, the latter is equipped with a roller. In this testing-room view, the two rear engines are running carrying full load, without vibration, and, notwithstanding their kerosene fuel, are exhausting through the mufflers which may be seen extending diagonally above them directly into the testing room, without any perceptible smoke or odor. After the carburetor has been properly adjusted for the engine, these exhaust pipes are connected to the flexible exhaust pipe *C* extending down from an overhead exhaust system so that the burned gases will be conveyed away from the testing floor. These engines use no hot air other than a small quantity which is drawn by a breather pipe from the crank case in order to keep the latter free from oil fumes.

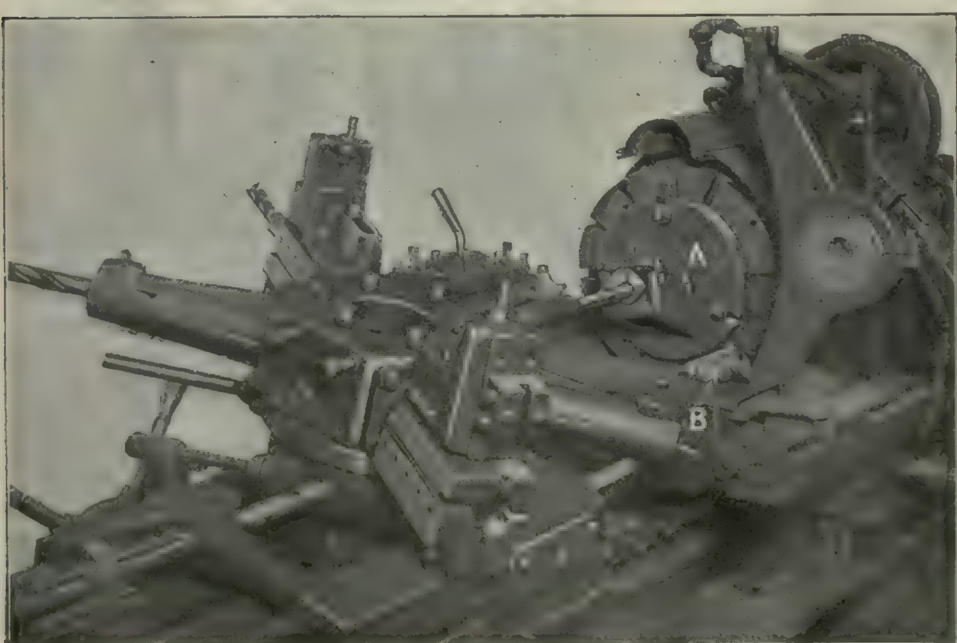


FIG. 15. MACHINING FUEL AND AIR FEEDER CONNECTION

Electric Steel Production

That the manufacture of electric steel is now a well-established industry is shown by statistics recently published by the American Iron and Steel Institute.

While the total annual steel output of the country has about doubled in the last five years, the tonnage of electric steel has been increased twenty-fold. In tonnage the electric furnace leads the crucible by a wide margin, the latter having just about stood still since the electric furnace appeared. The electric process has passed the crucible and bessemer processes for the production of alloy steels and is almost equal to the open hearth acid process. A little more than 16 per cent of the 1918 alloy steel production came from the electric process; 36 per cent of the 1918 electric steel output went into alloy steels.

The total tonnage capacity of the electric steel furnaces in 1919, of the United States, was about 1,350 short tons. On the basis of three heats per day, operating 300 days per annum, these furnaces are capable of producing 1,215,000 short tons. This is the possible production on an 8-hr. day basis, provided there are no interruptions. For continuous operation of 24 hrs. per day it would be possible to average five heats per day on casting and ingots, taking into account delays for repairs.

On this basis the annual capacity would be 2,025,000 short tons.

The increase from 155 electric steel furnaces in the United States in 1917 to 330 in 1919 is about 113 per cent, and the increase from 1910, a period of nine years, is about 2,500 per cent.

Among the chief reasons for this phenomenal growth in the electric steel industry should be mentioned the following:

1. The electric furnace met the demand for a more scientific way of producing uniform steel.

2. The results obtained in general average practice indicated that the electric furnace steel was uniformly better by a startling percentage.

3. Due to the fact that electric steel can be poured at a much higher temperature in a still or dead condition, it has become possible to produce intricate thin section castings with regularity and without high percentage of rejections.

4. Quality of electric furnace steel offered a possibility of applying a distinctly new atmosphere to the sales work. This was directly in line with the demand for quality products of all kinds which has grown up in the past few years.

The demands of the Government on account of wartime requirements and the development of new fighting machinery brought out requirements which could only be met by using the electric furnace.

This naturally stimulated the industry and placed it on a firm foundation.

A Foundry That Perseverance Built

BY FRED H. COLVIN
Editor, *American Machinist*

In these days of huge manufacturing plants, many of which have never gone through the primary or small shop stage, it is of peculiar interest to find a comparatively new plant which has been built, almost from nothing, from the ground up. It is still small, but so are the opportunities as compared with large industrial centers; but it shows that skill, plus perseverance, can win out under adverse circumstances.

JUST on the outskirts of the City of Pensacola, Fla., is a small foundry which has many unusual features, not in the way of special equipment, but as an example of how perserverance and the determination to make good, has made it possible to build a substantial foundry business from the smallest kind of beginning. Starting with one man as a helper, Joseph A. Stauter began building the business of the Bay Shore Foundry Co. about five years ago with almost no capital. His main asset was a thoroughly practical knowledge of both patternmaking and foundry work, a combination which has proved particularly successful in a foundry of this size and kind. The whole equipment is homemade, the cupolas being built of discarded steam boiler shells, and the charging platform and runway being primitive as shown in the headpiece. The cupolas can together handle enough metal for a 4,000-lb. casting, and some of the emergency ship work done during the past two years has taxed this capacity to the utmost.

A general idea of the layout can be had from Fig. 1 which gives approximate proportions, the office being the latest addition and being clearly shown at the extreme right of the headpiece. Near this is the "skull cracker" or casting breaker shown in more detail in Fig. 2. The weight or drop is hauled up by means of the windlass shown in Fig. 2, the windlass being operated by manpower. The brass furnace is shown in Fig. 3, which also shows an old locomotive driving box to be broken and melted and a keg for drinking water at the extreme left. The core oven, shown from the outside in Fig. 4, is a comparatively new addition

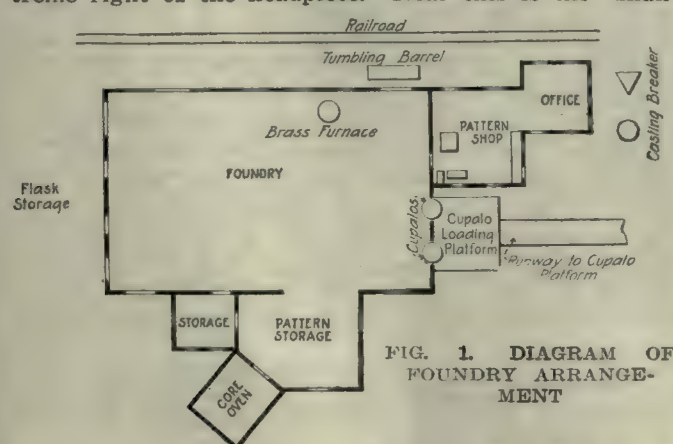


FIG. 1. DIAGRAM OF FOUNDRY ARRANGEMENT

and has a counterbalanced door of plate iron to retain the heat and also reduce the fire hazard in the shop. The top is of sheet iron, covered with a layer of sand about 6 in. deep which makes a very good nonconductor. The heat is secured by building a wood fire inside the oven itself.

Fig. 4 also shows a large pouring ladle and a good sized flask used for making one of the large castings for the emergency ship work previously referred to. Part of the flask storage is shown in Fig. 5, the flasks under the shed being cast iron with well-fitting pins. The tumbling barrel shown in Fig. 6 is just outside the foundry door and is substantially mounted on concrete blocks as shown. This is a very modern tumbling barrel and is particularly interesting, because both the patterns and the castings were made in this foundry. Before criticising the out-of-door appearance of much of this foundry, it must be remembered that the climate in and around Pensacola very seldom gets much below freezing and is far above this temperature much of the time. A closer view of the runway and charging platform is seen in Fig. 7.

The accompanying cuts should prove interesting to those familiar with foundry methods in the North, because they give an idea of the effect of conditions and locality upon founding processes. The group of frame buildings would not

FIG. 2. THE SKULL CRACKER

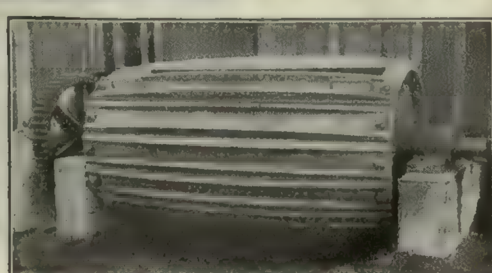


FIG. 6. THE HOME-MADE TUMBLING BARREL

FIGS. 3, 4, 5 AND 7. VIEWS OF THE FOUNDRY
Fig. 3—The brass furnace. Fig. 4—The outside of the core oven and large ladle. Fig. 5—Part of the flask storage. Fig. 7—A closer view of the runway and charging floor.

compare favorably with the big modern foundries, with their large-scale production methods; but that is not the point of this story, as has been explained.

At the present time there are two members in the firm, B. M. Bell having joined the concern to look after the business end, which now requires that a responsible man be in the office at all times during the day. This allows Mr. Stauter to spend his time in the plant, and may be taken as an evidence of the growth of the business and its present activity.

Scientific Argument, or Jazz Publicity?

PROF. C. W. PARK
University of Cincinnati

About a year ago, a good many people, as the phrase went, were "jumping up and down with idealism." They awoke each morning expecting to find a new heaven and a new earth, or rather a new earth that would be so perfect that heaven could be dispensed with as no longer necessary. They expected to see not merely the millennium, but their *interpretation* of the millennium, ushered in immediately and completely. It was all very simple. Just a signature here, a decree there, and presto!

Among the reforms that were to bring about this golden age was the adoption of the metric system by the United States and England, as advocated chiefly by the World Trade Club, of San Francisco. Their propaganda in the name of James Watt and all things anti-Hun will be remembered by all who received copies of a circular designed to convert the reader instantly, and enclosing for his convenience two stamped envelopes for addressing an appeal to President Wilson and David Lloyd George, respectively. How many kilograms of paper or liters of ink were expended in this campaign, would be difficult for outsiders to estimate.

The merits of this scheme from the standpoint of practical affairs have been discussed elsewhere in these columns by men who know what its effect would be. Quite apart from the subject matter of the famous Watt circular is its method, which is surely unique in the annals of scientific literature. Its circus-poster style and its spirit of palpitating pep are illustrated by the following quotations, which the reader is challenged to examine in an attitude of dispassionate scientific inquiry:

"Yes, the time has come when both of these nations (Britannia and America) must align themselves with the rest of the civilized world. They are too progressive, too patriotic, too democratic, too scientific, too forward-looking to hold aloof from civilization and to perpetrate methods so wasteful, and so inadequate, so hazardous to the life of the nation."

"President F. O. Wells of the Greenfield (Mass., U. S. America) art cap die gage hole jig jag nib nub rim ream slot slip slit slide snip screw tab tip top test terse tie tread trim tug tube zig zag machine-tool Co., the concern that manufactured so many things indispensable to the supply of war munitions, declared (and hosts of other experts agree with him) that the German kaiser would not have dared declare war if America and Britannia had been standardized on metrics when the Germans adopted the system exclusively in 1871. In that event they could instantly have co-operated with one another and with all their allies, co-ordinating the supplies and munitions from every part of the world."

"After the World War, whatever else may be, the world will be a smaller place. Whatever methods may add to better understanding and better business and better safety from German attack, this is surely the best of all. Why not try it? Foch has made 10,000 winning decisions for all allies, why not let Foch decide this? . . ."

"One weight, one measure, and one coin, will soon the warring world in friendship join!—and keep the World War won."

Much of the millennial fog of last year has cleared away and the noise of the panacea-monger is drowned by the hum of industry, for which, after all, there appears to be no satisfactory substitute. Judging from pending, or impending legislation, the metrical scientific enthusiasts, almost alone, persist in the original hope of a world made over by decree.

Donald A. Hampson

The lure of the great outdoors, and the reports of easy money in the garage business have induced many a heretofore contented machinist to "chuck up" his job, borrow a little money, and set up for himself. There are many snares and pitfalls, however, and a few general hints for the guidance of the newly established machine-shop proprietor, or for those not hitherto connected with the automobile repair line who contemplate expansion in that direction, are here given by one who has been "through the mill."

THE passenger car business, which was held in check by the war for several years, has come back in a veritable storm during the past few months, with indications of keeping up at the present rate for an indefinite period. Besides the manufacture of new machines, there is a decided briskness in the repair and overhauling end of the business; cars that have been out of service for years, cars that were let go because of the scarcity of skilled mechanics, and the thousands of new cars being placed in the hands of new owners.

This volume of business should serve to fill the gap in scores of machine shops which find the old lines dull, and it should constitute a field for those that wish to expand or for the shop-of-their-dreams which so many ambitious men have longed to start.

Not All Easy Money

The "automobile game" is not all easy money; no more easy money than any other branch of the machine business. In fact it is the presence of those who make it a "game" that gives it a more or less deserved black eye, for it is an undeniable truth that retail selling has been characterized by sharp practices while the repair shop and service station department has often been manned by workmen of the "plumber who couldn't plumb," and the graduate stable boy, variety. One man, who in his heyday conducted a chain of garages and was wont to assert that "a machinist never makes a good automobile man," lived to see his house crumble about him; learning too late that customers ultimately find out a few things for themselves and avoid the unskillful workman.

If asked to state the first rule of success for any machine shop that wants to make a serious drive for the automobile trade, the writer would say this: "stay out of the garage end of the business." This may seem like poor advice to those who have heard that "you can make your rent on gas sales alone," and "storage is clear profit"; who have heard of the big money to be made out of the sale of old and new cars, or who have seen the Saturday afternoon string of patrons clamoring to have their work done. Go around on Tuesday morning if you would note the vanished gas buyers and the absence of work customers; wait for the long winter to eat up the profits of sales and storage—if then you are bound to do a garage business too, *do* so, but conduct it at a different location from your machine shop and with an entirely separate crew of men. Best of all, run a machine shop that *is* a machine shop and do the automobile work just as you do work on any other class of machinery. Every machine shop, large and small, should have its system of tool keeping, of discipline, of training apprentices or instructing new men or routing and dividing work, and of financial affairs.

The automobile is the most intensive piece of machinery in common use—then why is the machine shop not the logical, the very best, place to take it when in need of repairs? It is; and if it were not for the adjustment side of the business, the machine shop might easily cater to all the wants of the motoring public.

Road Work Not Good for Machine Shops

Adjustments necessitate road work and road work means running in and out of the shop, with several outsiders trailing along and the bench and machine hands looking up every time to see what is the latest excitement. Chauffeurs and owners and men-with-time-to-spare are particularly noisy when they come in from outside and they are extremely interested in the work they see being done in the machine shop. Spread three or four of these idle, inquisitive persons around in a shop of twenty workmen and you would have to charge $5 an hour to break even on the one job that drew them inside. It is all well enough to say, "Keep them out," but the chief mechanic calls the chauffeur in to ask something that was forgotten outside, or the foreman's buddy slips past the "No Admittance" sign with a wink, and soon the whole gang is back again.

Road work is a form of "service" and goes along with sales, adjustments, garage work, and garage mechanics; not machinists. Mixing this part of the business in with machine shop work in any plant small enough to want to take in repairs and jobbing is fatal to dicipline. That is a fact that will bear endless repetition. It is because it is so easy to be beguiled by persuasion and

plausible assumptions that this phase has been dwelt upon at length. Experience has so thoroughly demonstrated to the writer that a mixing of this sort only leads to financial distress and mechanical laxity, that he advises any machinist who feels that he must go into it to forget his trade and set up a gas-and-oil station in the nearest vacant shanty rather than invest one cent in machinery for one of these shops.

If automobile work is brought into the shop—parts to be refitted or made or repaired—go at them as if they were steam engine parts. Put a machinist on them who is equal to or may be coached in the job. Let the work take its turn, or use discretion as to how far a hurry job may rob other work under way. Supervise in the same way and insist on an equal standard of workmanship, even though the owner may not know iron from brass. When a man drives up and wants some one to do adjusting or tuning up, tell him frankly that you do not do that sort of work; tell him that you are leaving garage work to the garages and are concentrating on the very best kind of machine work you know how to turn out. In the end, this policy will make friends and bring plenty of business.

Do Not Trespass on the Garage Man's Field

A plan that has worked well for all concerned is for the machine shop owner to visit the garages in his town or community with a view of soliciting their business. Make an agreement with them to do all of their machine work—they to stay out of that branch and you to stay out of the garage and sales end. Such an arrangement is advantageous to the garages; it leaves them free to concentrate on service, it saves them the expense of tool equipment, and it raises the standard of their work, for the grade of repairing done by the man who has only picked up his knowledge of, say, lathe work and touches a lathe only two hours a week is very low indeed.

Machine shop work should bring a decided advance over garage charges, fully 25 per cent more and fifty would be a more equitable figure. In no other business is there the money tied up in tools and machinery that there is in shops; the workmen do not become skilled over night as do the "mechanics" of the garage, it costs money to train them and they in turn must spend years in training where application is essential. Compared with the building trades, whose investment is practically *nil*, machine shop work should bring twice their hourly rate. Good work is worth all it costs and is decidedly the cheapest in the end.

The writer was connected with a repair shop during the time that a dry town campaign was at its height, and one of the shop's best customers was a brewery that had a fleet of auto trucks and a plant full of machinery; our shop policy was "dry," on account of the saloon evil, and activity in the campaign automatically lost us the brewery's work, but in a year's time we had the brewery work back again simply because they knew that we did conscientious work and they found out that the other kind was expensive and risky.

Work that is brought in from garages is almost always done on a time basis. They accept without question the machine shop's charge and add perhaps 10 per cent for handling, thus relieving the shop man of a vast amount of kicking and disagreeableness. On the other hand, many customers bring their work directly to the shop for an estimate.

Experience has proved that there are two ways to make friends and customers of automobile owners, who usually are not mechanics. First: tell them frankly that they should buy factory parts explaining briefly the principle of quanity production and buying, with the certainty of getting thereby better parts for the same money or the same parts for less money; second, if an estimate must be made, make it high enough to begin with so there will be no extra charges when the bill is ready. The customer who has been advised to buy of the factory and decides not to has no come back; and there is generated a feeling of honest treatment to find that a job has cost a little less than estimated.

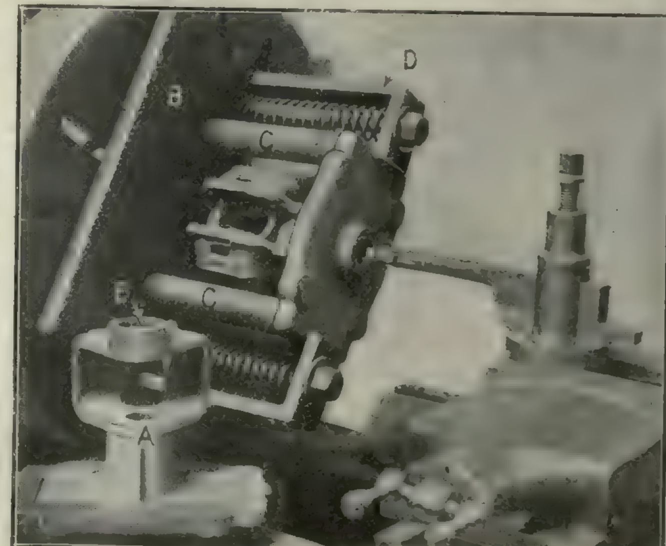
Education a Factor in Making Friends

Education is a big factor in making friends. The shop man who is familiar with materials and the latest processes and who is not afraid to explain these things as related to repair parts soon finds that he is drawing trade and making a reputation for himself as an informed man. In this latter connection there is nothing like the trade papers to keep one informed of what is new and what is being done elsewhere; the advertisements too are a help and they can often be used for the customer's benefit in cases where an address or article is wanted.

Lathe Fixture for Holding Irregular Castings

By John Vincent

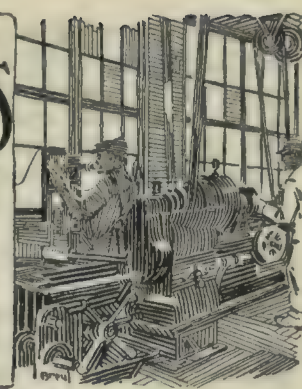
The steel casting shown at *A* in the illustration is bored in the tractor shops of the Minneapolis Threshing Machine Co. while held in the peculiar fixture shown bolted to the faceplate. Ordinarily a pot-chuck would be made for such a piece, but the device shown was made at much less expense and has proved serviceable. An old plate *B* is fitted with four heavy studs *C*, and also with a pin on the rear side which serves as a driving dog. The casting is held against the studs *C* by the spring-released clamps *D*, which relieve themselves from the work as soon as the clamping nuts are loosened. A pilot-stud, which fits the large previously bored hole *E* in the inside end, serves both to center the work and to prevent side-slipping.



LATHE FIXTURE FOR HOLDING BRACKET WHILE BORING

MODERN PRODUCTION METHODS

By
W. R. Basset
of
Miller, Franklin, Basset & Co.



IF WE compare the book-keeping and stock-keeping methods used in most plants, it appears that money is of great value until it has been transformed into material, whereupon what happens to it becomes of no moment. Executives must O.K. expenditures and sign checks, and the greatest of red tape is warranted if we make sure that no penny goes out of the business without a good reason, and that a proper charge for it is made against something-or-other.

But when the money comes back into the stockroom as material we lose all respect for it. The receiving clerk will "guess" that it is all there. Many of us don't even look it up; just let any workman who "needs" it help himself. Or if we do demand that he have authority for using it, we are seldom persnickety about what it is to be used for. If, at the end of a month or so, an actual count shows that we have only 95 per cent of the material on hand which our stock records show we have, we correct our records to agree with the count without investigating. Suppose we handled our bank balance that way?

III. Need for Systematic Stock Keeping

Just why a man or corporation will take scrupulous care of every cent and then leave stock worth hundreds of dollars in places where it can be stolen with the utmost ease, is more or less of a conundrum. In this installment the author presents some specific remedies for this evil.

(Part II appeared in our April 22 issue.)

Of course, accounting for stock can be so surrounded by red tape that loss results. Good sense and a knowledge of the needs of each shop must dictate to what extent we go. But we must not forget that the stockroom is a tool of both production and cost finding and can be made a most valuable one to both. With this in mind, let us see why we have a stockroom in a machine shop. It is by means of the stockroom and the stock-keeping records that we are able:

1. To make sure that all material is used for the purposes of the business.
2. To prevent production delays through lack of needed material.
3. To prevent over-buying with the consequent "freezing" of working capital.
4. To make sure that all material will ultimately be accounted for as part of the cost of the finished product.
5. To facilitate taking the inventory.
6. To save the time of men, who, when they need something, can count on finding it in a certain place, instead of roaming around the plant searching for it.

Many of the points I am going to make in this discussion of stock keeping may seem too obvious, but my experience shows me that it is often the most obvious things which are overlooked in managing a shop.

An instance of what I mean came to my attention when the owner of a shop complained to me that much of his finished stock, consisting of small brass parts, just the right size for a coat pocket, disappeared unaccountably. He apparently saw no connection between this shrinkage of finished stock and the location of his finished stockroom. This stockroom was open both to the factory and to the outer world—it was the exit through which the workers left at night—and the stock clerk himself almost invariably "beat the whistle." When so obvious an invitation to theft is not obvious to the man most concerned I feel that I cannot go wrong by at least mentioning the "obvious."

The location and design of the stockroom and the routine of running it are all dictated by the six aims set forth above. Of course, physical conditions will sometimes be such that the ideal cannot be realized—so the best possible compromise must be accepted. The materials carried in stock by a machine shop may be of five kinds: 1, raw materials; 2, partly finished materials; 3, finished materials awaiting assembly; 4, finished materials awaiting shipment; and 5, supplies or so-called non-productive stores. In some shops only raw materials and supplies will be kept, the product going straight through the plant and being shipped as quickly as finished. In others al lor part of these stocks will have to be carried.

Whether all of these classes of stock shall be kept in a single stockroom, whether two or three shall be grouped, or whether each class shall have a room of its own depends upon the size of the plant, its arrangement and the total amount of stock kept. In some plants it is easy for one man to care for and issue all classes of stock; therefore if space is available all of the stock may be kept in a single room. Of course bulky material of comparatively low value per pound like pig iron, heavy plates, castings and so on may safely be kept in an open space like a yard, close to where it will be used. This saves valuable floor space and heavy trucking, and there is little chance of material of that sort disappearing.

If the stock carried is so large, or if the issues and

receipts are so frequent, that the full time of several men is required it is often best to split up the stockrooms so that each may be put in the best possible location. In many machine shops that cover considerable area, this has been done. One of these shops manufactures large quantities of several assemblies to order. It is a quantity production proposition and many of the parts are common to several assemblies so that a considerable quantity of finished parts is carried in stock.

This shop combines in one stockroom its raw materials (which consist of small castings, gear blanks and bar steel) and its supplies of non-productive stores. This stockroom is located as nearly as possible in the center of the plant. The factory was originally so designed that freight would come in handy to this stockroom. By this arrangement the trucking of raw materials and supplies both to and from the stockroom is at a minimum.

The finished parts are kept in a separate stockroom adjoining the assembly floor, so that no long hauls are needed when they are ordered out.

This is usually the ideal way to locate the stockrooms, but it cannot always be achieved. The rule, if we were to make one, would be, "Store everything close to the department which will use it so that trucking and time may be saved."

When, for instance, a plant is spread out over an unusually large area the first operations on various products are apt to start at widely separated points. This may make it desirable to split up the raw material and supply stock, locating them near the primary departments.

Location of Stockroom a Difficult Problem

In buildings of several stories the location of stockrooms often presents difficult problems. Receiving and shipping must generally be done from the ground floor, while the process quite often starts at the top of the building and the material flows downward. Usually under these conditions it is best to store the stock on the first floor. It must be taken to the top sooner or later; usually the light is better on the upper floor and is more needed for manufacturing departments than for storage; and if the stock is heavy it would often be quite expensive to build strong enough to allow it to be carried on an upper floor.

I consider that poorly arranged stockrooms are one of the most potent causes of leaks and delays in production. In one plant I recall, a mere physical rearrangement of stock not only eliminated most of the delays in production, but by giving the management a correct knowledge of what they had in stock and where it was, cut the amount of the inventory 31 per cent. The stockroom as it formerly existed is shown in Fig. 6.

The cases, barrels and kegs extended back about 80 ft. A barrel of brass trimmings can be seen perched atop a keg of rivets. The particular style of trimmings contained in the one barrel was almost a year's supply.

It was a recent arrival purchased at the then high price of brass; yet piled behind the many cases in two different places were two more barrels of the same trim purchased at a lower price.

Their existence was not suspected until an investigation brought them to light, for when an impatient shop superintendent failed readily to find the trim he sought, a further supply was ordered. The style of assembled product changed before all the trim was used and the excess became obsolete and was scrapped.

It was easy to arrange this stock so that the location of each item and the amount on hand could be known.

Of course this looks like an extreme case. Because of the apparent disorder it may be. But not infrequently the well-kept, orderly looking stockroom is actually, though not apparently, just as bad. If no one knows where the materials are that are so neatly piled, they might just about as well be piled helter-skelter. Take, for instance, the wastes that were eliminated in one well-equipped stockroom which at first glance seemed to be admirable.

The finished stock department of this plant employed thirty-two men, exclusive of seven clerks in the office. This force was divided into four general groups: receiving and storing, inventory, mail order parts and delivering parts for assemblies. As the department had grown from a comparatively small beginning to its present size, additional metal bins and shelves were provided, but no particular attention had been paid to providing a fixed location for every part. The old method of receiving a truck-load of parts was to find an empty bin, dump the parts into it and then rely upon the memory of "Jack" or "Gus" when the part was needed.

FIG. 6. A BADLY ARRANGED STOCKROOM

No attention was paid to grouping like parts or arranging the parts most frequently used in a convenient manner for discharging. For example, in making up one assembly the requisition might call for nuts of several different sizes located in a number of sections, 20 to 40 ft. apart, which necessitated considerable back tracking and lost time. The following steps were taken to improve conditions.

First, we made a new layout for the entire department with a definite and fixed location for each part, grouping like parts in one section or locality, to give the minimum amount of travel in making up the order.

Incidentally, in this stockroom we effected a considerable saving of wages by means of a wage incentive plan. All parts were classified; the large parts went into a class by themselves; the small parts into ten classes covering them all. The class each part went into was determined by the size and time required in handling the part. Time studies were made from which to determine the number of pieces of each class which could be handled in an hour.

For putting away, counting, making up assemblies and so on, for a certain fixed number of pieces of any

class, the man or gang is given one unit, the units of the entire force are totalled up each day and divided equally among the gang at the end of the day period, each man receiving a bonus according to the number of units earned. By this method a man can be transferred from any branch of the stock department activities to another without affecting his bonus or necessitating the services of an extra time clerk. These improvements resulted in reducing the stock department force approximately fifty-five per cent.

FIG. 7. INDEX BOARD FOR STOCK

This incident brings out one point quite pertinent to the present discussion; that of arranging the parts. There are three ways that parts may be grouped. The most common is to follow no particular plan—simply to utilize the nearest vacant space.

The first attempt at order usually is to arrange the parts by part number, or by type of part. As part numbers frequently are assigned in order as the part is designed, this method has little to recommend it except that it does offer a chance to index the stock. In some shops it may be best to group parts of a kind, having, say, all bolts, or all valves, in definite sections. But for concerns turning out an assembled product in quantities, it is usually best to group, so far as it is feasible, those parts which go into similar assemblies. Often the parts for several assemblies differing only as to a part or two can be grouped in a single section so that the stock keeper can pick out the parts needed for an assembly without chasing all over the room and perhaps holding up production while he chases.

If the assemblies have been properly engineered it is easy as a rule to make the stockroom self-indexing by part numbers. The parts for similar assemblies will have similar numbers so that if the bins and shelves are laid out by assembly letter and part number they will be grouped handily.

If the seasonal demand makes it necessary to carry widely varying quantities of a part this grouping may not be feasible, for it may be necessary at peak production to fill the usual bin and use several other bins —whichever ones happen to be empty—to take the overflow.

This method, in use in a well-run machine shop, handles this condition well. The stock—small parts and large—is kept in bins and on shelves, to the front of which are attached bin cards showing the part number, the name of the article, the location of the bin, and the record of receipts and withdrawals. This bin card really is not needed—a number to identify the bin would be sufficient.

The unusual part of the system lies in the index board by which the stock clerk can tell at a glance where he will find any needed parts. This is shown in Fig. 7.

The Stock Board

The stock board contains small pockets, each being given the number of a part in rotation. Whenever a supply of a given part is put into a bin a small ticket is made out and put in the pocket bearing the corresponding part number. This ticket shows the exact location of the bin in which the part may be found.

If several bins contain the same material, a separate tag is made for each bin and kept in the single pocket. Thus when the stock clerk wishes a part he goes to the board and under that part number sees at a glance just which bins contain the parts wanted and how many parts are in each bin. Vacant pockets of course show empty bins which are available.

You may note that a ticket in the third row of pockets from the bottom, on the left of the board, bears a dot. This is in reality a red tag, used to flag attention. It happened that the part in question was stored in several partly filled bins and it was desired to empty one of them as soon as possible. The next order for that part will be taken from the "flagged" bin.

Stockroom Equipment

Whether to build the storage equipment of wood or steel and what the parts shall be stored in are important questions. While steel is usually more expensive at first than wood, the economies in operation are continuous. Wood wears out rapidly, is less adaptable to expanding needs than steel, becomes dirty and oil-soaked and is a considerable fire risk. Then, too, with steel the stock can be concentrated in much less space than with wood.

Whether materials can best be stored on racks, or shelves, in bins or in tote boxes is often settled by the nature of the material. Personally, I believe that tote

boxes are not used for storage as much as they might well be. They offer great possibilities for economical storage, provided thought is given to their use.

Often they are too large to be a really desirable unit and storage space is wasted because a partly filled box takes up as much room in the stockroom as a full one. In one plant, where the stockroom was in chaos, due largely to congestion, a study showed the following condition in one section alone:

No. of Boxes	Condition	Boxes Actually Needed
134	boxes completely filled	134
46	boxes one-quarter full	12
68	boxes one-half full	34
70	boxes three-quarters full	54
318	boxes used	234 needed

Obviously by using smaller tote boxes and filling them to capacity the same amount of material could be kept in 73 per cent of the space.

The boxes in use were of wood. Their outside measurements, $18\frac{3}{4}$ x $40\frac{1}{2}$ x $34\frac{1}{4}$ in.; the inside measurements, $17\frac{1}{4}$ x 36 x $33\frac{1}{2}$ in. In other words nearly 20 per cent of the space occupied by tote boxes was taken up in storing the lumber of which they were made rather than the parts with which they were filled.

We therefore reduced the size of the boxes and had them built of sheet steel instead of wood with the result that now on the same racks we can store 72 per cent more material. Incidental advantages from the change are that the fire risk is less, the smaller tote boxes are more easily handled in the shop, and the metal boxes can be nested so that they take up less room when empty.

I do not say that metal boxes are always best. I know one shop, in which the parts made are mostly very small screw-machine products, where collapsible cardboard tote boxes are used to advantage. They are made in a variety of sizes so that lots of widely different quantities can be stored in boxes of just the right size. When empty the boxes are folded to take up little space. Of course they wear out rapidly, but offer a low first cost as compared to steel.

As a rule, though, it works out better for most shops to standardize one or two sizes of metal tote box, small enough to be handled easily.

Where parts are made to stock which moves rapidly, shelves can be constructed in the storeroom to fit the boxes. Parts can then be stored without removal from the trays in which they have been carried while in process and can be reissued for final assembly in the same boxes. This avoids a large amount of rehandling and reduces the work of taking inventory.

The trays are relatively inexpensive, and are almost indestructible, so that the investment is usually not very heavy.

The excessive cost of handling small parts in boxes of various size and shape is often not appreciated. In one plant we found that the time consumed by the operators in moving pieces from one box or bin to another amounted to 15 or 20 per cent of the total time required for the productive operations. The standardization of the boxes and the method of handling resulted in a large net return on the investment.

So much for the physical side of the stockroom.

Importance of Accurate Stock Records

The stock records are the key to all factory routine, whether costs or production, and they should therefore be kept by someone capable of keeping them accurately. As a rule the type of man most suited to handling the stock itself is not the best clerk, so that leads us in most shops to put the stock records themselves in the office.

Where the factory production is planned, the planning department is the one most interested in the stock records and so should keep them. I shall first describe the routine found most successful in plants having a planning department.

In general the stock records to be used are of two kinds, dictated by whether the shop turns out a standard product which the sales department must dispose of, or whether the sales department sells an order which the shop must make up.

In the first instance the raw material purchased will be based on the sales department's estimate of future sales; in the second the materials are ordered in quantities sufficient to fill an order actually sold. The first condition allows as a rule much the simpler stock forms.

For one thing, no records need be kept in the stockroom itself, except some device whereby the storekeeper may tell quickly the exact physical location of all materials. The perpetual inventory sheet or card will be kept in the planning department, for it is safe to assume that a concern of this sort which is so well adapted to production planning will not try to do without such planning.

Cards are much used, but personally I prefer loose sheets kept in a stock book, for cards are easily put into pockets or stuck up behind telephones where they often stay. Fig. 8 shows a good stock sheet, while for the card "fan" Fig. 10 is good. If the demand is sufficiently seasonal to make it desirable to have the

MAX ____________ ARTICLE ____________

MIN. ____________ UNIT ____________ SIZE ____________ LOCATION ____________

[redacted] FORM 333 500-3-18

ORDERED			RECEIVED			APPORTIONED			USED			BAL. AVAILABLE	
DATE	ORD. NO	QUTY.	DATE	PRICE	QUTY.	DATE	ORDER NO.	QUTY.	DATE	ORDER NO.	QUTY.	DATE	QUTY.

FIG. 8. STOCK SHEET

maximum and minimum quantities change from month to month, this can be provided for as shown in Fig. 9.

The "minimum" method of controlling the supply of material is fairly well understood and applied throughout manufacture, but frequently the minimum is based upon an "educated guess" and not in accordance with conditions actually governing manufacture.

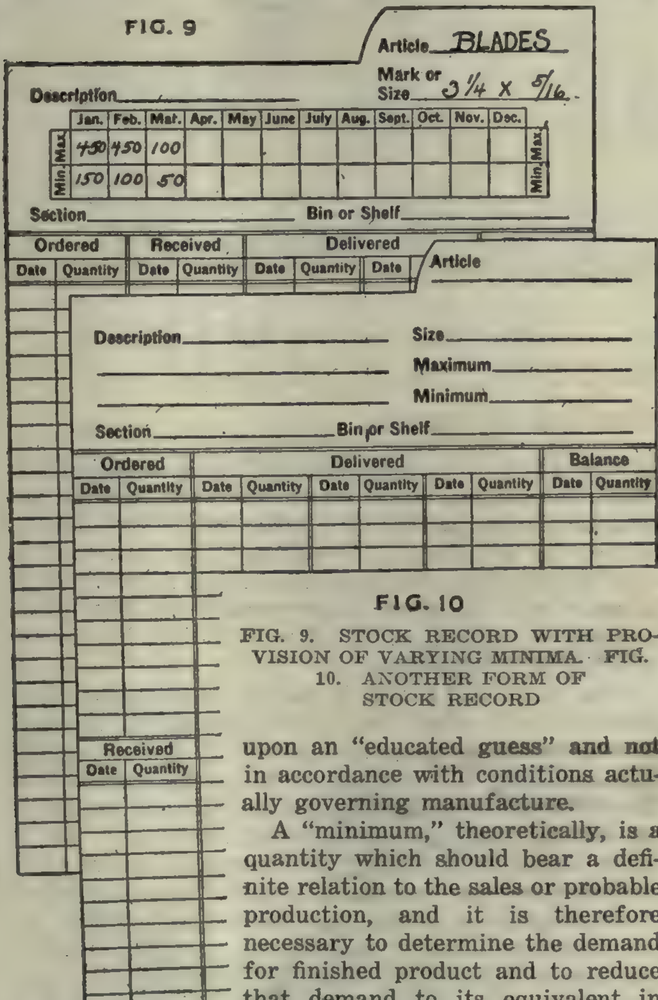


FIG. 9. STOCK RECORD WITH PROVISION OF VARYING MINIMA. FIG. 10. ANOTHER FORM OF STOCK RECORD

A "minimum," theoretically, is a quantity which should bear a definite relation to the sales or probable production, and it is therefore necessary to determine the demand for finished product and to reduce that demand to its equivalent in terms of material. Take as an illustration a manufacturer producing a line of assembled articles composed of about fifty parts, each carried on a minimum basis.

To determine the minimum we would proceed somewhat as follows:

A "part" card is used and this card shows every finished article on which the part is used and also the quantity used for a dozen of each finished article. The estimated sales are then entered on the card and the total of probable parts used developed therefrom. The minimum is then set as a certain percentage of this quantity, expressed in terms of so many days supply, as 30, 45 or 60 days, dependent on the length of time needed to make the replacing order quantity.

The requirements of raw material are ascertained by means of a "material estimate card." This card shows every part which uses the same kind and size of material shown, and the quantity of material required per hundred. The number of parts shown on the cards is then employed to determine the probable total material requirements, which amount is then used to determine the minimum stock of material to be carried.

The minimum must be of a size sufficient to allow the production, shipment and receipt of the replacing order quantity and it, too, is expressed in terms of so many days supply, as 30, 45, 60 or 90 days.

This describes briefly a very simple yet accurate means of setting minimum quantities and is peculiarly suitable to assembly manufacture.

To get back to the records. Note that in Fig. 8 there is a column headed "Apportioned" which does not appear in Fig. 10. Sometimes it is desired to set aside a part of the available stock for an order which it is known will be run but which is not needed at once. If all orders are run as soon as the requisition for the material is issued, this is not necessary.

As a purchase order is placed and as material is ordered out of the stockroom by requisition the transaction is recorded on the stock record for that material. When the clerk having charge of this record enters a requisition which brings the supply of the material close to or below the minimum quantity he enters the item on a shortage report like that shown in Fig. 11.

This is the purchasing agent's authority to buy more of the material. He has no authority to order until automatically instructed to by the stock reaching a minimum.

It is good practice to send this shortage report to the stockroom so that the stock keeper may actually count the stock of that item as a check against the record. This enables him to keep a frequent check easily for he makes his physical check only when the stock is smallest and thus can be counted quickly. Furthermore the check is made at the most important time for if error is then discovered a needless order is prevented from going forth.

Some shops keep a double check to prevent the stock from falling much below the minimum by so arranging the stock physically that the stock keeper can see at a glance when the minimum is reached. If materials or supplies come in packages the minimum quantity packages may be marked with red crayon so that when a "red" box is opened the storekeeper knows he has gone below the limit. A cord may be tied around the minimum quantity of such materials as steel bars, so that the same effect is secured.

If the stock keeper fills a requisition which brings him below the minimum and he receives no shortage report he can jog up the clerk who keeps the records.

WEEKLY SHORTAGE REPORT

MAKE PHYSICAL COUNT OF ITEMS BEFORE ENTERING ON THIS REPORT

DATE March 15/18

DESCRIPTION	MAXIMUM TO BE CARRIED	MINIMUM TO BE CARRIED	LAST ORDER NUMBER	NOW ON HAND
SAFETY POSTS	1500	500	1472	496
BLADES	2500	1000	1340	1120

FIG. 11. SHORTAGE REPORT

This set of forms, and the routine we have described will, I believe, with minor changes to make them fit the individual shop, do for most machine shops. Certainly it will give definite control which is what a large number of concerns lack.

The problem of keeping stock records is somewhat different in the shop which manufactures large quantities of the same product to order. An example of

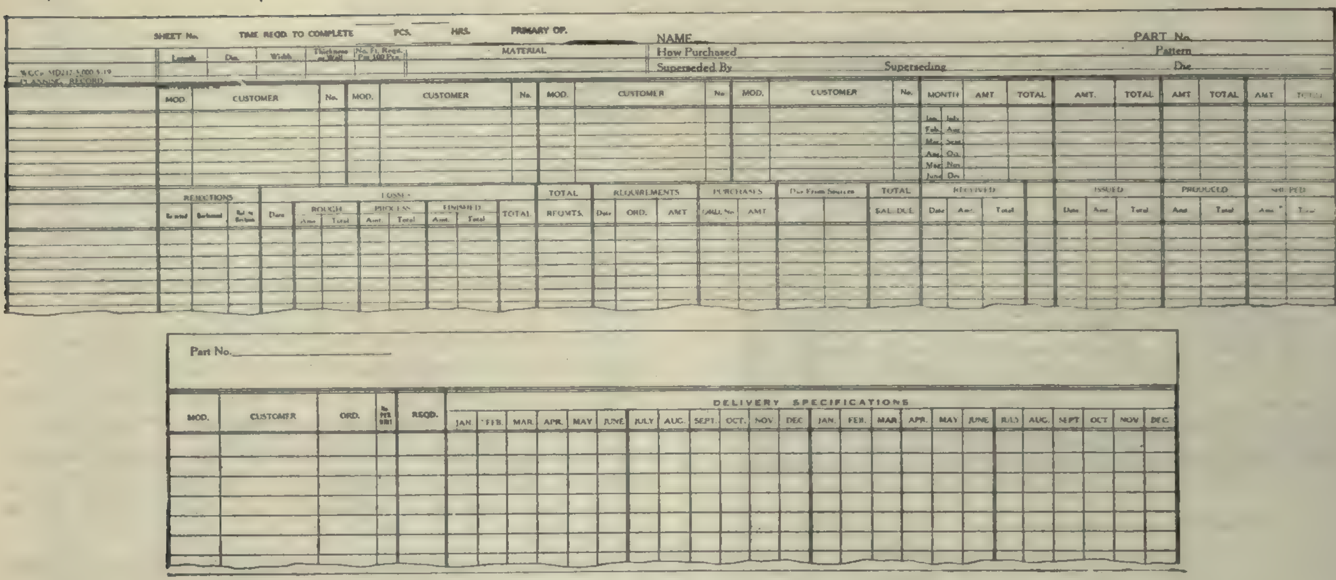


FIG. 12. PRODUCTION STOCK AND DEMAND RECORD

this type is the Warner Gear Co. which turns out automobile transmissions, differentials, clutches and so on in large quantities to individual specifications. This concern buys its raw material to cover sales orders and so carries practically no permanent stock of raw materials. Its stock is carried solely to cover sales contracts actually on hand.

The sales call for delivery of a certain number of assemblies monthly. Therefore, in buying the needed raw materials, the deliveries are asked for in such monthly installments as will permit of meeting the requirements of the sales order.

As the planning department is responsible for material from the time it arrives in the plant until the finished product is shipped, and as it must have absolute control of raw stock, it has been possible to devise a single form to give the needed bird's-eye view of material. It is shown in Fig. 12 and is called the "production stock and demand record."

This provides a sheet for each part and shows not only each customer's requirements as to delivery but the exact condition of all of the parts of this kind. From the data on this form it is possible to tell quickly how much raw material for the part is in stock, how much is in process and how much is in finished stock. It tells in addition how many pieces have been rejected, how many reclaimed and how many scrapped. This is a most valuable form in other ways which will be discussed in more details in later articles on planning. A somewhat simplified form having the same application is shown in Fig. 13. It is self-explanatory.

So much for keeping track of the productive stores. The same forms and routine will do for the non-productive stores or supplies. One thing additional is worth considering with them, however; that is the need to prevent buying of supplies which are obsolete or the use of which is declining. This can best be done by the clerk who keeps the store's record. When he sees from his ledger sheet or card that the use of a supply is falling off he should call the fact to the attention of an executive.

Some shops find it well to have a committee on obsolescence which from time to time passes on the need for continued carrying of supplies.

Theoretically a minimum stock record or perpetual inventory will do away with the need of that bugbear—the taking of a complete physical inventory. But it seldom does. If the items are frequently counted and checked with the records, as I have recommended, it is often possible to keep the discrepancy within one per cent—and usually within 5 per cent. But that is not close enough. And after all, the goods in process must always be inventoried by actual count and it is that item usually which takes the time. Safety dictates that once a year all stock be inventoried and the records changed to agree with the actual.

The fact that it is so difficult to get perpetual stock records to agree exactly with the facts is one reason why so many manufacturers throw up their hands and look on the attempt to keep records as useless. That is wrong. Even an approximate record of the stock on hand is better than none—that is if the manufacturer wants to save himself production troubles.

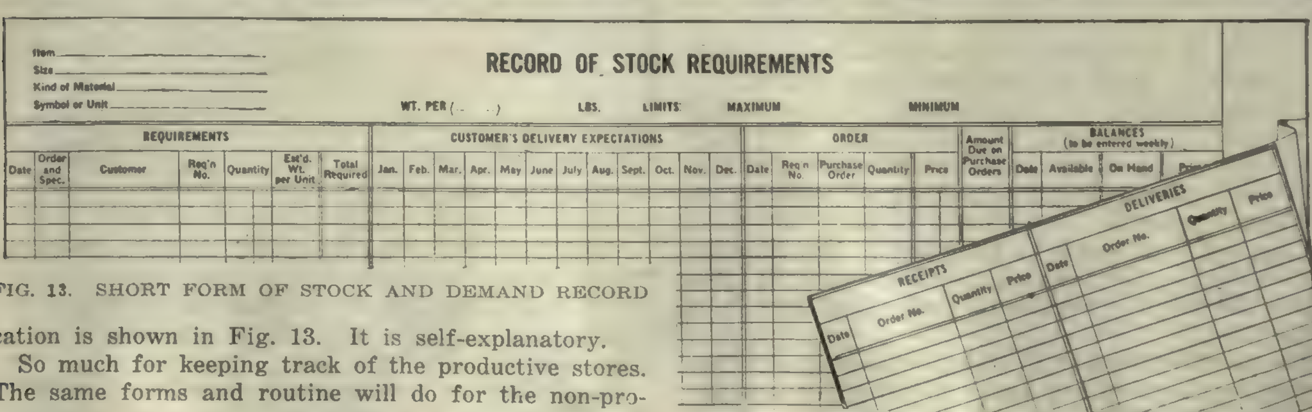


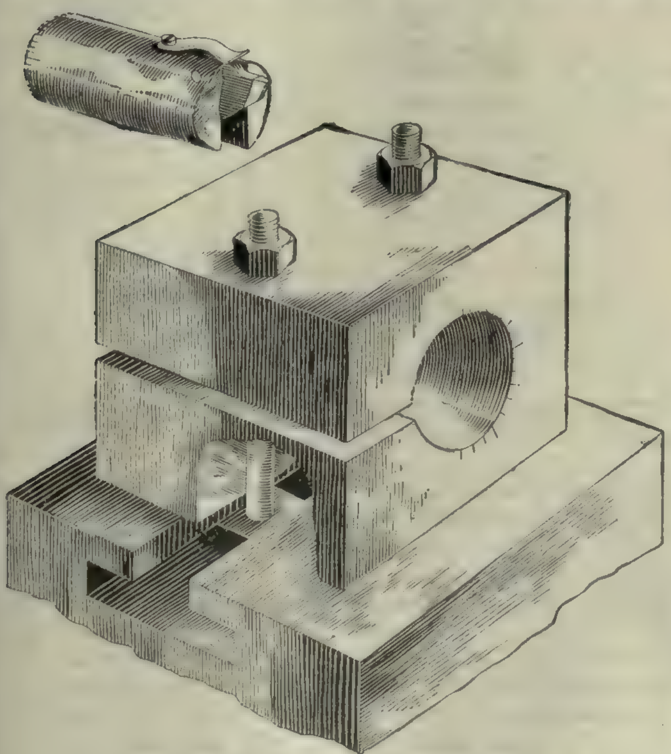
FIG. 13. SHORT FORM OF STOCK AND DEMAND RECORD

A Self-Relieving Thread Tool

By E. A. Dixie

In connection with the article under the title, "Cutting Screws of Quick Lead," published on page 883 of *American Machinist*, I want to illustrate a self-relieving tool which I designed for that purpose.

The body of the device may be made of cast iron or of steel as may be desired. It should have a rib to fit the toolpost slot of the cross-slide and two clearance holes for T-head bolts to hold it down. A hole through the center takes a round tool bar, and the slot at the side of this hole allows the bar to be tightened or released by manipulating one of the bolts while the other bolt remains tight to hold the body in place.



SELF-RELIEVING THREADING TOOL

The edge of this hole may be graduated as shown and a zero line drawn on the tool bar to facilitate setting the tool to any desired angle of helix.

The business end of the bar is to be slotted and the actual cutting tool fitted to swing on a hardened pin as shown in the sketch. When the lathe is run back, this tool will lift in the same manner as the tool of a planer or shaper.

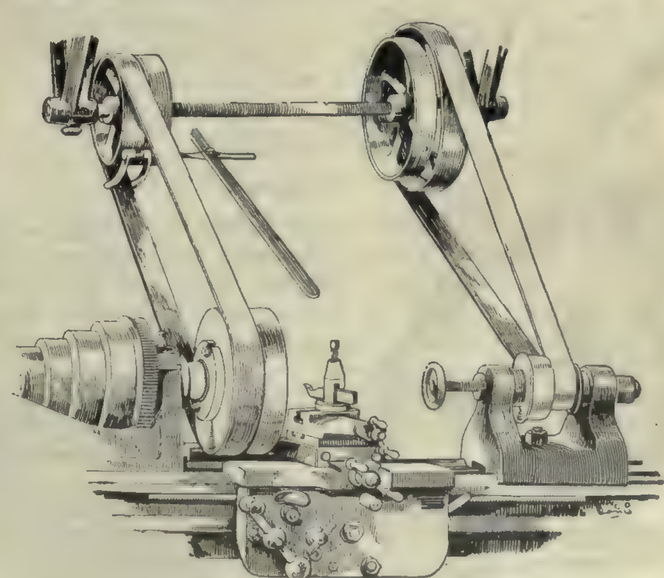
A small flat spring serves to return the tool to cutting position when set for high helix angles.

Speed Attachment for Engine Lathe

By H. H. Parker

A heavy lathe is not at all adapted to small work requiring high speed but is often used when no speed lathe is available. If there is much small work and it is not practicable to install a speed or bench lathe it would pay to make up a speed head, as suggested in the sketch, to be attached to the larger lathe when required. This head should be of the same swing so that the tailstock could be used.

The speed head should be planed to fit the ways and held by a bolt similar to the steadyrest. A hardwood straight-face pulley, bolted to a flange and screwed to the spindle nose, drives the speed spindle through a special light countershaft installed at any convenient location above the lathe.



SPEED SPINDLE FOR ENGINE LATHE

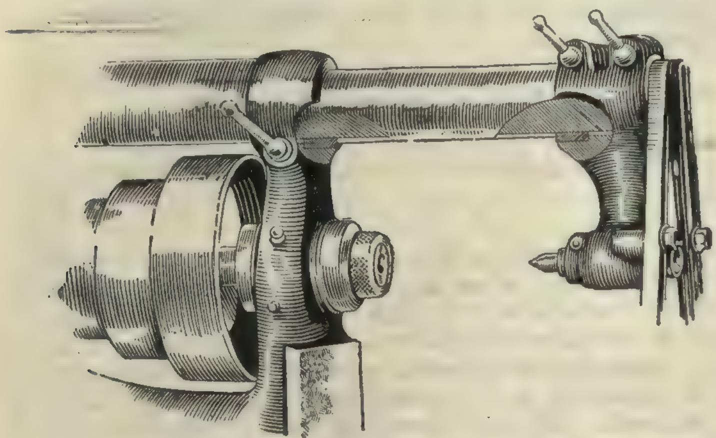
With only one pulley on the speed head, the latter, though speeded up, will have as many speed changes as the regular spindle and by providing it with two- or three-step cone the speed range may be doubled or tripled.

As small work frequently requires much stopping and starting the inertia of the heavy cone and spindle would be detrimental so a special control lever is provided, operating a belt shifter and tight and loose pulleys on the counterchaft. This lever should be arranged so that it could be quickly turned up out of the way or removed when the speed head is not attached to the lathe bed

A Suggestion to Makers of Milling Machines

By A. B. Chiarello

Through the columns of *American Machinist* I would like to suggest that the makers of milling machines put easily removable keys in the overarms and brackets



KEYING THE OVERARM

of their machines as shown in the illustration, to enable the operator to establish an accurate line-up when using very small arbors or boring bars.

Bulldozer Dies

By W. B. Gilbert

It is not the intention of the writer to show the advantage of forming different shapes in wrought iron and steel on bulldozers, over forming them with hammer and anvil as in these days of accuracy and speed the advantage of machine over manual work is self-evident. It may not pay to make dies if the quantity wanted is very small and the order not likely to be repeated; yet bulldozer dies are usually very simple to make and their cost is so little that they will pay for themselves on a very small order.

Fig. 1 shows a cast-iron angle plate for mounting the female dies, the male die usually being bolted direct to the crosshead of the bulldozer. The dimensions may be made to suit any particular machine on which it is to be used. The tongue fitting between the ways of the bulldozer is a sliding fit. The angle at the back is used on the inside as a stop for the die and the backing screws of the machine are brought up against the outside, the length and width being made to suit the bulldozer on which the work is to be formed.

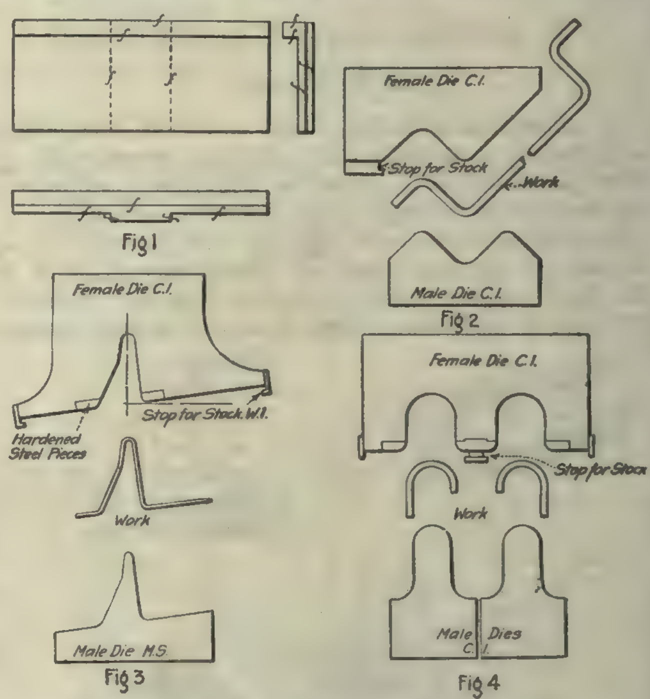
Fig. 2 shows a pair of dies for forming a wall bracket of $\frac{1}{2}$ x 4 in. wrought iron or steel. Both dies are made of cast iron and the work is formed one end at a time, thus allowing for different lengths between the feet of the bracket, by forming first one end and then the other.

The female die is bolted to the angle plate shown in Fig. 1 and the male die is bolted direct to the crosshead of the bulldozer with tap bolts.

Fig. 3 shows an example of a well-designed pair of bulldozer dies. Instead of attempting to form this piece with the center line of the bulldozer parallel with the vertical leg, the faces of the dies are at an angle of $7\frac{1}{2}$ deg., half of the 15-deg. angle at which the piece is to be formed. This arrangement divides the strain equally upon both sides of the dies. The female die is made of cast iron, machined on back and bottom and bolted to the angle plate, Fig. 1.

The stops for the stock are bolted to the ends of the die.

Hardened-steel wearing pieces should be set in, as shown, if the dies are to be used continually. The male



FIGS. 1 TO 4. BULLDOZER TOOLS

Fig. 1—Angle plate for holding male die. Fig. 2—Tools for bending wall bracket. Fig. 3—Equalizing strains in bending angle pieces. Fig. 4—Forming two pieces at once.

die in this case is made of machine steel and finished all over. It is bolted to the crosshead of the bulldozer.

Fig. 4 shows a pair of dies for forming pipe hangers of $\frac{1}{2}$ x 2-in. wrought iron or steel. Both dies are made of cast iron, with hardened-steel wearing pieces set in the female die. The female die is machined on back and bottom and is bolted to the angle plate. The male dies are bolted to an angle plate, which in turn is bolted to the crosshead of the bulldozer, the back of the dies coming up against the crosshead. The male dies are machined on backs and bottoms. As shown in the cut, two pieces of work are formed at each stroke of the machine, the stock being cut off to length and placed between the stops provided.

The country job shop gets some strange orders at times. For instance, the other day a farmer blew into one such shop bringing with him a large flat-iron with the handle busted off. He wanted a wedge for splitting logs and thought that our blacksmith could forge this useless chunk of cast iron into such a wedge, thereby saving him the cost of material.

WHAT to READ —*for the man in a hurry*

Suggested by the Managing Editor

IN OTHER issues since the first of the year we have had quite a little to say about the multiple drilling machines of the Foote-Burt Co. Our leader this week takes up the tapping machines of the same concern which have proved to be a valuable contribution to our supply of manufacturing machines. There are two important technical articles in this issue, the first of A. J. Langhammer's series on the testing of high-speed steel, on page 979, and the eleventh article of Prof. Furman's cam series on page 987. The former article is also being run in *Chemical and Metallurgical Engineering* and the editors of that paper have checked up the chemistry which appears therein. As to the cam article, you can't afford to miss it if you have been following the series. On the other hand, we would hardly advise anyone to start in on it at this point without having studied what has gone before.

Somebody has said that the successful executive is the man who gets some one else to do his work for him. According to that definition we are one, for part of this week's work has been done admirably for us by the gentleman whose letter appears in the panel on this page.

What would be the results of a compulsory metric law on everyday life? Read Raymond F. Fletcher's humorous account on page 985. On page 1014 the Army deals a body blow to the World Trade Club. After a thorough trial of metric units during the war, a general order has been issued directing the return to the inch system except in certain specialized branches. Prof. Park adds his work of condemnation on page 1000 and from an entirely different viewpoint.

Nobody who is holding down a man's job has time to read all of the "American Machinist." On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials —they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.

Detroit, Mich., April 26, 1920.
Ethan Viall, Editor,
American Machinist,
10th Avenue at 36th St.,
New York, N. Y.
Dear Sir:

Please accept my congratulations upon your new style of handling automotive articles.

The grouping of the practices of different manufacturers is the only practical way for studying them. Heretofore the writer has been obliged to do his own grouping and this has not always been handy.

Very truly yours,
F. E. Watts,
Chief Engineer,
HUPP MOTOR CAR CORPORATION.

Every man who is employing other men is facing at this time the stiff problem of keeping up interest, maintaining morale, getting production or whatever else you choose to call it. On page 983 Dr. Kitson gets at the question from the point of view of the psychologist. Sounds high-brow, but there are some real ideas mixed in with it that are worth noting.

Whatever else the average automobile repair mechanic may be he is seldom an expert machinist. If you have a small shop and have been bitten by the garage bug, read Donald A. Hampson's words of warning on page 1001 and stop and consider before doing anything rash. While we still have a little space left we must mention Part III of "Modern Production Methods." This takes up stock-keeping and the stockroom and points out the common tendency to save at the spigot and waste at the bung.

As we go to press things in the machine-tool business in Cincinnati are in a very unpleasant mess because of the action of certain radical agitators. We feel rather strongly on this point and hope that our position as stated on page 1012 will be thoroughly understood. Viall has gone to the seat of the disturbance to be on the ground and watch developments at first hand. His statement is a result of his impressions.

To show that we in this country have plenty of company in our industrial misery you have only to read the letter from our London correspondent on page 1018. He points out the feeling of insecurity that persists and calls attention to the almost universal decline in productive efficiency. From raw material supply to the finished product he reports a general slowing down.

A Stand for Industrial Americanism

THE largest machine-tool building center in the world is now facing a crisis that affects the entire manufacturing industry of the United States.

On numerous occasions radicals have threatened to "get" Cincinnati—very likely because machine-tool building is a key industry—the backbone of our entire industrial system.

Now a large number of machine-tool shop workers in Cincinnati are on a strike for a large increase in wages and a minimum wage scale. But—NOTE THIS—the shop men THEMSELVES made no demand on their employers, the demands being made by OUTSIDE PROFESSIONAL AGITATORS assisted by ONE RADICAL resident professional agitator!

Since 1915 the cost of living in Cincinnati has gone up the same as it has everywhere else, but the figures to which we have access show that wages have been voluntarily raised as the living cost increased—IN FACT, THE PERCENTAGE OF WAGE INCREASE HAS BEEN CONSIDERABLY GREATER THAN THAT FOR LIVING EXPENSES. The output, per man, however, has steadily DECREASED.

Regardless of the cause of this trouble in Cincinnati, the employers would pay increased wages PROVIDED production was in a normal condition—but—IT ISN'T.

Isn't it time that demands for more pay for less production were stopped? Have some lost their sporting instinct and are trying to shift it all onto others rather than to do their parts on the great Union team, and play their positions to the best of their ability? No one should forget that if he loafs on his job he adds to the High Cost of Living of others as well as himself.

Without the professional agitators the sober thinking men could easily see things from a rational standpoint and come to an understanding with their employers.

The employers are not fighting the union as such, nor its conservative members, but they ARE fighting the professional agitators.

All Americans—and especially other American manufacturers—should support the Cincinnati employers in their fight to eliminate the radical elements — ELEMENTS WHICH ARE JUST AS DANGEROUS TO THE WORKER AS TO THE EMPLOYER.

If the professional agitator is successful in this case, the way is open for him to attack other cities.

Already far behind on their deliveries of machinery, the Cincinnati machine-tool builders need assurance from their customers that they will give them complete moral support.

Cancelled orders mean a weakening of the resources of the men who are making a fighting stand for Americanism and for YOU. Back up the fighters!

Ethan Viall

Editor

What Other Editors Think

Opposes Adoption of the Metric System

FROM *Iron Trade Review*

IN a new edition of the book entitled "The Metric Fallacy," the author, Frederick A. Halsey, commissioner of the American Institute of Weights and Measures, outlines the result of an investigation of the claims made for the metric system and especially of the claim that its adoption is necessary in the interest of the export trade. Chapter I is devoted to a brief history of the metric system in France. Metric standards were made compulsory by a drastic law in 1793 and remained in force 19 years, or until 1812, when Napoleon, who had no faith in the system, had the law repealed. Under the relaxed laws, the people immediately reverted to the universal system in which twelve inches makes a foot, and continued the practice for 25 years, or until 1837, when the metric enforcement laws were reimposed, continuing in effect until the present day.

In Chapter II, the replies to 500 questionnaires distributed in South and Central America and the West Indies indicate that the metric system is not used extensively in Latin America. The results of the questionnaires are tabulated in the back of the book. In but one country, Uruguay, can the metric system be said to be adopted for domestic trade and from this country answers were received to the effect that while the metric system was official, the English system was customary and no effort has been made to abolish the latter system.

In substantially all of the countries investigated, the English inch is used for mechanical purposes and the English nautical units are used for navigation and sea shipments. That most derided of English units, the nautical mile, is used by all countries that sail the sea and they use no other. In machine shops both English and metric units are used, depending chiefly on the country of origin of the machines they have to repair, but the inch is predominant.

Another chapter is devoted to arguments against the claim that the metric system is necessary in the interest of foreign trade. A summary of the replies to questionnaires submitted to American exporters shows that of 1,445 replies, 1,189 did not use the metric system; 160 used it slightly; 29 used it considerably; 16 used it extensively; 5 used it exclusively and 46 did not reply.

One manufacturer reports that 95 to 100 per cent of his tools shipped to South America are made to English unit specifications. Referring to engineering standards, it is stated that although the metric system is used to a limited extent in American engineering practice today, its adoption for exclusive use would mean the revision in practically every industry. No manufacturing nation has ever attempted to change its weights and measures and the United States and Great Britain are the only such countries in which the change has been proposed.

Iron Castings in Iron Molds

FROM *Chemical and Metallurgical Engineering*

EVERY so often the question pops up, "Why are not permanent molds more widely used for iron castings?" The questioner may have in mind the great success of die casting as applied to white metal alloys or more recently to the more difficult aluminum bronzes; or he may have a recollection of having heard that such a procedure has been or could be applied to the iron foundry.

Perhaps the usual answer if the question were put to the "old-timer" would be that chill castings would have a heavy skin of white iron and the machine shop could do nothing with them. The answer would be entirely correct, and could be substantiated at any time by pouring a little of the iron regularly coming from the cupola and destined for green sand into a pig mold.

The depth of the white-iron shell might even be intensified by filling a heavy deep iron cup. Examination of this sample when fractured would immediately show whether there was any possibility of a die-cast piece being machinable, a test used by Outerbridge for over thirty years. It was he who discovered and put to thorough commercial application a long time ago the fact that if the metal possessed the correct composition, either by original melting or by ladle additions of ferromanganese and ferrosilicon, such a chill cup would not produce even the thinnest skin of white iron, and a properly designed mold would give a commercial casting, soft and strong, very fine grained, almost steel-like in appearance after machining, yet having practically no combined carbon at all. He first set chill blocks in sand molded gear wheels, so that the rate of solidification could be so controlled that an accumulation of deep-seated cavities would not appear at the arm-junctions. From that point, progress naturally suggested a like practice on lathe beds, where dense sound iron is requisite.

If correct iron could cool against a series of blocks set in supporting sand without developing hard spots in the casting, there seemed no reason why the entire mold should not be made of iron, even to any necessary cores.

Outerbridge did it, and has made over a million castings in iron molds, machinable castings of exceedingly fine grain, free of dirt, sponginess and other defects, and having a marked increase in strength over the sand-cast metal. In this work the cores were withdrawn quickly to prevent seizure, but the casting cooled black in the mold.

This work at the Sellers foundry was kept a close secret for many years, with only bits of information leaking out from time to time. Therefore later work was along independent lines and without advantage of the accumulated experience at this particular foundry.

Annual Convention of the Chamber of Commerce of the United States

With headquarters at the Traymore in Atlantic City and ramifications that extended to most of the other big hotels in the convention section, the Chamber of Commerce of the United States held a successful and enthusiastic convention on April 26, 27, 28 and 29. The number of delegates present was variously estimated at from three to five thousand and the excellence of the speakers was attested by the attendance at the meetings. The correspondent can vouch for the truth of this statement for he sat for three hours on the hard floor of the Belvedere Room of the Traymore and considered himself lucky to have obtained a piece of floor big enough to sit on. Many men stood throughout this session. It was only a group meeting, but those who were fortunate enough to be there, found it to be the high point of the convention.

The general subject was "Industrial Production" and the keen interest of every [illegible] in this topic was illustrated by the representatives of the business men of the country. Exactly the same interest has been displayed at most of the engineering society meetings of the past year and augurs well for the chances of working out a successful solution of our present difficulties. Chairman Charles F. Lang, of the Lakewood Engineering Co., presided and the speakers were Dr. Charles A. Eaton, of *Leslie's Weekly*, Rumsey W. Scott, of the Otis Elevator Co., Pomeroy Burton, Managing Director of the *London Daily Mail* and the Hon. Henry J. Allen, Governor of Kansas. Great stress was laid on the need for educating both employer and employee, and the supreme importance of supplying better leadership than that offered by the radical labor leaders was dwelt upon. Governor Allen described the events leading up to the founding of the Kansas Industrial Court and discussed its operation in the three months since it was formed. He brought out the facts that this court has done more for the coal miner in three months than his organization leader had done in thirty years and that eleven out of twelve decisions handed down in that time had been favorable to labor.

In answer to the claim of the radicals that all union labor would gradually leave the State of Kansas he gave it as his opinion that many of the radicals would, but that for each radical that left, two conservatives would come in, and that eventually much new business would come to Kansas to take advantage of the conditions existing under the new law.

It would take many issues of the *American Machinist* to begin to give an account of all that was said and done in the general sessions and the many section meetings. Suffice it to say that the following named sections had one or more meetings and did much business: I, Railroads; II, Shipping; III, Cost Accounting; IV, Foreign Commerce; V, Finance; VI, Domestic Distribution; VII, The Business and Daily Press; VIII, Highways; IX, Industrial Production; X, Civic Development; XI, Insurance; XII, American Committee on International Chamber of Commerce.

Most of the work done on Monday was of a preliminary nature and was followed by a buffet-dance and smoker in the evening: Tuesday morning was devoted to reports and address of President Homer L. Ferguson. The Tuesday evening session was enlivened by the presentation of inside and outside views of the Federal taxation by Daniel C. Roper, Ex-Commissioner of Internal Revenue and George T. Buckingham of Chicago. Secretary of Commerce Alexander and George E. Roberts of the National City Bank also made addresses.

Wednesday morning was given over to transportation, the parts played by the railroads, the electric railways and the motor truck being presented by Messrs. Post, Pardee and Graham. Admiral Benson spoke on the merchant marine. On Wednesday evening the delegates had the pleasure of listening to the first public speech of the new British Ambassador, Sir Auckland Geddes, who painted the plight of the European continent in none too glowing terms. Other speakers were James H. McGraw, President of the McGraw-Hill Co., Inc., on the "Functions of the Business Press in Relation to Production;" Secretary of Agriculture Meredith; J. H. Howard and C. C. Parlin. H. A. Wheeler made a report for the building committee and spoke of the purchase of a plot on Connecticut Ave. and H. St. in Washington and of plans to erect a two-million-dollar home for the Chamber at once.

On Thursday morning the relation of labor and immigration to production were presented by Matthew Woll, vice president of the American Federation of Labor; John W. O'Leary of Chicago and Charles Nagel, former secretary of Commerce and Labor. Governor Allen spoke again at this meeting which turned out to be a rather warm session when many of the delegates disagreed audibly with Mr. Woll's statements.

The representative of organized labor made the mistake of talking too long at a closing session. This irritated many of his listeners almost as much as some of his statements and they called "Time!"

Army Order Limits Units of Weights and Measures to English Standards

British units of weights and measures are to be used as far as possible in the Army according to an order from the Chief of Staff issued April 28. The Chief of Staff in his order states that the Secretary of War has ordered that the following policy will govern the use of weights and measures by the Army:

"As an incident to the World War metric units of weight and measure necessarily were used in instruction and training. As a result more or less confusion now exists as to what units should be used normally. Hereafter the customary former units of weights and measures (including the degree Fahrenheit) will be used, as far as practicable, throughout the Army, as they were before the war. Material and equipment now graduated in metric units, when worn out, will be replaced by articles graduated in British units in such manner as will cause all parts of a regiment or similar organization (or smaller organization when there is no regimental organization) to be provided at all times with material and equipment graduated alike.

"This order shall not be construed to prevent the utilization of metric units of weight and measure when desirable in connection with specifications and contracts, medical and scientific supplies, scientific and research developments, international meteorology, foreign maps, monographs, handbooks, and similar subjects."

SHOP EQUIPMENT NEWS

–Edited By–
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

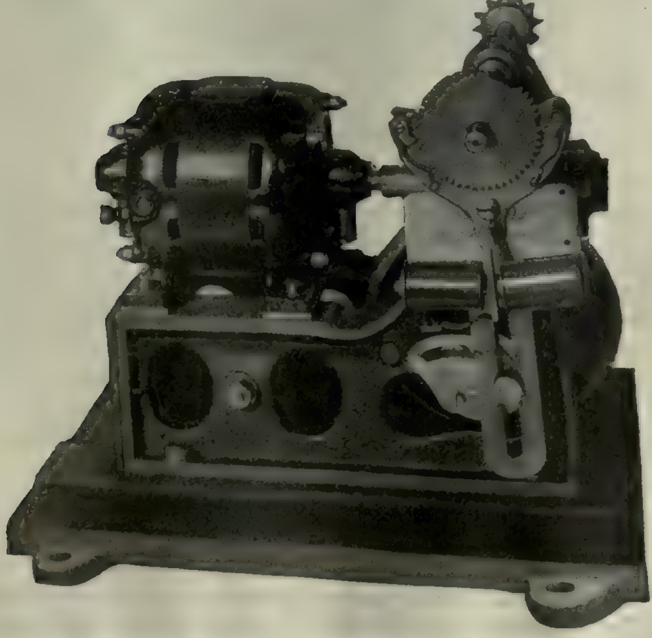
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Engelhard Automatic Temperature Regulator

Charles Engelhard, 30 Church St., New York, has brought out the automatic temperature regulator illustrated herewith.

The motor, through worm gearing and a wrist pin, keeps the slotted link shown, in constant vibration. As the link is pivoted on the upper shaft and carries a yoke on which are mounted two pawls, the pawls must also vibrate about the ratchet wheel also attached to the upper shaft. Connection with the valve to be opened or closed is made by chain from the sprocket wheel on the rear of the upper shaft to a sprocket wheel on the valve stem. It will thus be seen that if one of the pawls be engaged with the ratchet wheel the upper shaft will be intermittently revolved, imparting the motion to the valve stem and the valve will be either opened or closed according to which one of the pawls is engaged. The pawls are controlled by oppositely located electromagnets in circuit with a pyrometer having two plate contacts beneath the pointer, one on each side of the dividing line. A depresser bar located within the instrument and over the pointer and controlled either by clockwork or a solenoid magnet is allowed to fall at predetermined intervals.

The pointer carries a small pin at a right angle to its longitudinal section and it will be understood that when the depresser bar forces the pointer down this pin completes the circuit between the depresser bar and one or the other of the two plates beneath, depending on whether the pointer is above or below the dividing line. The circuit thus completed is passed through one or the other of the electromagnets according to the plate with which contact is made.

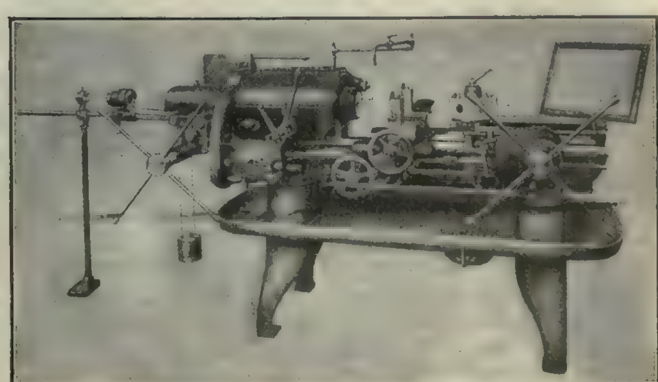


ENGELHARD AUTOMATIC TEMPERATURE REGULATOR

Herbert Universal Turret Lathe

One of the turret lathes manufactured by Alfred Herbert, Ltd., Coventry, England, is here illustrated. It is shown at the company's showrooms, 54 Dey St., New York City, and is made in one size only, known as No. 4. It is designed for both chuck and bar work. The single pulley head provides eight speeds in either direction and can be supplied with or without the geared draw-in chuck and automatic feed for bars. The automatic bar feed furnished with the draw-in chuck is of simple design and is operated by an adjustable weight.

The tailrod carries an adjustable, ball-bearing revolving carrier which avoids the necessity for using feeding collars for every size of bar. The hexagon turret may be rotated automatically or by hand. The turret slide carries a hexagon stop bar geared to rotate with the turret and is provided with six adjustable stops, which trip the feed and act as dead stops. The square turret for the cross-slide and the taper attachment are furnished as extras, the former is recommended for chucking work.



HERBERT UNIVERSAL TURRET LATHE

Specifications. Draw-in chucking capacity, $1\frac{5}{8}$ in. Spindle hole capacity, 2 in. Working stroke of turret, 9 in. Spindle speeds, 8. Hp., 5. Pulley, 8 in. Belt, 4 in. Swing over cross-slide, $6\frac{3}{4}$ in. Automatic feeds, 4. Tool holes in turret, $1\frac{1}{2}$ in. Net weight with plain head 2,256 lb. With draw-in chuck and bar feed 2,460 lb.

Wallace Bar-Twisting Machine

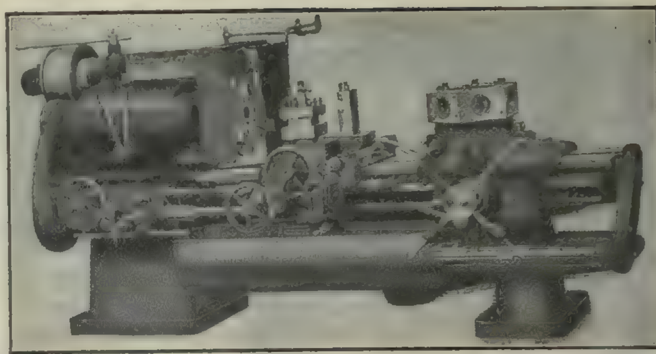
The Wallace Supplies Manufacturing Co., 412-420 Orleans St., Chicago, Ill., has recently put out the bar-twisting machine shown in the accompanying illustration. This machine has been designed for giving a quarter twist to the ends of flat bars; and it is arranged for offsetting the stock in such a manner as to leave one edge of the twisted end of the same plane as the flat side of the bar, instead of merely twisting about

WALLACE BAR-TWISTING MACHINE

the center of the bar as an axis. Twisted pieces are shown below the machine. Either hot or cold bars can be twisted, the necessity for heating being determined to some extent by the size of the bar. These machines are made to order only.

Herbert Combination Turret Lathe

The turret lathe shown is one of the types manufactured by Alfred Herbert, Ltd., Coventry, England; New York sales offices, 54 Dey St. The machine is made in three sizes, Nos. 3, 9 and 20, the No. 9 size being illustrated herewith. The single-pulley drive through friction clutches and sliding gears provides eight speeds for the No. 3 machine and sixteen speeds for the two larger machines. The turret slide is guided on the bed by the front shear only, and is clamped by a long taper gib moved endwise by a hand lever. The turret-slide apron provides feeds in each direction, six self-selecting stops being furnished which also act as dead stops. The gears in the apron are all of steel or bronze and a change gear enables the relative feeds of the turret slide and saddle to be changed when it is required to use a fine turret feed with a relatively coarse saddle feed. Power rotation of turret is provided for both the Nos. 3 and 9 lathes by depressing a hand lever at the front of the slide. A device is furnished for adjusting the two stop bars for the saddle and turret slide in unison along the bed to accommodate varia-



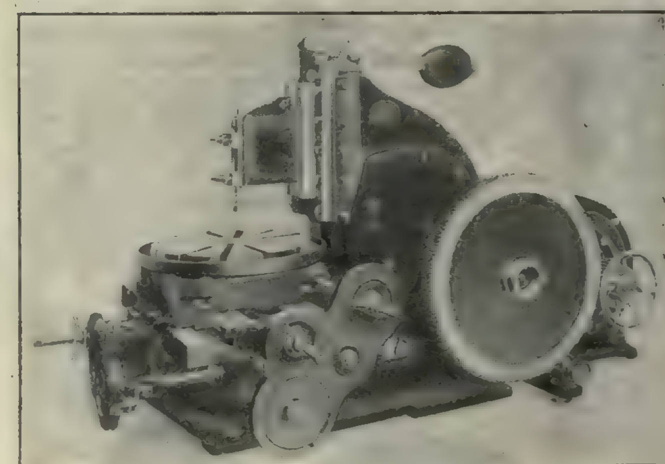
HERBERT COMBINATION TURRET LATHE

Specifications. Sizes Nos. 3—9—20. Swing over beds, $16\frac{1}{2}$ in., 20 in., 28 in. Swing over cross-slides, $8\frac{7}{8}$ in., $12\frac{5}{8}$ in., 18 in. Holes through spindles admit, $2\frac{3}{8}$-in., $3\frac{1}{2}$-in., $4\frac{1}{2}$ in. stock. Driving pulleys, 10 in., 12 in., 14 in. Belts, 5 in. Hp. 7—8—10. Net weights, 5,280—6,680—11,050 lb.

tions in the thickness of the articles being machined. The stop bars in the No. 9 lathe are adjustable independently. The taper attachment will deal with internal or external tapers, and taper threads can be chased as easily as parallel threads.

Muir Slotting Machine

Alfred Herbert, Ltd., 54 Dey St., New York City, is the selling agency for the English-built machine here illustrated and known in England as a "Puncher Slotting Machine." It is claimed this machine can remove continuously 18 cu.in. per minute of steel of 60,000-lb.—tensile—strength and do so with an ample



MUIR SLOTTING MACHINE

reserve of power. The machine is specially recommended by the makers for the gapping of cranks, and the tooling of deep work beyond the scope of the milling machine. The table is solidly mounted on large square slides provided with adjustable gibs. The stroke can be quickly changed and the toolholders are supplied in a variety of forms to suit a wide range of work. The machine is built in four sizes, the maximum stroke for each size being respectively $8\frac{1}{2}$, $12\frac{1}{2}$, 15 and 18 in. The table diameters range from 27 to 42 in. and net weights from 12,100 to 33,000 lb.

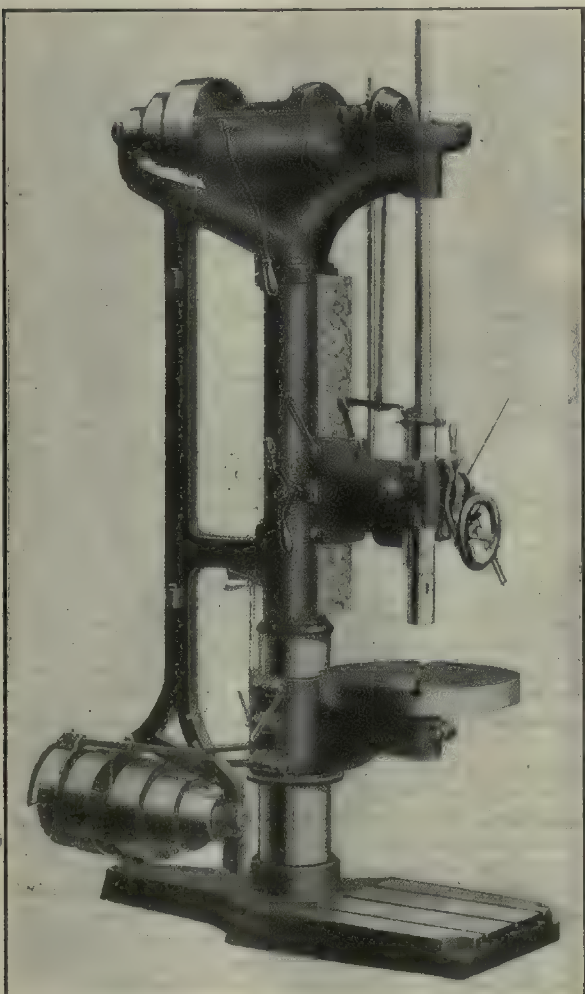
Hess "Tinol" Soldering Paste

Hess & Son, Philadelphia, Pa., have recently put on the market a special soldering paste known as "Tinol." They especially recommend it for soldering cast iron.

When applied to cast iron the volatile part of the paste evaporates when heated and leaves behind a thin coating of bright tin to which solder readily adheres. The paste will not injure silk insulation on electric wires, nor will it attack the metal, but it has the property of removing oxide.

Sibley 26- and 28-In. Sliding-Head Drilling Machines

The Sibley Machine Co., South Bend, Ind., has added to its line 26- and 28-in. drilling machines of the sliding-head type, one of which is shown in the accompanying illustration. The general description and



SIBLEY SLIDING-HEAD DRILLING MACHINE

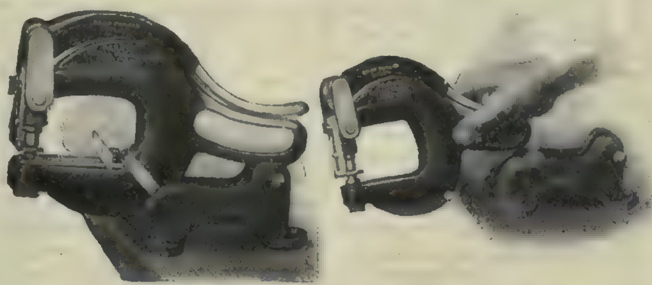
specifications of the 26- and 28-in. machines are the same as those of the 24-in. machine, published in the *American Machinist* Nov. 13, 1919, except in swing and size of tables, which, of course, add somewhat to the weight.

Parker No. XX Combination Punch

The combination punch shown is a product of the Parker Supply Co., Inc., 785 East 135th St., New York City.

It may be used as a hand tool or bench tool, as it is quickly detachable from the bracket that is screwed permanently to the bench. The open jaw and wide throat will accommodate work that has rolled or formed edges.

It is equipped with a polished-steel gage for spacing parallel holes and a stripper adjustable to position, or that may be removed when not needed. The tool is made of drop-forged heat-treated steel, with



PARKER NO. XX COMBINATION PUNCH

working parts hardened. It measures 9 in. in height, weighs 4½ lb., and will punch a ½-in. hole in 20-gage steel, or the equivalent.

No. 1 Grand Rapids Tap-Grinding Machine

The machine illustrated herewith is an addition to the line of the Grand Rapids Grinding Machine Co., and is designed for grinding the tapers on the ends of taps. It will grind plug taps from No. 6 machine-screw sizes to 1 in. and also taper taps where the length of taper does not exceed 1¼ in. Taps with or without centers can be ground, the former on centers, the latter being held at one end in a chuck and at the other by a female center. The angle of the taper is adjustable so that taps either with a short or long taper can be ground. Either right- or left-hand taps can also be ground.

NO. 1 GRAND RAPIDS TAP-GRINDING MACHINE

In grinding, the tap is held in a horizontal position and the work is done by the periphery of the wheel. The principle of the operation is, that the axis on which the tap is swung, is offset from its working axis an amount sufficient to provide the desired angle of clearance.

A countershaft and diamond truing device, together with a diamond, are included in the standard equipment.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

London, April 9, 1920.

IMMEDIATELY preceding the Easter holidays two items of importance were announced. One was a statement of revenue and expenditure in the United Kingdom during the last fiscal year, which ends with the month of March. The total revenue for the year was £1,339,571,381, or more than £450,550,000 in excess of that for the preceding year. The expenditure amounted to £1,665,772,928, which again is about £913,528,000 less than for the preceding year. Thus, a deficit of £326,201,547 is disclosed. The revenue is without precedent and the deficit, while about £76,000,000 in excess of that estimated at the time of the introduction of the budget, a year or so ago, is £147,000,000 less than was predicted by the Chancellor of the Exchequer about five months before.

Whatever satisfaction may be felt from the result must be discounted by the fact that, included in the revenue, is a sum, the exact amount of which is undisclosed, derived from the sales of war properties. It has long since been pointed out that these are assets or capital and that their sale does not produce true revenue. The excess profits duty brought in about £290,000,000 and much remains to be collected in this direction, even at the reduced rate of the past year. As to the future, it is sufficient to say that the next budget will be introduced, it is expected, on April 19.

The Findings of the Court of Inquiry

The other matter relates to the findings of the court of inquiry set up to investigate the employment of dock laborers, etc. It may possibly have an even more lasting influence on Great Britain. Here for a number of years statistics have been gathered and digested on the state of employment, and more particularly on the proportion of unemployed workpeople in any given period. Official returns have been published regularly, month by month. They have disclosed the fact, now pretty well known, that however good may be the conditions of trade, men in considerable numbers were unemployed.

Apologists for existing conditions always hold that such a reservoir of labor is necessary from the employing point of view; probably no argument has been so effective as this in setting workmen against present systems. Insecurity has been the prevailing feeling. An attack, mild in its way, was made on the operation of this theory when the government employment insurance act was introduced for engineering, shipbuilding and building trades, these being the three industries held to be most liable to employment fluctuation. Contributions are made by the workpeople, by the state and also by the employer, the call on the latter being on the ground that he benefits from the said reservoir of labor and should therefore contribute to its upkeep.

A System of Registration of Dock Labor

Now the same point of view is seen in the majority report issued in connection with the dockers' inquiry. The words used are: "In one sense it is a convenience to authorities and employers, whose requirements are at the mercy of storms and tides and unforeseen casualties, to have a reservoir of unemployment which can be readily tapped as the need emerges for a labor supply. If men were merely the spare parts of an industrial machine, this callous reckoning might be appropriate: but society will not tolerate much longer the continuance of the employment of human beings on those lines." A system of registration of dock labor is to be introduced and, in accordance with the above quotation, the principles of maintenance of unemployed labor of casual character is approved. Dock labor is to be paid weekly, and bodies of a Whitley character are, it is recommended, to be set up. Further, "with a view to establishing a national minimum standard" a rather high minimum for day workers and piece workers is recommended.

A minority report, signed by two of the nine investigators, suggests the unsettling effect of the special rates proposed for other classes of labor.

The decline in the effort of the worker is fairly general. Thus, at the annual general meeting of the Metropolitan-Vickers Electrical Co., Ltd. (which will perhaps be better known to American readers by its former title, the British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park), the chairman held the diminished output of labor, with increased cost of materials and difficulties of transport, responsible for the fact that the firm is not turning over capital as often as formerly. Then of course increased volume of business means more plant and buildings, calling for largely increased investment. In addition is the difficulty in obtaining labor to work new machinery, etc. At the Westinghouse works, at any rate, a large drop in output per man is reported. The lessening of the weekly working hour is held to be a direct influence. It is a fairly general experience that, whatever may have been the case previously or in experimental instances, now as a rule the shortening of the working day by reduction in hours not only is not compensated for but the output per hour worked is lower.

A Temporary Increase in Production

There have been cases where with the introduction of the 47-hour week, the output increased. The writer recalls one machine-tool firm where the increase was at first about 10 per cent. A spurt had added to the pace, but in a few weeks this had disappeared and the output was lower and slowly diminishing. To return to the Metropolitan-Vickers Co., the chairman was of the opinion that "the lion in the path was suspicion—suspicion of labor in the mind of capital, suspicion of capital in the mind of labor. Suspicion is bred of fear; fear is bred of ignorance." The remedy suggested for this distrust is identification of interest; that is, payment by results or profit-sharing. The effect of suspicion was suggested in the result of the action of the directors in setting aside £100,000, of an issue of a million shares, for subscription by the firm's own employees, with provision for advances on easy terms. Only £10,000 worth of shares were taken up by the workpeople. The company, by the way, showed a profit of £320,659 against £246,575 in 1918. Orders received during 1919 exceeded those of 1918 by about 20 per cent. Orders received during the first two months of the current year had about three times the value of those taken in the same period of 1919.

To return to the new unemployment bill, a deputation of the Federation of Professional and Administrative Workers, representing, so it is said, about a score of associations and some quarter of a million members, waited recently on the minister of labor in order that the case of the brain worker rather than the manual laborer might be placed before the government. It was claimed that associations providing better benefits voluntarily should have the right to contract out of the act. Further, the fact was stated that as regards professional, etc., workers standard rates of pay did not as a rule obtain; therefore the safeguards proposed against disqualification if a man refuses a job at less than standard rate hardly apply. Equal contributions and benefits were claimed for men and women. A new association, by the way, has just been formed to combat the notion that for equal work the woman teacher is entitled to equal pay with the male teacher.

Coal Supply Unsatisfactory

Special attention was drawn here a few weeks ago to the unsatisfactory coal supply. As to the Bradford district, it is asserted that in many cases it was only possible to obtain 75 per cent of the full-load capacity in steam-raising plants, whereas with better coal it would have been possible to get

overloads of 10 to 20 per cent. The cause was the poor quality of fuel available, this resulting from unsatisfactory screening and washing and from the operation of price limitation which withheld any inducement to collieries in the way of extra profits, to add to labor and other expenses in this direction.

Increase of Coal Output Not in Sight

The hopes of increase in the coal output entertained a month or two ago have not been fulfilled and rather less than five million tons a week is still the figure. On the one hand, the miner is blamed; on the other, want of appliances and transport troubles are adduced.

Reference was recently made to the way in which engineering firms are insuring supplies of raw material by acquiring shares or otherwise obtaining control in steel and other firms. The latest announcement has a reference to the joint action of Sir W. Beardmore, and of Swan, Hunter & Wigham Richardson, Ltd., the shipbuilding and marine engineering concern of Wallsend, who have purchased the shares of the Glasgow Iron and Steel Co. and acquired the Blaydon Iron Works, the purpose being to secure a foundry, a supply of steel plates, etc. The capital of Swan-Hunter is to be raised to £9,000,000 but at present no public appeal is to be made.

The steel output in Great Britain, largely augmented during the war, is again increasing, though much has yet to be recovered. Some thirty-five years ago the output of Great Britain exceeded that of America, whereas even in 1918 when the British output totaled some 9,700,000 tons, the American output, as stated in Great Britain, was 36,400,000 tons. The present rate of British steel production is apparently nearly 25 per cent in advance of the 1913 rate.

As part of the new move to insure increased efficiency in works and offices a National Institute of Psychology and Physiology is being formed. It is supported by many industrial leaders. A research laboratory is to be equipped to deal with problems of output and fatigue, and an annual income of £6,000 is regarded as the minimum on which to start work. The new institute will work in connection with the Industrial Fatigue Research Board and the laboratory and library will be in common.

Demand for Materials Exceeds Supply

The supply of engineering materials is, generally speaking, nowhere near the demand and this relates particularly to steel plates, sheets, etc. The foundries have in no sense caught up, and the working of overtime is highly restricted or, as is more generally the case, refused by the workpeople.

Notwithstanding, for example, the serious plight of Great Britain and the problem presented by the lack of houses, building-trade workers in the Manchester district have refused to put in an extra hour a day as overtime, though before long the ordinary weekly working period will be reduced from 48 hours to 44. All branches of the engineering and machinery-building industry have more orders than can be met, price apparently being even less than a secondary consideration with present-day customers.

A Contract for 200 Locomotives

It is stated that Armstrong, Whitworth & Co., Ltd., have received a contract from the Belgian government for the supply of 200 locomotives, which will be built in the firm's Scotswood works to the designs of the Belgian state railways administration. In Great Britain this has been regarded as the largest order of the kind ever given, and, according to a statement that has been issued, the value is said to approach £3,000,000.

The prices of machine tools have lately been advanced by 5 per cent and a further advance is anticipated in the course of about two months. This is not expected to handicap the machine-tool builder. To take an instance from the knowledge of the writer, a firm having informed one of its customers buying in quantities for resale that an increase in price would shortly be made, the firm of merchants wrote back protesting and cancelling the order, which was of considerable proportions. The machine-tool firm accepted the cancellation, but was immediately told that the order was not cancelled but postponed. Nevertheless, cancellation was insisted on by the builders. They will have no difficulty in finding other customers. Anything that exists can be sold.

As to output, the writer was a day or two ago in the works of a firm situated within an hour's railway journey of London and employing rather less than 1,000 workpeople in machine shops and foundry. The hourly output here was reported only 60 per cent of that previously obtained.

More Resolutions Against the Metric System

By the National Association of Machine Tool Builders

The experience of Germany, in which the old measures are still in large use, has shown that the change cannot be completed even after a generation of confusion.

The sale of many million dollars' worth of machine tools has been made abroad, by members of this Association, especially to France and Germany, without requirement or request by the purchasers for changes in general construction to conform to metric measurements, the only changes being in adjusting and measuring screws, the great majority of machines needing no changes whatever.

The adoption of the metric system would entail an enormous first cost of new equipment to conform to the new standards and a constant increased cost in the maintenance of a double standard for repairs and renewals, and a consequent increased cost of the product to the consumer.

By the National Metal Trades Association

WHEREAS, The renewed agitation for the adoption of the metric system has reached the danger point and called into being the American Institute of Weights and Measures to combat it; and

WHEREAS, The National Metal Trades Association is in full sympathy with the object of the American Institute of Weights and Measures;

RESOLVED, That the Association make application for Association Membership in the Institute;

RESOLVED, That we urge all our members to lend their co-operation to this work by joining the Institute as Corporation Members.

What Is a Machine Tool?

By L. L. Thwing

Someone has recently asked for volunteers to make up a definite list of all tools or machines that can properly be included under the general heading of machine tools. Such a list would be rather long, and in its place I would like to offer a definition that includes all machines that are entitled to be included in such a list.

A machine tool is any metal working machine whose waste is in the form of chips. This is not a descriptive definition, but it has at least the virtues of being both definite and brief. There is little dispute about what a machine is, and none about chips. We know that grinding wheel sparks are chips, and that press and shear waste is not.

It is evident that this definition excludes sheet-metal machinery, and various other machines that are often included in the machine-tool class, but I will not attempt to answer any objections until they take definite form.

SPARKS FROM THE WOR

Valentine Francis

Low Production State of Mind, Says J. H. McGraw

Outlines Position of the Business Press As a Force in Increasing Production

"Low production is an accepted axiom in industry throughout the world today, and to bring about increased production it is necessary to change the state of mind as well as the physical element," declared James H. McGraw, president of the McGraw-Hill Publishing Co., at the general session of the United States Chamber of Commerce in convention at Atlantic City, N. J., last week. He said:

"No greater force for practical accomplishment exists at hand than the business press of America. This huge fabric of industry is threaded by more than 2,400 business papers, trade papers, engineering papers, technical journals and industrial papers.

"The one great problem of how to increase production, which is facing the world today, divides itself into several major problems. If the business men of America will intelligently consider these major problems, if they will recognize the slow, but sure, process of education in the solution of these problems the business press stands ready as one all-embracing medium through which the vital and intimate needs of the separate trades or professions may be consistently and comprehensively developed.

"If we may emphasize, as we can emphasize, through the business press that the majority of the industrial leaders of America were once workmen, that 11 out of the 24 railway presidents, for example, today, were once messenger boys or clerks, that dozens of managers and superintendents, and hundreds of capitalists and financial men were one time store clerks or farmer boys or mill men, we will have at least gone part way toward the solution of the so-called labor problem.

"There is a business paper for practically every trade and profession in the country. The editors of these papers are alive to the fact that workmen of today are managers of tomorrow, and have an opportunity for leading the thinking of their industries in no uncertain way. America is still a land of opportunity in industry, and hundreds of business papers today are pointing out individual opportunities for men, making them better merchants, better engineers, literally acting as text books for the teaching of common-sense economics in industry.

"The business press is pointing out the practical plans that have been and are being worked out in individual plants for bringing men and management together. We can make rules and we can agree on fundamentals with regard to the relations between men and men, but no plan will succeed and no rule will work unless the white-collared workers in the office, who are responsible for carrying it out, have an actual working contact either themselves, or through others in sympathy with their ideas, with the overall-clad workmen in the factories.

"I have said that increased production and the possibilities of increased production is a state of mind. No body of men is more responsible for this state of mind than the management. There is just as much opportunity for the development of the intelligent application of management to industry as for the intelligent application of machinery to the processing materials. The business press sees men and machinery and material and capital put together, and made a co-ordinate working whole by management.

"We will never have production until we have maximum skill in labor, minimum use of materials, and maximum skill in management. Here again our nation has led the world in certain kinds of thinking. Periodically we have had waves of efficiency cross our fields of industry. Our drive for more efficient operation brings the ideal conditions that much nearer, and here again the technical press has had and will always have an educational function in the forwarding of such movement.

"In all this work the business press has a double relation. It is evident from what has been said that one of its values is based on the vitality of its editorial relation to the industry which it serves. It must draw and in worthwhile business does draw, its editors from the industry. They may be and are men of knowledge of their particular lines.

"But of more importance possibly than the relation of the business press as a recorder and a clearing house of ideas is its professional relation to its industry or trade. The editors of the business press have the opportunity to be both a part of an industry and to stand on the side lines looking out over industry. They can see, because of their exceptional opportunities for investigation and association with leaders of their particular fields, the general trend of an industry. They can help and do help point out and chart the way of the industry, and they have a sense of responsibility toward the public which that particular industry may serve, which is one of the fundamental values of the business paper."

Machinery Sales Association Organized

A syndicate of seven large machinery manufacturing concerns has been formed under the name of the Machinery Sales Association. The combination takes over the duties of a sales agency for the various products of its members, each firm acting as an advertising and selling agency for the other six.

To date the members of the association include: The Day Machinery Co., of Buffalo, N. Y.; W. J. Baird Machinery Co., Detroit, Mich.; Scott, Banshach Machinery Co., Chicago, Ill.; Cleveland-Duplex Machinery Co., Cleveland, Ohio; Siefreat-Woodruff Co., Cincinnati and Dayton, Ohio; McCoy-Brandt Machinery Co., Pittsburgh, Pa.; and the Eastern Machinery and Equipment Co., Philadelphia, Pa.

G. J. Hawkey, of the Cleveland-Duplex Co. is secretary of the association.

Peru Ratifies Pan-American Trade-Mark Convention

A cable from the American legation at Lima, Peru, announces the ratification by the Peruvian Congress of the International Trade-Mark Convention on April 14, 1920. Including Peru, six South American countries have ratified the convention and only the ratification by one additional country is necessary to complete the number required for the establishment of the registration bureau at Rio de Janeiro, which is to have charge of the registrations for the southern group. According to a recent announcement by the Director of the International Bureau for the Registration of Trade Marks at Habana, the privileges of international registration through the Habana bureau have been extended to the ratifying countries of the southern group of States, pending the establishment of the second bureau at Rio de Janeiro.

Frevert Machinery Co. Acquired by Peter A. Frasse & Co., Inc.

The announcement has been made that Peter A. Frasse & Co., Inc., New York, has purchased the stock of machinery and merchandise, and the good-will of the Frevert Machinery Co., of 38 Vesey St., New York. All of the employees of the latter company will continue with Peter A. Frasse & Co., Inc.

The Frevert Machinery Co. has been in business since 1906 and is well known to the trade as a dealer in a general line of metal-working tools and machines of every description. It has acted as agent for many prominent manufacturing concerns, among which might be mentioned the R. A. Kelly Co., Ohio, crank shapers; Reading Chain and Block Corp., Reading, Pa., multiple gear chain hoists; W. Robertson Machinery and Foundry Co., Buffalo, Economy hacksaws; F. J. Lindgren & Co., Rockford, Ill., drills; Richert & Shaffer Co., Erie, Pa., tapping machines; Builders Iron Foundry, Providence grinding and buffing machinery; Woods' Turret Machine Co., Brazil, Ind., turret machines; Albany Hardware and Specialty Manufacturing Co., Albany, Wis., 12 in. high-speed drills; Diamond Machine Co., Providence, emery grinding and polishing machinery; Walcott Lathe Co., Jackson, Mich., lathes, shapers and rack cutters.

H. T. Tucker and H. B. Slate of the sales force of the Frevert Machinery Co. will continue with Peter A. Frasse & Co. They have a wide experience in the machinery line, and are well known to the trade in the territory covered by New York State and parts of New Jersey, Connecticut, Rhode Island and Delaware.

From Elevators to Machine Tools

Announcement has been made that the Standard Plunger Elevator Co., of Jamesville, Mass., will discontinue the manufacture of complete elevators and will devote its entire efforts to the production of machine tools. The company will specialize in the building of metal planers.

Governing Boards of Founder Societies Meet in Chicago

Consider Plan to Amalgamate All Engineering Societies to Promote Teamwork Among Engineers

At the suggestion of the Western Society of Engineers the governing boards of the four founder societies met in Chicago on April 19 and 20, to consider a plan for uniting all Chicago engineers into one society for combined action in technical and professional advancement and public affairs. The meeting was also planned to give an opportunity for a discussion of the inter-relations of the Western Society of Engineers and the Chicago chapters of the founder societies as well as the general plans for service. The opportunity for a general interchange of ideas between the various representative bodies came at a luncheon on Tuesday. The problems confronting each society were taken up at individual meetings of the respective councils throughout the two days.

On Monday evening there was a dinner of the joint engineering societies, at which A. Stuart Baldwin, past president of the Western Society of Engineers, officiated as toastmaster. In his opening remarks, Mr. Baldwin referred to the four founder societies as the foundation on which all other engineering associations had been formed, and to their early tendency toward separation and division, each new society specializing in its own particular field. Recently the pendulum has swung in the opposite direction, and engineers of the present day are drawing more closely together. They realize that in union there is strength and that maximum service can result only through unison of effort and co-operation.

The toastmaster called in turn upon Arthur P. Davis, president of the American Society of Civil Engineers; Arthur Fletcher, representing the American Institute of Mining and Metallurgical Engineers; Fred J. Miller, president of the American Society of Mechanical Engineers, and Calvert Townley, president of the American Institute of Electrical Engineers. Each spoke of the change in the last five years which has brought the recognition that to keep abreast of the times all societies must broaden their fields and functions and that they should always stand ready to adopt new ideas.

It was conceded that there was need for more teamwork among engineers, and in order to do effective work for the city, the state and the nation they should combine. There should be publicity to enlighten the public about engineers and their work so that confidence might be placed in their judgment. In rendering service to the public it was the thought that views expressed should be on the technical side of the question. In other words, the engineer should in a sense be an expert witness, not a politician.

By joint activity there was expectation of dealing more effectively than ever before with public matters.

There are one hundred thousand engineers in the country separated into many organizations, each doing something in its own way. If they could be made to understand that no attempt was being made to interfere with their work, and that they were requested to participate only in questions of public interest, they should be willing to co-operate and it was the consensus of opinion that they would.

As the closing event in a most enjoyable evening, enlivened by community singing and an orchestra, Dr. Theodore G. Soares, of the faculty of the University of Chicago, delivered an address on "Efficient Democracy." He impressed the audience with the need of co-operation and more able direction in the great undertakings of the day—that the problem is not to find big things to do, but to find enough big men to do the work waiting for them. Also the need for expert advice in questions of finance, education, engineering and for a more intelligent democracy to choose its experts.

A. L. De Leeuw With Illinois Tool Works

A. L. De Leeuw has associated himself in an advisory capacity with the Illinois Tool Works of Chicago, and will be located at the New York branch, 127 Water Street. Mr. De Leeuw has an international reputation built up by years of study and practical experience.

Cutter and milling problems will be handled by Mr. De Leeuw in the Eastern district.

A complete stock of high-speed-steel tools will also be carried by the Illinois Tool Works in its new and greatly enlarged quarters.

LD'S INDUSTRIAL FORGE

News Editor

A. S. M. E. Program for Its Annual Meeting

Headquarters in Hotel Statler, St. Louis—Some of the Papers to Be Read, and Subjects for Discussion

The program for the 1920 meeting of the American Society of Mechanical Engineers has just been announced. The meeting will be held at St. Louis, Mo., May 24 to 27, with headquarters at the Hotel Statler. Subjects for discussion comprise Aëronautics, with important data from the Air Service at McCook Field, Dayton, Ohio, and from the Bureau of Standards; Appraisal and Valuation; Industrial Housing; River Transportation, a subject of pressing importance in the Mississippi Valley; Foundry Practice, dealing with cast iron, steel castings, malleable castings, die castings, alloys, etc.; Power and Combustion, including stokers, pulverized fuel, feedwater heaters, and feedwater treatment; and miscellaneous topics, among which are Screw Threads, Weirs, Flow of Air and Gases, Heat Transmission, etc.

Two papers have come from Government sources, one by Lieut. E. R. Jackson, Tank Trailer and Tractor Division, U. S. A., on The First Transcontinental Motor Convoy; and the other by Lieut.-Col. H. W. Miller, Artillery Division, U. S. A., on The German Defenses on the Coast of Belgium. These timely and interesting papers will be illustrated by slides and moving pictures.

A large excursion is planned, en route to St. Louis, to the wonderful plant of the Mississippi River Power Co. at Keokuk; and following the meeting there is to be a trip to the oil fields at Tulsa, Okla.

At St. Louis an entertainment program of extreme interest has been arranged by the Local Committee, with a banquet, an entertainment at the open air municipal theatre and visits to many points of interest.

Blast Furnace at Newcastle

A new and up-to-date blast furnace is being erected at Natal, Newcastle, Australia. This furnace will include all modern appliances. It is at first intended to manufacture cast-iron pipes and the management is in negotiation for machines working on the centrifugal principle. Another line will be heavy iron and steel castings, using a side-blow converter for making steel, to be followed later by open-hearth furnaces and a heavy 28-in., three-high rolling mill.

Secretary of Navy Authorizes Sale of 30,000 Tons of Steel

The Secretary of the Navy, in view of the continuation of the shortage of manufacturers' steel, has authorized the sale of an additional 30,000 tons of steel held by the Navy. This is the second quantity of steel which the Navy has put on sale recently, the first sale being held about six weeks ago. There are included in this sale most of the merchantable types of steel, including plates, sheets, rods, billets, angles, channels and I-beams. Bids will be received up to May 5, 1920, at Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for this steel.

A catalog may be obtained upon request showing the size, physical and chemical characteristics of every piece of steel offered. Purchasers may select the exact pieces which they may require and all offers will be considered either for small or large quantities.

The Shaw-Walker Co., of Muskegon, Mich., is building a new addition and will buy additional press equipment later.

Westinghouse Opens Largest Employees' Cafeteria

On April 6, when the largest industrial eating place in the world was officially opened by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., evidence was given of what the larger manufacturers of today are doing in the way of providing for the comforts of their employees. This new cafeteria which is a three-story reinforced-concrete and brick building, 236 x 100 ft., has a seating capacity on the first two floors alone of nearly 2,600 persons. In addition, on the third floor is a dining room with a capacity of 500 and an auditorium with a seating capacity of 1,000.

One of the main features is the fact that there are no steps in the main part of the building. Gradual inclines or ramps are used exclusively in order to facilitate moving the diners from floor to floor.

The first and second floors are devoted to cafeteria service, a section being reserved for women employees of the company.

The cafeteria is equipped with the most modern labor-saving conveniences that are obtainable. On the first and second floors are eight service counters, sixteen coffee urns, milk freezers with a capacity of 40 gal. each, and sanitary drinking fountains.

THE WESTINGHOUSE CAFETERIA

Soiled dishes are carried from the first and third floors to the second floor where two large motor-driven dish washers are installed, which wash and dry the dishes.

A portion of the first floor adjacent to the cafeteria is fitted up with a motor-driven washing-machine mangles, steam dryer for the purpose of washing and drying linens, motor-driven ice-cream freezer with a capacity of 10 gal. and an ice-making machine with a capacity of 2,000 lb. every 12 hr. The ice manufactured is to be used for the purpose of packing ice cream, cooling butter, making iced tea, lemonade, etc. There is also an ice-cream storage artificially cooled.

All food will be cooked on the third floor and will be supplied to the cafeterias by subconveyors. The kitchen is equipped with every possible method of convenience, including large gas ranges as well as double unit combination gas and coal ranges, steam meat roaster, steam service table, potato peeler which peels 40 lb. of potatoes in less than 2 min., bread cutter, potato masher, and a coffee urn for dining-room service. Two steam-heated kettles with a capacity of 60 gal. each are used to make soup. There is also an electrically heated pie baker with a capacity of 65 pies in 15 to 20 min., one large refrigerator for cooling meats and two smaller ones to cool vegetables and dairy products. All the refrigerators throughout the plant are cooled by brine pipes.

By means of the auditorium on the third floor a suitable meeting place for the various employee organizations is provided.

F. F. Beall Heads Gray Motor Corporation

Formerly Vice President of the Packard Motor Car Co.—New Concern Capitalized at $4,000,000

F. F. Beall has accepted the presidency of the Gray Motor Corporation, a newly formed $4,000,000 automobile concern. Mr. Beall for the last seven years has been vice-president in charge of manufacturing of the Packard Motor Car Co. Associated with Mr. Beall are a number of prominent Detroit automobile men, including William H. Blackburn, formerly production manager of the Cadillac Motor Car Co., who is factory manager of the new Gray Corporation. The company's securities have been underwritten.

The Gray Motor Corporation capitalization consists of 400,000 shares of class A stock, par value $10, and 400,000 shares of class B stock of no par value. Later a syndicate offering will be made. The plant, equipment and business of the Gray Motor Co. of Detroit, builders of the Victory motor, have been acquired and the body will be designed by Briscoe and Storey, under plans originated by the Benjamin Briscoe and Stahl Engineering Co. It is stated that the new company starts business with an assurance of capacity orders, for beside the domestic demand arrangements have already been perfected for the sale of the Gray car in Europe and other foreign countries. It is planned to produce 30,000 cars annually upon which production the management estimates net earnings of over $3,000,000 after full allowance for taxes and depreciation.

Expansions in the Link-Belt Co.

The increasing amount of business in its line has made it necessary for the Link-Belt Co., Chicago, Ill., to plan a very extensive program for expansion of its various manufacturing plants. At the Indianapolis chain works two new furnaces have been added in the last few months, making a total of eight. The Link-Belt Co. has also recently purchased the Fairmount Foundry at Philadelphia, which will be used an an adjunct to the Eastern works, supplying it with gray-iron castings. New office buildings are planned or under construction at both the Philadelphia and Chicago works, and at the foundry of the latter works, a new conveying system is being installed to speed up the output.

Machinery Club of Chicago Votes

The fourth annual election to fill vacancies on the board of governors of the Machinery Club of Chicago was held on April 20, 1920. The following members were elected to serve for a term of three years: Charles J. Becker, E. L. Essley, J. R. Porter and A. G. Bush.

After having been torn up for several months while extensive alterations were being made in the club rooms, the club is now fully settled and enjoying the additional space which was secured on the same floor of the building they had been occupying. The dining room and kitchen were both enlarged and the billard room has received the addition of two new billiard tables. The old lounging room has been changed from the east to the northwest corner of the building, the space it formerly occupied having been added to the dining-room. More room was secured for the lounging room in the additional space which was secured by the club. The club has now a membership of well over 1,000.

Spang & Co., of Butler, Pa., is building a new forge shop.

Trade Letters from New York and Chicago

NEW YORK LETTER

April 30, 1920.

There has been no noteworthy development in the machine-tool market during the past week. While inquiries were not as numerous as during the previous two weeks, there was a steady volume of business reported for all lines.

The largest list was submitted by the Roanoke, Va., office of the Norfolk & Western R.R. Co. Proposals were asked for on cutters, boring machines, lathes, grinding and drilling machines. Short lists were sent out by the Boston Elevated Co., and the Chesapeake & Ohio R.R. Co.

Although the embargo on freight caused by the railroad strike has been lifted on the New York Central lines, shipments are slow and uncertain, and conditions on the other roads affected by the strike are still chaotic. The expressage embargo also is hindering machine-tool shipments.

Deliveries in the many lines cannot be promised inside of three or four months. This fact, together with the uncertainty of the raw-material market, prevents many manufacturers from installing new presses and other equipment to take care of present rush orders. There is a growing tendency reported on the part of machinery manufacturers to withhold enlarging their plants until stable conditions are guaranteed for the future in both the labor and raw-material markets.

CHICAGO LETTER

With the "outlaw" rail strike still in effect, though with constantly diminishing force, dealers have been working under a severe handicap the past few days. Conditions have been mitigated to such an extent that shipments into and out of Chicago are proceeding with fair regularity but shipments from any point through Chicago are still under embargo. The effect is that dealers are enabled to replenish stocks and to ship therefrom, but direct-shipment business is badly interfered with. No complaint is heard in the trade and the let-up in purchase orders has not been nearly so severe as might have been expected.

Orders and inquiries continue to come in with demand spread over a wide range of equipment and originating in an equally wide variety of industries. So diversified is the buying that it is hardly possible to point out any particularly notable feature. It is very probable that when April totals are struck it will be found that new business booked equals or exceeds the amount of goods shipped. Thus the gross amount of goods on back order remains about constant.

Credit conditions, for the first time in many months, appear tight. This arises from three factors: the inability of manufacturers to make shipment on completion of goods, thereby increasing the volume of capital tied up in finished stock inventory; the greatly increased time consumed in transit, thereby proportionately increasing the length of time money is outstanding on transactions; and the general reluctance of banks to extend or renew credits. This should cause care in the granting of credits by machinery dealers in the near future and should accentuate the existing healthy condition of the trade.

The Krasberg Engineering and Manufacturing Co. announces that they are to discontinue their tool and die making and their special contract department, devoting their entire energies to the manufacture of phonograph motors. The rearrangement of their plant will give them a capacity of 3,000 motors a day. The Pullman Co. also has contracted to devote a great portion of its capacity to turning out talking machine cabinets.

Business with dealers in supplies continues excellent. The removal last week of the long standing embargo on express shipments has removed a serious annoyance.

Short News Notes

The equipment inquiries recently made for the Chilean state roads will exceed in value $8,000,000.

The Lacey Manufacturing Co., of Bridgeport, Conn., has been organized with a capital of $25,000. The company will manufacture machine tools and small parts of machinery. Franklin G. Hubbard, is president, and F. E. Lacey is secretary and treasurer. Mr. Lacey was formerly connected with the Bridgeport Gun and Tool Co. Mr. Hubbard is of the firm of Hubbard & Harris, of Bridgeport. The new company will begin operations shortly.

Engineers to Meet at St. Louis

The tentative plans for the fifth annual convention of the American Association of Engineers have been announced here. The Planters' Hotel, St. Louis, will be the gathering place and the dates have been made public as May 10 and 11. According to the programme as announced, the following subjects will be among those discussed by the engineers: Shall a special charge for special service be made by the employment department? A permanent home for A. A. E. What part shall A. A. E. take in the Presidential campaign? Americanization and man power engineering. The Federal department of A. A. E. at Washington. Opportunities for the engineer in civil, structural, mechanical, mining and chemical fields. Unity of the engineering profession in the United States.

WHAT "DR." W. T. CLUB WOULD MAKE 'EM DO.

House Wife: Syrup, 90 cents a gallon? Let me see: a liter is 0.2642 gal. Well, bring me a liter of it, and bring change for a $20 bill.

General Electric Co. Has Machinery Sent to Bartlett-Hayward Plant

Local machine-tool manufacturers who had contracted to furnish machines to the General Electric Co. for its Bridgeport, Conn., plant, which was formerly the U.M.C. factory, were notified this week to divert the equipment ordered to Baltimore, Md. The General Electric Co. has taken over the Bartlett-Hayward plant —which was used to make ammunition during the war. By adding some machines to the tools already at the factory the plant will be fully equipped and ready for operation within a short time.

Charles W. Johnson

Charles W. Johnson, assistant director of engineering for the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., died from double pneumonia on April 21, 1920, following an illness of only a few days.

Mr. Johnson was born June 30, 1874, and was graduated from the Ohio State University in 1896. He then entered the employ of the Steel Motor Co., Johnstown, Pa. Later he became superintendent of the Allis-Chalmers Bullock Co. of Cincinnati, Ohio. He entered the employ of the Westinghouse Electric and Manufacturing Co. in 1907 and was soon appointed chief inspector. In 1912 he became general superintendent of the East Pittsburgh Works, and in the early part of 1919 was made assistant manager of works. On Jan. 1, 1920, he was appointed assistant director of engineering.

Mr. Johnson was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the Engineering Society of Western Pennsylvania.

Personals

Arthur Kirkland, formerly sales engineer with the Detroit Tool Co., is now manager of the Cleveland office of Russell, Holbrook & Henderson, Inc., of New York. This office has been established for the purpose of handling the sales of the Sanford precision centerless cylindrical grinding machine. It is located at 548 Leader News Building.

Leslie B. Stevens has been promoted to office manager at the Elmwood plant, of the New Departure Manufacturing Co., of Bristol, Conn. Mr. Stevens is a graduate of Dartmouth College, class of 1917; he has since been with the New Departure company.

C. A. Severin has been appointed manager of the Cleveland branch of the Becker Milling Machine Co., located at 408 Frankfort St., Cleveland, Ohio, handling its full line of milling machines and milling cutters. Mr. Severin will be assisted by Charles Brandhill who has been in the employ of the Becker Co. for a number of years.

Paul C. Baldwin, formerly office manager at Plant "C," of the New Departure Manufacturing Co., of Bristol, Conn., has been appointed office manager in Plant "D" of the company, which is in Meriden, Conn. Plant "C" is in Elmwood, a suburb of Hartford, Conn.

Charles E. Hildreth, president of the Worcester Chamber of Commerce, made his first visit to the general office yesterday in several weeks, having been confined to his home with pneumonia. He was able to resume business and last week went to Atlantic City, N. J., with other delegates, to represent the chamber at the annual meeting of Chamber of Commerce of the United States.

Charles D. Ingram, of Sacketts Harbor, N. Y., has become associated with the mutual interest department of the Aluminum Co. of America, Massena, N. Y.

Lyle B. Marcy, formerly superintendent of the Hart & Cooley Co., Inc., New Britain, Conn., has become connected with the Chase Companies, Inc., Waterbury, Conn., in the capacity of research engineer.

Leon B. Stoddard, formerly with the Pratt & Whitney Co., of Hartford, Conn., is now superintendent of the toolroom of the Gilbert & Barker Manufacturing Co., of Springfield, Mass. Mr. Stoddard has assumed his new duties.

F. L. Rowland has been made second assistant treasurer of the Gilbert & Barker Manufacturing Co., of Springfield, Mass., at a recent meeting of the company directors. Mr. Rowland has been with the company since November, 1918, during which time he was office manager.

A. C. Johnston, formerly chief engineer of the Chicago Works, has been elected a vice president of the Link Belt Co., and resident general manager of the Chicago plant. He succeeds Prentiss L. Coonley, who has resigned in order to devote his time to the presidency of the Isko Manufacturing Co.

Frank Heffernan, of the New Departure Manufacturing Co., Bristol, Conn., has been appointed to have charge of the Sub-Die work in the new plant D of the company at Meriden, Conn. Mr. Heffernan has been with the company over seventeen years, and is now with the Sub-Die department of plant A, in Bristol.

Edward Keeling, for many years connected with the Traut & Hine factory, New Britain, Conn., as foreman of the tool department, left the employ of the company recently.

Robert M. Roof, mechanical engineer for the Laurel Motors Corporation, has returned from business visits to Detroit and Indianapolis where he purchased several thousands of dollars worth of new machinery for the new motor building addition which is to be built to the Laurel plant on Sycamore Street.

Evald Anderson, assistant superintendent of the gage room in plant A of the New Departure Manufacturing Co., in Bristol, Conn., has been selected to have charge of the gage department in the new plant D of the company, now nearing completion in Meriden, Conn. Previous to being with the New Departure, Mr. Anderson was with the Corbin Screw Corp., of New Britain, Conn.

Harry G. Stoddard, official of the Wyman & Gordon Co., drop-forgers, of Worcester, Mass., has been elected to the board of directors of the Boston & Maine Railroad Co., at a meeting held in Boston, April 14.

May 13, 1920 American Machinist Vol. 52, No. 20

1023,

Comparative Methods of Machining Automobile Engine Connecting Rods

Packard—Cadillac—Peerless—Chandler—Franklin

By FRED H. COLVIN, Editor
American Machinist

Packard

This article gives an outline of the method used in machining the connecting-rods for the Packard Twin-Six. Only plain rods are used, two being coupled to each crankpin, obviating the necessity for the forked type of rods.

THE preliminary operation includes heat-treatment which consists of, first heating and quenching, and then reheating to draw the temper to the desired point. They are then counted, sandblasted, snagged and straightened, after which they are ready for machining.

The ends are milled in the double-spindle rotary machine shown in Fig. 1, and the side of the large end rough-ground to present a locating point for future operations. Then comes the drilling and reaming of both ends in the special machine shown in Fig. 2. This is a station-type machine with double fixtures so that each station handles two rods at the same time. The ground surface of the large end rests on the block *A*, while a projection on the nut *B* centers and clamps the rod by means of an inside bevel which fits around the outside of the large boss. This nut is handled by the spanner wrench shown. The small end of the rod is centered by a small fork *C*, which is operated by the star handle *D*.

The large hole is then chamfered, the outside finished with a hollow mill and the sides of the rod milled. The outside radius of the rod is then finished in the vertical milling machine, as shown in Fig. 3. The fixture is a very simple one in which the piston-pin hole fits over the stud *A*, the forked arm *B* supportng the rod and swinging it around the stud *A* while the outside is being milled. This turning is done through a worm

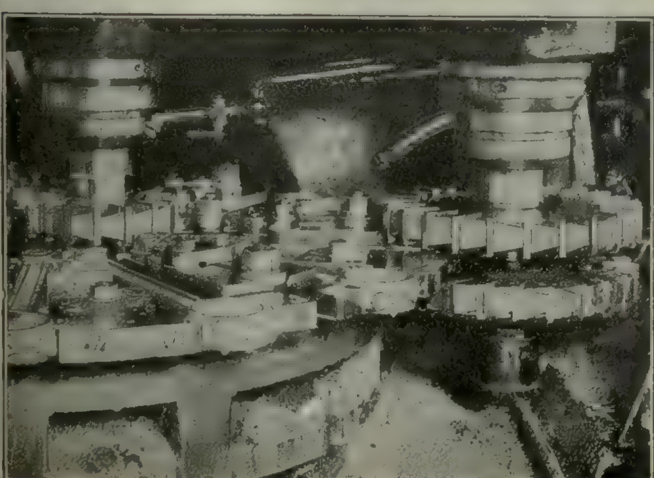


FIG. 1. MILLING THE ROD ENDS

FIG. 2. SPECIAL MACHINE FOR DRILLING ROD ENDS

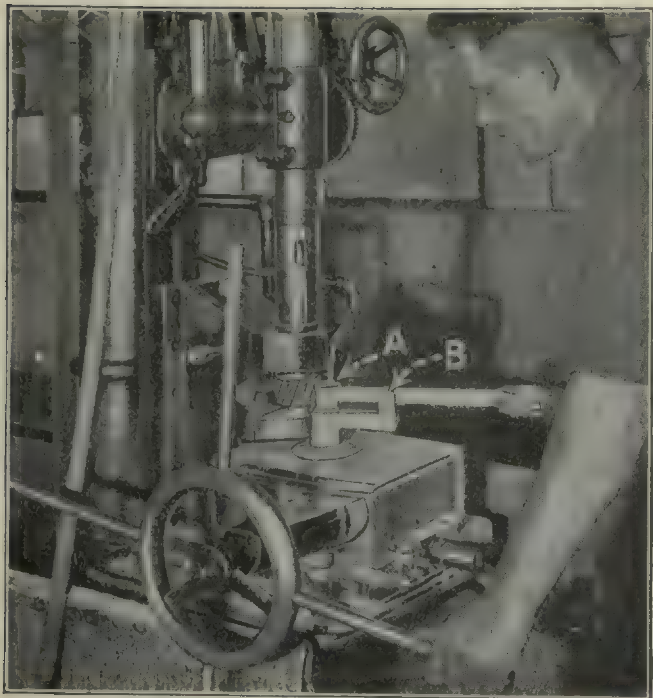


FIG. 3. REMOVING SMALL END OF ROD

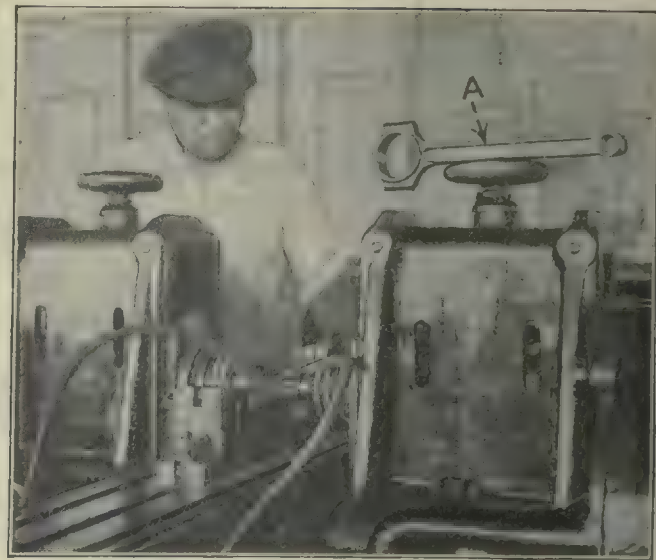


FIG. 4. MILLING THE CHANNELS

gear locatea in the base of the fixture and operated by means of the pilot wheel shown. The depth of cut is regulated by moving the slide toward the milling cutter.

The grooves or channels are milled on each side in the double-headed machine shown in Fig. 4; this operation bears a close relation to spline milling. The rod shown on the machine at *A* indicates how it is finished all over.

The rods are marked before any machining is done in order that when the rod and cap are separated there can be no question as to where each belongs. The same number is stamped on each in the fixture shown in Fig. 5. This holds 10 rods by nesting them as shown, and a place is provided at the side for the full set of number stamps. This is a very convenient marking plan for any work of this kind.

The bolt-hole drilling fixture is shown in Fig. 6 and is used under a multiple drilling machine. The drills are arranged in a circle to conform to the circular fixture. The spindles at the left carry the drills while those at the right ream the holes. The drills and reamers are lubricated from the pipes shown. The central handle controls the indexing of the fixture.

After the bolt holes are drilled and the bolt bosses milled, the cap is separated from the rod itself. The faces of both cap and rod are then carefully ground on small surface grinding machines in the fixture shown in Fig. 7. The machine in the foreground is grinding the cap while the one in the rear is grinding the rod itself. The cap is located on dowels in the block *A* and held in position by the screw *B*. The rod is located by the pin *C*, which fits in the piston-pin hole, and held by the clamp *D* which locates it sideways from the bore of the rod. The grinding of this joint between the cap and rod plays an important part in securing a well-seated bearing and receives particular attention on that account.

The dowel-pin holes which hold the bearings in position are next drilled; the seat for the bolt is spot-faced, and the hole machine-reamed. The piston-pin hole is then reamed in the special fixture shown in Fig. 8, which is practically a hand-reaming operation with the exception that power is supplied by the air motor shown. The large end of the rod is supported at *A*, and there is a floating connection so that the reamer can assume a free position just as would be the case in hand-reaming.

FIG. 5. FIXTURE FOR NUMBERING RODS AND CAPS

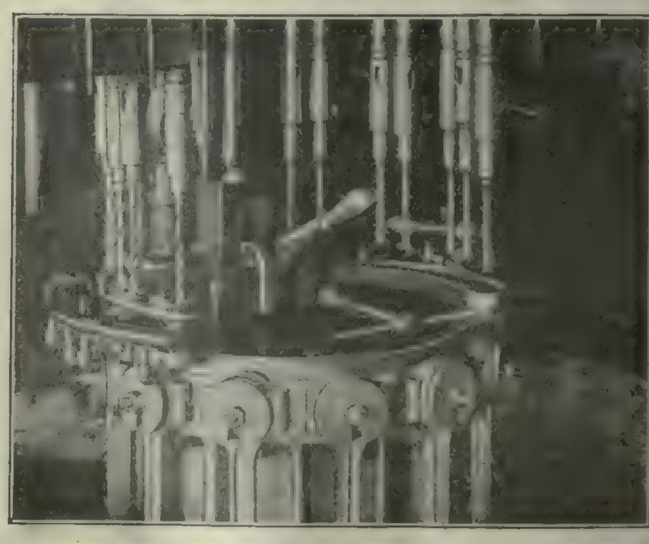


FIG. 6. DRILLING THE BOLT HOLES

FIG. 7. GRINDING THE ROD AND CAP JOINT

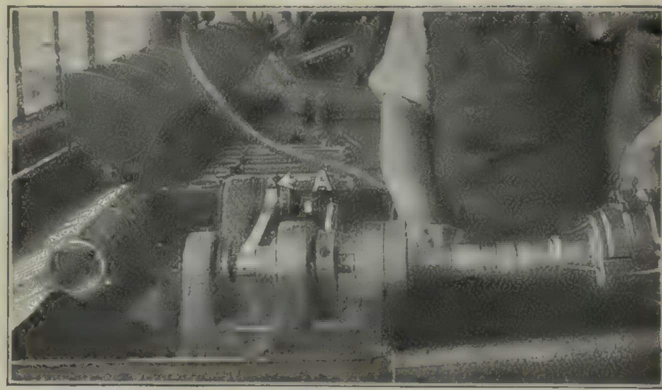


FIG. 8. "HAND" REAMING WITH AIR MOTOR

Using a hand-reamed hole as the locating point, the rod is then swung on a large faceplate and the large hole ground to finished size. After this the sides of the rod are ground to the desired thickness and after inspection the rods are ready to go to the assembling department.

Cadillac

The machining of connecting-rods involves a great variety of operations, depending largely on the design of the rod and the idea of the engineer as to how much finish is necessary. This article shows the practice of the Cadillac Motor Car Co. in making the forked rods of its eight-cylinder motor. The rods are finished all over in order to secure lightness and uniformity as to weight.

THE machining of the forked type of connecting-rods involves a number of operations which are not required in the plain rod, the type of rod necessitating many precautions against the springing of the two forks and the imperative need of keeping them in perfect alignment, not only with each other but with the piston-pin hole. The transformation sheet, Fig. 1, shows the sequence of operations. Fig. 2 shows how the forgings are inspected to be sure that they will clean up during the machining and to enable them to be straightened should this be necessary. The straightening goes through two hands in order to insure the forging being in the best possible shape for the future operations. The locating spots on the small end are next milled, then the sides of the rod, and the locating points on the forked end. Next comes the rough-milling of the large ends, the milling of the channel, between the two forks, which is divided into two operations, the burirng of the inside and outside edges, and the preliminary inspections, the burring of the eration is shown in Fig. 3, one gang of cutters being seen at *A*, *B*, and *C*. The rods are located on the surface at *D* and clamped by *E*, while *F* holds the small ends against the thrust of the cutter.

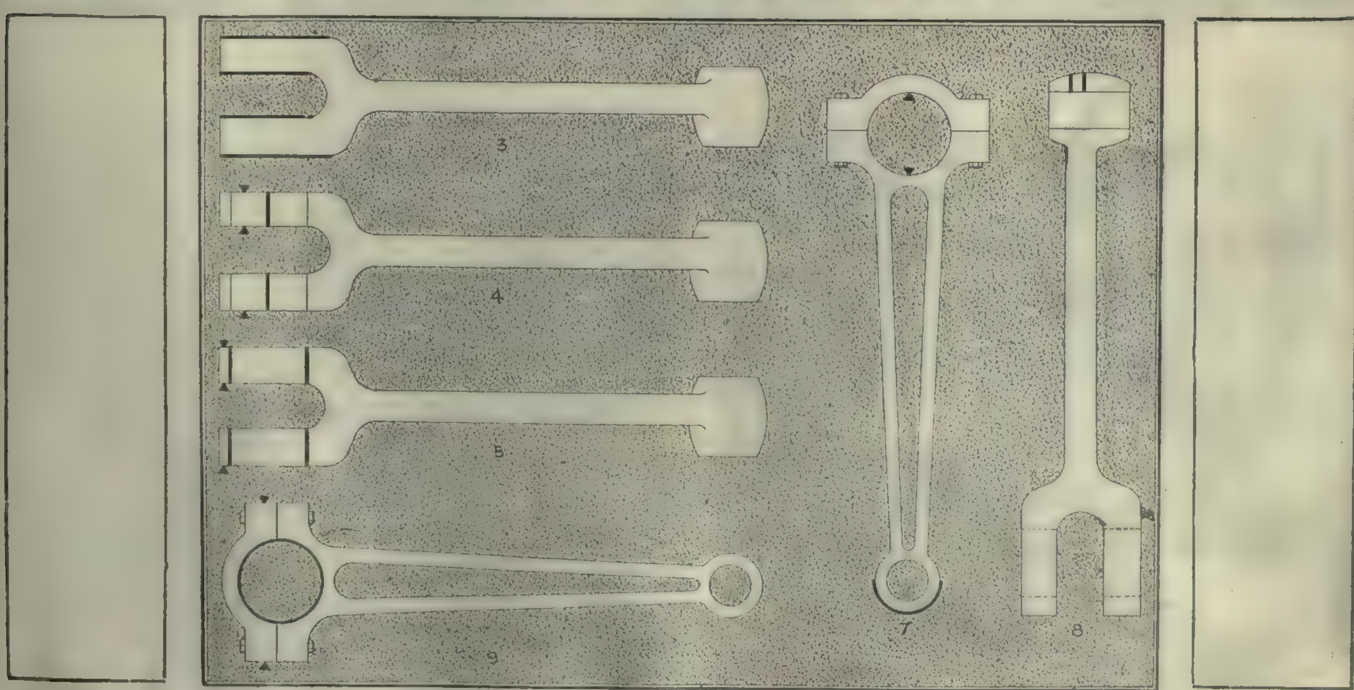
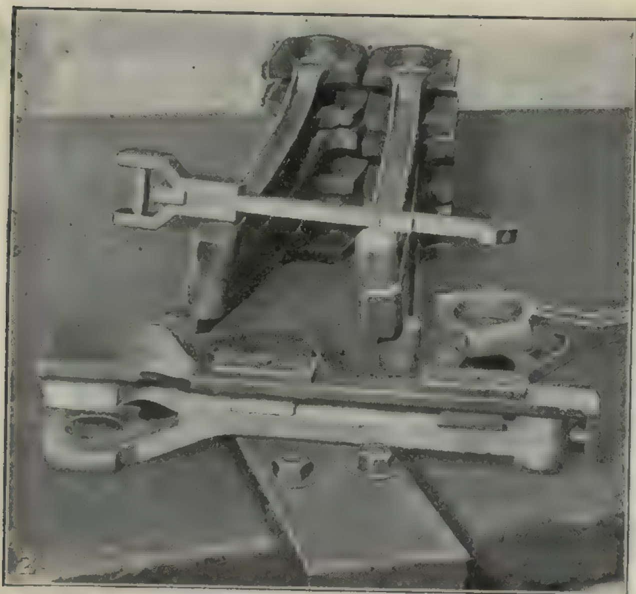
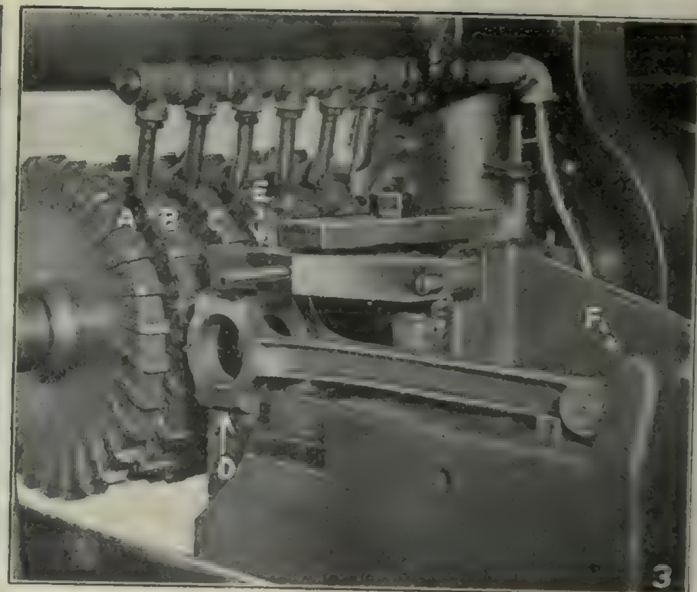
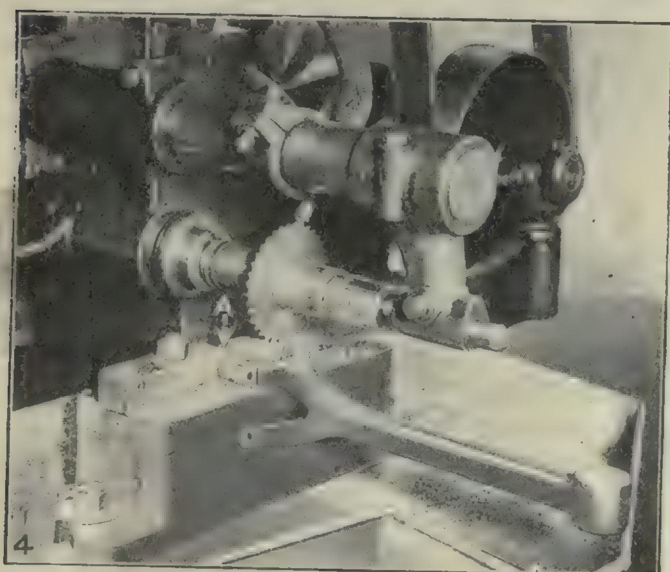
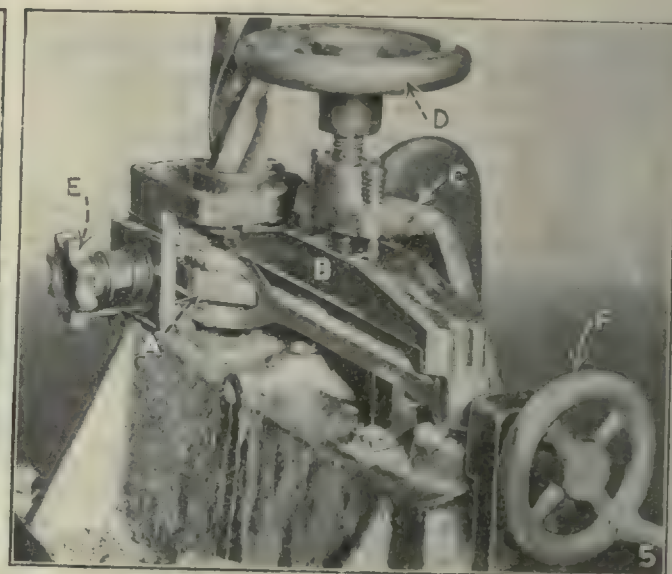


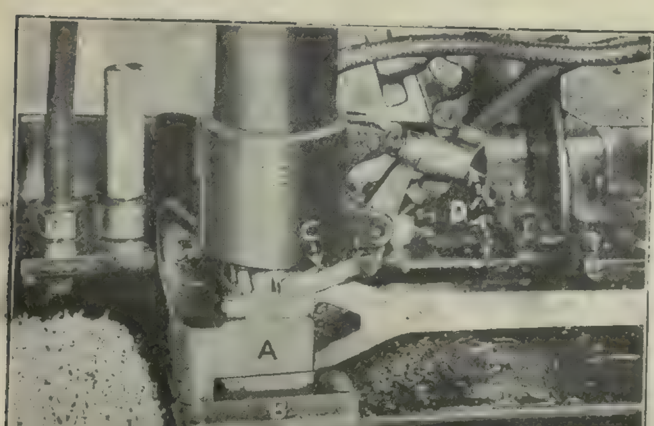
FIG. 1. TRANSFORMATION SHEET OF OPERATIONS











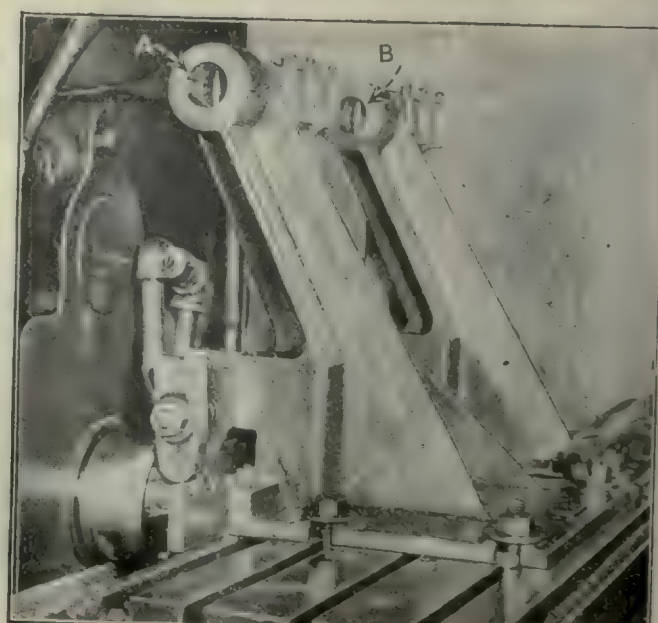


FIG. 2. STRAIGHTENING THE FORGINGS
FIG. 3. ROUGH-MILLING THE LARGE END OF ROD
FIG. 4. SAWING THE CAP FROM THE ROD
FIG. 5. DRILLING LARGE END OF CONNECTING-ROD
FIG. 6. REAMING THE LARGE END
FIG. 7. MILLING THE SMALL END

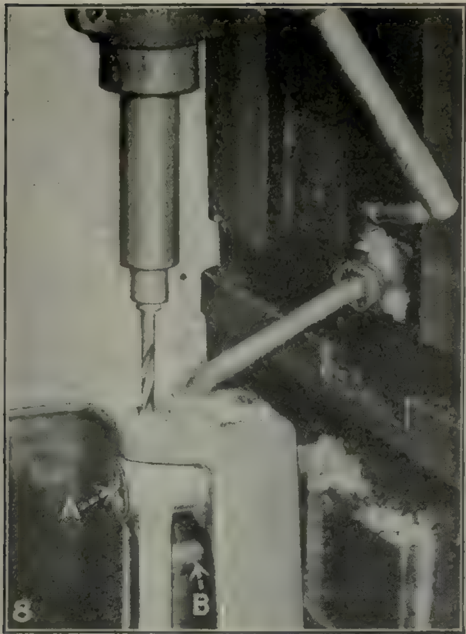


FIG. 8. DRILLING THE OIL HOLE

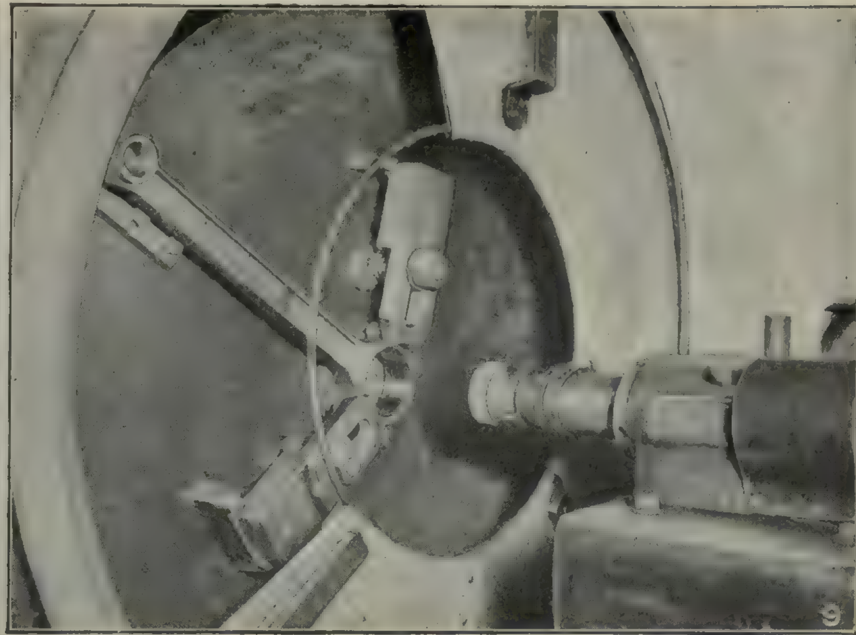


FIG. 9. GRINDING LARGE END OF ROD

From here the rods go to the stockroom for issue to the heat-treating department, after which they are straightened and both ends milled, the bolts lug faced, the caps milled, the bolt holes drilled and reamed, and the caps sawed from the end as in Fig. 4. Only one cap is cut off at a time, the rods being held firmly by small straps at *A*.

After the caps have been sawed from the end of the rod it is bolted in place and the holes drilled in the fixture shown in Fig. 5. This is a very substantial fixture in which the forked end of the rod is supported by the anvil *A*, the rod being held firmly in position by the long clamp *B*. This is guided in the arm *C*, the springs which surround the guide holding the strap away from the work. The wheel *D* affords an easy method of fastening the rod in position. It will be noted that the rod is located sideways by means of the knob *E* and endways by the wheel *F*. The ends of the clamp are so cut away as to allow the free passage of the drill at both ends. Fig. 6 shows the reaming of the hole in the large end of the rod. Here again the fork is supported by the anvil *A* and is firmly held in position by the claw C operated by the thumbnut *D*, while the lower half rests on the plate *B*, as shown, the whole being supported by the substantial guide *E* which surrounds the reaming spindle. This guide is cast integral with the anvil *A*.

The small hole for the piston pin is next drilled, the center distance being controlled by the large end holes which have already been reamed. The small hole is then reamed in a similar manner, after which the rods go to the special milling fixture shown in Fig. 7, for forming the radius at the small end. The rods are supported by a mandrel which goes through the holes *A* and *B* of the arms, while the lower ends are clamped between suitable distance pieces to insure rigidity.

Then comes the drilling of the oil hole at the upper end of the rod, as shown in Fig. 8, the rod being cen-

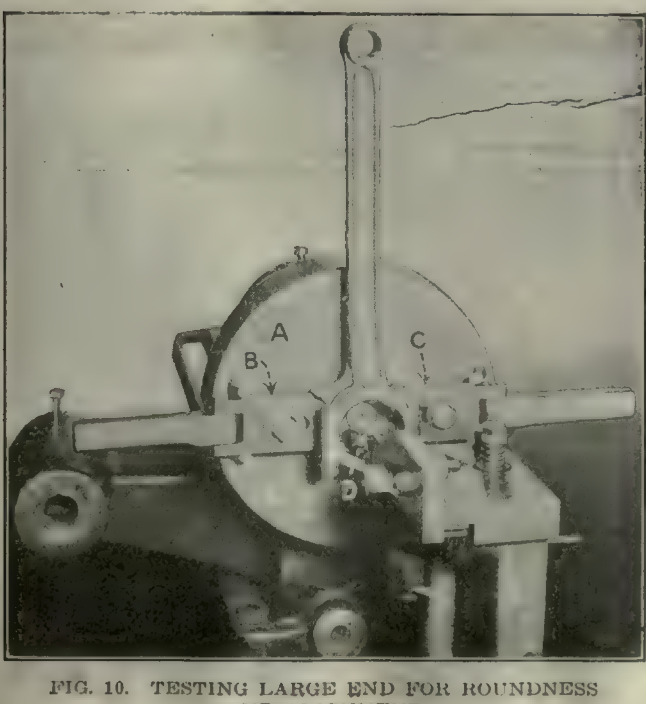


FIG. 10. TESTING LARGE END FOR ROUNDNESS AND ALIGNMENT

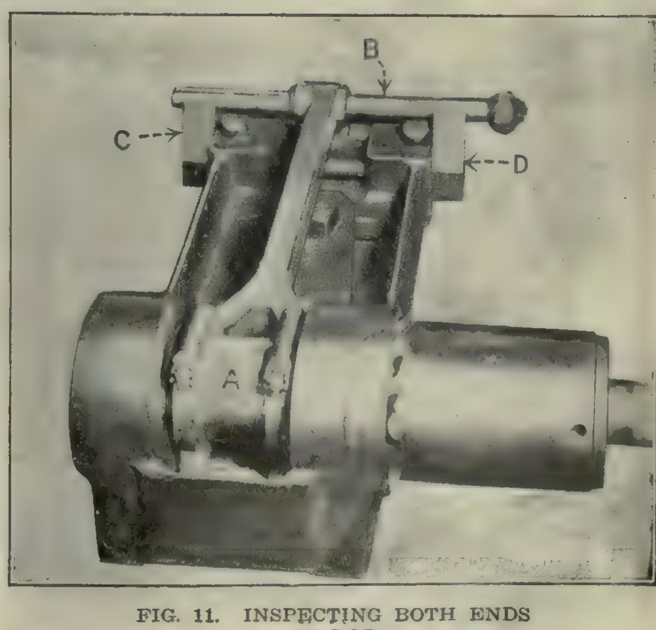


FIG. 11. INSPECTING BOTH ENDS OF ROD

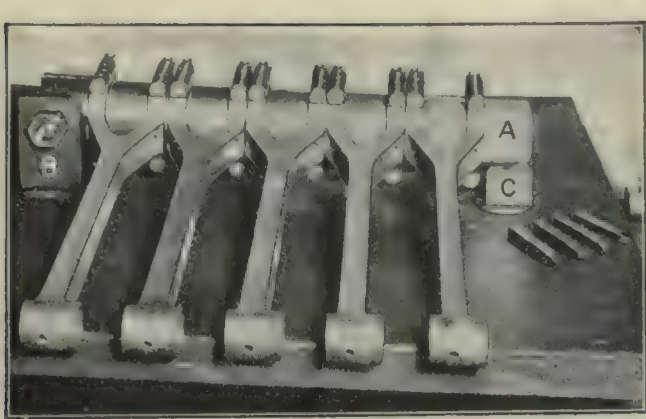


FIG. 12. FIXTURE FOR NUMBERING RODS AND CAPS

tered on the pin *A*, which has a channel to allow the free passage of the drill, its position being located by the pin *B* which fits into the channel of the rod.

The large hole is finally reamed by means of an air-driven reamer in a floating fixture, which gives all the characteristics of a hand-reamed hole. The large hole is then ground in a special grinding machine as shown in Fig. 9.

The method of testing the concentricity of the hole is shown in Fig. 10, the rod being located on a suitable boss on the faceplate *A* and held against it by the quick-operating clamps *B* and *C*. A dial indicator at *D* readily shows the roundness of the hole.

The inspection of the rod for center distance and alignment of holes is shown in Fig. 11. The close-fitting mandrel *A* is pushed through the holes in the forked end of the rod and the test bar *B* through the small end. The position of the test bar with relation to the blocks *C* and *D* shows the length of the rod, the parallelism of the holes, and also any twists in the main part of the rod itself.

When the rods are finally completed and, before the caps are removed for the final assembly, each rod and its corresponding cap is marked to insure easy and positive identification. This is done by slipping five rods over the bar *A*, Fig. 12, which is hinged in the block *B*, and fastened to the benchplate shown. The outer end of the bar swings down on the block *C*, and the whole forms a convenient anvil for the stamping operation. It is, of course, necessary to have the rods all in the same relative position, which in this case means that the long end of the piston-pin boss is to the right.

Peerless

While the amount of production has its effect on the quantity of equipment and on the use of specially designed machinery, familiarity with modern methods enables the economical machining of parts, even on a comparatively small scale.

ALTHOUGH the Peerless motor is of the 8-cylinder V-type, it uses the plain connecting rod instead of the forked type. These rods are comparatively simple to machine, there being but 15 operations in addition to the various inspections. The transformation sheet, Fig. 1, shows the machining operations which are illustrated by halftones, the first machining operation being shown in Fig. 2. This is a double fixture for milling the sides of the rod, and the clamping arrangement is both unusual and interesting. This differs from the clamp used by the Winton Co. in having each clamp independent of the other. The clamps on the nearest rod are pivoted at *A*. The arm *B*, which holds the large end of the rod, carries the heavy screw *D*, which bears on the lever *C*. In this way the tightening of the screw clamps both ends of the rod and equalizes the pressure so that it is firmly held against the milling cut. The illustration shows very clearly how the rod is centered at each end and also the type of milling cutter used. This cutter has forged inserted blades which present a sharp shearing angle to the metal. The fixture is

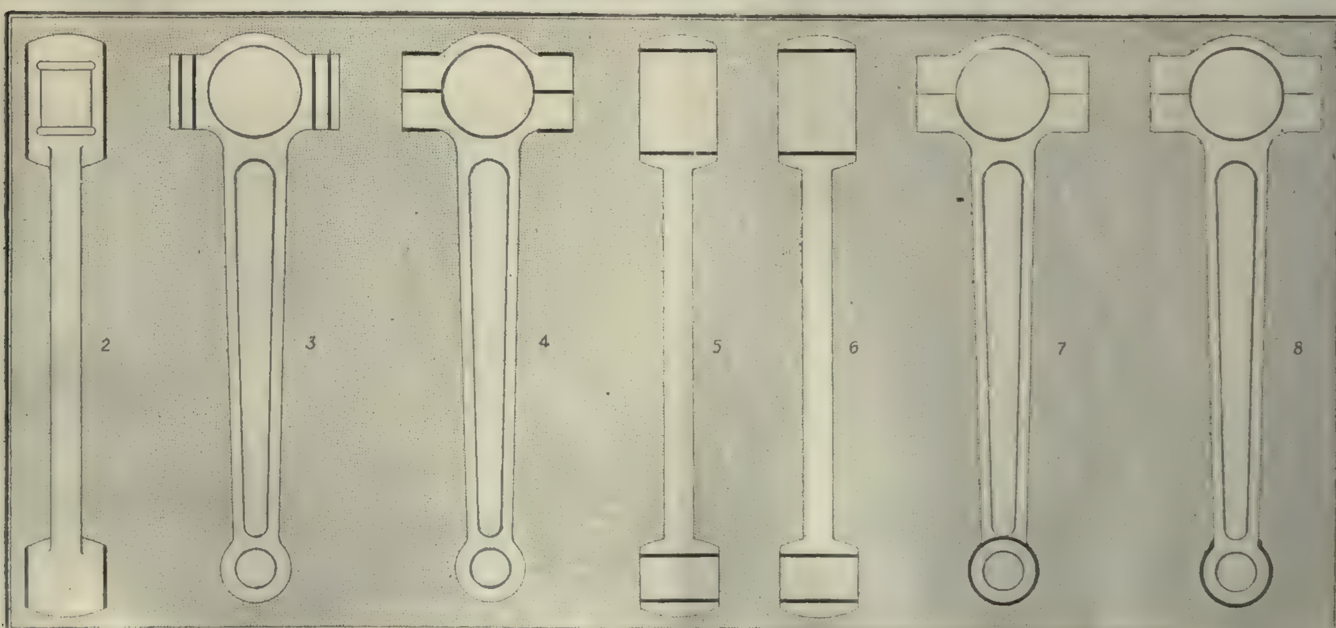


FIG. 1. TRANSFORMATION OF OPERATIONS

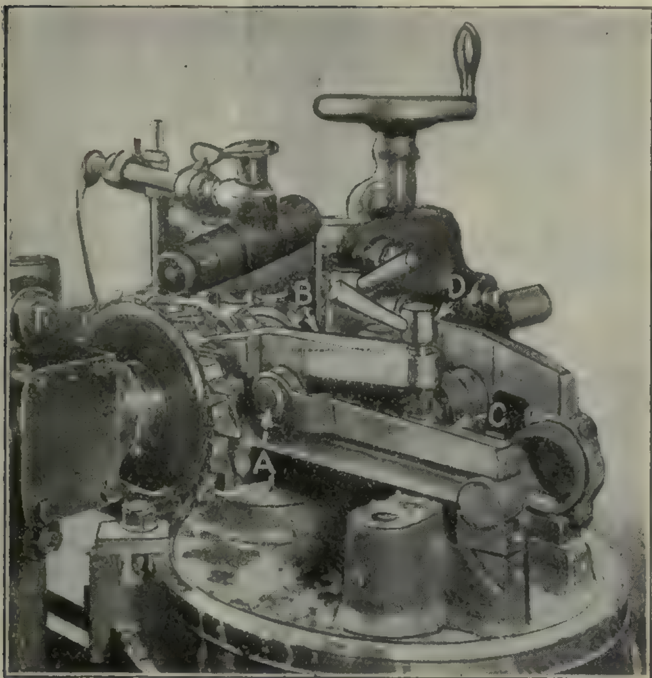


FIG. 2. MILLING THE ENDS

mounted on an indexing base to be easily reversed, so that both ends of the rods may be milled at one setting.

The bolt holes are next drilled in the fixture shown in Fig. 3. This holds four rods, so that half the fixture can be loaded or unloaded while the four bolt holes are being drilled in two rods. The small end of the rod rests in the V-shaped opening at *A*, being backed up against the pin *B*. The upper end of the rod is held by the clamp *C* in the usual manner.

In the next operation, shown in Fig. 4, both ends of one bolt boss are faced by the cutters *A* and *B*; at the same time the slitting saw *C* separates one side of the cap from the rod. The fixture holds two rods, one on each side of the central bar *D*, and is so arranged as to be readily turned over for milling and slotting the other side. The work is simply fed under the cutter until both rods are cut on one side, and then the fixture reversed so as to complete this operation at the one setting. A substantial manufacturing type of milling machine is used for this purpose.

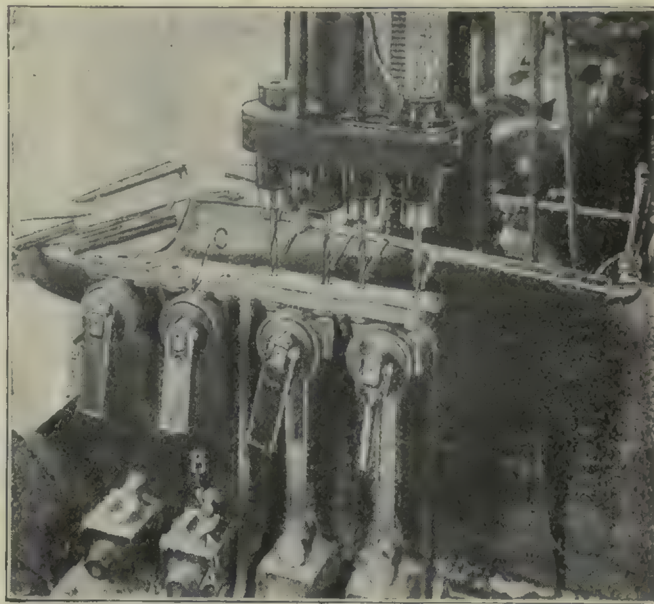


FIG. 3. DRILLING BOLT HOLES

The caps are then bolted to the rods, which then go to the special fixture, shown in Fig. 5, for rough- and finish-boring both ends of the rod. The boring operation requires almost no explanation, as the construction of the fixture is very clearly shown. The rods are loaded at the front of the fixture and the table turned to the left, so that the roughing drills come into play first. Slip bushings are used to accommodate the different size drills and reamers. These bushings fit inside the hollow clamping nuts *A* and *B*, the lower end of the rod boss fitting into a suitable centering cup.

Broaching Both Ends

Following the drilling and reaming comes the broaching of both ends of the rod in the double-broaching machine shown in Fig. 6. This practice is almost identical with that of the Locomobile Co., and, as seems to be usual in such cases, the locating pins *A* and *B* are not considered necessary in actual use. The guide

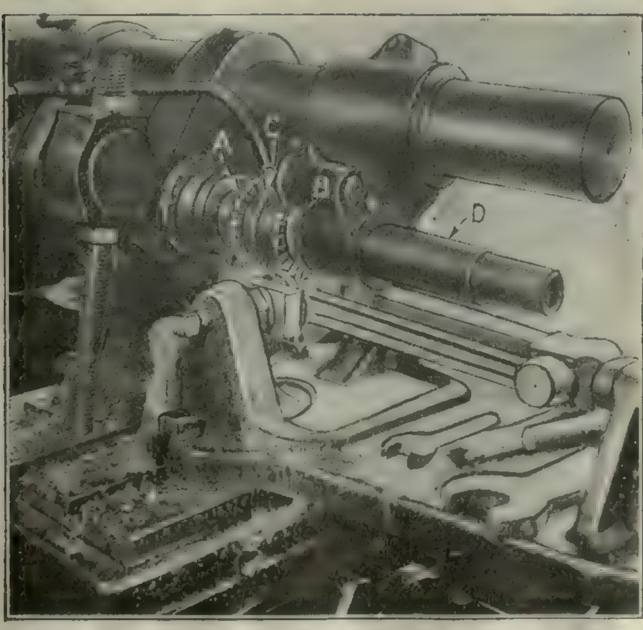


FIG. 4. MILLING BOLT BOSSES AND CUTTING OFF CAPS

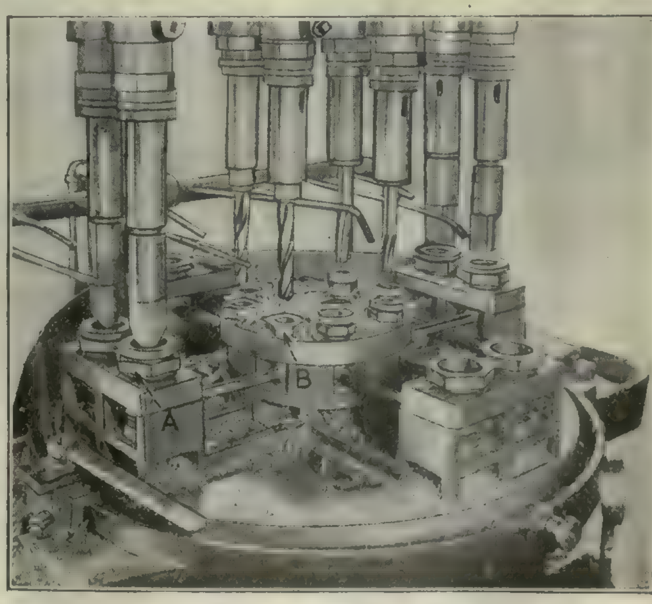


FIG. 5. DRILLING AND REAMING BOTH ENDS

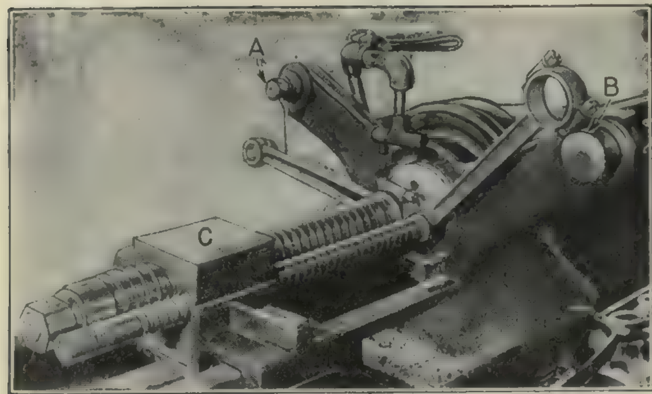


FIG. 6. BROACHING BOTH ENDS

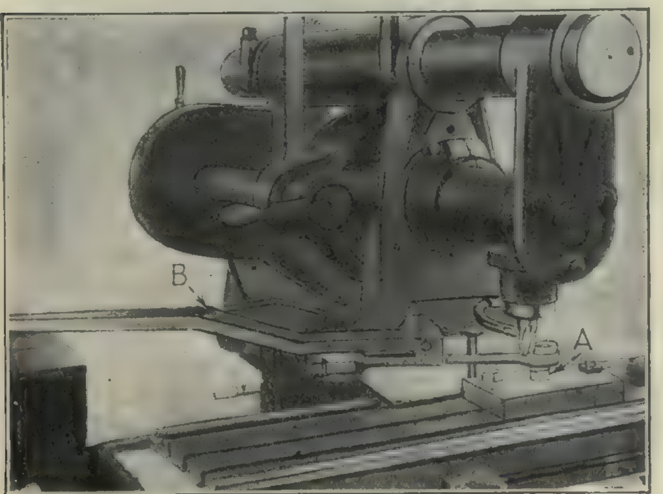


FIG. 8. MILLING SMALL END

block *C* supports the broaches during the first portion of the cut and prevents any tendency of sagging, due to the overhang.

Finishing the Small End

The outside of the small end of the rod is then hollow-milled in a substantial drilling machine, as shown in Fig. 7. A hollow-mill having long inserted cutters is used, as can be seen, with the connecting rod located over a pilot in the piston-pin hole.

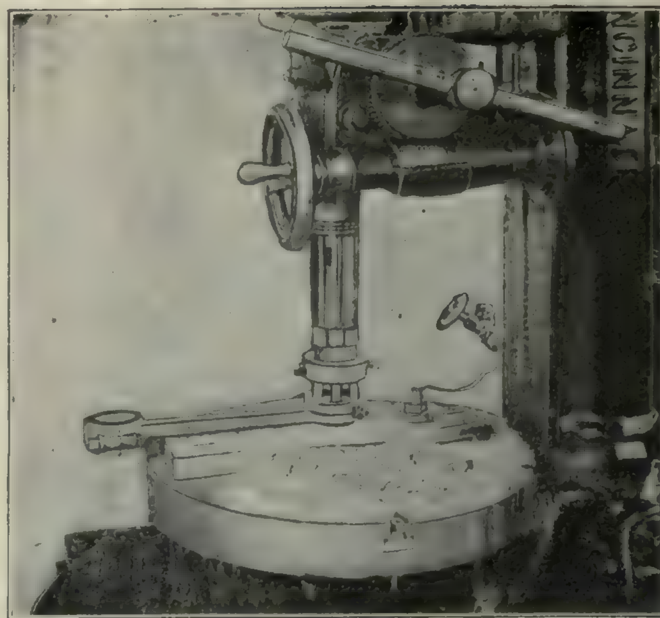


FIG. 7. HOLLOW-MILLING SMALL END

The rounding of the outside of the piston-pin boss is shown in Fig. 8. Here a substantial milling cutter is held in the vertical milling attachment on a knee-type milling machine, while the connecting rod is mounted on the stud *A* with the outer end supported in the handle *B*. This is a hand-feed operation, the connecting-rod being swung slowly by hand around the stud *A* until the outside of the piston-pin boss has been properly milled. Suitable stops are provided to limit the swing of the connecting-rod and prevent cutting into the rod itself.

This leaves only the final burring to remove all sharp edges, and the inspection to insure that the holes are parallel and the rods straight. Separate bearings are used in both ends of the rod, and after these are in place the rod is ready to go to the assembling department.

Chandler

Connecting-rod machining operations in the Chandler plant are typical of the manufacturing methods employed to get quantity production. Double-spindle and Lincoln-type milling machines and multiple-spindle drilling machines handle the major part of the job.

THE output of the Chandler shop is sufficiently large to warrant the use of special tools and machines, and it is interesting to note the simplicity of some of those which have been designed for this purpose. The principal operations are described in this article.

One of the first operations is the milling of both ends of the rod in the double-spindle Becker machine shown in Fig. 1. Each spindle carries straddle-mills which machine the ends of both bearings by the continuous-milling method. The rods are located by their bolt bosses as can be seen, and are supported under the channel sections so as to bring the small ends into proper position. Flooded lubrication is used.

The rods are next rough-drilled in the simple fixture shown in Fig. 2. The large end of the rod is located at *A* by the bolt bosses and the outside of the cap, while the piston-pin end is centered and held by the sliding block *B*. Independent fixtures are used on the long table of a gang drill. Next comes the drilling of the bolt holes in the indexing fixture shown in Fig. 3. The ends of the rod are located by studs *A* and *B*, and the drill bushings are carried in the casting *C*, which acts as a reservoir for the lubricant and insures the drills being always surrounded by it. The machine is of the multiple-spindle-drilling type and it both drills and reams the bolt holes as the connecting-rods are indexed from point to point.

The caps are sawed from the rod in a somewhat unusual manner on a double-headed Lincoln type milling

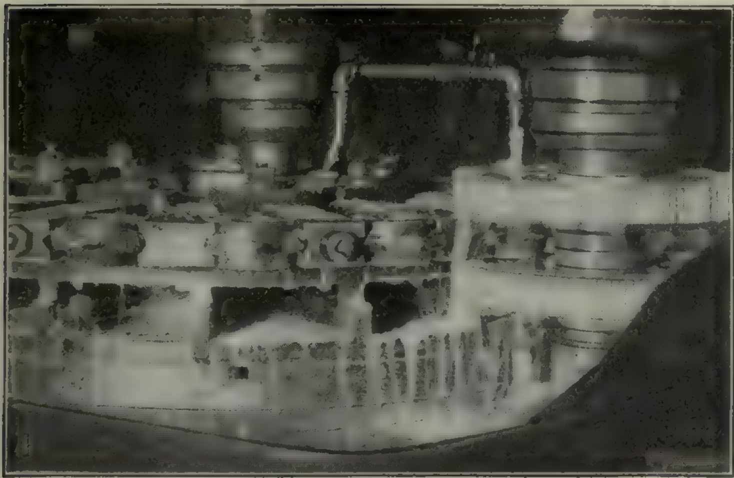


FIG. 1. MILLING BOTH ENDS OF THE ROD

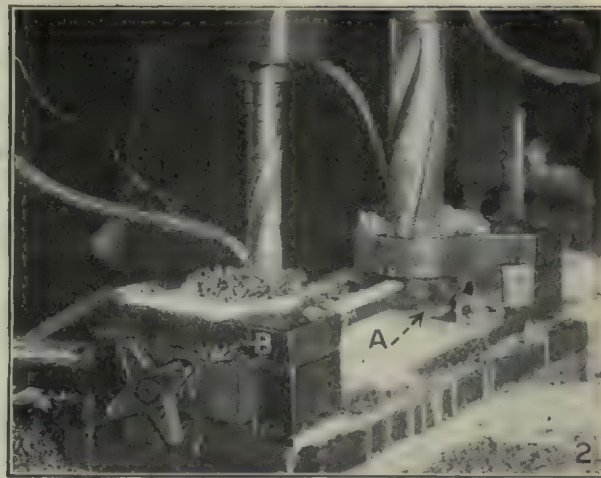


FIG. 2. DRILLING BOTH ENDS OF THE ROD

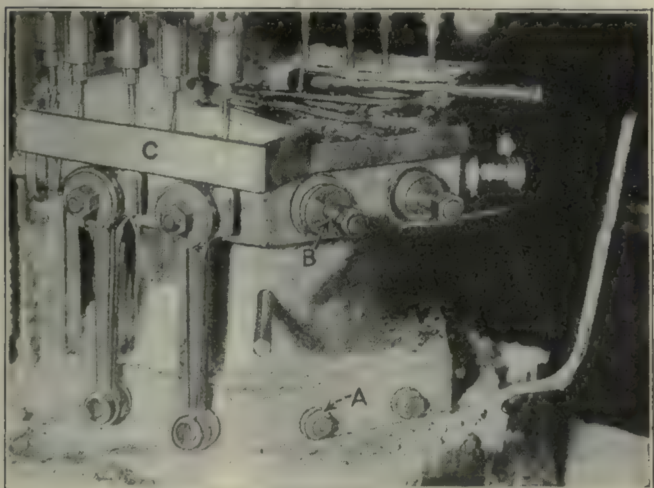


FIG. 3. DRILLING BOLT HOLES

machine as shown in Fig. 4. The left-hand head carries the three cutters *A*, *B* and *C* on the arbor *D*, this arbor being supported in the outboard bearing at *E*. The spindle of the right-hand head carries a similar arbor which is supported at *F*. The arbor on the right-hand head carries a duplicate set of cutters which mill the ends of the bolt bosses and cut off the caps at the lower side simultaneously with the upper cutting. This fixture, which handles two rods complete at one passage through the cutters, is made double and carries a pair of rods on each side of the supporting arms *G* and *H*. By this means, one side of the fixture is loaded while the work in other side is being milled. The fixture is then reversed so that the operation is practically continuous.

A Simple Drilling Feature

A simple fixture for drilling the oil hole through the top of the rod into the large bearing is shown in Fig. 5. After drilling, the fixture is moved under the next spindle carrying the countersink for the upper end of the holes which is to allow the oil to enter easily. This fixture is easily and quickly handled, and the rod clamped or released almost instantly by the hand nut *A*.

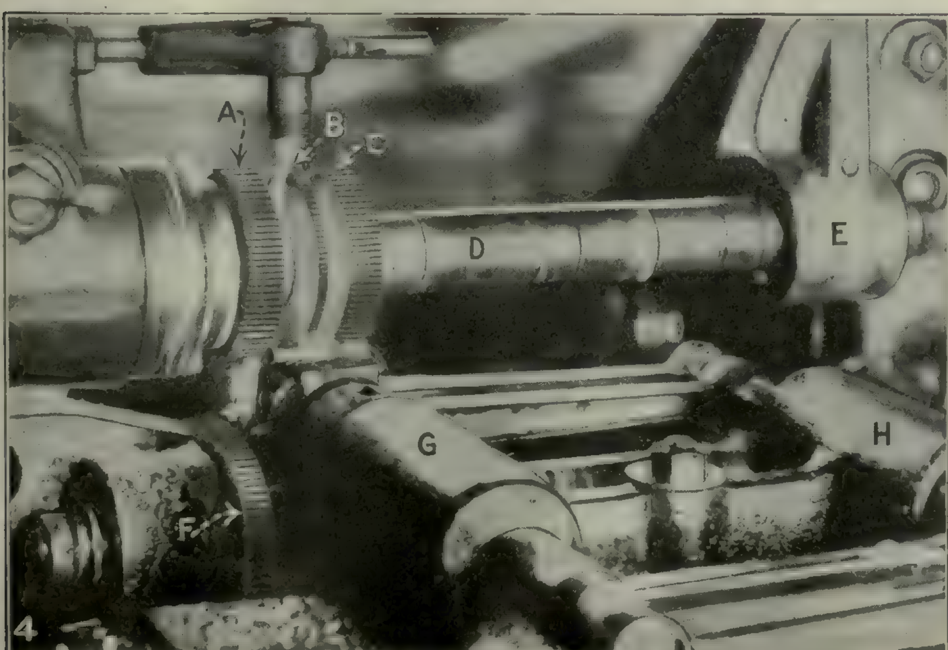


FIG. 4. DOUBLE FIXTURE FOR MILLING BOLT BOSSES AND CUTTING OFF CAPS

FIG. 5. DRILLING OIL HOLES

Franklin

THE first operation is to anneal the forgings so as to remove all internal stresses. They are then sandblasted and squeezed between heavy dies in what is almost a coining operation, to set the metal and compress it as much as possible.

Then comes the hand-straightening, should this be necessary, which is followed by a preliminary inspection and heat-treatment, this being again followed by sandblasting and inspection. The machining operations follow:

The methods which have been developed by the Franklin Co. differ somewhat from those in general use, and are particularly interesting on that account. Perhaps the most striking operation is the cold-pressing or "coining" of the forging after it has been annealed and sandblasted.

The operations are shown in outline by the transformation sheet in Fig. 1, the first being to grind all four faces, using a special table on a Blanchard grinding machine, as shown in Fig. 2 On account of the difference in the width of the two ends of the rod, it is necessary to make two operations of this, the first finishing the faces of the large end, as shown in Fig. 2, this being followed by grinding the face of the small end at the same setting. This simply means moving the table so the wheel will clear the large bosses, and lowering the wheel into contact with the smaller ends.

Fig. 2 also shows how the rods are held so as to utilize as small a diameter plate as possible, and at the same time grind 16 rods at one setting. The plug *A* centers the large end by means of the prongs shown, while the small end is held against the block *B* by the clamp *C*. The rods are then reversed and the other side ground in the same way.

The holes are next drilled in both ends of the rods by means of the special machine shown in Fig. 3. This carries four rods in an angular position as can be seen, the clamps *A* and *B* holding the large and small ends respectively. The rods are placed in position at the loading station in front, and indexed to the right so that spindle *C* drills the small hole at the same time spindle *D* is boring the large end. The next index point brings spindles *E* and *F* into play, the spindle *E* carrying the reamer drill for the small end, while the drill in spindle *F* does the second boring for the large end. The third and last position reams both holes as can be seen at *G* and *H*.

The method of holding the tools in this machine is unusual and worth noting. One side of the shank is flattened and the plate *I*, held by four studs, clamps the tools firmly in position. It will also be noted that the table carrying the four rods moves under a guide plate *J*, this plate carrying the bushings for all six of the tools. Lubrication is supplied in each case by short oil

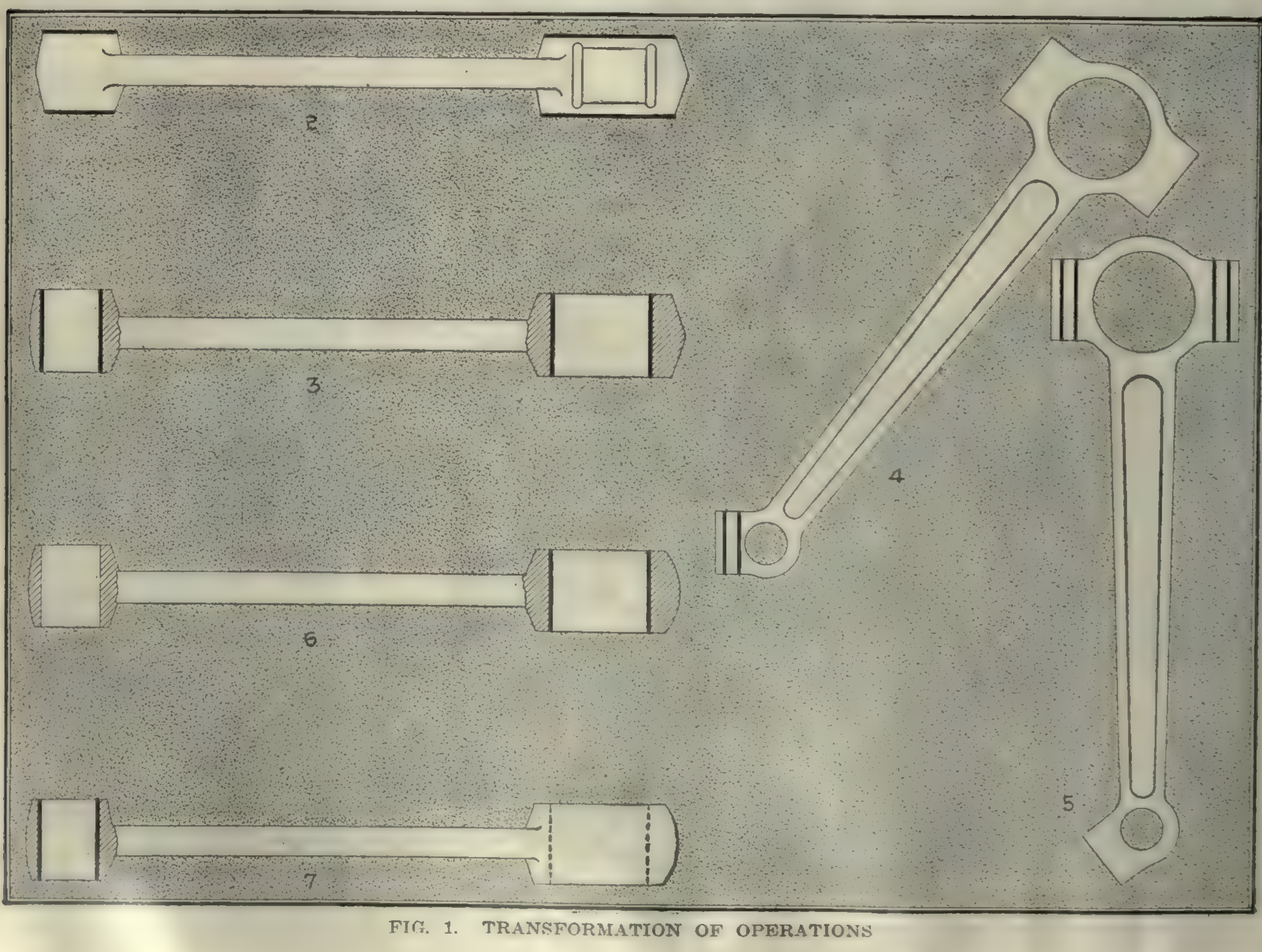


FIG. 1. TRANSFORMATION OF OPERATIONS

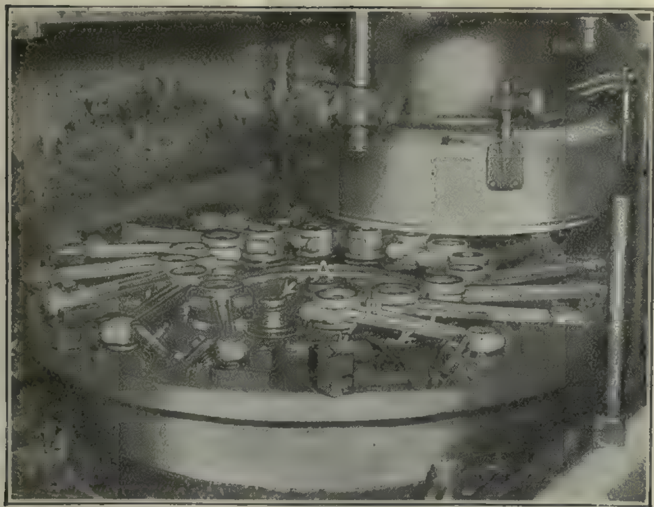


FIG. 2. GRINDING THE SIDES OF THE ROD BEARINGS

pipes leading directly to the drill, these being supplied by the large semi-circular pipe *K*.

After chamfering, the ⅛-in. slot is sawed in both the small end and the large ends, but not sufficiently to remove the caps.

The holes for the clamping screw in the small end of the rod are drilled in the special fixture shown in Fig. 4. This is a very compact and interesting fixture for use under a multiple-spindle drilling machine. The wings *A* and *B* each hold two rods, one on each side, and as there are two pairs of these wings in use at the same time, it allows eight holes to be drilled at one operation. In reality this is so arranged that the four drills *C*, at the right, drill the body holes while those at *D* drill the holes for the taps. This is the reason for drilling the rods in the inverted position shown.

Slotting Both Ends of Rod

A new method for milling the connecting rod, which includes the milling of the rod bolt-faces, and splitting the rod both for the removal of the cap and at the piston pin end, is shown in Fig. 5.

As can be seen, this is a four-sided fixture, each side carrying six rods. The two milling cutters at *A* face

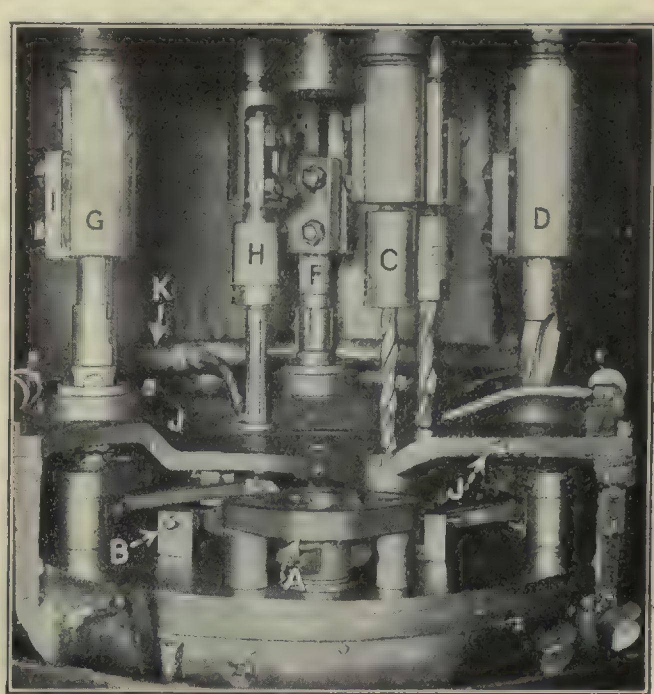


FIG. 3. SPECIAL DRILLING MACHINE FOR BOTH ENDS OF ROD

the bolt bosses for the connecting-rod bolts, on both rods at the same time. Slotting cutters *B* and *C* are also at work in separating the cap from the rod itself. At the other end of the milling fixture the cutter *D* is facing the angular small end for the capscrew which compresses it on the piston pin, while the cutter *E* slots the compression opening.

The fixture is indexed into four positions, and may be said to complete three rods at each passage, the operation of completely separating the cap from the rod being accomplished at the same time. The angular spindle is driven through suitable gearing, and eliminates what was formerly a separate operation on the rod.

After the cap is finally separated from the rod itself, the two are bolted together with a suitable shim between them.

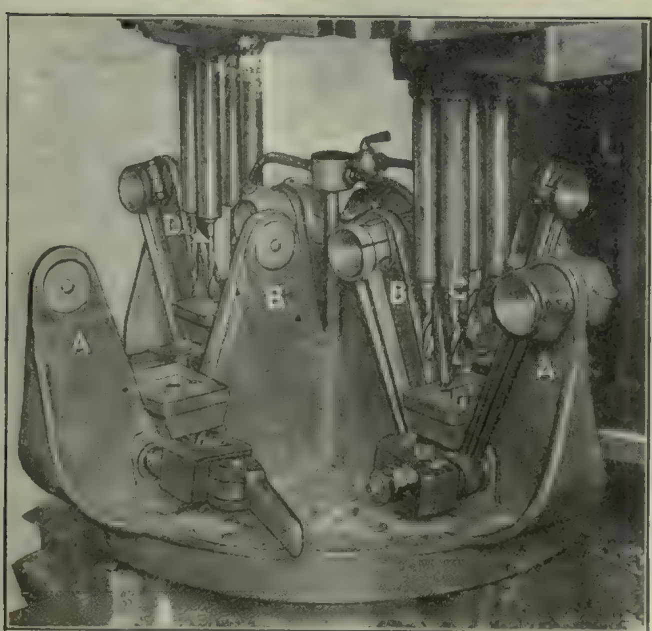


FIG. 4. DRILLING SMALL END FOR CLAMPING SCREW

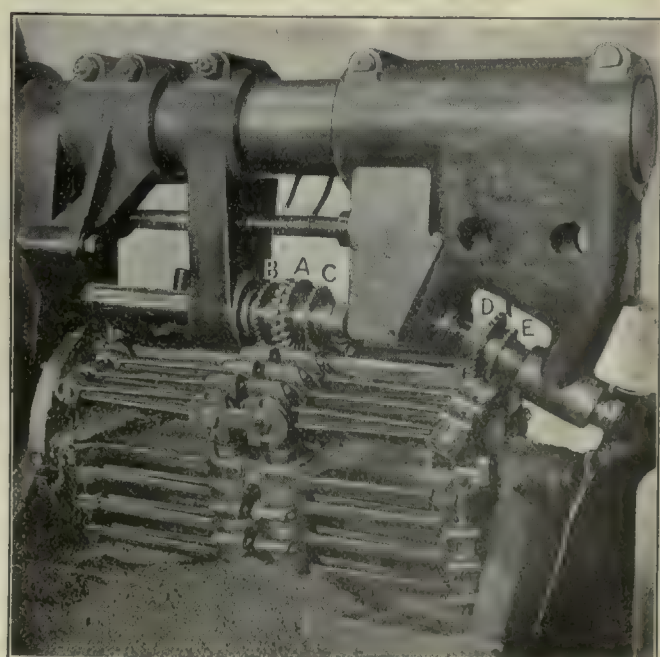


FIG. 5. SLOTTING CAPS AND SMALL END OF RODS

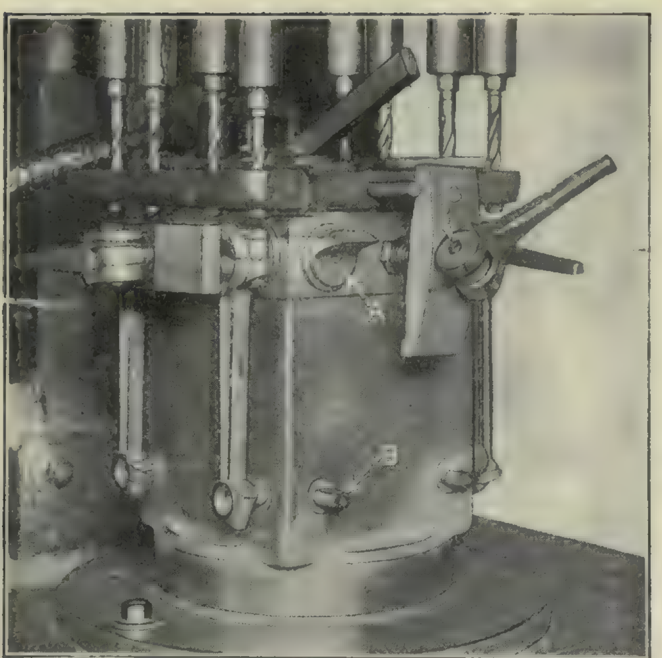


FIG. 6. DRILLING THE BOLT HOLES IN LARGE END

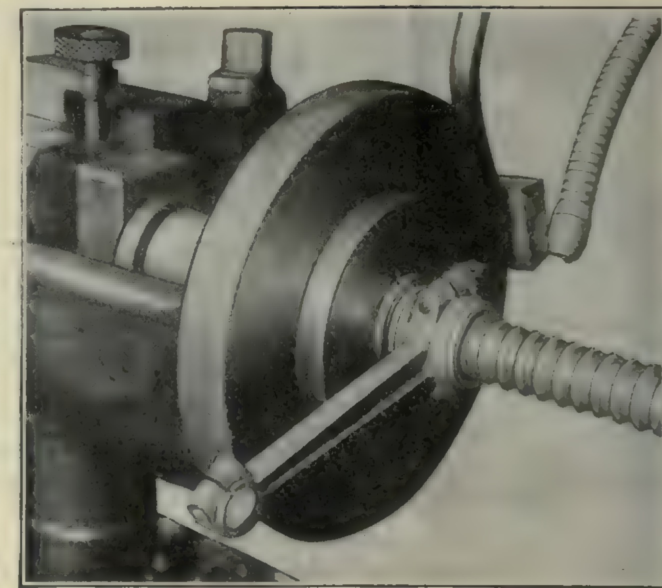


FIG. 7. BROACHING HOLE IN LARGE END

Then the rods go to the revolving fixture shown in Fig. 6, where they are placed in pairs over the pins shown. By relieving the large pin as shown at *A*, the rod is thoroughly supported and at the same time there is no binding or delay in putting the rods on or taking them off. The lower pin *B* is flattened top and bottom, its only object being to support the rod against side movement. The rods are held in place by the quick-acting clamp *C*. Eight spindles are used in this operation, the two sizes of drills allowing for the body and tapping size for the bolts which hold the caps in place. The hole is then broached as shown in Fig. 7, producing a hole which carries the bearing shell.

A Different Grinding Fixture

The grinding operation is somewhat of a departure from the usual practice, for instead of clamping the rod against the end surface of the bearing ends, the larger area of the bore is used for this purpose. Fig. 8 shows the method of using a Bryant grinding machine for this purpose, and the special faceplate which is provided for it. The faceplate carries the stud *A*, the piece *B*, and the counterweight *C*.

The stud *A* is expanded inside the large bore of the connecting rod by means of the screw *D*, the cams *E* and *F* centering the bore of the small end as it is swung into the position shown. The back side of the rod is supported by the pads *G* and *H*, which are controlled by the thumbscrews *I* and *J*. Great care is taken to support this end of the rod without undue pressure from any direction, so as to avoid all tendency of springing. The cams *E* and *F* are flattened on one side so as to clear the end of the rod with a quarter-turn movement. This makes a very satisfactory method of doing this

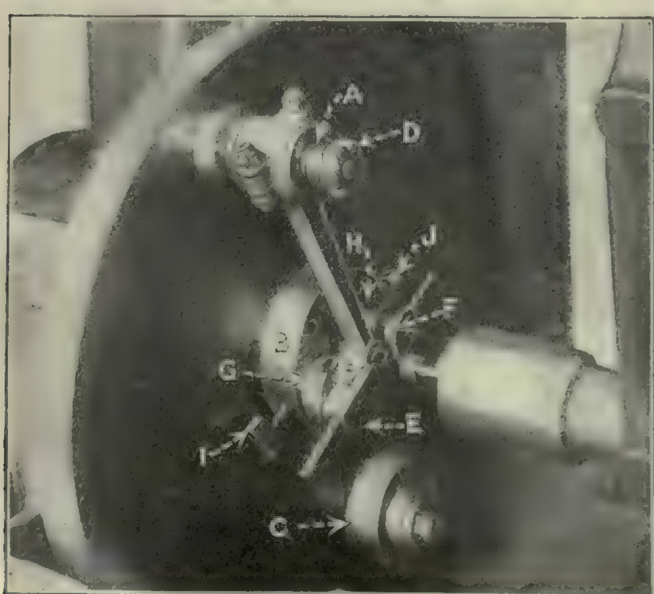


FIG. 8. GRINDING FIXTURE FOR SMALL END

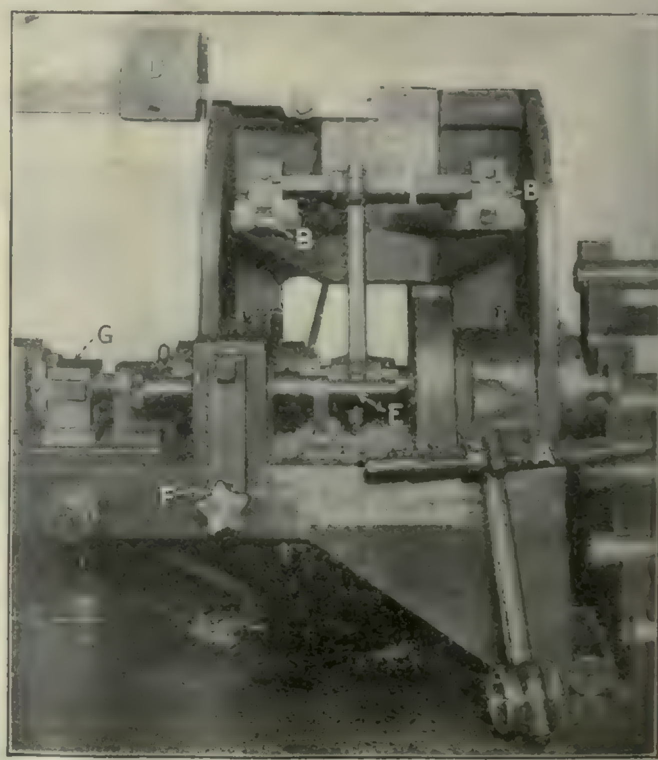


FIG. 9. SPECIAL FIXTURE FOR FINAL REAMING

work and one which can be quite readily handled. Its accuracy has been found to be superior to any method previously used.

Special Fixture for Final Reaming

A special device for boring the large end bearing of the connecting rod is shown in Fig. 9. The small end of the rod is placed on a special mandrel *A*, as can be seen both from the rod in position in the machine and the one waiting to be reamed. This rod is easily placed in position in the end bearing by means of the clips *BB*, these allowing the upper V-block to be easily swung out of the way for removal after the reaming has been completed.

The head *C* carrying the mandrel through the small end of the connecting rod, works on a dove-tailed slide and is free to travel in a vertical position. The weight *D* on the lever is to counterbalance the head. This sliding head takes care of any slight variation in the center distance of the two holes in the connecting rod. The connecting rod is first placed on the mandrel which is then clamped in the sliding head. The large hole in the connecting rod is centered by means of a centering plug which fits the bushing on either side of the rod and also fits the semi-finished large hole in the rod. The connecting rod is then clamped in this position and the centering plug withdrawn from the spindle. The spring *E* on the bar in front of the connecting rod is an L-shaped clamp.

There are two of these clamps, one on each side of the rod. This forms a two-point bearing support for the rod. The lower part of the L-shaped clamp or finger travels in a slot to prevent the clamp from turning. The bar of which this clamp is a part, is hollow and carries the shaft of the hook bolt which is actuated by the knob at the end of the bar. Both bars carrying the clamps are free to slide in a horizontal position and are independent of each other so that they will not cramp the rod on account of any variation between the center line of the mandrel in the small end of the rod and the face of the large end. After the centering plug has been withdrawn the knob *F* on the front of the machine is tightened. This compresses the straps on both sides of the machine which in turn forces two binding studs against the bars carrying the clamps and hook bolts. This locks both clamps and the connecting rod is then ready for boring.

The boring bar is inserted through the spindle and has a hole in the end for driving to accommodate the shank on the end of the feed screw. The driving principle is very similar to the Eclipse counterbore driving-shank principle.

The jaw mechanism over the starting switch at *G* is a split nut through which the feed screw passes. The feed screw is driven by the boring bar by the method already described through this split nut which accommodates the thread on the feed screw. The split nut being stationary draws or feeds the boring bar through the rod.

The shifting lever at the tail end of the machine operated by a foot lever forces a slide on top of the gear box between two fingers on the split nut. This opens up the nut and by the same motion of the shifting lever pushes the feed screw back into starting position.

Knowing Your Insurance Policy—II

By Chesla C. Sherlock

The mere facts that you hold an insurance policy and pay the premium which the company asks upon it, do not guarantee that you have the protection which the policy states you have. The item of insurable interest which enters here should be understood by all who hold insurance policies. The author gives a clear conception of the conditions necessary for insurable interest.

(Part I was published in our April 29 issue.)

It ISN'T everyone who can obtain insurance when he wants it. Men who have attempted to procure life insurance at some time in their lives know the truth of this statement, but it is not in this connection that the statement is made.

No person has a right to obtain insurance on property or the life of another unless he has what is called an "insurable interest" in such property or life. This insurable interest is a quality of property which is exceedingly hard to understand and define, but it is an element that is absolutely necessary to the validity of an insurance contract.

One authority defines it as follows: "An insurable interest in property is any right, benefit or advantage arising out of or dependent thereon, or any liability in respect thereof, or any relation thereto, or concern therein of such a nature that it might be affected by the contemplated peril as to directly damnify the insured."

Parsons defined it as follows: "What is the interest in the property which shall make the contract valid? We think the best definition to be, any such interest as shall make the loss of that property a pecuniary damage to the insured."

The California laws define it: "Every interest in property or any relation thereto, or liability in respect thereof, of such a nature that a contemplated peril might directly damnify the insured, is an insurable interest."

The South Dakota civil code defines it: "Every interest property or any relation thereto, or any liability in respect thereof, of such a nature that a contemplated peril might directly damnify insurer."

Speaking of insurable interest in so far as it relates to the life and health of another, the California law states: "Every person has an insurable interest in the life and health;

1. Of himself,

2. Of any person on whom he depends, wholly or in part, for education and support,

3. Of any person under a legal obligation to him, for the payment of money or respecting property or services, of which death or illness might delay or prevent the performance,

4. Of any person upon whose life any estate or interest vested in him depends."

Insurable interest in property extends to similar broad lines, but it is, if anything, broader in the case of property. Sometimes it exits where there is no present property at all.

As one authority says, "It may cover inchoate rights, or rights in expectation, such as profits and commissions." And, another authority says: "The right need not necessarily refer to the whole or part of the thing, nor necessarily, or exclusively, to that which may be the subject of privation." Absolute ownership, or title, or even possession is not necessary.

Things Necessary for Insurable Interest

The point simply is that the law requires a man to have such an interest in the integrity and well-being of the property which he proposes to insure, that, upon his own motion, he would not be likely to do anything to injure such well-being or integrity. If a man has no insurable interest in property he is apt not to care whether the peril the insurance guards him against comes to pass or not. Indeed, without that interest he is very apt to want it to come to pass, for having no interest in the property he does not stand to lose anything from the peril taking place, while if he does have an insurable interest he is going to recognize that it would be good business to do all in his power to preserve the integrity of his property, for losses from the peril are going to mean losses to him, even aside from the insurance.

No man, who has an honest insurable interest in a house, even though that house is protected by insurance to the last dollar of value, is going to sit passively by and permit it to be destroyed by fire, simply because he has a policy or two stored away in a safe deposit vault.

It is upon this calculation of human nature that the casualty and fire-insurance business of the country, in so far as it relates to property, is based. Without it our insurance scheme could not survive over night. And it is this very sort of an interest in property, known as "insurable interest" that the courts require to be present in a man before he can take out a valid policy to cover such perils, fancied or real, as may assail the property.

It does not, as we have already pointed out, require that only the man who has title to the property may be so protected. A man buying the property on a contract, while not having title or ownership in the property and possibly no immediate legal interest in it, may have a perfect "insurable interest" in it. Loss to him would be a financial disaster as serious as it would to the one having title; sometimes more of a disaster.

Says one authority: "An insurable interest must be an interest in favor of continuance of the life (or property) and not an interest in its loss or destruction." This is a test which business men can well afford to keep in mind when they are wondering whether or not they may procure insurance upon a given property; or whether the insurance which they have already procured would stand the test of the courts.

Mere Payment of Premiums No Protection

It has commonly come to be accepted as a matter of course that if the company accepts the premium and issues a policy that the matter is closed, and the business man has iron-clad protection. Usually the transaction does end there, for who should have a better understanding of the matter than the insurance agent or his immediate superior?

But even insurance companies do not always seem disposed to accept the judgment of their agents or general representatives. Of course, they seldom dispute that judgment until the property has been injured or destroyed, and then it is a serious matter, not only to the insurer but to the insured. Too often it means prolonged litigation and uneasiness, even bankruptcy that might have been avoided.

A Question of Rights

For instance, where a policy provides that if there is insurance in another company that it shall release the company from liability, what are the rights of respective parties? Suppose that a manufacturer has installed machinery in his plant and that he is paying for this machinery out of the profits of his business. He takes insurance on the machinery, not knowing that the seller of the machinery has similarly protected himself, and then this question comes up: Which one is entitled to recover; and can the business man or manufacturer hold his company to the policy in spite of the clause mentioned? This, and other questions are some of the matters of prime importance which grows out of the question of insurable interest and matters immediately surrounding it.

In fact, it may be announced as a general rule that will be supported everywhere by the courts that if there is no insurable interest that the insurance policy is just as void as if it had never existed. The manufacturer who has no insurable interest in property and who takes out insurance upon it and pays premiums has no more right to hold the company than has his neighbor who never insured or heard of the specific company. The fact that he had paid premiums gives him no greater claim on the company, for thousands have done that very thing and found out that it availed them nothing.

In fact, the expressions of the courts found in the reports in cases referring to insurable interest have all come from cases where business men and manufacturers and others religiously paid premiums upon a policy thinking that they had protection. Not having an adequate knowledge of the subject of insurable interest in the beginning and taking the word of someone else for it, they simply spent their years pouring money in the form of insurance premiums into a hole in the ground. Paying premiums to a company on a policy does not entitle anyone to protection.

The point we are making here and the one of prime importance to all who do business and have occasion to avail themselves of insurance protection, is that there is only one thing that determines whether such protection exists and whether the company is bound. That thing is the contract, or the agreement between the parties and it is the sole evidence of the rights and liabilities of the parties.

The Insurance Policy as a Form of Contract

An insurance agreement is nothing but a contract, a sort of sanctified contract protected by the state, to be sure; but it is a contract none the less, and its effectiveness depends upon whether or not it is a good contract or a bad one.

To understand insurance one must first understand the elements of the law of contracts. They apply to insurance policies and insurance rights, because a con-

tract for the protection of property is no different in this respect than a contract for the acquisition of the property in the first place.

We have already discussed very extensively in these columns, the subject of contracts and if the reader followed it closely he cannot fail to understand what we are now saying about the subject of insurance.

Contractual elements are of importance, for, as one authority points out, "if no insurable interest exists, the contract is void; for the principal thing is that the assured has not only acted in good faith, but has also an insurable interest."

Those who understand the elements of the law of contracts know that unless one acts in good faith that the transaction is void, no matter how valid it may appear to be on its face. This principle applies to the law of insurance just as effectively, and where one acts in the absence of good faith in an ordinary contract transaction, practically the same situation arises as where there is no insurable interest in insurance matters. But it will be noted that in the case of insurance that not only insurable interest is required to validate an insurance contract, but good faith as well.

The California code points out that "the sole object of insurance is the indemnity of the insured, and if he has no insurable interest the contract is void."

Another authority states: "A policy on property wherein the insured has no interest or title is void and no recovery can be had thereon, in case of loss either by the assured or his assignee, and notes given for premiums upon such insurance are void, for want of consideration."

Consideration is a very important element to a valid contract. There must be a consideration else there is no object in enforcing the contract as made. In most instances there is on the one hand a money consideration, on the other a transfer of property or of services in exchange thereof.

In the case of insurance, there is a money consideration payable in the form of premiums, on the one hand; and on the other, there is the presence of insurable interest. Failure of either the money consideration or of the insurable interest will render the contract of insurance void for want of consideration.

Insurable Interest a Modern Development

The term "insurable interest" is a growth of the modern law. It was unknown and had no place at common law. This does not mean that insurance is a comparative recent development, for insurance was known at common law; in fact, it was pretty well developed in all of its branches at the beginning of the fifteenth and sixteenth centuries. The fact that we now have the quality of insurable interest in our law shows that it has been put there to correct the very abuses which, we pointed out, would arise in case one having no such interest in property were permitted to insure it.

It is likewise a maxim of the law that there is no insurable interest in an unenforceable contract. In other words, a contract void in some particular has no insurable interest, for the reason that one can have no insurable interest in something which the courts will not recognize his right to claim or defend.

Wagering contracts are not enforceable at law for want of consideration and as being against public policy. So where there is no actual interest in property and the policy is issued merely to cover a wager, it will not be enforced, because, among other reasons, there is no insurable interest.

In a Maryland case, it was pointed out that an insurable interest need not be personal, but may be an interest existing in the insured as trustee, agent, administrator, judgment creditor and the like. In other words, insurable interest is a property right and it exists where the property is, independent of a naked personal right in it.

The Trials of Old Baldy—V

By A. R. Durant

There was an unwonted activity around the machine shop of the Ajax Co. one warm May morning.

A regular spring cleaning was in progress. Tools and parts of machines were hauled from under the benches that brought no ghost of recollection to the


If he had known.

minds of the oldest hands. Old faceplates and centerrests covered with grease and bewhiskered with dust and cobwebs were brought to light; and rusty nuts, capscrews, washers, etc., suddenly became plentiful now that no one was hunting for them.

A mixture of kerosene oil and "elbow-grease" was being liberally applied to most of the machine tools, while the casting pile had been concentrated in one corner of the room instead of being distributed all over the floor.

The cause of all this hubbub was the word from the office that the students from "Miss Skinner's Select Seminary for Young Ladies" were to make a tour of the works.

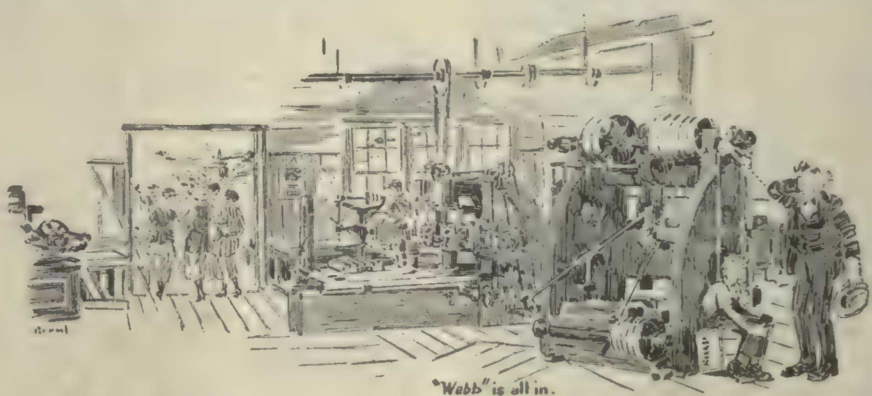
Had "Webb," who had been selected for the official guide, known what he was up against, it is probable that he would have left home that morning in the opposite direction with a fish-pole and a bottle of bait, instead of dolling himself up in a boiled shirt and his Sunday suit and coming to the shop.

Now the pupils of this exclusive school were thoroughly versed in psychology, physiology, botany, natural history, etc., as well as in English and the Deceased Languages, but on matters concerning machine-shop practice their minds were a bit foggy.

While enroute to the plant there was much speculation as to just how articles of metal were fabricated. One Miss remarked that "it must take an awful while to pound a hole through a big piece of iron," while another thought anything must be extremely sharp to cut steel.

A third young lady, whose brother was office boy for a screw-making concern, informed the party that there was "nothing to it." "Everything is done by machinery, you know. All the men have to do is put some iron in one end of a machine and it comes out at the other end all finished."

This seemed to satisfy everyone for a while, or until a quiet, thoughtful looking girl upset their composure once more by asking: "Who makes the machines?" The party was met at the office by the appointed chaperon and in a short time the flock had covered the drafting, shipping and pattern departments, and had reached "Old Baldy's" shop; the big show; the realm of grease, noise and mystery. The first stop was near a small lathe, where the party was informed that the operator was "chasing a thirty thread." As they moved away, one young lady inquired seriously: "Did he catch it," and "was it silk or cotton?"


"Webb" is all in.

During the inspection of a planer the girls were treated to a great flow of oratory pertaining to its operation and methods of strapping down the work, etc. The planer hand nearly strangled when one young woman remarked "I can see the straps all right, coming down from those wheels at the ceiling, but where is the work?"

While endeavoring to explain how some of the heavy stuff was moved their guide said, "You see the chain falls over there—when he was interrupted by a chorus of "No! when does it fall? I didn't see it!"

While watching a milling operation Webb said that they could examine the cutter just as soon as the shipper was thrown out. "Oh!" cried one fair damsel, "you're not speaking of that nice young man we met in the packing department?"

"What is the cage for, in the center of the room?" a student in big horn spectacles asked. "Oh, that's where we keep the menagerie" replied the guide carelessly. "You see, besides two sets of 'mikes' and a 'jimmy' or two, we've got lathe 'dogs,' 'monkey' wrenches, 'crow' bars, and 'cat' heads, besides a lot of 'hog-nose' and 'goose-neck' tools."

Webb next called attention to another quarter as follows: "You see that machinist at the lathe by the open window? Well, he's 'chucking' out an order of our most particular parts." This statement required considerable explanation, before the visitors were satisfied that the work was not being thrown into the yard.

As the party approached the lower end of the shop, much interest was exhibited in a special automatic machine, then being built for an outside concern. As "Old Baldy" was standing nearby, Webb thought it a good chance to give him a crack at entertaining. He forthwith asked if he would explain to the school the action of the machine.

Now, Baldy did not intend that anyone should get ahead of him, so he started in manfully something like this:

"You see the pulley here takes the power from the shafting, turning this flywheel and connecting by a clutch to the gear box. Part of the gears can be engaged to the upper shaft by a sliding feather. Two dogs hitched to the ram, time the reverse of the bullwheel, which in turn changes the motion of the spider that is rotated by a worm. The stock is fed in by these two fingers located at the end of the arm, the movement of which is actuated by cams on that shaft with the knuckle-joint. While the pair of toothed jaws close together and hold the work during the heading operation a tool starts turning the other end to a shoulder. Is this all plain to the young ladies?" inquired Baldy with a satisfied look, as he paused for breath. "It's *very* interesting," ventured one of the smaller pupils. "At first it seemed just like a zoology 'exam,' but later it was more like anatomy." This finished the "Old Man" and he immediately found pressing business elsewhere.

As the party trailed out through the front door, Miss Skinner was heard to say that "she always supposed that a 'lathe' was called a 'lath.'" While a young girl added "And 'shippers' are sticks; I mean in the machine room."

"Young man," said Webb to a cub who was "resting" behind the big boring mill, "do you know what 'Old Baldy' said when 'Pop' Waters left?" "No," was the reply. "Well, it was this, 'Some people don't know enough about mechanics to saw wood.'"

Longer Working Hours

By Laurence Parker

This is written in answer to Mr. Harry Beau's "Longer Working Hours" in the March 11 issue of the *American Machinist*.

There is undoubtedly considerable sentiment among working men for longer hours. There are two classes of men who worked to get the shorter hours. There is the man who works to live, who is interested in his home, his children or his automobile, and works only long enough to support the family in good shape. Then there is the man who has worked to get short hours in order to boost the rate of pay. He, as soon as the boost came, wanted to work overtime to get more money.

I doubt very much if you could persuade many working men to go back to a ten-hour day, let alone twelve hours. It is only the time-and-a-half for overtime after eight hours have been worked that looks good to them.

Initiative

By John S. Watts

My experience with the younger generation of draftsmen leads me to believe that they have a general lack of initiative, probably due to the modern methods of education and more largely to the system of distributing work in the drafting rooms of today.

To make my meaning clear in using the word initiative, I give the definition according to the dictionary as being "introductory; an introductory or first step; power of commencing." The latter shade of meaning, namely, "power of commencing," is the one that more nearly agrees with my own.

I mean to say that the young draftsman, if given work which is unfamiliar to him, lacks the "power of commencing" on the job unless assisted. But when shown how to apply the knowledge he already has to the problem in hand, he will usually be able to complete the work creditably. In other words, although he is equipped with the knowledge necessary to successfully attack a given piece of work, he lacks the initiative necessary to commence on an unfamiliar piece of mechanism, even if its design must conform to basic laws with which he is quite familiar.

He may be likened to an automobile without a self-starter, as both may be said to be without the "power to commence" but once started will run until the work in hand is completed. Undoubtedly the getting started on a novel problem is the hardest part and it is sometimes best to just make a start on it, even if it is a false start; at any rate this will eliminate one solution as being the wrong one and something will have been learned in the making of it.

I do not intend that this article should be taken as a criticism of the ability of the coming young men, but as an attempt to show them where their training is likely to leave them weak in initiative, and to point out how best they may train themselves to overcome this defect.

The older men do not possess any higher initiatory powers they may have in comparison with the younger ones by any superiority of brain power or education, but came by it largely because of the necessity they were under to cultivate this power.

The education given by the engineering colleges in the old days was certainly not as comprehensive as it is today, consisting then almost solely in the study of theory and such of the laws of nature as were then known. Because of the paucity of the machinery available, very little study could be given to the application of these laws to any particular machine.

Today, the smallest college has quite a quantity of machinery which is used to give the students an opportunity to study the theories they have learned as applied to the design and operation of the machinery owned by the college.

This practice, while very beneficial in assisting the student to grasp the functioning of the natural laws as they apply to the particular types of machines used in the college, seems to weaken the ability of the average student to apply the same laws to machinery which he has not seen in actual operation.

This condition of affairs explains to some extent the difference in initiative between the younger and the older men, as the older men were from the first used to studying the functioning of mechanism which was not available for actual test and had to be studied from drawings or descriptions.

Then again, in the old days before specialization came into vogue, the engineering firms handled a great variety of work and were taking up new lines continually, which meant that the work in the drafting room was very frequently designing mechanism with which none of the staff was familiar. Under such conditions the training tended to produce a class of men who were used to tackling the design of new or unfamiliar machinery and they naturally gained in self-reliance and confidence in their ability to successfully apply their knowledge of the principles of engineering to any problem that might arise.

On the other hand, the designing draftsman in the present day office is mostly given only that class of work with which he is familiar and is kept at work on a line which is similar in most respects to what he has done before.

This has all tended to produce a generation of designers who know only a small section of the field of engineering, and are at a loss when called upon to consider a problem outside of the narrow bounds of their own experience.

This specialization of work has proceeded to such a stage as to be at times ludicrous in its results. For example, I have met structural designers who, while experts in that particular line, had not the faintest idea how to calculate so simple a matter as the reactions of a motor on the steelwork supporting it, and had to consult a mechanical engineer to advise them of the direction and amount of the strains. This, not because they had not the knowledge necessary to find these reactions, but solely because it was out of their field and they did not know that they could and had not the initiative to try to do something which was not every day work with them.

Then also, the flood of text books now available with their numerous tables, showing the solution of all of the more common problems, while a decided advantage and saving of an inestimable amount of laborious calculation, has had a tendency to almost atrophy the minds of the users. To such an extent has the use of these charts and tables extended that it is now rather unusual to have to work out the long elaborate calculations we used to have to do, and many times I have known men to hunt for hours through all the available text books for a table, which would if found have saved them only one quarter of the time they spent looking for it.

In structural engineering especially is this the case, the properties of practically all conceivable combinations of sections having been calculated and tabulated. I once heard an observant bookkeeper say of the engineers, "All they have to do is to work out the formulæ the book gives them and they will accept the answer, even if a moment's thought would tell them it must be wrong." He compared them to a man operating a sausage machine, they put the figures into the formulæ, turned the handle of the calculator and out came the answer.

That this dependence upon the text book has reached a stage where it is a serious detriment has been proved to me many times by men who are able and intelligent and occupy fairly lucrative positions, asking for information which they would have had no difficulty in getting for themselves when they were at college.

To give only one example out of many like it; a really expert steel construction designer hunted for a formula to give him b and d for a reinforced concrete beam having a given Mc. He said the only formula he could find was $Mc = f_s\, p\, j(b\, d^2)$, but what he wanted was to know b and d. On being reminded that the formula could be transposed to $b\, d^2 = \frac{Mc}{f_s\, p\, j}$ he looked blank for a moment and then faded gracefully away to his corner. This is a fair example of a man allowing himself to become so dependent upon his text books to relieve him of all brain work, that his brain actually becomes atrophied.

Now I do not wish it to be thought for one moment that I do not believe in the use of text books, as I do most decidedly. In actual fact, I have myself a most comprehensive collection of them, and have in addition three loose-leaf binders packed full of tables, clippings, charts, etc., from all sources, all card indexed, to which I refer continuously, and to which I am constantly adding new ones. Further I have at various times made up charts and tables of my own, and have published more than a few.

But fortunately I think for myself. I have always happened to be employed with a firm where I could not specialize, and have had to tackle almost everything in the line of mechanical engineering at one time or another. Moreover, as I am frequently away from my office, and have then to work without much help from my books, it tends to make me independent of them when necessary which is the spirit I contend should be cultivated.

The main point I am trying to make is, that the young engineer should have more confidence in his ability to handle unfamiliar problems, instead of throwing up his hands when confronted with anything a little out of his line.

He should bear in mind that the basic laws of nature, which if he is a real engineer he has been taught, are the same for all machines under all circumstances. It is not necessary for a man to have a lengthy experience in any particular line to produce at least a workable design of a machine in that line. We all know of cases such as that told in the story which concludes "that the damn fool did not know it could not be done, and so he went ahead and did it." This being only another way of saying that the narrow circumscribed experience of the expert lacks knowledge gained by others in other fields of engineering which would be of great value to him if he would cease to confine his attention so closely to his own field.

It might be a good idea to have a closed season for text books, and for those who believe in abstaining from some luxury during Lent, I would suggest that it would be a great benefit to their brains if they abstained to a reasonable extent from the too slavish use of the tables in their books during that period.

Lastly, I cannot condemn too strongly the growing practice of using formula, tables, charts, etc., on faith. A point should be made to understand the construction and theory of all formulas, etc., that are used. The brain will be exercised, and the knowledge so gained will prove extremely useful, as well as preventing one from using a formula that does not really apply, as is quite possible if the formula is not understood.

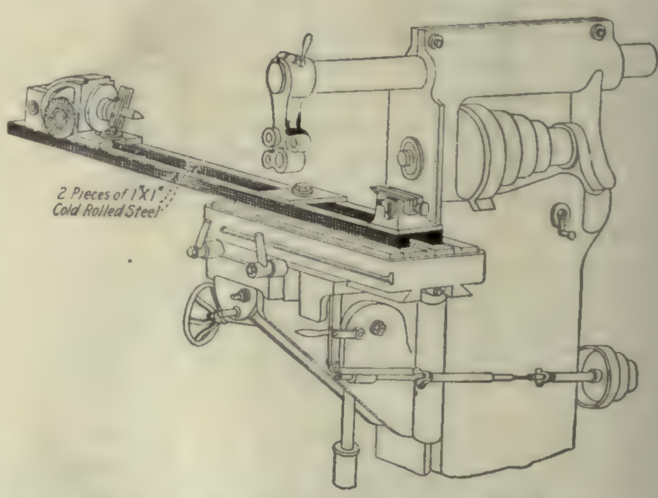
Understanding the formula used also gives one that pleasant feeling of assurance about your work, which is absent when the only authority you can bring up if your work is criticised, is that of a formula whose accuracy you cannot prove.

Increasing the Range of a Milling Machine

By O. F. Kuhlman

Recently there came to our shop the job of repairing a shaft and pinion, the object being to use the same shaft but to make a new pinion smaller in diameter.

The old pinion was next to impossible to remove from the shaft, so we decided to turn it down, while in place,

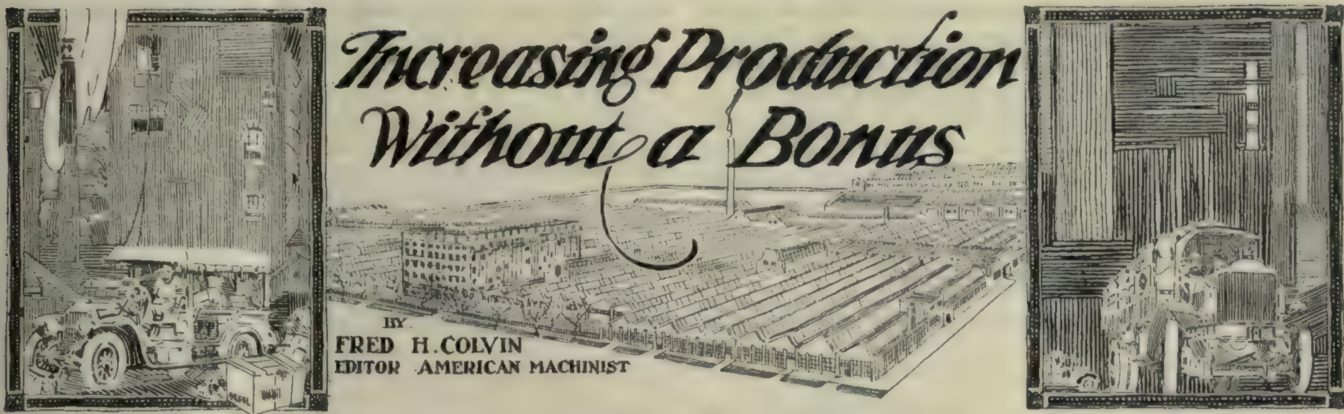


EXTENDING THE REACH OF A MILLING MACHINE.

to the new blank diameter and cut the teeth without removing it.

There was no milling machine available to handle a shaft 6 ft. long, so we rigged up our Brown & Sharpe as shown in the sketch by putting long steel parallels on the platen, and attaching the index centers to them.

Two blocks are set into the T-slot to keep the parallels in line.



Increasing Production Without a Bonus

BY
FRED H. COLVIN
EDITOR AMERICAN MACHINIST

II. The White Book

This article, which is the second on the White Motor Co.'s plan of management, shows how large a part is played by its monthly publication—the White Book. This publication discusses all questions freely and frankly, and does much to establish confidence and co-operation.

(Part I was published in our April 22 issue.)

THE *White Book* is a monthly magazine of about fifty pages and is mailed free of charge to the homes of all employees. It is a worth-while magazine which is well and liberally edited, as will be seen from some of the extracts which are to follow. It places before the employees and their families the company's policies with a full discussion thereof, and includes, from time to tme, charts showing the development of the business, a comparison with other years and complete accounts of the expenditures of company funds. It is felt by the management that the *White Book* is the greatest single factor in maintaining confidence and securing co-operation, as well as making White motor principles a power for good in the community. This "cards on the table" policy meets with a noticeable response.

Ambitious employees are given opportunities for study. Lectures by experts cover the general principles of economics, production, accounting, marketing and finance. Lectures are naturally attended principally by foremen and assistant superintendents, but it is the intention to give them a wider scope in the future.

Classes in Americanization

There are also classes in Americanization for the benefit of non-citizens, who a year ago amounted to about 20 per cent of the total payroll. This instruction is given on company time. This is done to enable them to secure second papers, and a man is never sent for examination until he has been thoroughly prepared and is certain to pass the requirements. The class comprises one hour of instruction per week until this stage is reached.

Another example of the broad-gage policy pursued by the management is to be found in the factory library, which is operated as a branch of the main public library and makes it possible for a man to order any book from that institution. In addition to this, there is a large independent library which, it is interesting to note, contains a remarkable assortment of books on the various theories of economics. This library includes the standard works on socialism and co-operative movements of various kinds. The management takes the very liberal and sensible position that attempted repression never secures the desired result, and that every man should be free to study all sides of the economic question.

The White management is not paternal in any way, but has the belief that the individuality of the men must be respected in every way. They of course keep a record of the books asked for in the library, but such records are not used to trace men who may want to read radical theories, as it is considered a sign of broad-minded intelligence to want to understand both sides of all questions. What a man reads or thinks does not affect his standing with the company. The management thoroughly believes that the sort of comfortably housed, sane thinking families fostered by its method of treating men—families who have the responsibility of paying taxes and improving property—are not fertile soil for revolutionary propaganda.

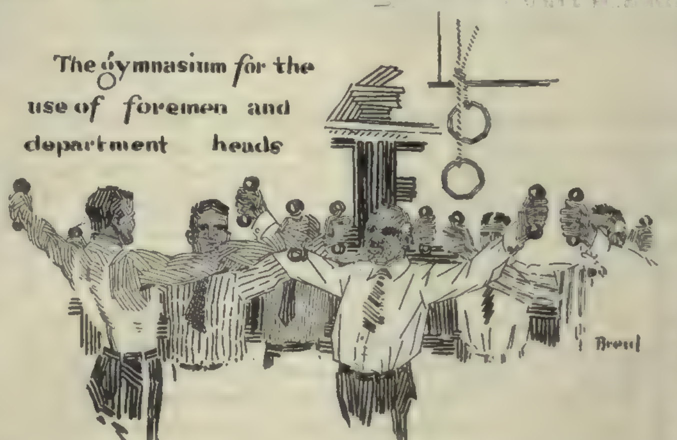
One of the methods of "laying the cards on the table" is to post bulletins in large type, showing the value of the factory equipment, the value of the product, the number of men employed, and the wage rate, covering a period of years. This points out what product must be turned out in order to keep the company in a prosperous condition, and in this way educates the men in the questions of overhead and the cost of production, which are too often a mystery to them.

The effect of this kind of management on the contentment of the employee is clearly illustrated in the small labor turnover, both Government reports and company statistics showing this to be one of the lowest of all like industries in the country. With an average turnover for Cleveland and vicinity for the year 1918 at 300 per cent, the labor turnover of the White Motor Co. was only 63 per cent, 8.75 per cent of this being army enlistments. The percentage for 1919 was very much lower, being

24.28 per cent, with an average working force of 5,465.

While the management encourages all sorts of activities among its employees, it avoids all interference with their management. The only exception to this is the gymnasium for the use of foremen and department heads, where they are required to attend classes daily for one hour on company time. Class work and exercises of this kind are of such an informal nature that they tend to break down reserve and build up in its place a spirit of co-operation and team play rarely found in the administration of a large industry.

The men run a small co-operative store in the main corridor, managing it entirely themselves, and hiring their own clerks. While there is as yet no extensive co-operative buying of home supplies, it is quite probable that something of this kind will be done in the near future. The profits of the co-operative store are divided so that 70 per cent goes to the benefit society and the remainder to the amusement fund.


The gymnasium for the use of foremen and department heads

In order to understand thoroughly the influence of the company publication, known as the *White Book*, which as before stated, is mailed to the home of every employee, it is necessary to quote from some of its editorials to show the frank and open way in which it discusses the various problems as they come up. This evidence of sincerity insures real co-operation. It makes the men feel as though they were really a part of the organization.

What the White Book Says

In order to appreciate the effect of these editorials from the *White Book* on the men, the date as well as the tone, should be carefully noted.

IT'S VITAL TO OUR COUNTRY

The fair living wage is the vital thing in our country today. It is as vital as the war. It may affect the result of the war. Big Industry has got to figure it out whether it wants to or not. It will be a great deal better for everybody concerned if Big Industry makes up its mind that it wants to, for if Big Industry doesn't do it, Uncle Sam will. Uncle Sam is getting ready and may some day speak with authority on that very subject.

White Motor's policy of adjusting wages according to the dollar's value, has simply anticipated what is bound to happen all over this country, and probably all over the old country before the war is over. And it proposes to continue this policy.

Another one of those rumors which are continually being circulated concerning this plant, is to the effect that White Motor has stopped raising wages. But I have the word of the management that White Motor is prepared to meet the situation by the necessary adjustment of wages, so long as rent and food keep soaring.

Of course, in an organization as big as White Motor, somebody occasionally doesn't get all that's coming to him. Little injustices creep in here and there. Feelings are hurt. These things are not the will of White Motor. Wages are being adjusted as rapidly as possible and the well-being of employees is looked after as comprehensively as possible. Those who have been with White Motor long enough to understand the policy, know this and know also that the men have in their own hands the means of adjusting every complaint or criticism.

SIMPLY COMMON SENSE

Wage matters, and, in fact, everything connected with the factory operation, have been very frankly discussed in the committee meetings. Manager Hulet has not hesitated to put matters squarely before the men. At some of the committee meetings which it has been my privilege to attend, I was surprised at the matter-of-fact manner in which the management laid its cards on the table. To say the least, it is unusual. But it is right, and if more companies would follow the same method, there would undoubtedly be a better understanding between the men and the companies and consequently less labor trouble.

After all, common sense is about all that is needed to bring about a proper understanding. The employee who exercises common sense knows that his wages do not entirely depend upon what the management can do. He knows that they depend considerably upon his own actions—upon factory production, upon good workmanship, upon good feeling all around. He knows that strikes and lockouts will affect his wages disastrously because they affect production and create discontent. Therefore he does his part toward paying his own wages, knowing that he is probably just as responsible as the management for the rise or fall in his pay envelope. *June 15, 1918.*

The effect of such heart-to-heart talks as these with the men and their families, in their homes, is bound to have a widespread influence for the general good.

CITIZENSHIP

Teach your children the morals of good citizenship; that while each individual has his rights he also has his duties; that the rights and duties of others must be respected as well as our own. If we had a little more of this moral teaching in our homes and schools, Cleveland would not have its annual "crime wave."

Said President Thwing of Western Reserve University:

> "Crime waves such as Cleveland is passing through are due in large part to the fact that thousands of American children are brought up with no conception of right and wrong * * * If you are caught in crime you are unlucky; if not, you are lucky—that is the highest conception most American children get of morals."

If this is so—and we must grant that results bear out the statement—whose fault is it?

Are American parents bringing up their children to be GOOD American citizens? *March 1, 1919.*

FACTORY CLASSES

One of the men in the parts department has written a letter to the *White Book* in which he suggests that the company start Saturday afternoon classes for those men who wish to fit themselves for better positions.

In addition to such classes, he proposes that "the foreman of each department call his men together twice or three times a month and discuss how the company is progressing, how the men can help to get better results, and also tell the men how important a factor they are in the company's interests."

The last suggestion, as you know is along the lines of a plan which the company has already adopted—that of informing the men concerning the operation of the factory and its product. Education along this line was started

with the charts commented upon in the *White Book* of Feb. 15, and will continue until every worker in White Motor has a clear idea of how the business is being run. In other words, the company is showing every employee just how much of a partner he is in the business of making White trucks. *March 1, 1919*

No secrecy here as to what costs are and how they affect the truck business. Simply another case of laying the cards on the table and avoiding misunderstandings.

RAW MATERIAL AFFECTS US

A great deal of raw material goes into White trucks. The material used in this factory absorbs 58 per cent of the factory production value, at present.

While the cost of material stays on the abnormal war level, White Motor is hampered in its plans for greater production and therefore greater prosperity for everybody concerned.

The prices on materials have steadily mounted since 1914, in some cases having risen as much as 150 per cent in the four years. Screw stock, for instance, while it is slightly lower now than the 1918 price, shows an increase of 150 per cent in 1919 over the 1914 price. Other percentages of increase in the same period are: 35 per cent for malleable iron; 78 per cent on galvanized sheet; 142 per cent on black sheet; 62 per cent on axle steel and 98 per cent on strip steel; gears up to 113 per cent; toggles up to 140 per cent; front axles up to 81 per cent; hubs up to 140 per cent; and so on. The apex of prices was reached in 1918, while the war was raging. Here and there slight reductions are being made, but in the great majority of cases the price remains the same as it was last year.

These prices of raw material are holding up business for White Motor. They are holding up business for the United States.

Raw material—which includes food—is being shipped abroad in great quantities, according to the Federal Reserve Board's review. According to the same review, other countries than ours are showing a tendency to return to a stable price level and the danger is that if the United States cannot soon come to a normal price level, we shall lose out in the big game of getting the world's business for American products.

GRABBING OFF THE CREAM

Everything else is being adjusted as rapidly as possible, to a peace basis. But we cannot adjust to a normal peace basis in business so long as the prices of raw material keep us dangling in the air. We cannot adjust wages as we would like, while old Raw Material hogs all the profits. Many a manager is getting gray-headed today trying to make ends meet and keep production going, because Raw Material insists on grabbing off all the cream.

March 15, 1919.

This talk on food gets home to every man and his family, and points out that there must be a limit to wages.

FOOD PRICES STAY UP

Food costs continue to soar.

Yet, according to the latest Government report, food stuffs in storage March 1 were considerably larger than at the same time a year ago. The monthly survey of the Department of Agriculture at Washington shows that meat in storage March 1 amounted to 1,424,193,903 lb.—an increase of 139,000,000 lb.; lard, 123,017,336 lb.—about 58,000,000 lb. more than last year; butter, 25,781,637 lb.—about 6,300,000 lb. more. Yet prices of meats, lard and butter continue to rise. Even flour has gone up, in spite of the fact that England and France are buying flour from other countries quoting lower rates than ours.

The farmer is not getting for his product even a decent proportion of these high prices. In fact, the worst paid man in the country today is the farmer. The lowest wage paid in White Motor is wealth compared to what the average farmer gets for his labor, and the hardest worker in White Motor has a lazy job compared with what a farmer has to do.

Farmers who are perfectly willing to feed city people at decent prices, have been known to be compelled to plow under perfectly good growing foodstuff, simply because they were not permitted to market it. Dairymen and poultrymen and cattlemen are in almost the same predicament. They are more than willing to supply the demands of the people for plenty of good food at reasonable prices. But the middlemen must have their rake-offs and the big profiteer who controls meats, or butter and eggs or flour or any of the necessary foods, lays down the law as to what and how much may be sold, what and how much must be stored, what and how much the farmer or grower may dispose of out of his production.

There must be some means of getting the farmer and the city consumer together, if we are going to be able to eat enough of good American food to keep us fit for producing American goods.

Wages cannot go up indefinitely to meet a constant mounting cost of living. There is a limit somewhere. Every time wages go up, the cost of living moves another jump ahead. It's a losing game for the wage-earner, and no industry can stand such a strain indefinitely.

April 1, 1919.

Note here how the management discusses new moves with the whole force and tells them of possibilities of the future.

NEW MACHINERY COMING IN

Besides employing many new men, White Motor is buying thousands of dollars worth of new machinery. This machinery, it is expected, will enable the workers to put out a better product in fewer hours, possibly without shortening the pay along with the workday. This, of course, is something of an experiment, but the management of this plant has an idea that its expectations can be realized by the way the men will take hold of the idea and work it out. After all, the management can only present the opportunity. The men themselves must grasp it and make the most of it. That their ingenuity and persistence will achieve what some might consider the impossible—which is: producing more and working less while earning just as much as ever—is the honest belief that Manager Hulet entertains. I wonder if he is right. I hope he is. In fact, I THINK he is, but some folks have accused me of having too much faith in what the workers can and will do. * * * We shall see what we shall see. *July 1, 1919.*

This editorial brings out points which are usually discussed only in committee meeting of officers. This puts

it up to every man to do his share in making the expansion possible.

When the management tells us that expansion is the order of the day and proceeds to put it in effect, we have full confidence that the management knows what it is talking about and has the means to carry out its plans. There isn't the slightest doubt in the mind of the average worker that by 1930 we shall have a factory twice as large as at present, keeping some 10,000 men busy trying to fill orders for White trucks.

But this expansion business isn't quite as simple as it seems.

Matters of importance to industrial concerns are happening rather rapidly these days. For instance, since the writing of the last editorial for the White Book, it has been deemed wise to change some of our plans. Instead of waiting until 1930 to double our plant, we must accomplish the fact in the next five years, putting on 1,000 men additional each year until 1925.

It must be done for self-protection. Only those firms which are now in position to become large and powerful within the next few years, will survive, according to present indications. This means the elimination of many lesser concerns—concerns under poor management. It means that a great many men who are bosses now, will be under a boss when the change comes.

There is a huge risk in taking the expansion step now, as White Motor is taking it. Doubling the producing capacity of a plant in so short a time, with industrial affairs as unstable as they are now and the outlook promising unheard of competition both at home and in foreign markets, means that this company is taking measures which will make or break it in the near future. From what we know of the foresight of White Motor management, most of us are certain that present plans will carry us safely through the troubled waters. At the same time, it is well to know that there are rocks which endanger our success, and that it will take the wisdom and the nerve of every man in the plant, from president to sweeper, to navigate the ship and keep it in the safe course.

ROCKS IN SIGHT

Our first danger comes in 1920, when business in this country will begin a competition such as we have never known before—and we have had some pretty fierce business competition in the past.

There may be an effort to put in cheap labor, to sell at low cost, to pile up profits at the expense of both workers and consumers. White Motor isn't playing that kind of a game, as you know, and whether White Motor will be able to keep on playing the game its way, or not, is the question. If we were twice as big as we are now, our power might be felt in the general industrial campaign. As it is, we are still too small. We can do much to establish public opinion, however, by our approval or disapproval plainly expressed, concerning other firms' methods toward employees and consumers. We can knit ourselves even more closely together for self-preservation and making an impression upon others. We can even influence large bodies of workers and some industrial managers, into employing "White" methods of business. In such a way every employee is an asset to this company and to himself.

If we survive the home competition—if we survive the year 1920, another danger confronts us—that of Old World competition.

July 15, 1919.

What Is a Machine Tool?

By A. W. Jansson

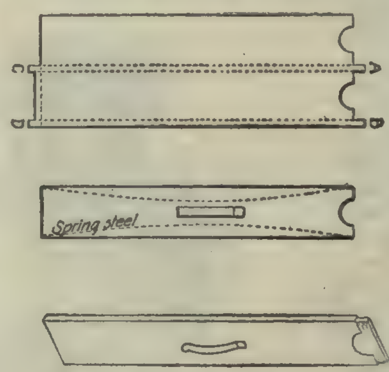
On page 548, vol. 52, of the *American Machinist* is an article with the title, "What is a Machine Tool?"

When I was a student at the Technical School of Stockholm, Sweden, we used to define machine tools (verktygs-maskiner) as machines that were able to reproduce themselves. That is, a lathe can reproduce most of the parts it is made of, but on the other hand a steam engine or punch press can not reproduce any of the parts of which they are made. Therefore, would it not be suitable to define machine tools as machines able to in part reproduce themselves?

Vest Pocket Case for Scale

By Michael N. Idleson

Many mechanics make a practice of carrying a steel scale in the vest pocket because of the convenience with which it may be reached when wanted, and all of them have suffered annoyance by reason of its falling out whenever they bend over; sometimes without their knowledge, and causing exasperation and loss of time in finding it. The holder shown in the illustration was designed to do away with this trouble. A piece of the thinnest sheet brass available is cut to the shape indicated and bent along the dotted lines. Two pieces of clock-spring steel of suitable width are placed inside the holder as shown and held by the taps A, B, C and D being bent over them, but not closed down so tightly as to interfere with their free movement. A short piece of spring brass or steel soldered to one of the flat sides makes a hook or clip by which the case is fastened to the edge of the pocket.

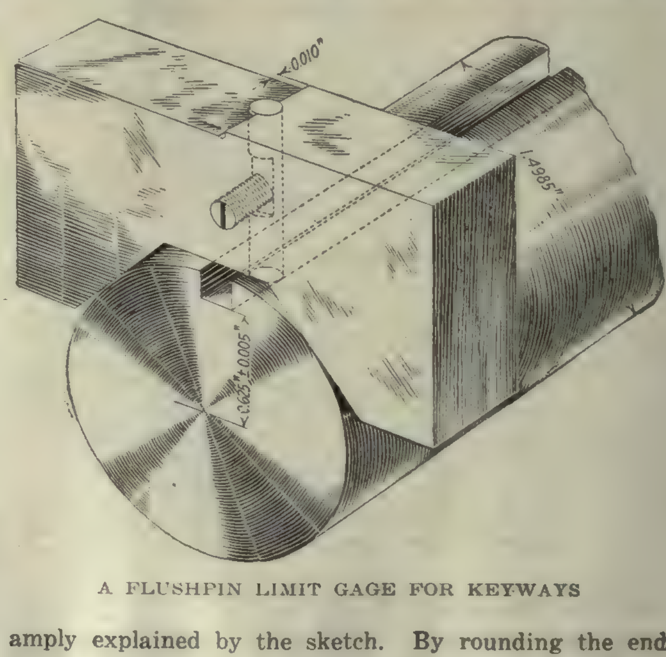


POCKET CASE FOR SCALE

A Flushpin Limit Gage for Keyways

By H. J. Henry

The illustration shows a gage made on the principle of the flushpin limit gage, for the purpose of gaging the depth of splines and keyways. The construction is amply explained by the sketch. By rounding the end of the slide the tool can be adapted to measure a Woodruff Keyway.


A FLUSHPIN LIMIT GAGE FOR KEYWAYS

Stellite, a New Gage Material

By H. L. VAN KEUREN
Consulting Mechanical Engineer, Boston, Mass.

The writer goes into a new field in search of some better material than steel to use for gages. Stellite, which has shown such remarkable results as a material for cutting tools, is the object of the investigation, which is quite thorough, considering the newness of the idea, and which brings out particularly the hardness and wear-resisting ability of this alloy.

STANDARD practice in the manufacture of gages and measuring tools has for a long time sanctioned the use of steel as a material—either machine steel pack-hardened, or preferably tool steel suitably treated. Consequently, when a departure is made from a well-recognized usage, it is because there is some peculiar condition to be met that justifies the expenditure of extra time and money. Thus, in the realization of the need of reference gages having extra wearing qualities, the writer investigated the characteristics of stellite as a gage material and constructed a number of flat, combination, precision gage blocks of this interesting alloy.

A Semi-Precious Alloy

Stellite is most generally known as a patented alloy having the peculiar properties of high-speed steel, and it is mostly used as tool points for heavy cuts on rough machining operations. Now, stellite is not steel, although it is sometimes referred to as an alloy steel. In fact, it contains no iron, except as an impurity, but is composed of a number of semi-precious metals. It therefore cannot be classed as steel.

The chemical composition is varied considerably according to the grade of material being produced. Three grades—Nos. 1, 2 and 3—are obtainable commercially. These grades vary in toughness, hardness and brittleness, grade No. 1 being the toughest and grade No. 3 being the hardest and most brittle. Table I shows average chemical analyses by different authorities, these being typical of the composition of stellite.

TABLE I. VARIOUS CHEMICAL ANALYSES OF STELLITE

Chemical Elements	Bureau of Mines Analysis, Per Cent	From Marks Handbook, Per Cent	J. E. Johnston, Per Cent
Cobalt	59.50	60.00	75.00
Chromium	10.77	15.00	20.00
Molybdenum	22.50	......	......
Carbon	0.87	......	......
Silicon	0.77	......	......
Manganése	2.04	......	......
Sulphur	0.084	......	......
Phosphorus	0.040	......	......
Iron	3.11	......	......
Tungsten	0.0	25.00	5.00
Nickel	0.0	......	......
Total	99.684	100.00	100.00

In some stellite alloys tungsten is used in place of molybdenum, it being claimed that its effect is about 100 per cent greater.

Fundamental Requirements of Gage Material

Inasmuch as a gage is primarily a tool for measuring or determining lengths accurately, it is essential that any material used for gages shall meet certain fundamental requirements established by the conditions under which gages are made and used. These fundamentals may be stated as follows:

1. Wearing qualities.
2. Suitable coefficient of expansion.
3. Permanency.
4. Resistance to corrosion.
5. Susceptibility to a high polish.
6. Ease of machining.
7. Uniformity of material.
8. Hardness.

The above analysis has been made particularly with reference to standard gage blocks of the flat precision type, but there is no reason why this analysis does not apply in the main to all types of commercial gages, such as snap, plug, ring and profile gages. Thus it is of interest to consider the suitability of stellite in meeting these fundamental requirements.

Wearing Qualities

Any material which has the property of resisting abrasion can be expected, of course, to possess high wearing qualities when used as a gage or contacting surface of a measuring tool. There are certain alloy steels which resist abrasion more than ordinary tool steel. Then, also, we find that in some precise measuring machines, agate or some other hard stone has been employed as a contact surface.

The fact that stellite stands up as a cutting tool under heavy duty would indicate that it would have long wear as a gage; but the real fact that insures long wear is, that in lapping stellite gages it was found that with exactly similar conditions it took five times as long to lap a stellite gage as it did a gage made of an alloy steel particularly well suited for wear. Thus stellite gages should wear at least five times as long as the best of steel gages.

Coefficient of Expansion

Different materials expand and contract varying amounts with a given change in temperature. An idea of this difference in materials may be obtained from Table II.

TABLE II. COEFFICIENTS OF EXPANSION OF SOME COMMON MATERIALS

Substance:	Expansion in Inches of a 1-In. Piece per Deg. F.
Aluminum	0.0000123
Brass	0.0000105
Glass	0.0000050
Gold	0.0000085
Iron	0.0000060
Steel, hard	0.0000073
Steel, annealed	0.0000060
Wood	0.000002

Now, as practically all accurate measuring or gaging is done on work which is made of iron or steel, the material used for gages or measuring instruments should have a coefficient of expansion approximately the same as the average of iron and steel. When this is true the main requirements in making accurate measurements are to let the work and the gage come to the *same temperature*, and to work as close as possible to the standard temperature, namely, 20 deg. C., or 68 deg. F. This can be done in any shop without the elaborate equipment of a constant-temperature room.

A substance such as Invar steel, which has practically a zero expansion coefficient, or aluminum, which has a very high rate of expansion, as can be seen from the above table, is practically out of the question as a gage material, as it expands very differently from the average (0.0000066) for iron and steel. A 6-in. aluminum gage would cause an error due to difference in expansion when measuring the average work at a temperature 10 deg. different from standard, say at 78 deg. F., of 6 $\times$ (0.0000123 — 0.0000066) $\times$ 10, or 0.00034 in., an appreciable amount according to present-day standards.

Stellite, as has recently been determined, has a coefficient of expansion quite in agreement with the average of iron and steel. Table III gives the results of recent findings of the National Bureau of Standards.

TABLE III. COEFFICIENTS OF EXPANSION OF STELLITE

Grade of Stellite	Range of Temperature, Deg. F.	Expansion in Inches of a 1-In. Piece Per Deg. F.
No. 1	77.0 to 123	0.0000056
No. 1	82.5 to 140	0.0000067
No. 1	140.0 to 212	0.0000067
No. 2	77.0 to 140	0.0000067
No. 2	140.0 to 212	0.0000061
No. 3	77.0 to 140	0.0000056
No. 3	140.0 to 212	0.0000061

Thus, with an average coefficient of 0.0000060, stellite is quite suited as regards temperature error, as this error is small enough to be negligible on all ordinary work, and it can be eliminated by making a correction for the small error that might interfere with very precise work involving measurements which must be accurate to within 0.00001 inch.

Permanency

The skilled mechanic knows by experience that a piece of steel, accurate when made, may change in dimension or shape with time. Freedom from this change is known as permanency. Difficulty is experienced with steel, owing to the strains that are set up in the metal during the hardening process; and where steel is used for gages of special accuracy it is necessary to relieve these strains by a seasoning process, in order to insure permanency. Now stellite in its original condition is extremely hard, and inasmuch as this hardness is the result more of the peculiar properties of the combined elements, rather than of an abrupt change of structure, such as occurs when red-hot steel is quenched in water, there is every reason to believe that stellite is much freer from strains and more permanent than hardened steel. However, the permanency of stellite can only be assured by a series of measurements on accurate samples taken at intervals of years. These measurements have already been started by the Bureau of Standards on some samples submitted by the writer.

Resistance to Corrosion

One of the remarkable properties of stellite is that it is practically non-corrosive, being acid resistant, except to hydrochloric, sulphuric and hydrofluoric acids. It has, therefore, found considerable use for table ware, surgical instruments, laboratory apparatus, and for jewelry. Being free from stains or rust, which often occur on steel gages as the result of handling, it is preferable to steel.

Stellite gages, made by the same methods and with the same refinement of abradants as used on steel gages, have a very excellent finish, the gage surface being practically polished. Experiments made at the Bureau of Standards by Dr. Coblentz indicate that on a brilliant stellite mirror a reflecting power of 50 per cent was found, but the freedom of the surface from imperfections and the brilliancy of the polish give the impression that it has a reflecting power of 100 per cent. In fact, stellite, owing to the brilliancy of its polished surface, gets its name from the Latin word "stella," or "star."

Ease of Machining

Ordinarily, if a material was available which satisfied all of the essential requirements of the finished product, difficulties of working would be overcome. This may occur in time with stellite, but, owing to its extreme hardness in its original condition, it cannot be machined by the convenient method of using cutting tools, but must on all operations be broken or ground. The present cost of the material and the difficulty in machining tend to make the cost prohibitive for strictly commercial purposes.

At present, stellite is obtainable only in simple cast forms or sections. Grinding operations are slow, owing to the fact that it is non-magnetic, and therefore cannot be held in the convenient magnetic chucks of grinding machines. However, with improvement in molding facilities, and with sufficient demand for precision gages of the better quality, there should be no reason why the present difficulties in preparing the material for the final finishing operations cannot be surmounted and the cost reduced.

Uniformity

Very often in steel we find numerous conditions which are difficult to control. The very object of elaborate processes of heat treatment is to obtain a uniform structure in the material. In the annealing and hardening process a few degrees difference in heating the metal will cause great variations in the resulting structure, and it is not every shop that is equipped with the pyrometers and controlling apparatus necessary to realize uniform conditions in heat treatment.

This difficulty is lacking in the case of stellite, as there is no annealing or hardening process. The uniformity depends entirely on the facilities and knowledge of the makers of the material. One difficulty experienced with stellite is the frequent occurrence of blowholes arising in the casting process. When these blowholes occur on the finished surface of the product, the piece must, of course, be rejected.

Hardness

The property of hardness implies the ability of the material to resist to a certain marked degree scratching by a diamond or other very hard substance. This quality is most desirable for gages, and stellite, being extremely hard, is therefore well suited for gage material. Most substances which are hard have good wearing qualities and resist abrasion, but certain alloy steels which have remarkable wearing qualities are not so extremely hard. Both hardness and wearing qualities are combined in stellite.

As has been previously mentioned, the writer recently constructed some flat, combination gage blocks of stellite. These gage blocks were ½-in. standards, ¾ in. square, and were made to be used as reference standards

in making other precision-gage blocks. The original lot of sixteen gages, all $\frac{1}{2}$ in. in length, were prepared for lapping by the laborious process of surface grinding. It was necessary to grind the pieces singly, as the blanks obtained from the makers of the material were quite irregular in shape.

A problem presented itself as to how the gages were to be marked. The blanks were too hard to be stamped, etching presented difficulties, and, while they could have been marked with an electric pencil, this method was not quite suited in regard to neatness for use on a precision gage. They were finally marked by sandblasting. A stencil was made of the desired marking and a few minutes under the sandblast was sufficient to give a clear, neat and permanent marking.

Of the sixteen gages finished there were about ten good ones, some being rejected on account of blowholes on the surfaces. Five of these gages were sent to the Bureau of Standards for measurement, Table IV being the report of the results.

TABLE IV. DATA ON THE FIRST STELLITE GAGES SENT TO THE BUREAU OF STANDARDS

B. of S. Test No. 27,845, Feb. 24, 1920

Identification Number	Marked Length, In.	Measured Length in In. at 20 Deg. C.	Maximum Error of Both Flatness and Parallelism of Faces
BS-A	$\frac{1}{2}$	0.500003	0.000005
BS-B	$\frac{1}{2}$	0.500001	0.000005
BS-C	$\frac{1}{2}$	0.500000	0.000005
BS-D	$\frac{1}{2}$	0.500008	0.000006
BS-E	$\frac{1}{2}$	0.500004	0.000005

An observational error of ± 0.000003 in. is possible on each measurement.

Owing to its excellent wearing qualities and its freedom from corrosion, stellite is very well suited for precision-gage reference standards of the better quality. Such a gage would be economical where it is necessary to use a reference gage at very frequent intervals or perhaps continually. Also, in large manufacturing plants where the inspection of parts includes hundreds of thousands and even millions of pieces the need of gages with exceptional wearing qualities is apparent.

Why cannot we utilize the process now so common with stellite cutting tools and weld a piece of stellite to the iron or steel frame of the gage or measuring tool at the point or surface where wear occurs? This question will be left unanswered, but the writer herewith predicts the use of stellite for commercial gages, which will result in economy and consequently profit to both the maker and user of gages.

Generating a Cam on a Milling Machine

By August De Angelis

We had to make a face cam about 18 in. in diameter with three different rises and three dwells, it being necessary to make the pitch of the rises quite accurate. After giving the problem considerable thought, we concluded that the best way to perform this operation was by generating the pitches.

We took a turntable from a vertical milling machine and geared it to the feed shaft of the horizontal milling machine by means of a silent chain, two sprockets and a train of gears.

It was necessary to make the speed of the worm on the turntable correspond with the speed of the handwheel on the up and down feed of the machine and this was accomplished by using sprockets with 15 and 31 teeth, this being the ratio of the two shafts.

We then figured out a set of gears to give us the correct amount of feed up or down for a complete rise, while the circular feed was running through the number of degrees in that section.

In operating this arrangement we marked the flange of the cam *A*, *B*, etc., to correspond with the different

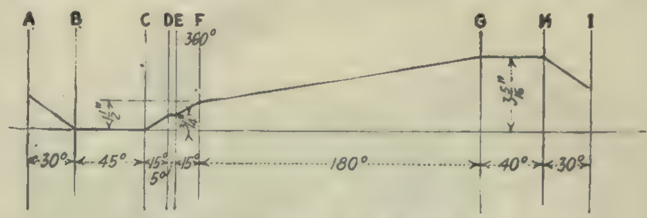


FIG. 1. DEVELOPMENT OF CAM

points of the cam as shown in Fig. 1 and put a pointer on the base of the turntable to correspond with the center of cutter. We then started at point *H* to mill

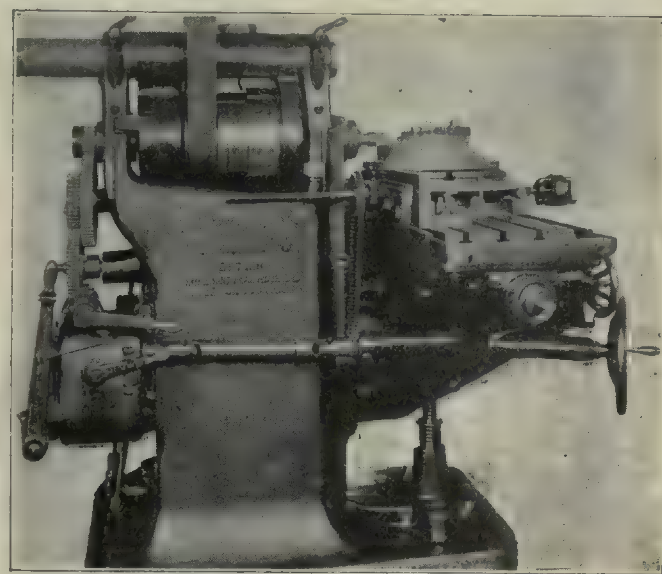


FIG. 2. THE SET-UP

the straight section or dwell *HG*, starting the rotary feed only. When the point *G* reached the pointer we threw in the up feed and ran to point *F*.

For the other sections we changed the gears to suit the different pitches and followed the same procedure, obtaining very satisfactory results. A photograph of the rig is shown in Fig. 2.

The formula for the gearing is as follows:

$$\frac{T}{F} = \frac{S}{W}$$

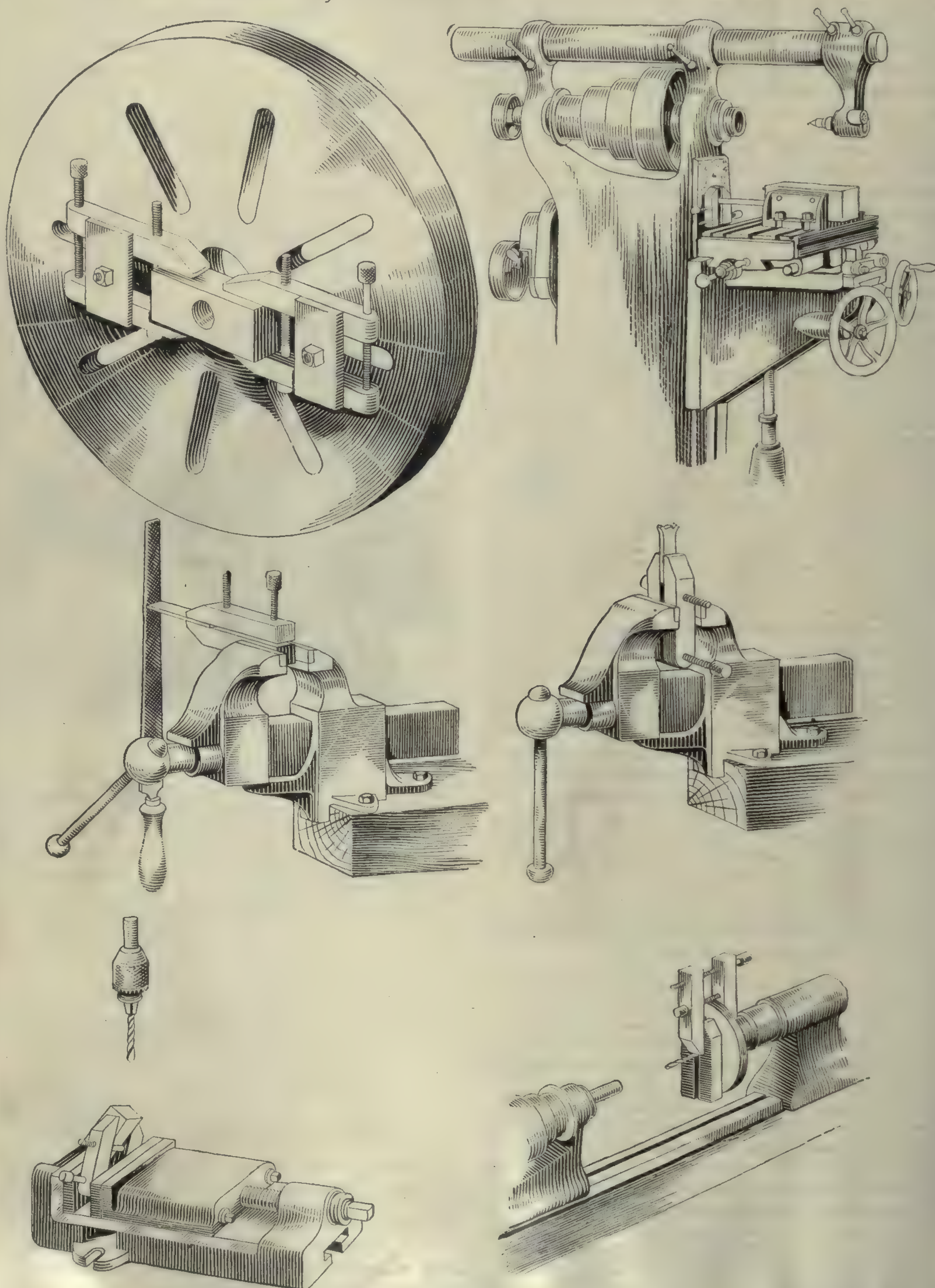
R = Rise;
A = Arc of section;
T = Turns of worm on circular feed for A;
F = Up or down feed for R;
W = Gear on worm shaft;
S = Gear on sprocket shaft.

How an Engineer Got Rich

We have just learned of an engineer who started poor 20 years ago and has retired with the comfortable fortune of \$50,000. This money was acquired through industry, economy, conscientious efforts to give full value, indomitable perseverance and the death of an uncle who left the engineer \$49,999.50.—Official Bulletin, Colorado Society of Engineers.

USES FOR THE PARALLEL CLAMP

By Atol Maker



Unusual Method of Securing Extreme Accuracy—III

By A. L. DE LEEUW, M. E.
Consulting Engineer

The third installment continues the boring and reaming operations on the two main holes in the cradle forging and then takes up the machining of the trunnions with a description of the unique fixtures and special machines used.

(Part II appeared in our April 29 issue.)

THE boring of the large hole differs from the small hole only in detail. Fig. 35 shows the boring tools. The body *X* is soft steel, *Y* is Rex AA high-speed steel, and fiber ring *R* is used to stop the chips, instead of having a full-diameter section below the chip openings as the French tools have. These tools are very satisfactory. Care should be taken to see that the slots in the cutting tool line up with the slots in the body to give a clear passage for the chips.

Fig. 36 shows the circular-grinding of the tool and bronze bushing. The bushing is ground 0.0005 in. below the cutter size. After circular-grinding the cutting edge is backed off to a line. The small-hole boring tools are ground in the same manner. A fixture similar to the one used for drilling is used for boring and reaming the large hole. One end is clamped in the revolving steadyrest on a 24-in. heavy-duty lathe as shown in Fig. 28, and the other end in a special bracket fastened on the stripped carriage and bored in position, as in Fig. 37. Fixtures of the type used on the small hole were found satisfactory in this case. Fig. 38 shows the boring tool leaving the work. Fig. 39 shows the method of fastening the large bar to the spindle of the lathe. The bar screws into the collar *A* which has a center fitting the lathe spindle. This collar is then held in the spindle by the capscrews shown. The large finish-reamer is like the small one. The large-hole operation details, including removing the finished work from the fixture, are shown in the accompanying table.

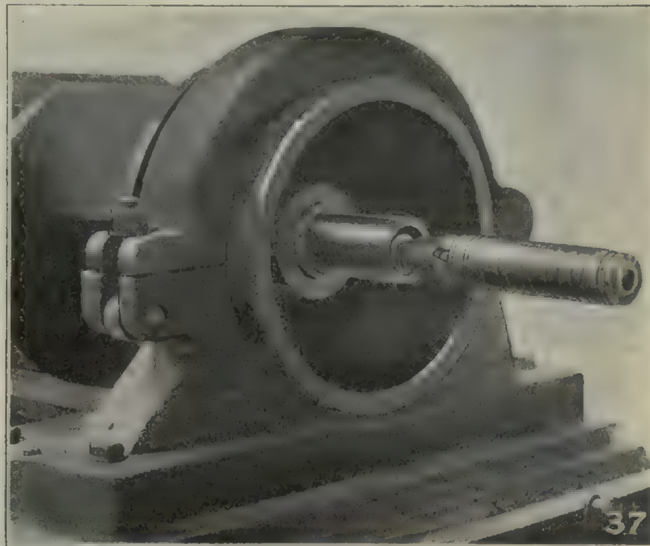


FIG. 37. BORING TOOL ENTERING WORK

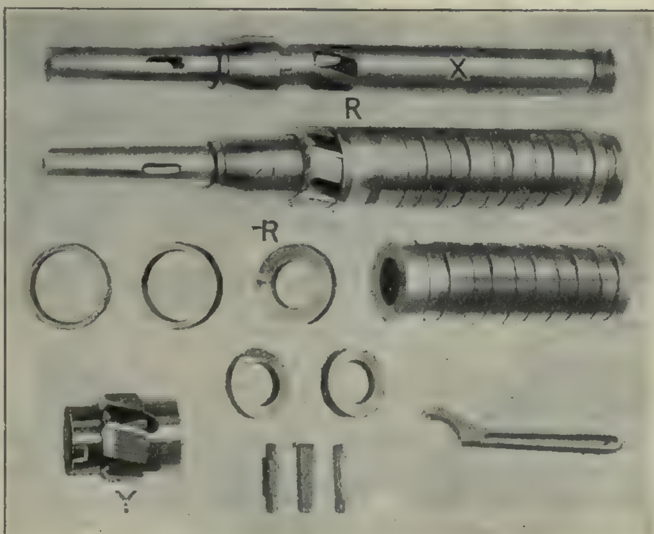


FIG. 35. TOOLS FOR LARGE HOLE

This method of reaming is very satisfactory for this class of work. The holes come very straight and parallel, true to size and remarkably smooth; 0.002 in. is left for lapping and polishing. After this method of drilling and boring was started, not a single cradle out of the 800 was spoiled in this operation. As little as 0.002 in. has been removed from a hole with the wood reamer. The three cylinder oil pumps used deliver plenty of oil at 80-lb. pressure. Care should be taken to screen or otherwise remove the fine chips. The boring operations are covered by operations 16, 17, 18 and 19. The lapping was not done immediately after boring but was made one of the final operations. This was due to the fact that it is of extreme importance to preserve the final finish of the holes and consequently reduce the handling

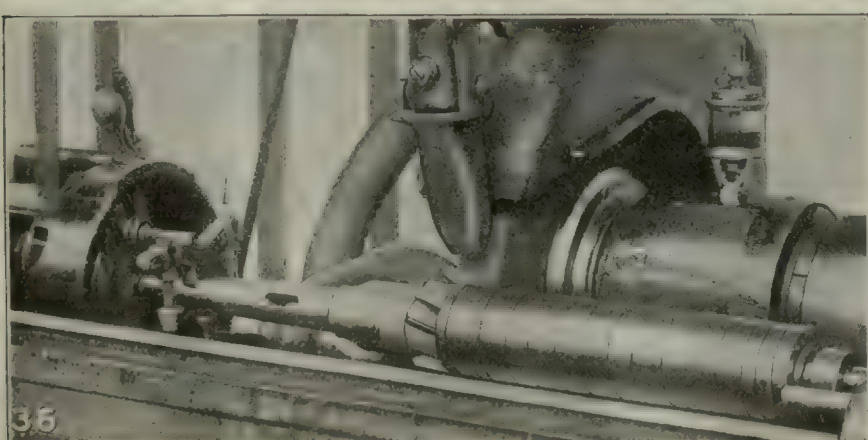


FIG. 36. GRINDING THE BORING TOOL

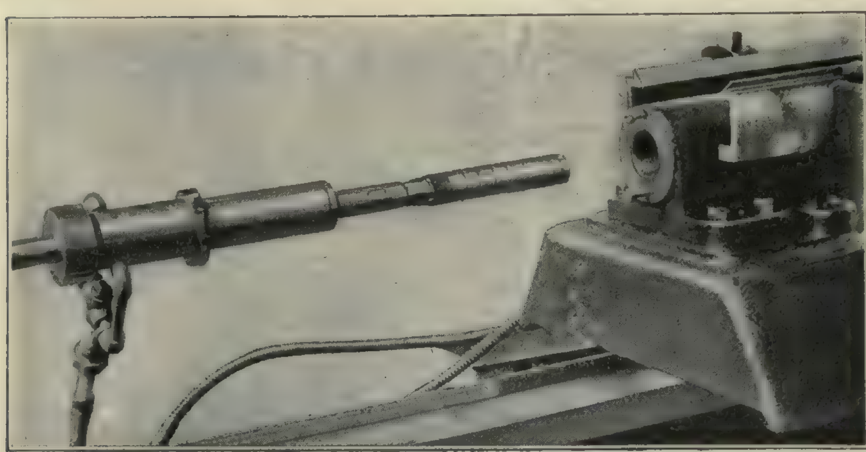


FIG. 38. BORING BAR AND OIL CONNECTION

finish-turning of the trunnions. It was considered to be of extreme importance to have the trunnions exactly in line with each other. The peculiar shape of the piece and its great length make it very difficult to swing the piece around the center line of the trunnion on a lathe or vertical boring-mill. Besides, such a procedure would require two settings of the piece for tuning the two trunnions. Then, too, the method of hollow-milling both trunnions on a two-spindle machine would not insure perfect alignment of the two trunnions. For these reasons it was decided to build a special machine which consisted principally of a large

of the piece after lapping to an absolute minimum.

Operation 22 shows the milling of the grooves and surfaces for attaching the cover plates. These grooves were on both sides of the piece, but on the side shown in operation 22, the grooves extend the entire length of the piece, whereas on the other side these grooves were interrupted. Operation 22 was done on a horizontal milling machine using two gangs of cutters, the pieces being set at the proper angle as clearly shown in Fig. 40.

The next operation was the rough-turning and drilling of the trunnions. At this stage the trunnions were square blocks or bosses and it was deemed advisable to remove the large amount of metal still left after milling so as not to have to remove much metal at the finish-turning. This roughing operation was done on a high-duty drilling machine, the table having been removed and a special fixture substituted. This was really a hollow-milling operation, the hollow-mill being clearly indicated in Fig. 41. It will be noticed that the fixture can rotate on its axis so as to present both trunnions to the hollow mill. A number of other tools such as drills, reamers, taper reamers, etc., completed the equipment for this roughing operation and are shown in Fig. 42.

Skipping a few of the operations, we now come to the

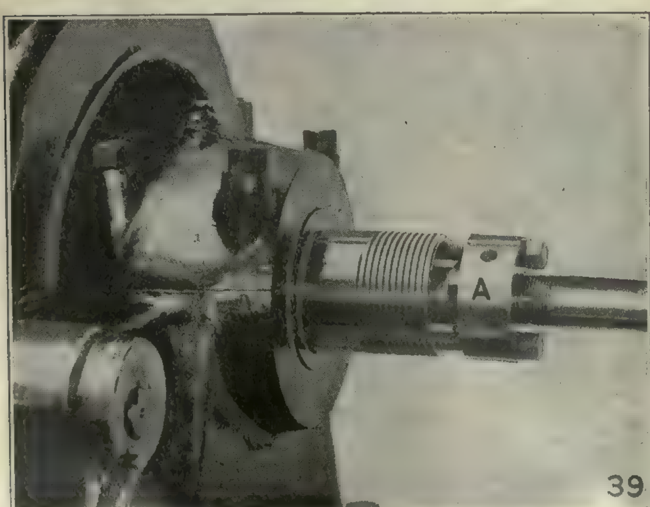


FIG. 39. HOW THE BAR IS DRIVEN

pulley about 74 in. in diameter as in Fig. 43. The pulley was made in halves, with the journals for bearings of the pulley entirely in one of the halves, the other half being merely a cover. Fig. 43 shows the cover as the upper part of the pulley.

In this position, the upper half can be removed by

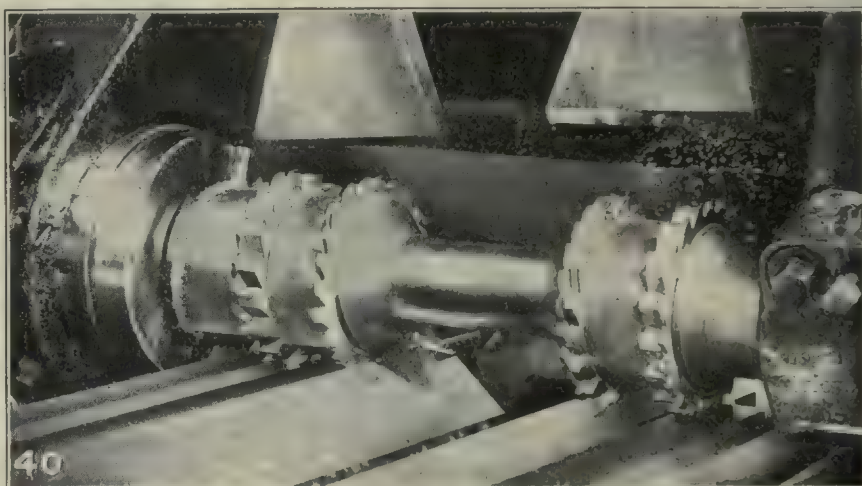


FIG. 40. GANG MILLING FOR SIDE PLATES

unclamping the swinging bolts which are clearly shown. The lower half is arranged as a receiving jig for the cradle as in Fig. 44. There are hardened bearing spots, adjusting screws, clamps, etc. A piece of work is placed on this lower half of the pulley and fastened, after which the upper half is put in place and the driving belt is thrown over the pulley. The machine is driven by a 7½-hp. motor with push-button control and powerful dynamic brake. There is, in addition, a foot brake of which the treadle is shown in the illustration. The motor is larger than is required for the running of the machine, but this amount of power is required for the starting up of the machine.

The trunnions of the pulley are hollow. On each side of the pulley there is a cast-iron stand on which is mounted a compound rest of an 18-in. engine lathe with a four-position tool block as seen in Fig. 45. After the

THE LARGE-HOLE OPERATION DETAILS

	1st Bore	2nd Bore	1st ream	2nd Ream
Size	2.476 in.	2.572 in.	2.586 in.	2.596½ in.
Revolutions per minute	90	90	55 to 60	30
Feed per revolution	0.014 in.	0.014 in.	0.0685 in.	0.090 in.
Time of cutting	55 min.	55 min.	17 min.	45 min.
Setting up, etc.	20 min.	20 min.	25 min.	45 min.
Total time	70 min.	70 min.	42 min.	74 min.

piece is put in place, a smooth brass cover is put over the trunnion of the piece and inside of the journal of the pulley. This is for the sake of safety so that no projecting parts of the mechanism shall touch the operator or the tools and also to provide a non-changing field for the eye of the operator. An idler puts the proper tension on the belt and permits the belt being thrown off when lifting out a piece.

Two Operators Can Work Simultaneously

As there is a stand and compound rest at each of the two trunnions of the pulley, it is possible to have two operators work simultaneously. It is plain, of course, that there was no possibility of getting the trunnions of the piece out of line with each other. The only thing requiring attention was to have the axis of the piece at right angles to the axis of the pulley and this, being once established, would so remain during the life of the machine.

Operation 24 and 24A are the milling of the interrupted slots. These required several settings and the use of sliding fixtures, one being shown in Fig. 46. The fixture shifts so that the hole *B* comes under the index pin *A*. Operation 25 was the fitting of the cover plates to the sides of the cradle. Operations 26 and 27 were the drilling, counterboring, tapping, and the fitting of screws for these cover plates.

A Few Planing Operations

Operations 29 and 29A were the planing out of the insides of the undercut portion of the cradle, $\frac{1}{32}$ in. being allowed there for finish. Fig. 47 shows the piece in position on the planing machine and one of the tools used. Operation 30 is the final finish-milling of the

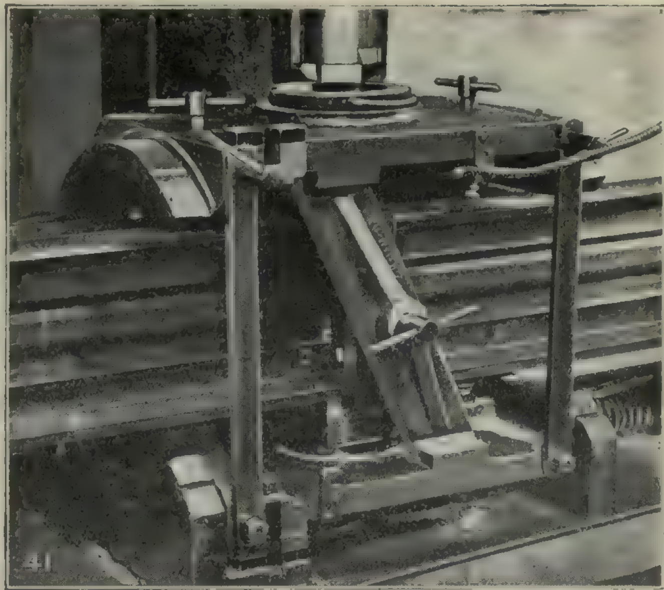


FIG. 41. HOLLOW-MILLING THE TRUNNION

inside of the forging and confines itself to the lips and what is called the nerve guide. This finish-milling of the lips would not have been necessary if the original cutters had been entirely correct.

Operation 31 is the finish-turning of the trunnions. Operations 33, 34, 35, 35A, 36 and 37 are all minor milling operations shown in Figs. 48, 49 and 50. These give a good idea of the fixtures, the cutters and the gages used for determing the different cuts. Many of these cuts were at various angles, some were in the nature of an arc, others required peculiarly shaped covers, but

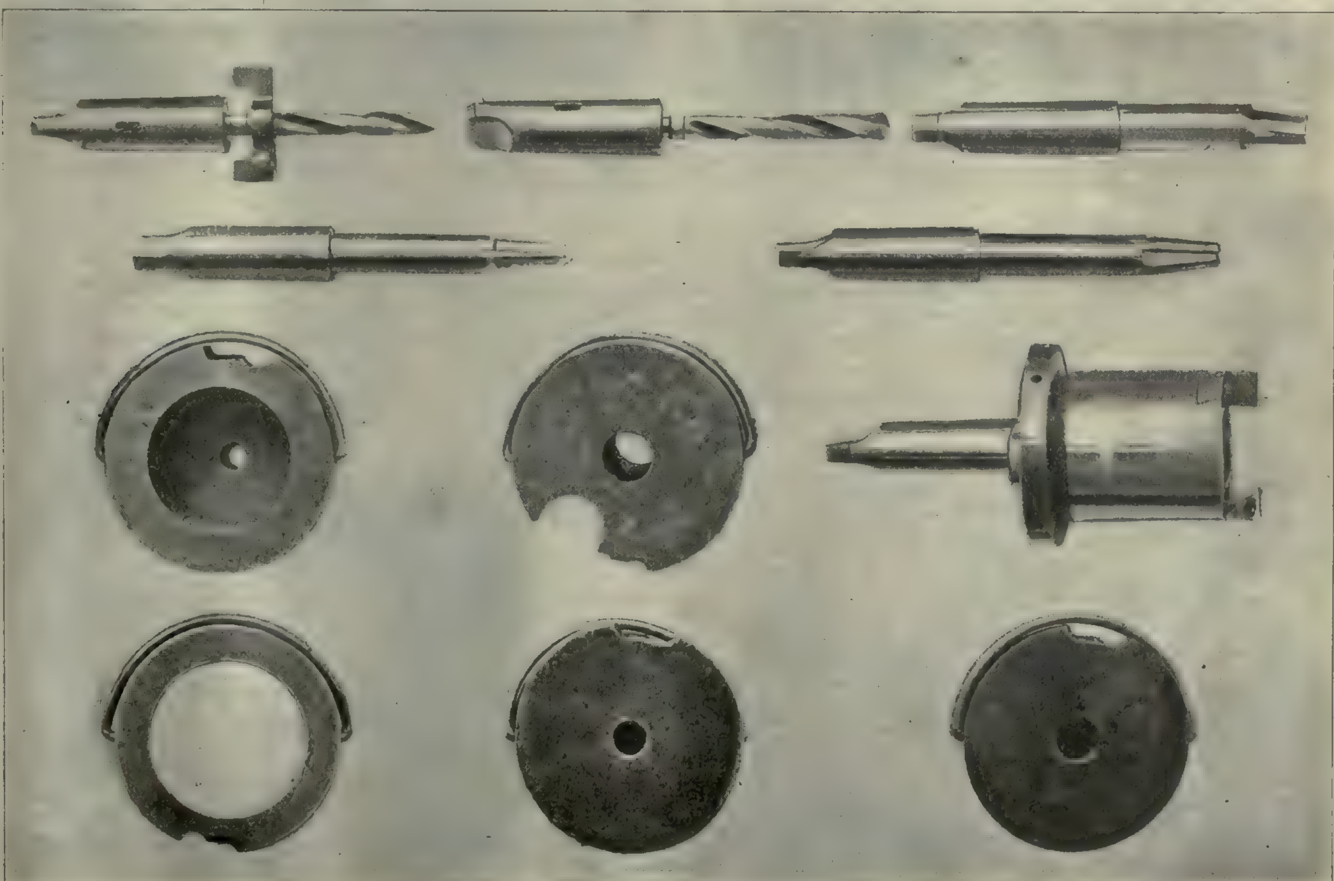
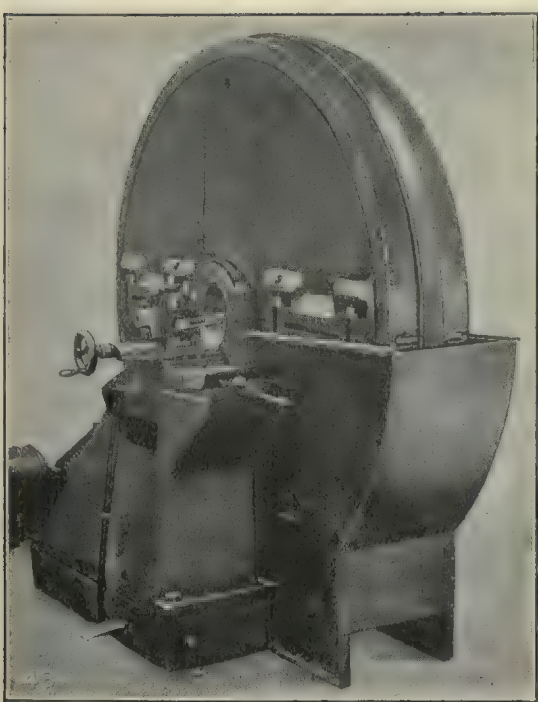
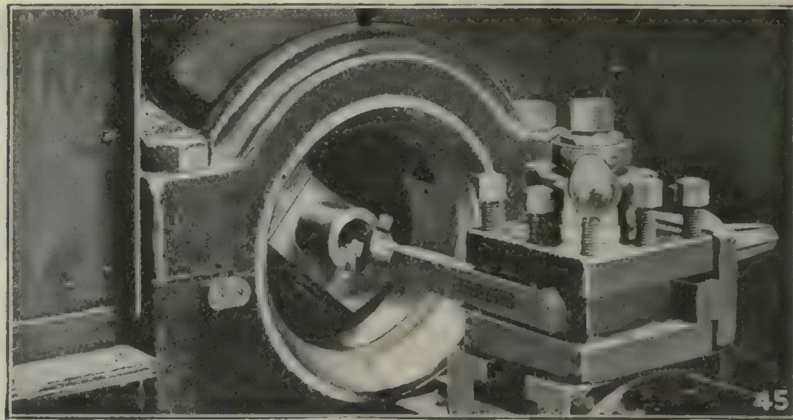
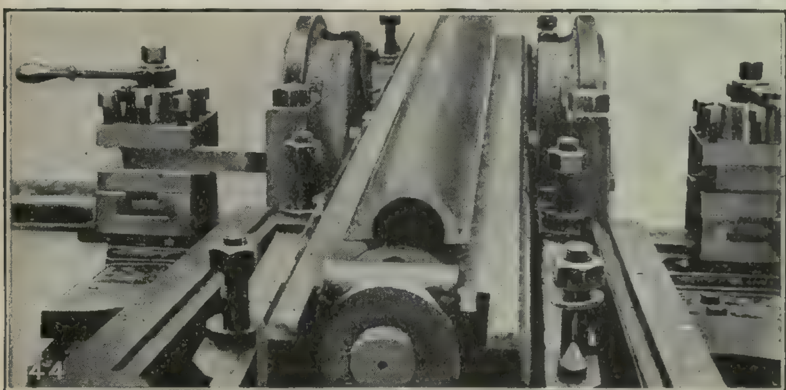
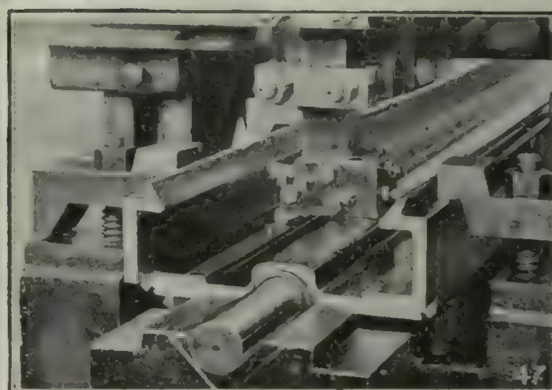


FIG. 42. SOME OF THE TRUNNION TOOLS









SPECIAL MACHINE, RECEIVING JIG, BORING, MILLING AND PLANING OPERATIONS

Fig. 43. Special machine for turning and boring trunnion. Fig. 44. How the cradle fits in the machine. Fig. 45. Boring the trunnion. Fig. 46. One of the small milling operations. Fig. 47. Finish-planing the inside

none of them presented any unusual difficulties. The drilling, counterboring, etc., of the various holes were also ordinary operations, but some of the jigs and tools used were of interest. Fig. 51 shows the fixtures used for holding the piece vertically. Fig. 52 shows a simple drilling fixture which utilizes the trunnion as a locating point. Fig. 53 is a tapping fixture which was found very convenient.

Parallel to the axis of the piece, and on each side of the center guide, there is a taper track with a very small taper per inch, which runs into a short piece of straight track. This straight part is the lower part of the track, very much like a street running level for a certain distance and then suddenly going up hill. The changing from the straight to the taper part was sudden, making a straight line across where they met. This required a

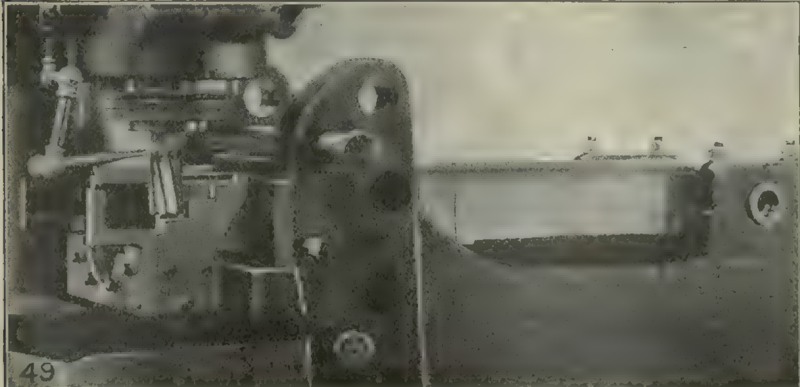


FIG. 49. MILLING FIXTURE FOR END, SHOWING GAGES USED FOR SETTING CUTTERS

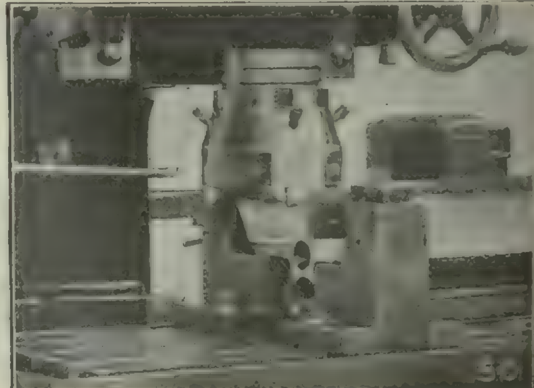


FIG. 50. ANOTHER END-MILLING JOB

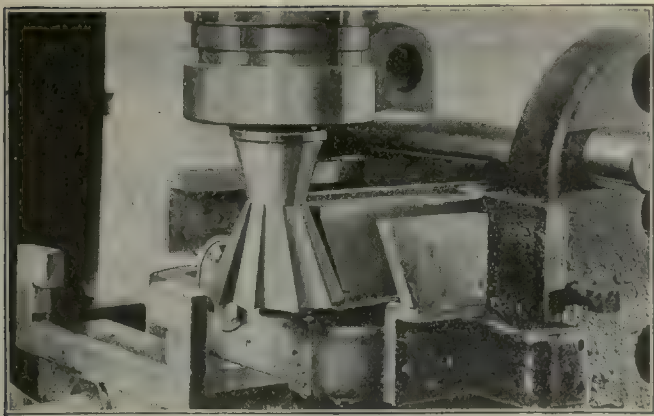


FIG. 48. MILLING END, AND SHOWING GAGES USED

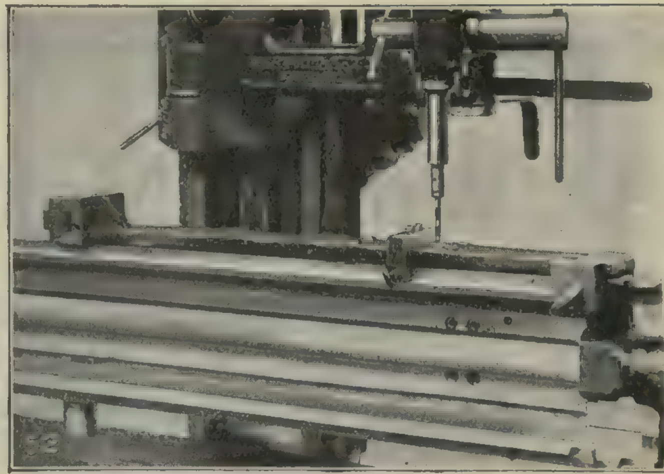


FIG. 52. LOCATING SIDE HOLES FROM TRUNNION

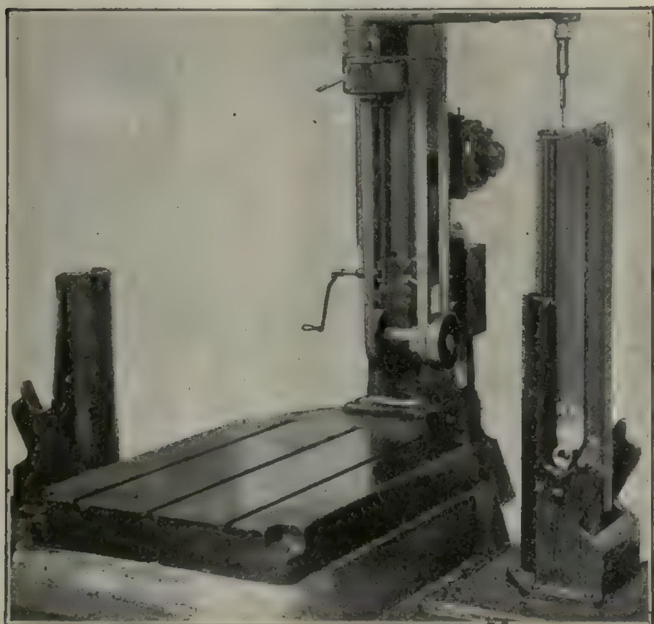


FIG. 51. DRILLING SMALL HOLES IN THE END

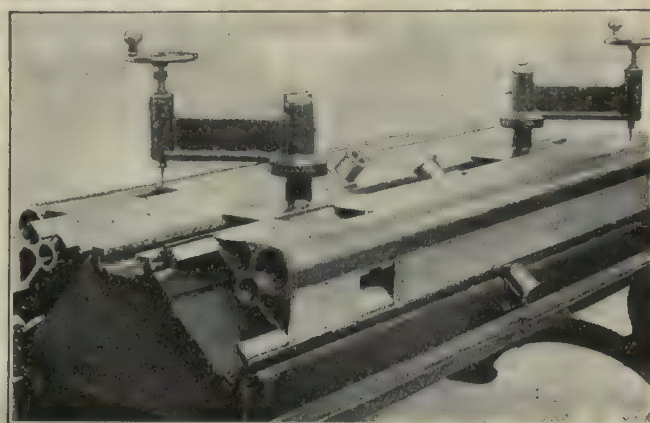


FIG. 53. A CONVENIENT TAPPING FIXTURE

certain amount of hand-finishing at the junction of these two parts and, in order to reduce this hand-finishing to a minimum, the following procedure was adopted:

The operation was done on a No. 5 milling machine with vertical attachments and lengthened table so as to give 60-in. table travel. First, the straight part of the track was milled out with an end-mill to within 1-64 in. of its final depth. Then the jig was tilted to the proper angle and the bevel part of the track was finished. As the straight part was not made to its full depth, it was possible to mill the straight part further than it should go and yet not touch the plane of the finished bevel part, so that, when this bevel part was finished, there was only a little corner left, 1-64 in. in height. This had to be removed by hand. Operations 40, 40A, 40B, and 41 41A, 41B and 41C were simple, presenting no difficulty.

A Workman's Compensation Digest

By Will J. French

Chairman Industrial Accident Commission of the State of California

In Vol. 52, page 77, of the *American Machinist*, Chesla C. Sherlock contributed an interesting article under the above title. He informed your readers that the waiting period in California under the Workmen's Compensation Act is two weeks. It is one week. Years ago it was two weeks, but it was reduced to ten days, and has been seven days since July 22, 1919. Another statement written by Mr. Sherlock was that California has a ninety-day limit for medical, surgical and hospital treatment. This is also an error. The law calls for unlimited treatment for men injured in industry, and all that can be done to cure and relieve the hurt man from the effects of his injury is provided by law, regardless of any time limit. Years ago we had a ninety-day limitation.

Attention is invited to the fact that employers in California must secure payment of compensation by (a) taking out compensation insurance in an authorized insurance company, which includes the State Compensation Insurance Fund, or (b) by obtaining from the Industrial Accident Commission a certificate of consent to self-insure, after furnishing satisfactory proof of ability to carry their own insurance.

While Mr. Sherlock has called the attention of employers to their maximum and minimum liabilities for compensation for injuries, the most important sentence in the California Act is: "Every employer shall furnish employment which shall be safe for employees therein." Another important sentence states that the employer "shall do every other thing reasonably necessary to protect the life and safety of such employees."

The foregoing is not written in criticism of Mr. Sherlock's article. It is impossible for a busy man to keep closely in touch with the numerous changes that are being made in the more than forty compensation laws in the United States. My purpose is simply to show that California is keeping abreast of the times in amending its Workmen's Compensation Act.

A "World" Metric Convention!

We have published letters proving the falsity of a number of the statements made in literature sent out by the World Trade "Club" and showing how little reliance can be placed in what this "Club" says.

Its latest effort is an apparent attempt to convey the idea that there is to be a World Metric Convention to be held in San Francisco, in connection with the meeting of the National Foreign Trade Council.

The announcement is made that a "World Metric Standardization Council" has been formed, to meet in San Francisco, May 17, "following the close of the trade Convention."

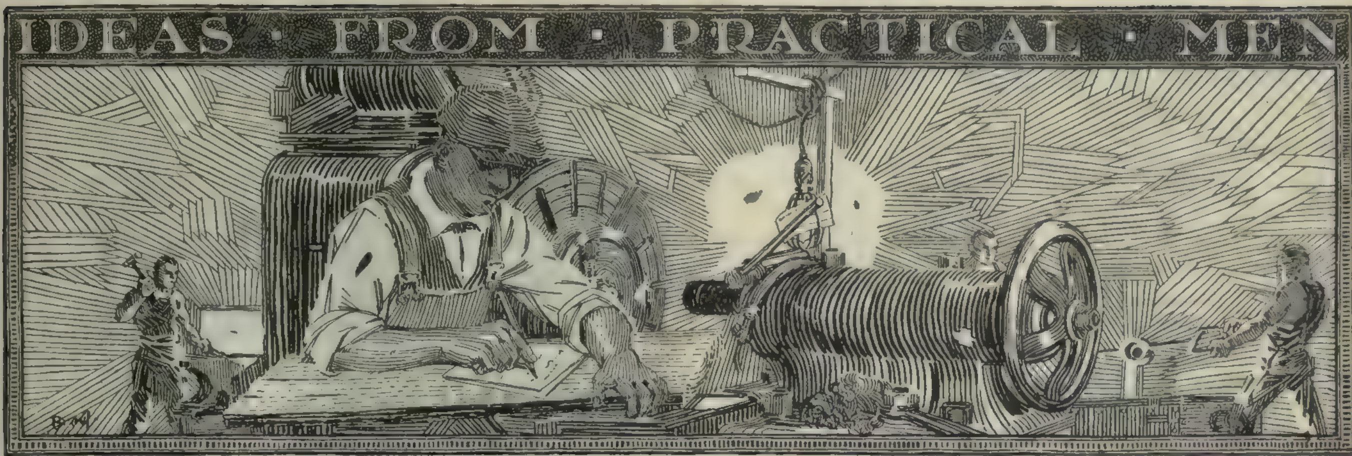
The announcement goes on to say that the Chairman of the Meeting will be John J. Arnold, foreign business supervisor of the Bank of Italy. Others on the list are James Speyer, "banker and publicist"; ALBERT HERBERT, "DEAN OF THE WORLD METRIC EXPONENTS (!)"; Franklin K. Lane, former Secretary of the Interior; Dr. Charles Eliot, president emeritus of Harvard University, etc., etc.

Now why aren't a few *real* representative manufacturers or engineers in the industrial field listed? The answer is plain to anyone who has read the letters we have published regarding the compulsory metric system.

However—regardless of any meeting of the metric advocates that may be held, do not be misled into thinking that it is a part of the program of the National Foreign Trade Council—*It Isn't.*

Ethan Viall

Editor

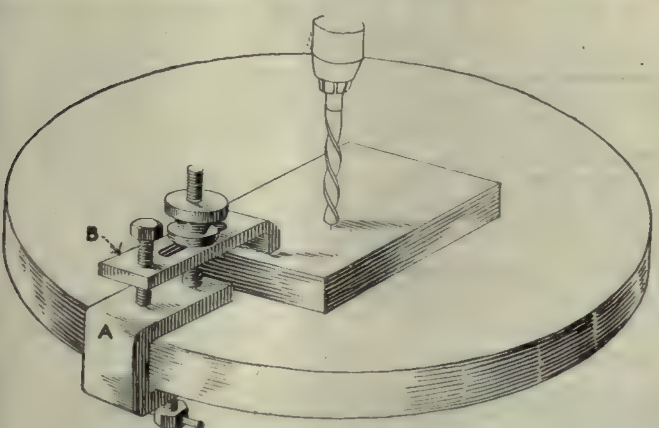


Inexpensive Clamp for Drilling Machine

By C. H. Willey

Some time ago one of our shopmen was hurt while drilling a piece of work which he held with a monkey wrench. In forcing the drill through the piece, the work caught as the drill came through and jammed the man's fingers against the drill-press column. The accident prompted me to design and make several simple clamps as shown in the sketch.

These clamps are very simple and inexpensive to make, being constructed almost entirely of flat bar stock



A SIMPLE AND INEXPENSIVE CLAMP

and stock screws. The section *A* clamps anywhere on the machine table and the strap *B* is adjustable in and out and to any angle.

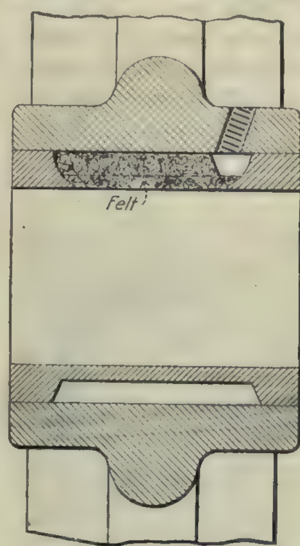
A pair of these clamps will be a valuable asset to any machne shop.

An Oil Reservoir in a Loose Pulley

By E. Shaff

On page 414 of the *American Machinist* is shown an oiling kink for a loose pulley. The plan is good but has some drawbacks. If much oil is used it will run out through so many holes while if little is used the holes become clogged in time and there is no way of opening them except to remove the bushing.

The following plan I have found to be better, and I have tried both. The pulley is bushed in the same way but, instead of drilling holes, a slot about $\frac{1}{4}$ in. wide is milled and the felt placed in this, one edge of the felt coming in contact with the shaft. The oil hole is in line with the slot and a corner of the felt is cut off to allow the oil to enter freely.



OIL CHAMBER IN LOOSE PULLEY

The reservoir can be filled nearly full of oil and there is little tendency for it to run out. If the felt becomes clogged it can be loosened by inserting a wire or other like article through the oil hole.

My experience has been that cast iron, if treated right, is equal or superior to bronze for bushing loose pulleys. The last cut should be taken with a keen-edged tool at not too high a speed and finished by scraping or reaming with a sharp reamer. It should be washed out with oil to remove any dust, and kept well oiled for a few days until it has become glazed over.

Obtaining the Radius of Three Equal Inscribed Circles

By Henry R. Bowman

Given an equilateral triangle with sides *A*; required the radius *R* of three equal circles which will be tangent to the triangle and to each other.

The above problem came up in the drawing room and as a solution could not be found in any handbook, I derived the equation: $R = \frac{A}{2} \times 0.366$ through the following demonstration:

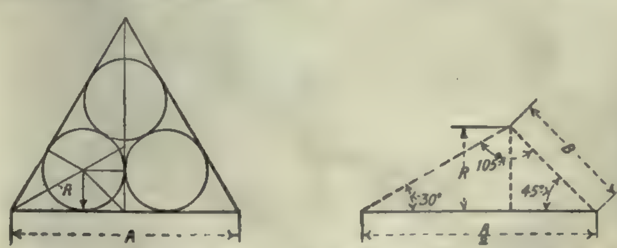


DIAGRAM FOR CALCULATING RADIUS OF THREE EQUAL INSCRIBED CIRCLES

The radius R is evidently normal to two sides, and the altitude and a line passing through an apex of the triangle and the center of a circle, will include an angle of 30 deg. giving the triangle on the right of the illustration:

$$R = B \sin 45^\circ = 0.7071B$$

$$B = \frac{\frac{A}{2} \sin 30^\circ}{\sin 105^\circ} = \frac{0.5 \times \frac{A}{2}}{0.9659}$$

$$R = \frac{0.7071 \times 0.5 \times \frac{A}{2}}{0.9659} = 0.183\,A.$$

Molding a Drum with Deep Sand Pockets

By E. A. Dixie

The casting, both ends of which are shown in Fig. 1, was produced by a molder from a pattern which, except for the core prints for the cored central holes, was exactly the same shape as the casting.

The molder referred to was a highly skilled man, but with all his skill and resourcefulness was able to produce only three castings a day, and that with the best of luck on his side. If the sand pockets were rammed too hard they would blow, and if too soft they would wash.

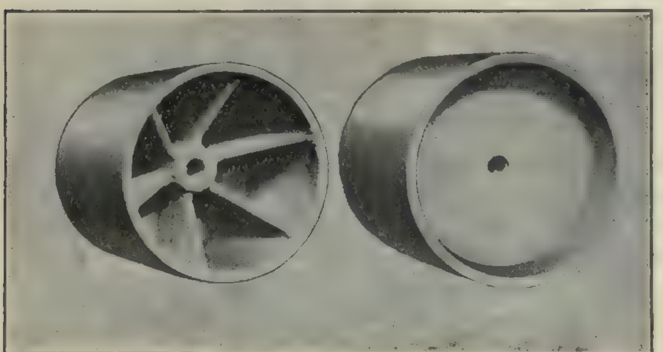


FIG. 1. THE WORK

Recently the pattern was sent to our foundry. We have a few skilled men to handle work that requires the employment of a skilled molder but wherever a job can be put on the jolting machines we always do so. With the pattern came an order for 50 pieces so it was possible to do a little work on the pattern and still save much on the cost of the finished castings.

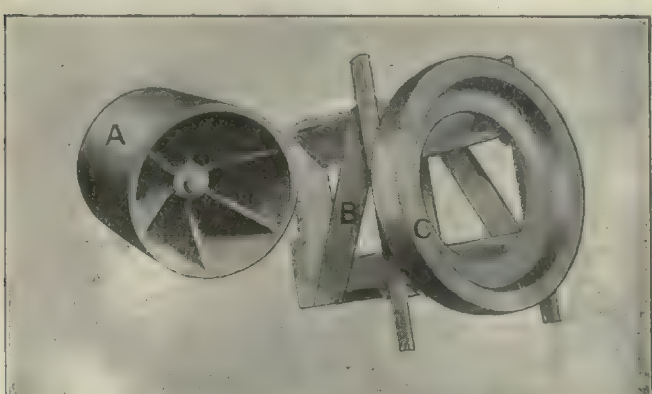


FIG. 2. THE PATTERN AND COREBOX FRAME

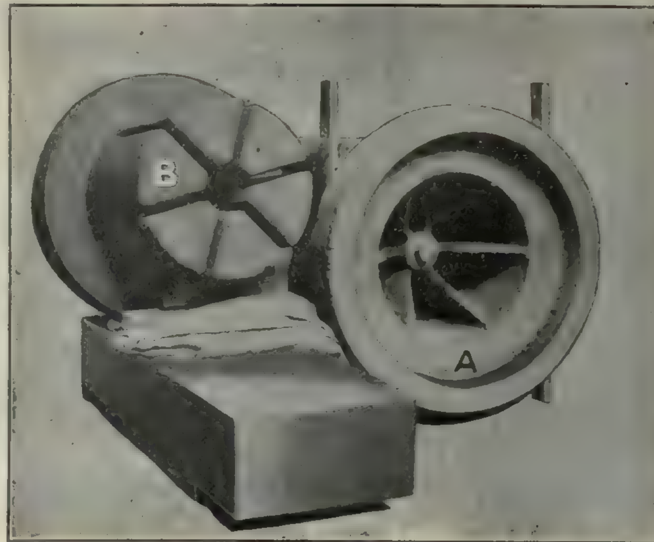


FIG. 3. THE COREBOX AND A CORE

The sand pockets are 9 in. deep and everyone knows what a job it is to support this deep body of green sand. It was therefore decided to cast the deep end of the pattern in a core. The pattern supplies the nucleus of the corebox around which the patternmaker built the holder and print shown in Fig. 2. Here A is the pattern and B is the holder with the print C around the top of the pattern.

In Fig. 3, at A, is shown the corebox complete as it is used by the coremaker and the finished and dried core B along side it. With this outfit a coremaker can make 20 to 30 cores a day. The patternmaker's time on the job of transmuting the pattern into a corebox was about 3½ hours.

With a number of cores made the pattern is removed from the holder and secured in the jolting machine as shown in Fig. 4. In this illustration A is the pattern with the shallow end up. To the lower end of the pattern the print B is secured. This print is provided with runners and riser C. The flasks are placed and rammed one after the other, the upper flask carrying the green-sand pocket for the upper end of the pattern. The mold is now removed and turned over as shown in

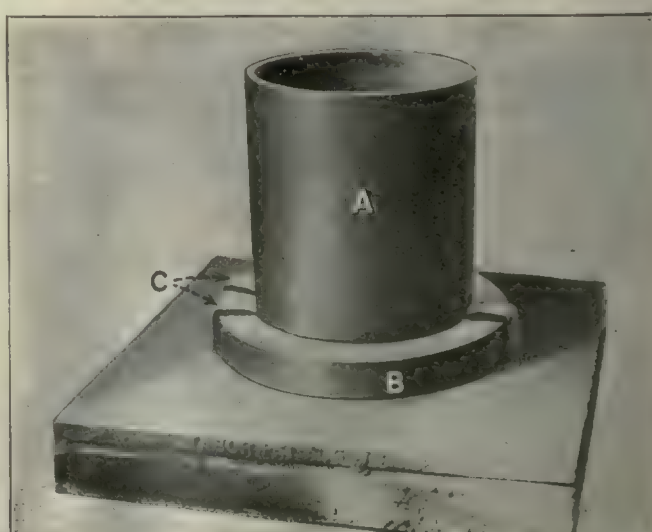


FIG. 4. PATTERN ON THE JOLTING MACHINE, SAND POCKET DOWN

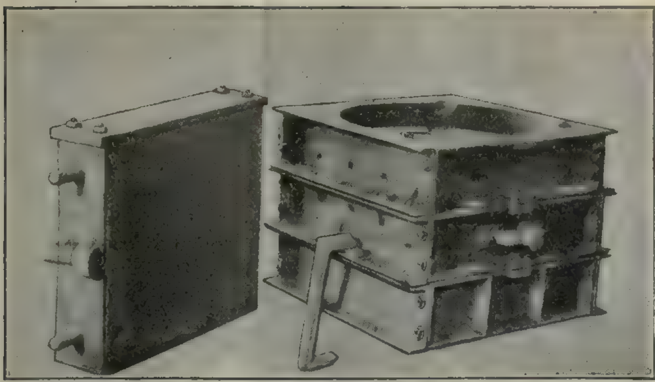


FIG. 5. THE MOLD READY TO CLOSE

Fig. 5. In this view the depression left by the core print is visible. The mold is now ready to close, which is done by lowering the core into its place.

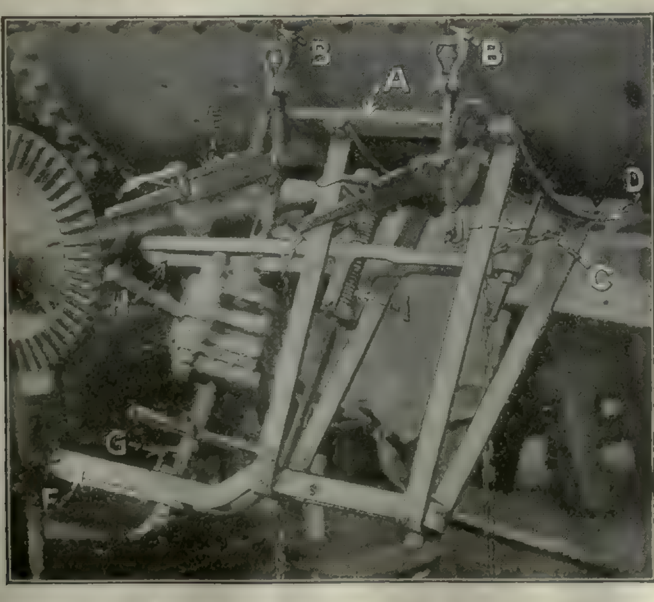
By the old method a skilled molder could perhaps produce as high as three castings a day. By the methods shown practically unskilled labor can produce at least ten molds a day with very little chance of a poor casting.

This same method of molding has been used by us for the production of cone pulleys and other castings which have deep sand pockets, with the result that the unskilled molder can, with the aid of a machine, produce from three to ten times as many castings as the skilled molder, and have fewer losses.

Drill-Motor Frame for Drilling Boiler Shells

By J. V. Hunter

A frame for holding portable drill motors has been developed in the steam-engine erection shop of the Minneapolis Threshing Machine Co. It is for use when drilling in the boiler shells, the holes required for the assembly of the various brackets. Unlike many of the common "old men" this frame does not depend upon the finding of a convenient hole in which it can be bolted, but instead it can be clamped and adjusted in a few moments to any portion of the boiler surface. The illustration shows it in use.



FRAME AND MOTOR UNIT USED FOR MILLING BOILER SHELLS

This frame rests on two strips *A* which bind the main V-shaped legs together, the construction being such that the frame may be used on shells of much smaller radius than that shown. The device is held to the shell by a pair of cables *B*, each terminating at one end in lengths of chain *C*. This permits of ready adjustment for the varying lengths required by merely taking up the necessary number of links where they are held at the point *D*. The other end of each cable terminates in a link connected to the fulcrum lever *E*. This lever is used to draw the cable to the requisite tautness, it being held in position then by a latch which engages a toothed quadrant secured to the frame.

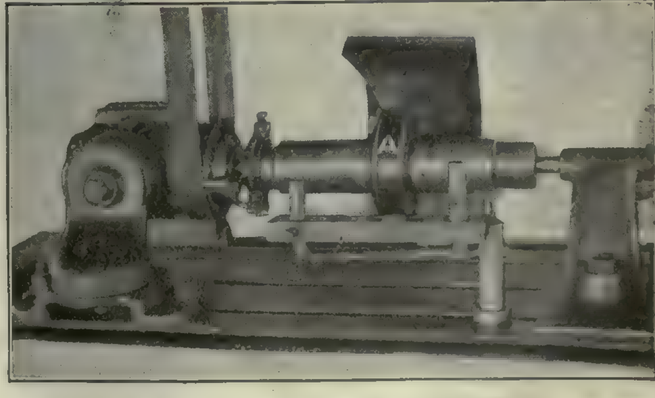
Although the frame is fastened rigidly when the holes are being drilled, the air motor carrying the drill is not. It can be moved in the direction of the length of the shell, so as to enable the drilling of a row of holes without changing the position of the frame. At the rear end of the air motor is a screw for feeding the drill while cutting, this, in turn, resting upon the block *G* which slides in the slotted arm *F* of the frame. The loop *H*, fitting around the spindle, serves to keep the motor in its proper position. To the middle of the loop is attached the spring *I*, the purpose of which is to hold the feed screw against the block *G* and to help in withdrawing the motor when the hole has been drilled. The threaded stud *J* serves both as a fulcrum for the loop *H*, and as a means of adjustment for changing the position of the loop and its pressure against the motor. To resist the torque of the cut the handles of the motor must be held, just as is done when the motor is used without the frame

A Simple High-Speed Polishing Device

By J. H. Vincent

Numbers of small parts such as the high-speed pulleys used on universal grinding machines, require polishing in the plant of the Oakley Machine Tool Co., Cincinnati, and for this work the device shown in the illustration has been rigged up. The angle-bracket headstock and the tailstock have been taken from one of the standard grinding machines and mounted on an old machine-tool table. The latter is supported by a table set on heavy wooden posts, so that the unit is entirely self-contained.

The pulley *A* is carried by the arbor and while being polished is driven at a high rate of speed. The headstock spindle is driven by a belt from a large pulley on the line shaft overhead. The rest *B* is provided for the support of the polishing tool.



A SIMPLE HOME-MADE POLISHING DEVICE

WHAT *to* READ —*for the man in a hurry*

Suggested by the Managing Editor

Nobody who is holding down a man's job has time to read all of the "American Machinist." On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials —they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.

THE third major section of our series, covering comparative methods of machining automotive engine parts, appears as the leading article in this issue. It treats of connecting rods as they are handled in five well-known shops, Packard, Cadillac, Peerless, Chandler and Franklin, exhaustively but not exhaustingly. Transformation charts are used effectively as in previous sections of the series. Following the leader we have, on page 1035, the second part of Mr. Sherlock's series on Insurance. Just here we wish to correct an erroneous impression with regard to Mr. Sherlock for which we alone are responsible. He advises us that he is plain "mister" Sherlock and not Professor Sherlock, as we have misnamed him heretofore. We can sympathize with him in this matter as we have had some experience of the same sort. Before the war we had a job as instructor in an engineering school in a small town and it was one of our worst trials to be called "Professor!" by the leading social luminary, outside the faculty, who was large, Austrian and oppressive, and whose voice easily carried over any conversational or railroad-car noises. Hence our apologies to Mr. Sherlock.

Then, on page 1037, "Old Baldy" entertains some visiting young ladies in his shop with descriptive terms that are entirely misleading to the sightseers.

The remaining installment of the method employed at the plant of the White Motor Co., "Increasing Production Without a Bonus," starts on page 1041. Some of the ideas may be radical, but the results sound worth while.

Stellite as a gage material is discussed by H. H. Van Keuren, formerly with the Bureau of Standards, on page 1045. The article is aimed principally at the engineers and toolmakers and opens a new field for consideration. While making the most of the good points of stellite for gages the author does not minimize the difficulties of forming this very obstinate material.

A. L. De Leeuw has the third installment of his manufacturing article on the machining of the cradle forging for a gun recoil mechanism, on page 1049. Mr. De Leeuw's work as a consulting engineer and as an important contributor to the *American Machinist*, leads us to give him a place on this page this week as a sort of an introduction to *Machinist* readers. Previous to the date when he hung out his shingle as a consulting engineer, Mr. De Leeuw was, for five years, chief engineer of the Singer Manufacturing Co., of Elizabethport, N. J., and before that was chief engineer for the Cincinnati Milling Machine Co. and the Niles Tool Works.


A. L. DE LEEUW, CONSULTING ENGINEER
Author of "Unusual Methods of Securing Extreme Accuracy."

Over on page 1059 is the concluding part of Donald A. Hampson's "Automobile Work and the Machine Shop." Some practical hints on the best equipment to install for this work are included and also some sound advice on certain kinds of jobs which should not be attempted. Mr. Hampson brings out a point of difference between ordinary machine-shop and automobile work which is too often lost sight of. Factors of safety in motor cars are sometimes very low and the consequences of breakage of repaired parts are far more serious. Following this article is one by R. S. McBride, describing the remarkably complete airplane-engine testing laboratory at the Bureau of Standards.

Automobile Work and the Machine Shop

By
Donald A. Hampson

A serious question with which the present or prospective machine shop owner who contemplates getting into the "automobile game" will be confronted is in respect to the nature and extent of new equipment he will be called upon to provide. This question, as well as what to do and what not to attempt in the way of automobile work is here discussed by the author, who adds a few valuable hints on spare time work that can be made to turn slack periods into profit.

(Part I appeared in last week's issue.)

II. Equipment Required for Automobile Work

WHAT extra equipment is needed to handle automobile work? None, if the shop is fully equipped to do first class general repairing and machine building. But if it is a small shop contemplating expansion, or if equipment is being purchased for a new small shop, there is need for careful study and much discrimination.

One or more lathes are essential. If only one is being purchased, it should swing a piece 15 or 16 in. in diameter and it should be one of those "titled" lathes—H.S., C.R., T.A., P.C.F., etc.—the hollow spindle being indispensable for bar work, the compound rest is fine for valve and other angle turning and for thread cutting, the taper attachment is the safest way of duplicating the ends of axles and gear shafts, and the power cross feed is a help in facing flanges.

If two lathes are purchased, one might well be a speed lathe; its cost is small and it saves the other lathe for heavier, more elaborate work while filing and scraping and much drilling can be done to better advantage on the hand lathe, which should be belted up to a higher speed. A lathe that takes 36 in. on centers is long enough for nearly all automobile work; drive shafts are the only pieces longer than this, and these rarely show up for lathe work.

Very Little Planer Work Likely

There is practically no automobile work that calls for the use of a planer. At rare intervals, a welded crankcase may come in for re-facing or the flanges of a manifold need similar attention, but that is about all. A large true flat surface such as a planer table is, however, of much value in laying out work and for lining up or testing. The shaper is of only passing value except in the absence of a milling machine when it can be made to do keyway work and square shaft ends, though not as quickly and as accurately as the latter.

The milling machine need not be larger than a No. 1 plain. It should be equipped with a 1-in. arbor and cutters for several standard widths of keyways as well as one or two slab milling cutters. A Woodruff key equipment is also useful. Centers are of little value for automobile work alone.

An upright and a sensitive drill press are necessary. These should be supplied with a full set of tools up to 1 in. and the upright equipped with a chuck (for straight shank drills) for this class of work. The portable electric drill of ½-in. capacity is a worthy auxiliary.

A good powerful press is as necessary as the lathe. The ordinary arbor press has not the power nor the range. A rugged grinding wheel stand is essential; its equipment should include a general purpose wheel, goggles, and a dresser. If one end of the spindle is fitted with a disc wheel, a multitude of jobs will be found that are just suited for it. Grinding gear teeth is a frequent job that is one for which an extra charge should be made, taking into consideration the wear and tear imposed by these hard pointed surfaces. A tool-post grinder should be supplied for the lathe for grinding hardened parts on the centers; then, if funds are low it can be rigged up to make a fine bench grinder for light work, when not employed on a lathe.

A full equipment of reamers, both solid and expansion, ought to be in every shop; also taps and dies from ¼ in. up to and including 1 in. of both the U. S. standard and the S. A. E. A number of unstandardized fine threads are encountered on shaft and axle ends; these can be successfully handled if the S. A. E. dies are of the adjustable kind, such as the Morse, and may be set for a number of different diameters through a range of perhaps a quarter of an inch.

Forging and Heat Treating

The forge and anvil have an important place in repairing—bending and straightening, tool dressing, "ironing," hardening, etc. A small gas furnace is not expensive and is cleaner than the forge fire for small work. The bunsen burner on a gas fixture is worth all it costs for little annealing jobs, tempering, and coloring. Some provision for sheet-metal work and soldering might be made and if there is a carpenter in the shop, he may be coached in the occasional pattern that may be required.

Heat treatment plays such an important part in

automobile steels and, the proper kind of treatment being possible only with elaborate and expensive furnace equipment preceded by scientific analysis and selection, it is folly for anyone not having such equipment to pretend to deliver parts up to original strength. Any shop not in the business that offers to produce gears and springs and sliding gear shafts and pivot pins just as good as the factory parts is a good one to avoid until a rigid investigation has been made by a competent person.

Any repair shop man is foolish to attempt such work until he has put in the proper equipment to handle it. There may be cases where it is excusable to turn out one of these makeshift jobs; in such cases, the car owner should sign and deliver a statement in duplicate accepting all risk and responsibility. This statement may later prove of real value to the shop.

Avoid Welding if Possible

Welding equipment would be given the first place on the list by many men. The writer would leave it out entirely. If done by specialists who have full equipment and broad knowledge, welding of many parts is all right but the presence of a couple of tanks and a torch and a "man who welds all the while" does not guarantee any sort of work that the writer wants to have on his car. At the risk of seeming to knock, the writer advises the would-be auto worker to avoid welding and he bases his advice on experience with the rank and file of city and country welders. The best way is not to have the equipment; there is then no temptation to try the "easy" job.

Welders are like bar tenders—they pass off an undesirable load on a man and then kick him out to get on as best he can. Not long ago a man came into our plant with a cylinder to be ground out. It had been cracked, and a piece of the base flange broken off. In welding, a hard ridge had been left inside the bore; yet the welder was the best in town and worked in a machine shop as big as ours. He had repaired the cylinder as requested but the poor customer, who had been led to believe that welding was an easy way out, was as badly off as before.

It would be an unpleasant revelation to many to follow up the welded jobs; to learn of the work that needed to be done before the welded part was restored to usefulness; to know how the piece broke a month later and nearly caused a death.

Almost without exception it is cheaper and safer to buy a major part than to have it welded. Other machinery is an exception but the stresses under which motor cars operate are so severe and the materials so varied, needing such careful treatment to attain their full strength, which even then leaves but a meagre factor of safety, that welding is a repair process to be attempted only in an emergency.

As life and limb are dependent on properly made vital parts of every automobile, it is of utmost importance that the man in charge of a repair shop have a full knowledge of automobile construction and of the materials used as well as a vivid conception of the stresses imposed by road work at the hands of careless drivers. It is just as important to know when to say "no" as to know what grade or kind of metal to put in a certain part. The shop man will be coaxed and begged to make a spring or a pivot pin or an axle or some other part of the steering gear under conditions that he knows will not produce a piece of requisite strength—coaxed to do it "just to get me out of this hole, then I'll get a regular piece put in." Experience has shown that these makeshift pieces are not replaced until an accident occurs. The machinist who was persuaded, and who had misgivings all along, then kicks himself for ever doing what he knew to be unsafe.

Slack Time Work

Are there any stock jobs than can be made up in slack hours? Yes. In one shop they made up Oldham couplings of a size that was frequently called for, and couplings of a semi-Oldham type used on starter shaft ends. It was a hilly country and axles frequently twisted off; these were made up of a good grade of axle steel and kept in stock for the cars most extensively used. Cored bronze bars were bored and reamed to standard sizes ready to be cut off for bushings (in this connection, a good way to avoid the waste ends that remain is to use them up inside of a gear where a two piece bushing is fully as good as one continuous piece).

Horn brackets of sheet metal are used on many cars, and these can be made in spare time.

Summing up, it may be said that the machine shop can take on automobile work and make an all around success of it if the owners have broad knowledge and keep themselves informed; if there is discipline in the shop, and both will power and sense of justice ready to hand in dealing with customers.

Repairing Dredge Buckets

By Frank C. Hudson

Among the varied work which comes to a shipyard is that of repairing dredging buckets, the accompanying illustration being secured in the yards of the Alabama Drydock & Shipbuilding Co., Mobile, Ala. The bucket at the left shows how thin the edge has been worn, while the half on the platform is having a new sheet put in place as a reinforcement.

The sides of the bucket have been trimmed off by oxyacetylene so as to meet with a fair degree of accuracy. Then the reinforcement is formed and drilled. The familiar type of "old man" is still in use, this being held in position by a heavy C-clamp over the foot. The old ratchet drill has, however, given place to the pneumatic, which not only reduces the time but also the muscular efforts of the workmen. In the background is shown a storage rack for plates used in the construction of standardized ships.

REPAIRING WORN DREDGE BUCKETS

A New Engine-Testing Plant

BY R. S. McBRIDE

This is a description of the engine-testing plant of the Bureau of Standards, particular attention being given to the apparatus used when testing airplane engines, for simulating conditions encountered at high altitudes.

THE Bureau of Standards has developed one of the most complete plants ever built for the testing of internal-combustion engines, and, incidentally, has made it possible to be safely on the ground with full control of an airplane engine while operating it under conditions similar to those found 30,000 ft. in the air. The new altitude laboratory at the Bureau contains many ingenius and unusual testing devices which are of considerable importance, not only to those interested in gasoline engines but also to others concerned with any type of power equipment testing. The work of this laboratory will be of very great significance, for many fundamental problems are being investigated.

It is generally recognized that conditions at high altitude are very different from those on the surface of the ground, but it is usually not realized how important these changes are for engine operation. For example, we know that it is necessary to supply an aviator with oxygen so that he may breathe when at a high altitude, but the engine is not provided with any such auxiliary equipment. Therefore it is necessary to so design as to operate under conditions that will take advantage of the best possible combinations of the factors involved, or otherwise large losses of power and fuel efficiency will be encountered. For example, at 20,000 ft. the atmospheric pressure is about one-half that at sea level, at 30,000 ft. about one-third sea level pressure, and the power production from the engine is reduced almost in proportion to the reduction in atmospheric pressure under which it operates. On the other hand, the fuel efficiency at high altitude does not decrease greatly; in fact, the fuel used per horsepower does not change materially until an altitude of 5,000 to 10,000 ft. is reached, after which it begins to increase.

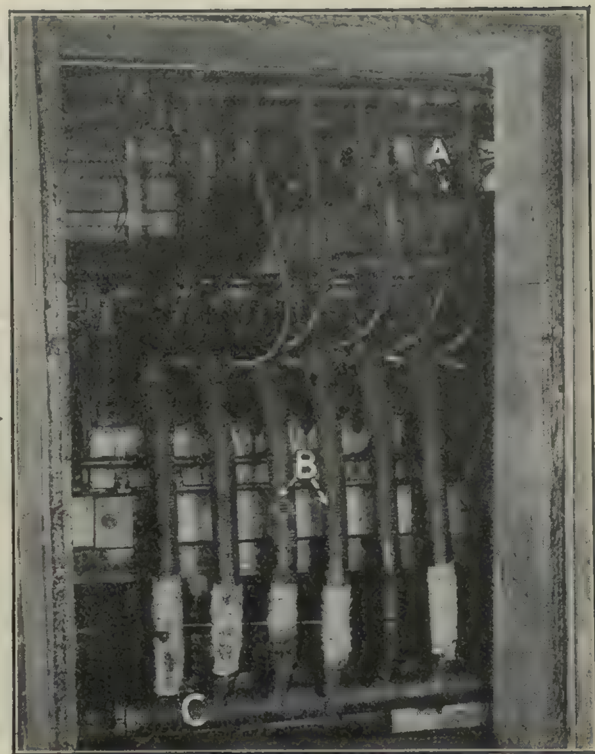


FIG. 2. LIBERTY 12-CYLINDER ENGINE SET UP IN ALTITUDE CHAMBER

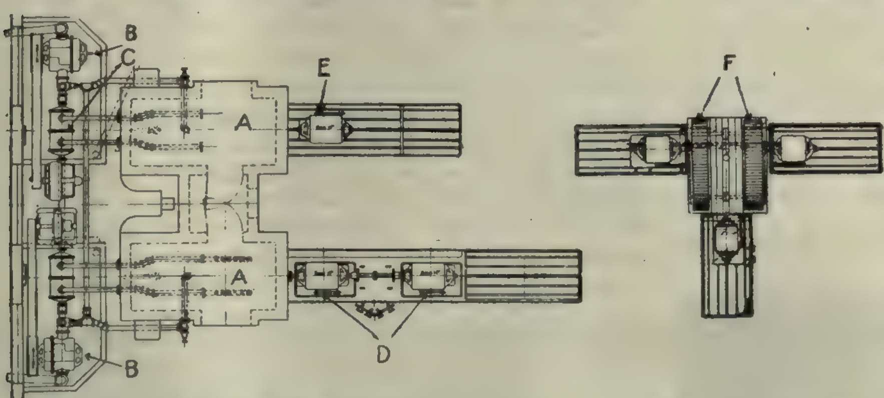


FIG. 1. PLAN OF THE PRINCIPAL APPARATUS IN THE NEW ENGINE-TESTING LABORATORY OF THE BUREAU OF STANDARDS

It was because of these general facts that various problems in engine performance had to be investigated as completely as is being done at the Bureau of Standards. The various factors studied include pressure, temperature, operating speed, kind or grade of fuel, gasoline-air mixture proportions, spark setting, jacket water temperature, oil temperature, back pressure on the exhaust, throttle opening, mechanical losses, and numerous other variables.

During the war period this work was housed in temporary buildings, but a new laboratory has just been completed. This is a substantial brick and concrete building about 50 x 150 ft., designed particularly to house the large altitude chambers, the car dynamometer and the various parts of the auxiliary equipment. Fig. 1 shows the layout of the main portion of the testing floor. The altitude chambers *A*, which are the most interesting part of the installation, had to be so designed and built that the conditions within them could be adjusted to duplicate any that are likely to be encountered at altitudes up to 40,000 ft. Each of the two chambers is 15 ft. long by about 7 ft. wide and 7 ft. high. They are thus of ample capacity for the largest airplane engines. Each chamber is built up of reinforced concrete, 12 to 14 in. thick on four sides, top and bottom, in order to resist the great pressure which is developed when the atmosphere within the chamber is reduced to a quarter or a third of the pressure without. For thermal insulation, the chambers are lined with a 2-in. cork layer. Access to the chambers is had through large counterweighted doors, which slide up out of the way and permit free access for either installation or

working about the engine under test. The engine itself is mounted on a heavy wood frame, which has been designed to be as nearly as possible of the same flexibility and inertia characteristics as the typical aëroplane-fuselage mounting.

The pressure within the chamber is reduced to any desired point by the operation of a Nash hydro-turbine type vacuum pump, *B* in Fig. 1, which has a rated capacity of 1,500 cu.ft. of air per minute when operating against a 12-in. vacuum at 300 r.p.m. This exhauster is belt driven by a 75-hp. motor, and is capable of lowering the pressure to that normally existing at 30,000 to 40,000 ft. altitude, or, in other words, about one-third to one-fourth of an atmosphere. The air circulated through the chamber and that supplied to the engine intake is cooled by passing over refrigerating coils. These coils are operated in connection with a York ammonia compressor using the direct ammonia expansion system. The installation, which is not seen in Fig. 1, is rated at 25 tons ice equivalent per 24 hours, and it is operated by a 50-hp. motor. All of this equipment is duplicated for the companion chamber, so that each cooling unit can be operated independently of the other.

The air for the engine intake is cooled in a separate set of coils and controlled separately throughout. The temperature in the chamber as a whole can be lowered to about zero centigrade, but the intake air can be cooled to minus 25 deg. C. The air to the engine, after passing over its cooling coils, goes through a settling chamber in order to eliminate the fine snow which is often carried in suspension. From here it is metered by three Venturi tubes, *A* in Fig. 2, arranged in parallel and passes through control valves to the engine intake.

The exhaust from the engine is cooled as rapidly as possible by water jackets around each exhaust outlet. The water-supply connections for these jackets can be seen at *B* in Fig. 2, which shows an engine mounted and ready for test. After this preliminary cooling in the water jacket, the exhaust gases and the cooling water mix together in the exhaust manifold *C* in Fig. 2, and are drawn out into a separating tank *C* in Fig. 1, and the exhaust gases are then taken out by the large vacuum pump and discharged outside the building. Air circulation in the chamber is arranged for by means of fans appropriately installed to direct the air current over the cooling coils and around the engine. It is estimated that this system will be adequate even to care for tests of air-cooled engines, though none of this type of equipment has yet been tested.

The two altitude chambers are connected together through a small vestibule, thus permitting the use of either set of cooling coils or both, as may be required; but either chamber can be operated independent of the other, thus permitting tests on one engine to be in progress while another engine is being set up in the other chamber.

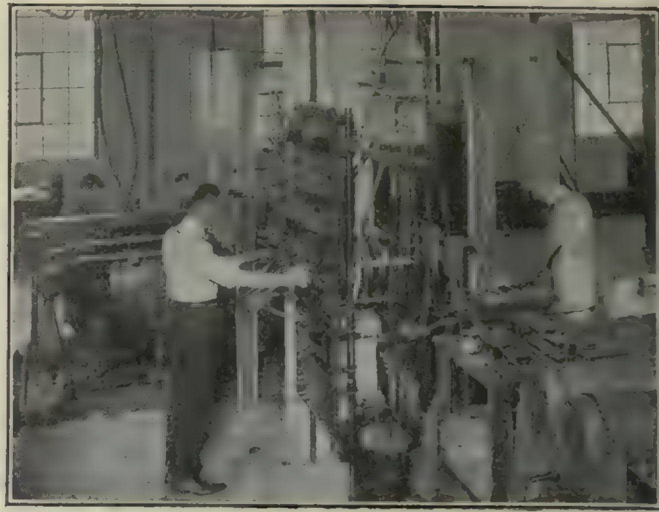


FIG. 4. TESTING A SINGLE-CYLINDER LIBERTY ENGINE FOR RATE OF FLAME TRAVEL

The power delivered by the test engine is measured by a combination dynamometer and water-brake system. On one of the chambers two dynamometers, *D* in Fig. 1, each of 300 hp. and a 400-hp. water brake not shown, are connected together in such a manner that the indications of all three can be weighed upon a single scale. Thus a total of 1,000 hp. can be measured directly by a single indicating mechanism. The other chamber is equipped with one 400-hp. dynamometer *E* to which a water brake of any desired capacity can be added in case of need.

The power developed by the dynamometers can be thrown into the power system of the Bureau, it can be dissipated by resistence grids alone or it can be used in operating the auxiliary motors and the balance absorbed in the resistance grids, which are then allowed to float upon the power line. For practical purposes, however, the best experimental results are found when all of the current generated in the dynamometer is dissipated through the resistance grids, because in this manner the most uniform and controllable conditions of tests are obtained. These grids can be seen overhead in Fig. 3, which shows a general view of the laboratory, the altitude chambers being in the rear on the left side.

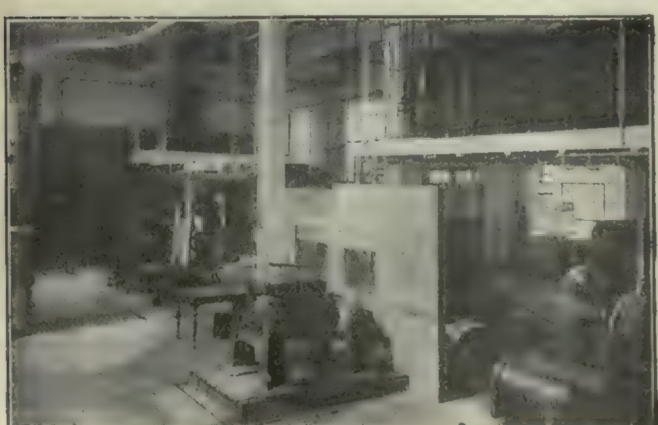


FIG. 3. GENERAL VIEW OF THE LABORATORY

One very great advantage in the installation of the new laboratory is the arrangement of the controls for the engine, the air system and the dynamometers, all of which are brought near together, so that a single operator has complete control of the system without moving from his regular position of observation. It is thus possible very quickly to adjust conditions for a test, carry through the observations and be ready for a new adjustment of conditions.

The complete determination of a heat balance in the system requires the determination of the fuel used by weighing and the estimation of the heat gained in combustion of lubricating oil, which together make up the total energy input. The output of energy is distributed to the brake-horsepower, measured by the dynamometer system, the heat lost in the exhaust, the

heat lost in the jacket water, the heat lost by direct radiation, and any mechanical losses. All of these quantities of heat depend upon the temperature, density of the air and many other factors. Practically a complete calorimeter system has been developed for measuring these different losses when complete determination of the heat balance is required. Temperature measurements are taken regularly at many points throughout the system, not only for control purposes but also to permit of thermal calculations.

Additional Equipment

Not content with studying the altitude effects, this laboratory has also developed an elaborate dynamometer system for car, transmission, axle, and engine testing for all sorts of automotive vehicles. By various combinations of dynamometer, water brake and prony brake, this apparatus can determine the effectiveness of operation under all varieties of conditions or for any part of the system. The engine itself, the transmission system, the differential and even the power delivery on the road, as judged by the application of the tire or service wheel to drum, can be separately studied.

For this work three dynamometers having capacities of 50, 125 and 150 hp. respectively, are installed on three sides of a rectangular pit in which the drums (shown at *F* in Fig. 1 and on the right in Fig. 3), and transmission outfit are placed. Extensive tests of lubrication and differential problems will be possible with this outfit since any one of the three dynamometers can be used either as a measuring or as a driving unit.

Each of these three dynamometers can also be used separately for independent investigations. For example, one of them, shown at the left in Fig. 4, is now being used in connection with tests on a single-cylinder Liberty engine built to study the rate of flame propagation within the cylinder while operating.

Flame Travel Determined by Triple Spark-Plug System

The means of determining the rate of flame travel within the cylinder has been very effectively developed here by a triple spark-plug system. At the time the flame of burning gas and air mixture passes over the spark plug the gases are ionized and a reduction in electrical resistance results. This permits the passage of a spark across the gap. The spark plugs are connected to a spark chronograph (which is being adjusted by the operator at the right in Fig. 4) or an oscillograph and the relative time of passage of the flame past these three points can thus be measured. A full description of this particular installation has been given by MacKenzie and Honaman in the *Journal* of the Society of Automotive Engineers for February.

A recent report of the laboratory gives a list of a number of tests of quite a broad range which have been carried on already, and plans for the investigation of more engine problems in the near future have been made. A determination of the optimum compression ratios for various altitudes is being made now, and it is planned to investigate such things as carburetor adjustment for altitude changes and the influence of temperature upon power production.

An Experience with the Metric System

We have received about all of the literature that has been sent out by the "World Trade Club." It has impressed us from the first as being of foreign origin and we have felt it to be insidious propaganda operating toward an accomplishment of some end that was not at all clear. It was, and is, one of those things at which all Americans, foolish though the Germans believe them to be, instinctively shy.

The writer was personally employed in one of the large factories in Germany during 1907-08 and instead of finding that the metric system was the only system in use, as the above mentioned propagandists would have us believe, he found not less than *four* systems; and he believes that this pandemonium of measures is general, not only all over Germany, but Europe as well.

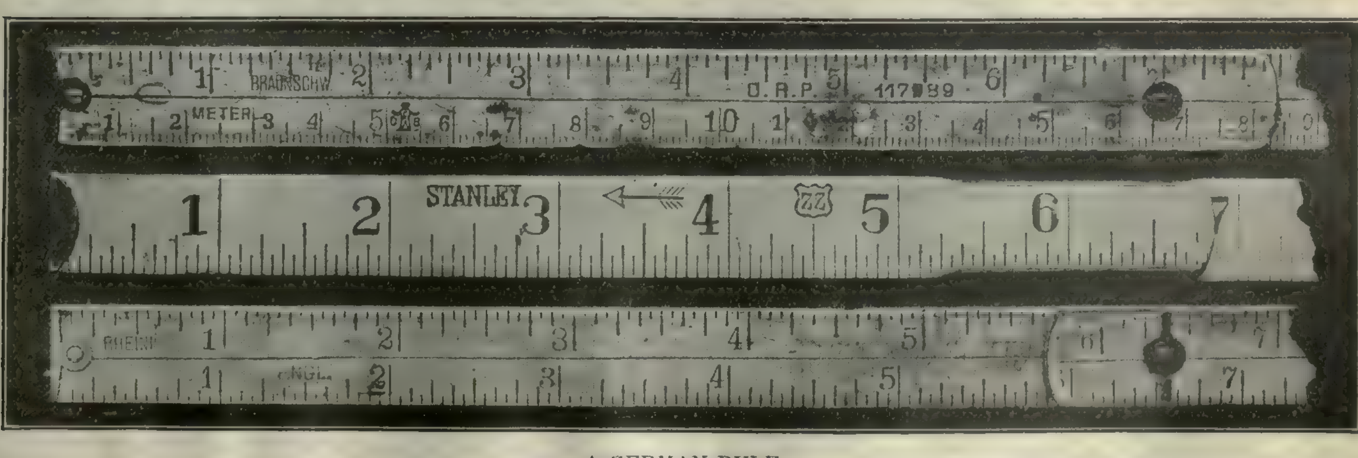
There is no doubt that "Some One" is very anxious to have things cleaned up, and as he (or they) is more used to thinking in terms of metric measurement, the metric system would naturally suggest itself as a foundation upon which to build that would involve less trouble than any other.

The last paragraph of Harry Senior's letter on page 631 of *American Machinist*, in which he speaks of the various sizes and shapes of letters and pamphlets received from the "World Trade Club," draws a good picture of the chaotic condition of measuring systems in Europe and indicates the crude processes of reasoning peculiar to the European mind.

I am inclosing part of a rule that was used in the German factory where I worked. No doubt such an instrument was used in measuring up the literature to which Mr. Senior referred. L. C. Sharpe,

The L. C. Sharpe Manufacturing Co.

[The halftone shows *both* sides of the rule mentioned by Mr. Sharpe with a standard American rule between the two views.—Editor.]



A GERMAN RULE

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs and equipment

Ingersoll-Rand Drill-Steel Sharpener

A compressed-air operated drill-steel sharpening machine, known as the I-R No. 50 sharpener, has been developed by the Ingersoll-Rand Co., 11 Broadway, New York.

This sharpener was designed primarily to sharpen and shank rapidly and exactly drill steel such as:

INGERSOLL-RAND DRILL-STEEL SHARPENER

cruciform steel up to 2 in. in diameter, or round, hexagon, octagon, quarter-octagon, auger or spiral steel up to $1\frac{7}{8}$ in. in diameter. When fitted with special devices it will forge bolt-heads, pins, stanchions, etc.

The single lever, which controls all of the operations of the machine, is fitted with a safety locking device. This prevents accidents by the impossibility of operating the machine unless the lock is released. The throttle valve is of the balanced spool type, operates easily and quickly, is positive and instantaneous in its action.

The hammer cylinder is an improved valveless type of hammer-drill cylinder. The construction permits the free-moving hammer to deliver fast and powerful blows against the end of the dolly, upsetting the steel and so forming the bits and shanks with extreme rapidity.

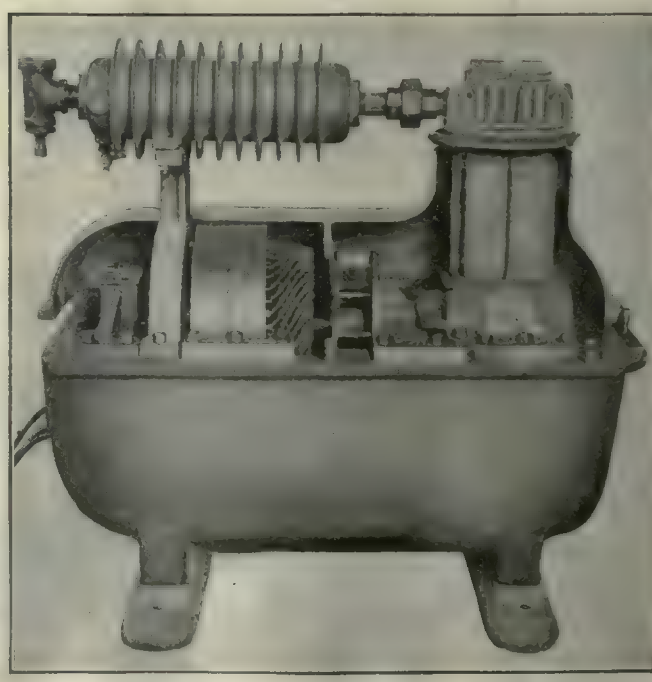
There are no sight-feed or other exposed lubricators. Positive lubrication is provided for the entire machine by a lubricator embodied in the throttle-valve chest casting that works automatically whenever the machine is in action. It is provided with adjustment for regulating the quantity of oil desired.

Black & Decker Electric Compressors, Nos. 46 and 412

The Black and Decker Manufacturing Co., Towson Heights, Baltimore, Md., has introduced the electrically driven air compressor illustrated herewith. The machine is furnished in two types, high and low pressure.

Both the No. 46 and No. 412 compressors are identical throughout except that the No. 46—the high-pressure machine—has a bore of $2\frac{3}{4}$ in., and the No. 412—the low-pressure machine—has a bore of $3\frac{3}{4}$ in. This means that the low-pressure machine can be changed over to high pressure, or vise versa, at any time by merely changing the cylinder and piston.

The No. 46 is designed especially for pneumatic truck tire work and other purposes requiring a good volume of air at pressures up to 200 lb.



BLACK & DECKER ELECTRIC COMPRESSOR

The No. 412 has an unusually wide variety of uses. Its capacity of 12 cu.ft. of free air per minute at pressures up to 75 lb. makes it unusually convenient.

The entire mechanism can be exposed for inspection or adjustment as conveniently as an automobile motor.

The entire unit is grease lubricated, including the cylinder walls, and fresh lubricant is required only at three-month intervals. There are no oil cups to fill frequently nor is there any oil level to maintain.

The unit, either type, can be furnished complete with tank, automatic starter, etc., for stationary installation, or as a portable outfit mounted on a three-wheel carriage, provided with a handle and brake to prevent outfit from rolling on inclines. The machines are completely piped and wired, ready to run as soon as uncrated and leave factory fully lubricated.

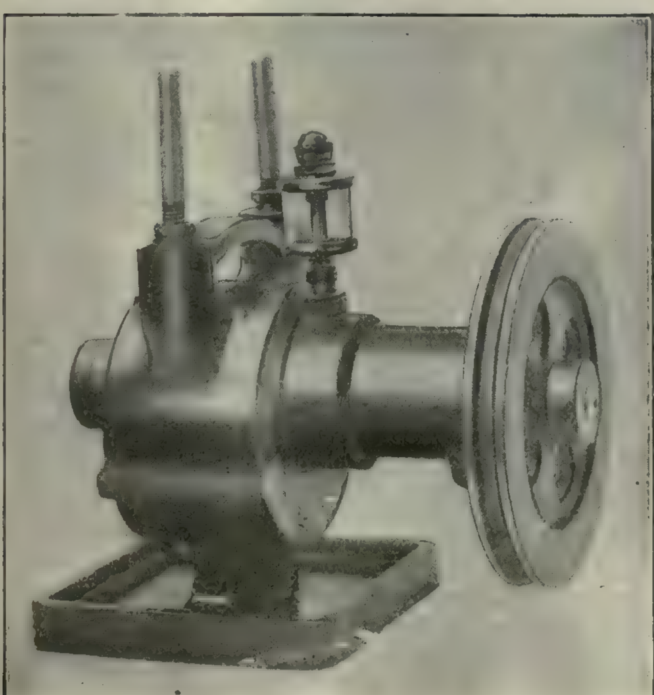
Either type is supplied for 110- or 220-volt direct curent, 220-volt two-phase, 110-volt three-phase 60-cycle alternating current.

Weight; net, 780 lb.; crated for domestic shipment, 1,000 lb.; for foreign shipment, 1,100 lb. Dimensions for foreign shipment, 62 x 26 x 62 in.

Newark Engineering Co. Vacuum Pump

The Newark Engineering and Tool Co., 476-482 Eighteenth Ave., Newark, N. J., has recently placed on the market the high-vacuum pump which is shown in the accompanying illustration, and which has been designed for producing the vacuum necessary in the manufacture of incandescent lamps. The builder claims that the pump has proved itself adaptable also to the making of X-ray and rectifying apparatus, scientific research and medical purposes, and the operation of vacuum furnaces.

The chief feature of the design is that the oil bath, in which pumps of this type are usually immersed for the purpose of preventing leakage, is eliminated and the vacuum is sealed by an internal oil seal only. The oil cup shown supplies the oil for the seal, located directly under it in the casing, and for lubricating the mechanism of the pump. The maker claims that this type of pump uses only 10 to 20 per cent of the amount of oil which is required for immersing the pump body when external sealing is employed.

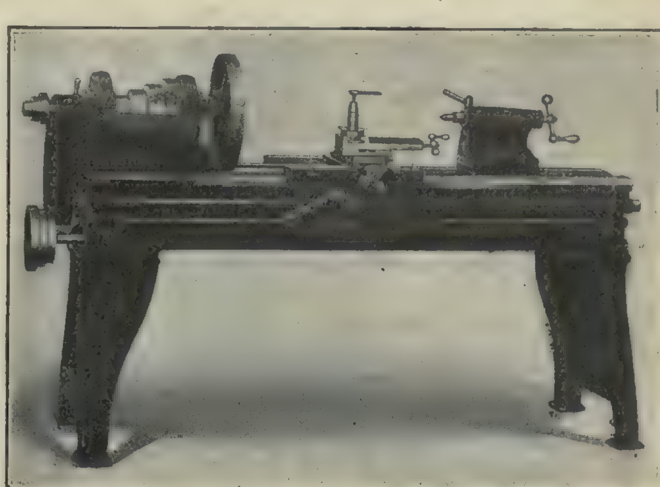


NEWARK HIGH-VACUUM PUMP

The pump is driven at a speed of 275 to 300 r.p.m. by means of a round belt running on a 7½-in. pulley, ¼ hp. being necessary. The pump as shown weighs 50 lb.

Sebastian Cone-Head Lathe

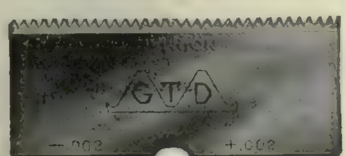
The lathe shown is a late design of the Sebastian Lathe Co., Cincinnati, Ohio. The headstock is of the semi-inclosed type and all gears are well guarded. The tailstock is offset, providing clearance for the compound rest when set parallel with the ways. The new design secures increased strength and is made in 13- and 15-in. sizes. It is also furnished as a gap lathe, the gap being 7¾ in. long and 3½ in. deep.



SEBASTIAN CONE-HEAD LATHE

The GTD Limit Screw-Pitch Gage

The GTD limit screw-pitch gage is a development by the Greenfield Tap and Die Corporation, Greenfield, Mass., wherein the handy, though old-fashioned, screw-pitch gage—which had no tolerance but was cut to a normal lead only—has been modernized and made more serviceable by providing it with two additional surfaces on the reverse side, one being cut with a lead 0.002 in. long and the other 0.002 in. short per inch, which converts it into a limit gage. When the old-style gage was laid in the thread of a screw it was only possible to tell whether or not the lead on the screw was normal, but it was not possible to tell how bad the error was. With the gage illustrated herewith, if it is found that the thread tested is not normal, it can readily be detected whether it is longer or shorter than the limit portion of the gage or whether the error is in between these limits.



THE GTD LIMIT SCREW-PITCH GAGE

These gages are made for the present to control lead limits of plus and minus 0.002 per inch, which is the most generally used lead limit. Eventually it is intended

to supply gages with tolerances of 0.001, 0.003 and 0.004 in. long and short lead.

As the gages are solid and without moving parts, they are not likely to get out of order easily and are in some ways preferable to flexible types of lead indicators.

When using these gages it is essential that the work being tested, as well as the gage, be clean in the threads and that the gage be held on the screw in a position parallel to the axis of the screw. In testing the thread, the work should be held up to the eye in front of a rather bright light, so that any resulting error in lead can easily be noticed.

Advice to Inventors

By R. V. Deane

I was much interested in reading James Leslie Lane's article on "Launching an Invention," published on page 404 of the *American Machinist*, and, while I agree with him on most points, I would like to take up the matter from a different angle, starting from the point where the inventor has secured his patent.

The writer was, for ten years, foreman of a jobbing shop which handled a good deal of work for the inventors; such work ranging from wire puzzles to automatic machines. From this personal association the point that stands out clearest in my mind is that the inventors who were the most successful financially were the ones that sold their inventions.

Mr. Lane states that the pessimist will usually tell the inventor that "inventors are seldom good business men," which statement I believe to be true, and I also believe it to be a fact that inventors as a class are not good production men. The average inventor is usually so interested in improving his invention, which is already commercially perfect, that he cannot take the time to manufacture it economically.

Many Inventions "Die Natural Deaths"

I have seen many inventions die a natural death because of being manufactured and marketed by a small concern without sufficient capital. Many small articles are absolutely worthless financially when made and sold independently, as the selling expense eats up all the possible profit, but if these same inventions had been marketed by a concern already manufacturing a line to be sold to the same trade they would have proven a valuable addition.

I have seen many men give the best years of their lives to trying to run a small business that did not pay, when they might have sold their invention at a good profit and have earned a good salary all the time. I recall a young electrical engineer who worked up an invention in his spare time. It was two or three years before he disposed of his patent but when he did he got enough to set himself up as a Consulting Engineer, which business he has conducted successfully ever since. I also believe that he patented several articles which he has sold at a good profit.

I might also tell you of a case which happened long before my time: Two men had a small shop doing a good and profitable business with the textile trade. One of these men invented a new spindle of exceptional merit. A large manufacturer offered them a price which would have kept them on Easy Street the rest of their lives, but they refused and the large concern fought the patent until the small shop was forced into bankruptcy. The partners lost every dollar they had in the world: the patent included.

In contrast to these cases I knew another inventor who got up a small article and started to manufacture in a small way at home, at the same time keeping at his regular employment. His home business gradually increased until after a few years he gave up his regular employment and at present conducts a very successful business, recently putting up a modern factory building to house it.

On the whole I believe it to be the best policy for the inventor to sell his patent if he has a good offer, and devote the proceeds to other inventions, this being more in his line than trying to run a manufacturing business.

Once an old fellow came into the shop who wanted us to make some kind of a wire contraption the purpose of which he would not tell. He was unwilling to pay over 25c. for it, but he stated that he was going to want millions of the article and if we made him one we could make the millions. We decided that the job was worth 50c. and he went away, sure that we had turned down the chance of a lifetime although he had only a quarter's worth of confidence in it himself.

The Compass That Was Spent

Another old reprobate came many times while having a small sewing-machine attachment made. He redesigned this frequently, using a pencil and a coin for a compass. One time he was redesigning it in a bar-room when an old acquaintance came in and asked him to have a drink. He accepted and after the friend had gone he started looking for the dime he had used to draw the circles with. He searched all over the table and floor, until finally the barkeeper told him that the dime had bought the drink.

Another bit of advice for inventors who are making their own models but are not well informed as to where to get different materials, etc., is to get advice from someone who does know. This is brought to mind by the case of an inventor who spent most of his spare time for ten years making a small model of an automatic machine for working wood. He was foreman of a plant where there was an urgent need for such a machine, but the owner of the shop was at the same time working up another machine for the same purpose but along different lines and had his machine in operation several years before our inventor had finished his model.

This model, considering the conditions under which it was made and that the man who made it was not a machinist, was the finest piece of work I ever saw and would actually do, on a miniature scale, the work required of the machine. He had made racks and gears by cutting the teeth with a file, with remarkable accuracy but at a great expense of time. The concern he worked for changed hands before he was through and they built several machines of the other type.

At this time I was asked to redesign and build a full-sized machine which I did. Mechanically it was very successful and in many ways superior to the other machines, but to the best of my recollection the company could not be induced to discard the other machines and build new ones and at the same time pay him for his idea. I do not believe he ever received a dollar for all his work.

If this man had known where to buy parts which

would have cost very little and have hired work done which he could not do to advantage himself, I thoroughly believe that he would have saved several years' time and that his machine would have been adopted in preference to the other and he would have been paid a good price for it. This man was financially able to have carried out such a plan.

My final advice to an inventor is to carry his experiments and patent proceedings to a close as soon as possible, for if there is a real demand for his idea others are probably thinking along the same lines that he is.

Mr. Jobber's Silent Partner

By Henry G. Fenn

Mr. Busy Jobber, I would like to make you acquainted with Mr. Alert Order Editor. Perhaps you never realized it, but Mr. Editor is ever on the job as your silent partner, zealously looking out at all times for your interests.

Never heard of an Order Editor? Well! allow me to explain that he is the gentleman who, in any busy manufacturer's office, handles the entry of your order into the plant and conducts all correspondence with you in regard to your specifications. He is ever at your service and takes a personal interest in all of your requirements.

I feel sure, Mr. Jobber, that it will be to your advantage to cultivate the acquaintance of Mr. Editor as he surely is in a position to do you many a favor and possibly save you expense and annoyance by correcting the occasional errors that are made by even your buying department.

An Order Editor's Duties

The best way for you to learn what his opportunities are to assist you, is for you to listen to a brief outline of his many and varied duties: Your specifications are turned over to him immediately upon their receipt at the factory office and become at once his personal responsibility. He first checks you up on terms, prices, catalog numbers or description, shipping and billing instructions, etc. (You will readily admit that this is some job, especially when you indicate your requirements by description rather than by catalog number).

Let me say right here that this part of Mr. Order Editor's job makes it necessary that he know his line of goods thoroughly from a mechanical and technical point of view as well as from the catalog presentation. In most every case he is a man who has been more or less in close touch with the manufacturing and operating end of the business. He has prices, discounts, and terms at his finger tips. If your buyer slips on any of this detail you will find a letter at your elbow promptly after receipt of your order, politely calling your attention to the discrepancy. This will avoid possible disputes at settlement of the invoice. He pays particular attention to any unusual billing instructions, such as requests for duplicate, triplicate or further extra copies of invoice.

Four Copies Made of Order

After he has scrutinized your order in regard to all these features he arranges to make copies of it on factory office forms suitable for economical and uniform handling in the plant. There are usually four copies made. One for his own record, one for the production department, one for the shipping department and one to go through the plant with the article, and which is later returned to him to be used in making out your invoice.

Some plants make out another copy of the factory order and mail it to you to serve as an acknowledgment of your order. Another method of acknowledgment is a form postal card advising you of receipt of order and thanking you for it; stating that it has been entered for prompt attention, and containing the factory order number which you are requested to refer to in any correspondence relating to it.

Securing the Friendship of the Order Editor

Right here, Mr. Jobber, is a chance for you to secure the friendship of your silent partner Mr. Order Editor. Just place this factory order number on your own record of order when you receive the acknowledgement. Then in any correspondence always refer to the factory order number. This information may save minutes—yes, hours—at times, in locating the particular order you are writing about.

Incidentally your reference to this number will almost invariably secure for you a more prompt reply, as it enables Mr. Editor to handle your letter more quickly than the one from the other fellow who leaves it off, thus making it necessary to search for his order. The point right here is that Mr. Editor can locate an order more quickly by his factory number than by any other means.

Mr. Editor is the connecting link between you, your order, and its progress through the plant. Say, for example, you send in a request for a shipping date after the order has been in for what you consider a reasonable length of time. Right away Mr. Editor gets busy, determines the status of your order, gets an estimate from the production department, and promptly transmits the information to you. Some more systematic editors go even further and secure a prospective shipping date on each and every order upon entry and have it on file anticipating your possible inquiry. This is probably why you secure more prompt replies from one concern than you do from another. Another duty that devolves upon Mr. Editor is the entering upon the various copies of the shop order before mentioned of any changes that you may make in your order subsequent to its original receipt.

Advantageous to Co-operate

Now, Mr. Jobber, here is a gentleman with whom it will be to your advantage to co-operate, as he is surely in a position to give you the service to which you are entitled, and this may be good or perhaps indifferent according to the manner or tone of your correspondence. Frankly, Mr. Editor is human and always a very busy, and often over-worked man. A frank, polite request from you is to him like a ray of sunshine compared with the bull-dozing, aggressive or whining style of some correspondents. Your courteous letter will insure a prompt and satisfactory reply.

Well! Mr. Jobber, in leaving you now, may I suggest that you try out co-operation with Mr. Order Editor for a month or two? I feel sure that if you do you will be agreeably surprised by the beneficial results. I have been an Order Editor myself, have handled your own orders, and know how it works out. So take a tip from one on the inside and keep on the right side of your invisible silent partner.

SPARKS FROM THE WOR

Valentine Francis

Trade Letters From New York and Chicago

New York Industry Still Affected by Railroad Strike—April Sales Satisfactory in Chicago

New York Letter

Manufacturers will not be disheartened by the lessened activity of the machine-tool market, recognizing that practically all industry has been gravely affected by the railroad strike. Inquiries are coming in from China and Japan, as well as from Belgium, indicating that the export market is in a healthy condition. The American Manufacturers' Export Association has received a request from Europe for machine tools for making automobile tires and tubes. A manufacturer of screw machines reports an exceptionally large order from Japan. It is of interest to note that machine tools exported to Japan this last month exceeded the shipment of any previous month.

Lathes and planers have been purchased by the Champion Silk Mills, while a variety of machine tools have been ordered for the Baltimore plant of the General Electric Co. It may be of interest to note that the Rainier Motors Co. is enlarging its plant in Long Island City. The General Motors Co. has bought a new plant in Doylestown, Pa.

As for the prospects for better business, it is largely a matter of when the freight difficulties will be cleared. Scores of machine tools are stalled in the freight yards throughout the country.

Chicago Letter

April sales totals have been figured by most dealers and found to have been very satisfactory. They were not so great as in March, which marked the peak of the buying, but showed such a slight reduction as to indicate merely ordinary trade fluctuation rather than a slump. Actual shipments in April were necessarily very light. As a result, delivery conditions are in no way improved and back-order files are as bulky as ever.

The railroad situation is very slowly getting straightened out. Shipments through Chicago are still embargoed, the only way such consignments can be handled being for the dealer to have the goods billed to him here, then to transfer the goods from one freight house to another at his own expense, and to reship them to the ultimate destination. This is a slow and expensive process and is not being done except in case of actual emergency.

Shipping delays are adding to the financial burdens of all concerned. Some manufacturers are causing their dealers to share their load by rendering bills for 50 per cent of the price of all goods actually ready for shipment but impossible of shipment. The dealer, unable to bill his customer, thus has more and more of his working capital tied up. With a continuation of the present gradual untangling of the freight congestion, this is a complication that will soon disappear.

The end of price raises is apparently not yet here. One general line of drilling machines was increased 10 per cent last week, and a line of lathes went up. On these lathes the 14- and 16-in. medium pattern and the 25-, 27-, 30- and 36-in. heavy types were advanced 15 per cent while the 18- and 20-in. medium and the 16-, 18- and 20-in. heavy went up only 10 per cent.

Much interest was manifested in the auction sale of the machine equipment of the tool and die making and special contract departments of the Krasberg Engineering and Manufacturing Co. Over a hundred thousand dollars worth of lathes, grinding machines, milling machines, shaping machines, presses and various high-speed equipment went at excellent prices. In several cases of items on which delivry is hard to secure on new stuff, old machines actually brought more than list.

Machinery trade conditions are threatened with further complications by a strike of mechanics in the tool manufacturing plants of Cincinnati. Numerous plants are affected by the walkout which began last week, some being closed while others are maintaining operations. Manufacturers state that they do not feel the trouble will be of long duration as in some of the largest plants the men refused to obey the strike call. The trouble seems to be the product of the professional agitator rather than from dissatisfaction of the mechanics.

Erratum Notice

It was erroneously stated in our New York letter of April 15 that the Conradson Machine Tool Co. was acquired by the Jos. T. Ryerson & Son Co. The latter concern is a distributor of the Ryerson-Conradson line of machine tools only.

Move Tractor Industry to Old Government Shop

The tractor department of the New Britain Machine Co. is being transferred from the main factory of the company to the shop formerly occupied by the Ordnance Department of the U. S. Army. In the future all operations in the manufacture of the tractor will be taken care of in the new plant.

W. H. Patterson Promoted by Westinghouse

W. H. Patterson, manager, resale section, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., has been appointed assistant-to-manager, Industrial Department, in charge of metal-working and wood-working industries. Mr. Patterson graduated from the electrical engineering course of Purdue University in 1905. The following January, 1906, Mr. Patterson entered the apprenticeship course of the Westinghouse Co. In 1910 he was made

W. H. PATTERSON

manager of the resale section. Mr. Patterson has been prominently identified for a number of years with the development of motors and control apparatus for application to cranes, elevators, hoists, and machine tools. During the war he served on the United States Shipping Board, Emergency Fleet Corporation, Electric Welding Committee. When the American Welding Society was formed about a year ago, Mr. Patterson was elected a director. Mr. Patterson is also a member of the American Institute of Electrical Engineers, National Electric Light Association, Pennsylvania Electric Association, American Society of Refrigeration Engineers, and Association of Railway Electrical Engineers.

American Manufacturer Issues Japanese Catalog

An interesting side light on the development of foreign markets by progressive American manufacturers is furnished by a catalog, issued by the General Commercial Co., Ltd., Yokohama. This firm is the agent of the Wright Manufacturing Co., Lisbon, Ohio. The product consists of hoists only and the catalog in question is printed in Japanese. Mr. Wright is authority for the statement that in foreign countries there is a distinct tendency to favor those American manufacturers who specialize in one product.

He further states that the Japanese have shown a ready appreciation, not only in being addressed in their native tongue, but in having the scientific principles embodied in the manufacture of hoists and the quality of the material used, thus directly explained and guaranteed to them.

The catalog presents an odd appearance with the title page at the back and the vertical colums of hieroglyphics. The catalogs are, of course, intended for distribution in the Japanese Empire.

The Franklin Moore Company Has New Members

At a recent meeting of the stockholders of the Franklin Moore Co., of Winsted, Conn., manufacturers of hoisting machinery, the following directors were elected: J. B. Adams, president, W. A. Battey, vice president; W. C. Briggs, vice president; J. H. Whiting, treasurer; C. S. Moore, assistant treasurer; A. E. Moore, secretary and G. W. Borton.

The company was organized in 1866 for the manufacture of high-grade carriage bolts and has since developed an extensive line of hoisting apparatus, including chain blocks, hand cranes, trolleys, electric hoists and electric cranes. In the past these products have been principally absorbed by the large manufacturing plants in New England and the East but with increased facilities and organization, this equipment is being more widely distributed through branch offices located in some of the larger American cities and by export connections.

Mr. Battey, Mr. Briggs and Mr. Borton, the new members of the organization, have long been identified with the manufacture and sale of material-handling machinery, and have a wide acquaintance among users in the Eastern and Central States. Mr. Briggs has been placed in charge of the works at Winsted, but will continue the study of material-handling problems and the application of mechanical-handling devices in the many industries in which they can be successfully employed.

The present labor shortage emphasizes the importance of all labor-saving machinery, and in no field is the demand more urgently felt than in that of material-handling apparatus. The rapidly growing business of the Franklin Moore Co., reflects this condition and has necessitated increased organization and manufacturing facilities. The company has done much pioneer design work in this important field, and with increased facilities will push the development of new types to extend its already comprehensive line of labor saving appliances. It has taken an active interest in the development of the industry in general and has co-operated in forming both the Chain Block and Electric Hoist Manufacturers' Associations. J. B. Adams, the president, is at present chairman of the Electric Hoist Manufacturers' Association.

Invitations for Joint Conference Sent to National Societies

Invitations have been sent out to a large number of local and national engineering societies to attend the joint conference of allied civil, electrical and mechanical engineering societies, to be held at Washington, D. C., on June 3 and 4. The conference is called by a joint committee from the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

The purpose of the conference is co-operation of engineering and allied technical organizations to further the public welfare wherever technical knowledge and engineering training are involved and to consider matters of common concern to these professions.

The American Bronze Corporation of Berwyn, Pa., Not Bankrupt

W. E. S. Anderson, president of the American Bronze Corporation, Berwyn, Pa., announces that his company, the manufacturers of Non-Gran bearing bronze, is not in any way connected, nor never has been connected, with any other company manufacturing bearing bronze.

This announcement is made to prevent any confusion arising as to the company's connection with another firm of an identical name, incorporated in another state, against which, according to an item in a recent Philadelphia paper, a petition in bankruptcy has been filed.

Munch Buys Miller Works

Benjamin S. Munch, director of the G. E. Prentice Manufacturing Co., of New Britain, Conn., has gone into partnership with his father, Samuel Munch, formerly a merchant in that city, and has bought the Miller Metal Works Co. of Southington. The authorized capital stock of the company is $100,000 and manufactures parts for automobiles, marine and airplane engines, and tractors. The new owners plan to increase the plant in order to take care of the increasing amount of business. The plant employs about seventy-five persons.

LD'S INDUSTRIAL FORGE
News Editor

Program of the American Drop Forge Association

The program oi the American Drop Forge Association's convention, which will be held at the Hotel Marlborough-Blenheim, Atlantic City, N. J., on June 17, 18 and 19, 1920, is announced as follows: "Lubrication of Drop Hammer Cylinders," by Harry Johnson, Ingalls Shepard Forging Co.; "Use of Forging Press and Upsetters," by Mr. Hopkins, Atlas Drop Forge Co.; "Powdered Fuel"; "Apprenticeship in the Die Room"; "Necessary Chemical and Physical Characteristics of Die Blocks," by W. C. Patterson, Packard Motor Car Co.; "Forge Shop Finances," by Leo Wellington, Scoville Wellington Co.; "The Place of Laboratory and Testing in the Forging Business," by Prof. Nelson, Wyman Gordon Co.; "The Company Store," by Edgar E. Adams, Cleveland Hardware Co.; "Heat Control in Furnaces," by W. N. Best; "Accident Prevention in the Forge Shop," by G. A. Kuechenmeister Dominion Forge and Stamping Co.

Connecticut Firms Combat Housing Shortage

At least two manufacturing concerns in Connecticut have opened war on rent-profiteering and the shortage of housing facilities in manufacturing centers.

The Trumbull Electric Co., of Plainville, Conn., has under consideration contracts for the building of thirty new homes for employees of its factory in that city. The houses will be erected on the property of the Plainville Realty Co., East St. This will make a total of fifty houses on this property which the company has built for the use of its employees.

The International Silver Co., of Meriden, Conn., has just purchased a house on Colony St. in that city. This building will be remodelled and made available for housing a number of its employees.

A Pamphlet on American Ingot Iron Wire

The Page Steel and Wire Co. has just published a very complete pamphlet describing fully the electrical and physical properties of American ingot iron wire. This is the first complete publication of this data and the result of many tests made during two years under the supervision of the Electrical Testing Laboratory, New York, and Frank F. Fowle, consulting electrical engineer for this company. This booklet is very interesting and will be mailed to any one, upon request to the Page Steel and Wire Co., 30 Church St., New York.

Kalamazoo Co. Changes Hands

One of the most important industrial transfers in the last ten years was consummated last week when Christian Girl, head of the $30,000,000 Standard Parts Co., of Cleveland, purchased the Kalamazoo Spring and Axle Co. The plant will be remodeled and extended to manufacture automobile springs chiefly, although the former company's manufacture of other types will not be abandoned. Mr. Girl will have personal charge at the local plant.

Carlisle Ellis, of the Hart-Parr Co., Returns from Europe

Carlisle Ellis has returned to Charles City, Ia., from a three months' trip in England and Europe with J. P. Gregg, of Charles City, on Hart-Parr tractor business. Mr. Gregg will remain for three months longer and visit other European countries on Hart-Parr tractor interests.

Mr. Ellis was much impressed by the up-to-date farming methods in use in Sweden, and states that all farms are equipped with their own electric-light plants and many modern farm conveniences. He states that while America is suffering from strikes and general unrest, conditions do not compare with the European countries and England. There is little or no production, much unrest and great dissatisfaction all over Europe and England. Several times they were held up by strikes and uprisings and were delayed several days in Copenhagen by an attempt to overthrow the government.

Foster, Merriam Co. Has New Foundry

The attention of manufacturers, consumers and investors in the New England States, has been called to the rapid and successful growth of the Foster, Merriam Co. of Meriden, Conn.

This firm, organized eighty-five years ago, is foremost in this country in the production of furniture casters. Cabinet and special hardware, phonograph parts, auto accessories and piston rings are also among the articles manufactured at this plant. A new foundry has just been added to the factory buildings which will greatly facilitate the production of the company's output of 2,000,000 piston rings per month. The officers of the company are: R. W. Millard, president; R. J. Merriam, treasurer; N. C. Johnson, secretary.

A. Y. Dodge, Chief Engineer of the Racine Engineering Co.

A new engineering company that will devote its entire energies to the development of standardized tractors and tractor parts has been formed with Adiel Y. Dodge as chief engineer. The company will be incorporated under the laws of Wisconsin as the Racine Engineering Co.,

A. Y. DODGE

and will have offices at 105 Badger Building, Racine, Wis. Mr. Dodge is particularly qualified for this line of work. A college trained mechanical engineer as well as a practical experienced mechanic, he has had unusual opportunities to acquire a thorough knowledge of tractor engineering and development. Since starting with the International Harvester Co., about eight years ago, he has been actively engaged in the automotive industry. During the war he was service manager for the Wright-Martin Aircraft Corp. and later was connected with the Bureau of Standards, Washington, D. C. Mr. Dodge states that tractor problems have passed the experimental stage and are now a matter of design. His company associates will be L. N. Burns, former vice president of the J. I. Case Plow Works Co. and H. L. Taite of the Wallace Tractor Co.

Industrial Relations Association to Meet at Chicago Next Week

The second annual convention of the Industrial Relations Association of America will take place at Chicago on May 19, 20 and 21. This meeting will be of vital interest to every business man—particularly those in charge of industrial relations, personnel and employment work in industrial and mercantile houses. The program includes a series of addresses by some of America's ablest speakers. The great Auditorium theater has been acquired and this assures a seating capacity for over 3,500 persons.

F. C. W. Parker, of the Central Y. M. C. A is secretary of the association.

English Trade Letter From London Correspondent

Introduction of Budget the Outstanding Feature—Shipbuilding Industry, Machine-Tool Matters, Etc.

Despite strikes that are threatened in connection with railway men, postal workers, tramway and omnibus workers, cotton operatives, builders, shop assistants, miners and general workers, to name no others, the introduction of the budget is the outstanding feature of British commercial and industrial life. It is long since a budget provided such a surprise as not merely the retention of, but the increase in the excess-profits duty.

Introduced as a war tax this duty reached 80 per cent of the profits beyond those of peace times, after £200 had been allowed. One of the reasons justifying the high rate was that so much of the extra profit being absorbed by the duty, it would not be worth the while of the trader to increase prices markedly. But the morality of commerce is now based solely on the what-the-traffic-will-bear idea. When complaints were made about high prices it was urged in reply that the excess profits duty should be removed, or at least reduced. Yet last year when the rate was lowered to 40 per cent, no one noticed any attempt to reduce retail prices. Now with a 60 per cent rate the extravagance induced by the tax and its handicapping effect on the expansion of business and enterprise generally is produced as the reasons for its removal. The writer can certainly recall extensions proposed in engineering works which were held up until the budget was introduced, in order to see which way the cat was going to jump regarding excess profits. Most people thought this duty would be allowed to drop. Even now it will cause little surprise if it is withdrawn or modified. In any case, the Chancellor of the Exchequer has undertaken that if a war levy is imposed later on in the year the duty will be reduced.

Another Proposal

Another proposal, not altogether a surprise except as an additional impost, is the tax of 1s. on the pound on the profits of limited liability companies after an initial allowance of £500. Apparently after excess profits have been paid at the rate of 60 per cent, an allowance will be made of £500 on the residue, when this new corporation profits tax of 5 per cent will be levied, and after that the ordinary income tax at the rate of 6s. on the £. The incidence of the income tax will be altered somewhat but the basic rate will not be changed, and some alterations are to be made in the super-tax, the exemption figure being lowered and rates increased to a maximum of 6s. Company share capital and stamp duties are to be increased. Telegrams will apparently be at twice the pre-war rates and higher telephone rates will be proposed; the exact amount has not been stated. Postage for ordinary letters, post cards, etc., will be increased, inland letters costing 2d. up to 3 oz. weight, plus ½d. for each additional ounce, post cards 1½d., and newspapers 1d. up to 6 oz., plus ½d. for each additional 6 oz. As to motor cars, the new duty proposed is £1 per horsepower.

The Estimated Total Revenue

The estimated total revenue is £1,418,300,000 and this is expected to leave a balance available for debt reduction of about £234,000,000, after the spending, according to the estimate, of £125,000,000 on the Army, about £84,000,000 on the Navy, £21,000,000 on the air force, and £497,000,000 on the civil service. The national debt services will cost about £345,000,000. This is not the place to discuss the details, but the chief line of attack will apparently be first of all on the excess-profits duty and then on the inflated estimates of expenditure and on the treatment of receipts from the sale of war stores as revenue. The land taxes are repealed and in short, the land interest benefits while the manufacturing and commercial world pays.

The House of Commons recently passed a grant of £26,000,000 in order to ease conditions under which trading is effected between Great Britain and the continent of Europe. Sums are to be advanced to British traders who either cannot obtain or cannot accept payment in the currency of the foreign country to which they are exporting. The purpose is to allow the transaction to extend over a period of years in the hope than exchange rates will become more normal or at least stabilized.

A Bad Feature of Money Market

One of the worst features of the money market of late has been the failure of several municipalities to raise loans direct from the investing public. Some time ago both Liverpool and Bristol had this experience to some extent. More recently Hertfordshire attempted to place

£2,000,000 at what is really 6⅛ per cent and only about £300,000 was taken up by the public, the remainder being left in the hands of the underwriters. Now the London County Council has attempted to raise £7,000,000 by 5¾ per bonds offered at 95 per cent, with the result that 90 per cent of the issue has been left with the underwriters. Birmingham has done better, about 60 per cent of its £3,000,000 6 per cent loan, issued at 98, being taken up by the public.

The London iron and steel market held yesterday, though well attended, transacted little business, the budget proposals receiving more attention and being regarded here, as in labor quarters, as likely to increase prices all round. Small supplies have been available from Germany. Prices have been raised—iron bars being advanced for the third time this year; Scotch plate prices have been raised, also joists, angles, etc., scarcity being given as the reason.

The Shipbuilding Industry

Great Britain, since the war ended, has felt some apprehension as to her foremost place in shipbuilding and every effort, or almost every effort, has been made to maintain this pre-eminent position. The Clyde is of course the most important shipbuilding area, and it has been disappointing to find that the returns from Scotland for the first quarter of the current year have not caught up with the best of pre-war years. Nevertheless, according to a return by Lloyd's Register, the position has improved during the year and at the end of March new steamers under construction in the United Kingdom exceeded those of the same period of last year by 1,160,482 tons. They totalled 825 ships of 3,382,931 tons. The Clyde had a tonnage of 1,172,841 tons under construction (almost as much as France, Italy, Japan and Holland put together); the Newcastle area was second with 629,408 tons, and Belfast, including Londonderry, third with 357,250 tons. The United Kingdom is, in fact, producing about three-sevenths of the world tonnage the rest of the world having about 4,418,519 tons on the way. Of this the United States is put down at 2,418,158 tons, Holland 366,257 tons, Italy 316,495 tons, Japan 285,676 tons, France 237,000 tons, and Canada 157,288 tons. No entry is made for Germany.

While shortage of plates is still alleged in connection with shipbuilding, it is certain that this branch of industry is being favored as compared with the automobile trade, which has only about half the quantity required for chassis, etc. The explanation lies in the fact that, weight for weight, the heavier plates needed for shipbuilding purposes call for less labor and are therefore up to a point more readily produced and are more profitable.

Yet another instance of securing a source of material supply is shown in the purchase for the Northumberland Shipbuilding Co., Ltd., of the ordinary shares of Baldwins, Ltd., South Wales, the transaction, it is stated, totalling more than £5,000,000.

Machine-Tool Matters

In machine-tool matters no change can be reported, for here, as with most branches of engineering, the only real question is of delivery. Tools for locomotive builders seem to be in most urgent demand. The London & North Western Railway Co. is extending its engine shops at Crewe and 500 more men are to be taken on there. Owing to shortage the company has had to place orders for ninety locomotives with private firms. Scottish firms will also provide fifty locomotives for the English Great Northern Railway and forty-five for the Bengal and Nagpur line. Reports state that the British Colonies and South America have called recently for much in the way of small tools and cutlery products.

Rumors are to be heard of amalgamations of British lathe interests and of expansions in organizations formed for overseas trade in such directions. It is also gathered that new arrangements with regard to production may be made by a well-known American firm that in the past has found a large continental and British sale for its machines, but now experiences an increasing British competition.

Production Still Far Below Normal

It cannot be said that the results of further inquiries suggest that output per workman is growing. At one of the largest firms, building fairly heavy tools, the output was regarded at about half of what would be regarded as the normal rate, but this was only a very rough estimate. In the case of a somewhat similar though rather smaller firm the output was said to be about 60 per cent. But here the molders' strike had had its effects, for, castings not coming in, the men slacked when they did not see another job in view. In another instance the time taken in the production of a standard machine was accurately recorded and proved to be exactly 50 per cent in advance of previous figures, so that the output was just two-thirds of that previously obtained. In a still larger firm the writer found that output was actually increasing. Here, however, a special system of payment is in operation. It is of course on time rates that working is slowest and the working rates are nearer to normal in the smaller organizations. In a large firm with many men, personal control does not appear to be so effective.

Committee of Production Set Up

The new committee of production has been set up and has been holding meetings, the body of the building trades forming the subject for the first inquest. It is understood that a questionnaire is to be sent out to firms asking for information on production rates, etc., and the reasons for any losses. Much the same is true regarding the engineering trades, for here a joint inquiry by employers and the trade unions concerned is being made into the advisability of introducing the 44-hour week and other matters, such as the premium bonus system.

The engineering trade unionists are of course balloting for or against payment by results, and the decision is confidently expected to be against. The statement has been made that as an alternative the principle of the collective contract will be put forward. The new amalgamation of engineering trade unions is now being effected. The total membership will be about half a million. The largest constituent will be formed by the Amalgamated Society of Engineers with more than 320,000 members, the other societies including the toolmakers, the steam engine makers, instrument makers and machine workers. It is said that the electrical trades union may also join.

A Safety-Device Museum

Before the war and stopped by it, the home office had on the way in the Horseferry Road, Westminster, London, S. W., the equipment of a building which was to form a museum of safety devices for machinery. The building was taken over for recreative purposes by certain of the colonial forces, but has now been returned to the possession of the British authorities and in the course of a few months, probably next autumn, will be opened for use. Full-size machinery and details will, where possible, be installed; in addition, photographs and drawings will be exhibited as relating to safety devices in factories. Besides this the best methods of lighting, heating and ventilating the shops will be shown and in a lecture hall demonstrations will be provided. The museum is intended apparently as an aid to factory inspectors, the inspection branch of the home office activities having long since proved its usefulness in industrial life, often against direct opposition. In the long run the value of the department can not be gainsaid however, whether by work-people or employer.

The Brussels Fair

Reports relating to the Brussels Fair, opened on April 4, are somewhat indecisive as bad weather was experienced. A well-informed, if interested, correspondent states however that it is a real success, with a large number of visitors. Delay in transport occasioned the late arrival of a number of exhibits and apparently there were some failings on the part of the stand decorators. Between fifty and sixty British exhibitors took part and a number of American tools were shown, the Norton, Le Blond, Pratt & Whitney, Allen, and other makers, productions, for example, being on the stand of Henri Benedictus, Brussels. The fair is being held in the Park of Brussels and is readily accessible.

Doehler Die Casting Co. to Expand

A loan of $1,000,000 has been negotiated by the Doehler Die Casting Co., one of the big industries of Brooklyn, where about 1,500 persons are employed. The Doehler Die Casting Co. has three plants, those outside of Brooklyn being at Toledo and at Chicago. Control and direct management of the company is in the hands of H. H. Doehler of Brooklyn, the president, and the General Motors Co. has an investment of $1,000,000 in the concern.

The rapid growth of the company is one of the industrial romances of Brooklyn. Starting in 1906 with a working force of 20 men the output for that year amounted to about $20,000. Today the employees number over 2,300 and the net sales in 1919 amounted to $6,466,193. The net sales increased from $1,853,000 in 1915 to more than $6,400,000 last year. The net profits in 1919 amounted to $664,195. The net earnings of the company are over nine times the annual interest charge on the $1,000,000 debentures to be issued. The debentures are due serially from May 1, 1921, to May 1, 1930.

Fred T. Ley to Head Reorganized Machine Company

A new company headed by Fred T. Ley, formerly president of the Napier Saw Works, Inc., Springfield, Mass., and Henry F. Blanchard, formerly treasurer and general manager, has been organized to take over only the band saw and band-saw machine business of the Napier Saw Works.

The new company will be known as the Metal Saw and Machine Co., Inc., and will be located in the Springfield, Mass., plant heretofore occupied by the Napier Saw Works. Mr. Ley is president of the new company and Mr. Blanchard treasurer and general manager. They expect to employ 100 persons. This year's schedule calls for the production of several hundred machines, but it is intended to turn out more than 2,000 in 1921. The Metal Saw and Machine Co., Inc., will continue to manufacture and market the "Napier" metal-cutting machine and "Napier" metal-cutting band saws.

Laurel to Build 16-Valve Motor

The Laurel Motor Corporation, Anderson, Ind., has just closed purchasing orders for several thousands of dollars worth of new machinery for the new motor building addition which is to be built to the Sycamore St. plant. When this machinery arrives the company will start the manufacture of the new 16-valve Laurel motor.

Business Association to Review Year's Discussion

The May tenth meeting of the New York Business Publishing Association, to be held in the Automobile Club, 247 West 54th St., New York, will take the form of an old-fashioned talk-from-the-floor business meeting. A dinner will precede the meeting.

The subjects covered in the meetings of the past year will be reviewed and a general discussion will take place. William Buxman, of *News-Record*, will discuss "Research"; R. B. Lockwood, of the McGraw-Hill Co., will talk on "Service"; F. J. Rockwell, of *Playthings*, will take up "Circulation" and E. J. Buttenheim, of the *American City*, will handle "Sales and Business Management."

William Buxman, Tenth Ave. at 36th St., New York, is secretary of the association.

American Locomotive Co. Reports Big Contracts

It was announced last week by the American Locomotive Co. that orders had been taken from the Northern Pacific Railroad Co. for 71 engines. Details of the order follow: Twenty-five 168-ton Mikados; twenty, 148-ton Pacifics; twenty 107-ton switchers, and six 238-ton Mallets.

The American Locomotive Co. further reported the following contracts: Three 158-ton Mountain type engines for the Central of Georgia, three 79-ton tank engines for the Chino Copper Co. and one 60-ton switcher for Koppers Co.

The Use of Trailers

Although the use of trailers or semi-trailers is feasible and profitable under many conditions, the truck owner always should consult the truck maker before installing such equipment. Adverse operating conditions sometimes would make the use of trailers ruinous.

Given proper conditions, however, the trailer or semi-trailer fills a definite need. Some of the many things that trailers can do are; (1) Reduce load-handling delays, by enabling the operator to load or unload one trailer while the truck is hauling another; (2) haul units too heavy for a single truck but which can be moved with the power of a single engine, such as boilers, heavy machinery, etc.; (3) carry bulky but light articles which would utilize only half the power of the engine if loaded on to a single truck. Barrels and boxes are in this class; (4) haul lengthy material too long to be loaded onto a truck, such as ship masts, motor boats, timbers and poles; (5) introduce trucks more extensive into the lumber trades by overcoming the unprofitable loading and unloading delays through the use of detachable and interchangeable semi-trailers; (6) increase greatly the carrying capacity of passenger buses.

The transportation departments of progressive truck manufacturers have made extended investigations and study of trailers and are in position to give honest advice as to their desirability under specific conditions. The question of what tractor gear ratios should be specified, of whether semi-trailers or four-wheel trailers should be used, of the method of attaching, all enter into the problems surrounding their use and the expert services of truck and transportation engineers should be enlisted before a decision is made.

Short Trade Notes

The Union Pacific Railroad is expected to issue a large inquiry for machine tools shortly.

* * *

In February the United States exported 132 locomotives at $4,588,074. Poland and Danzig 41, costing $1,903,000, Italy 30, costing $1,114,000, and Cuba 12, costing $314,845.

* * *

Col. W. G. Morden, of Montreal, announced on May 2 the consolidation of nine steel, coal and transportation companies of Canada into the British Steel Corporation, with capital of $500,000,000. Col. Morden said it was the largest merger of its kind in the British Empire and second only to the United States Steel Corporation.

* * *

The export offices of the Whitcomb-Blaisdell Machine Tool Co., the Reed-Prentice Co. and the Becker Milling Machine Co. are now at the Grand Central Palace, New York City. The companies will maintain permanent exhibitions of their machines as well as a complete stock of milling cutters.

* * *

The annual stockholders and directors meeting of the Independent Pneumatic Tool Co. was held in Chicago, on April 23. The reports show great progress in the company's business. There has been not only a steady increase in pneumatic tool sales, but the company is now strongly established in its electric drill department and has also commenced to manufacture a complete line of pneumatic motor hoists.

* * *

L. Brandenburger, of Salt Lake City, Utah, formerly located in the Walker Building, has taken over larger quarters at 59 West Broadway. Mr. Brandenburger was recently appointed sales representative of the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., for the territory of Utah, the western section of Wyoming, and three-quarters of the State of Idaho.

Detroit Meeting American Gear Manufacturers' Association

F. W. Sinram, President, and Other Officers Re-Elected—To Prepare Book of Standards on Gearing

Eighty-four companies and one hundred and sixty individual members are now enrolled in the A. G. M. A., which had its annual convention on April 29, 30 and May 1, at the Statler Hotel, Detroit. Starting three years ago at Lakewood, N. J., seven members of different gear-manufacturing companies formed the nucleus of what is now an enthusiastic, hard-working association of gear experts. The successful organization and advancement of the society to its present healthy state is due largely to the good work of its President, F. W. Sinram; Secretary-Treasurer Frank D. Hamlin and Publicity Manager J. C. McQuiston. As the society devotes its entire energies to the promotion of gear manufacturing, there was no time lost in getting to work after the opening address of welcome by Hon. James Couzens, Mayor of Detroit. In addition to committee reports and other routine work, papers of exceptional interest were presented by several of the members. Among these were: "Gears from a Purchaser's Point of View," by D. G. Stanbrough, general superintendent, Packard Motor Car Co.; "Routing of Gears and Machine Parts Through the Factory," by J. A. Urquhart, of the Brown & Sharpe Manufacturing Co., and "The Hump Method of Steel Treating," by G. W. Tall, of the Leeds & Northrup Co. As guests of the Michigan members, the society visited the Ford Motor Co.'s plant and paid particular attention to the gear manufacturing department, where hundreds of gear cutting machines are in operation. At the informal banquet for members and guests, held at the Statler Hotel, President F. W. Sinram was presented with a watch in recognition of his services. Afterward the pioneer manufacturer, Henry M. Leland, president of the Lincoln Motor Co., delivered an address on the science of manufacturing. On the last day of the meeting the following officers were re-elected by acclamation: F. W. Sinram, of the Van Dorn & Dutton Co., president; Henry E. Eberhardt, of the Newark Gear Cutting Machine Co., vice president; Frank D. Hamlin, of the Earl Gear and Machine Co., secretary-treasurer.

These officers were not allowed to resign, not only because of the good work they have done, but also on account of the inter-locking relations of the society at this time with other engineering societies, concerning the standardization of gear design, formulas, methods, etc. They were prevailed upon to "see it through" and when the work is completed it will crystallize in the form of a book of standards that will without doubt, be welcomed by the engineering profession. The next annual convention will be held at a place to be announced later by the secretary whose address is the Earl Gear and Machine Co., 4401 Germantown Ave., Philadelphia, Pa. The meeting terminated at a luncheon given by the Michigan members, at the Detroit Athletic Club.

F. W. SINRAM

FRANK D. HAMLIN

J. C. McQUISTON

Obituary

Frederick A. Bennett, of the manufacturing firm of Bennett and Seeley, of Bridgeport, Conn., died at the Bridgeport Hospital on April 25, following an operation for appendicitis. Mr. Bennett was 33 years old and up until about three weeks ago he had been secretary of the Bridgeport Manufacturers' Association, with whom he has been connected for the past 12 years. He resigned from the secretaryship of the association to give his entire time to the firm's business, that of foundry equipment, but was taken ill very shortly after.

Joseph H. Wesson, president of the Smith & Wesson Co., of Springfield, Mass., died on April 30, after a short illness, from heart disease. Mr. Wesson was 60 years old.

Personals

Harry D. Parker, of the Greenfield Tap and Die Corporation, of Greenfield, Mass., has been promoted to the head of the export sales division of the company, succeeding P. W. Thayer. Mr. Parker has been with the Greenfield Co. since early in 1916.

Charles E. Smart has resigned as works manager of the Wells Brothers division, of the Greenfield Tap and Die Corporation, of Greenfield, Mass. Mr. Smart has held this position for the past three years and has been with the company in various connections for the past thirteen years.

Fred. M. Churchill of the Walworth Manufacturing Co., of Boston, Mass., has been promoted to office manager of the sales promotion department. Mr. Churchill, has been with the Walworth Co., for twenty years, starting in as an office boy, and working himself up to his present position.

Harry A. Wheeler has been made factory superintendent of the Wells Bros. division of the Greenfield Tap and Die Corporation, of Greenfield, Mass. Mr. Wheeler was formerly tool supervisor.

Ernest T. Bysshe has been appointed gage engineer at the Wells Brothers division of the Greenfield Tap and Die Corporation, of Greenfield, Mass.

Joseph J. Williams, of the New Departure Manufacturing Co., Bristol, Conn., will have charge of the bearing assembly department of the Meriden, Conn. plant of the company, now under construction. Mr. Williams has been with the Hendee Co. for the last eleven years, and prior to that time was with the Sterling Piano Co., Conn.

Edmund C. Mayo has been elected president of the American Tube and Stamping Co., of Bridgeport, Conn., succeeding J. W. V. Reynders. Mr. Mayo has been secretary and general manager of the company for over a year, coming from the Worcester Pressed Steel Co. of Worcester, Mass., where he had been the general manager for five years.

J. M. Cook, formerly sales representative for the Norton Co., Worcester, Mass., is now sales and main representative of the Waltham Grinding Wheel Co.'s line of abrasive products. He will be located in the general offices of the Republic Tool and Manufacturing Co., selling agent of the company at Cleveland, Ohio.

W. C. Bennett is superintendent and engineer of the Virginia Shipbuilding Corporation, Alexandria, Va., builders for United States Shipping Board.

A. G. Norris has been appointed district manager for western New England with headquarters at New Haven, Conn., for the S. K. F. Industries, Inc., New York, sales distributors for the S. K. F. and Hess-Bright ball bearings and Atlas steel balls.

Vernet Dutton, formerly of the sales department of the New Departure Manufacturing Co., of Bristol, Conn., has been appointed manager of production in the coaster-brake department of the company at Bristol. He is succeeded in the sales division by Burton L. How.

Business Items

The Abrasive Co., Philadelphia, Pa., held its directors' meeting April 16, to elect the following officers: Frederick S. Dickson, chairman of the board; Louis T. Byers, president; J. Harvey Byers vice-president and general manager; Lawrence J. Morris, vice-president; Samuel P. Byers, secretary and treasurer; Thomas F. Muldoon, assistant secretary and treasurer.

D. Van Nostrand Co., publisher, has announced that it will move on May 1 from Park Place and Murray St., to 8 Warren St., New York City.

Carhart Bros., Inc., has been incorporated for \$75,000; it will operate a foundry and machine shop at 1618 No. Salina St., Syracuse, N. Y. The company will begin business June 1. H. A. Carhart, who was formerly superintendent of the Smith Premier and Remington Typewriter Co. plants, heads the new firm. His two brothers R. H. and G. C. Carhart are associated with him.

The Carnegie Steel Co. has been inquiring for several hundred steel car bodies.

The American Steel Foundries of 15 Exchange Place, Jersey City, filed a certificate with the Secretary of State to-day increasing its capital stock from \$42,184,000 to \$50,000,000. The State will receive a fee of \$1,600 on this filing.

Paul H. Vogel, George A. Forsberg and A. X. Vogel all of New Britain, Conn., have organized the Vogel-Forsberg Manufacturing Co. with a capital of \$50,000. Dies and tools will be manufactured.

Ground has been broken for the \$2,000,000 addition to the plant of Fairbanks, Morse & Co. in Beloit, Wis. The new buildings include a pattern shop 80 x 230 feet and a foundry 455 x 550 feet. The foundry will employ 1,200 men and will contain four cupolas, operating alternately in tandem, two one day and the other two the next. The capacity has been estimated at 500 tons of iron a day. The foundry is the first of two foundry units to be built. When the second is added the dimensions of the entire structure will be 550 x 900 feet.

Stockholders of the B. F. Avery Sons & Co., Louisville, Ky., manufacturer of machine tools and farming equipment have been notified of a special meeting on April 26, when they will be asked to authorize an increase in the capital stock totaling \$3,700,000. The directors already have approved the proposed increase of \$2,000,000 in the common stock and \$1,700,000 in the 7 per cent preferred. The present capitalization is \$2,300,000.

The Independent Pneumatic Tool Co., formerly located at 736 David Whitney Building, Detroit, Mich., has moved into larger quarters at Garfield Building, Detroit. The company will have 1,500 sq.ft. of floor space.

The Iroquois Tool and Die Co., Inc., 255 Stanton St., Buffalo, N. Y., has filed papers to change the name of the company to the Iroquois Tool and Stamping Corporation.

The annual meeting of the stockholders of the Lackawanna Steel Co. was held in the offices of the company at Lackawanna, N. Y., on April 28. No action was taken on the appointment of a successor to Charles H. McCullough, Jr., who recently died. The following directors were re-elected for a term of three years: George W. Burleigh, Ogden L. Mills, Edward S. Marston, Percy R. Pyne, Jr., all of New York City and Frederick F. Graham of Buffalo, N. Y.

The appointment of Maurice N. Landay as resident manager of the Hyman-Michaels Co. in the Pittsburgh District, effective May 1, and the removal of the Pittsburgh office on the same date from the eleventh floor of the First National Bank Building to suit 1312-1313 of the same building, has been announced.

The Russell Machine Co., Inc., Pittsburgh, Pa., has opened up a New York office at 118 East 28th St., in connection with the Anco Sales Corporation. Edward C. Angel will be in charge. The company has been in the used-machinery business for 25 years.

The Republic Tool and Manufacturing Co., Cleveland, Ohio, because of the rapid growth of its business, has found it necessary to expand its main offices. The entire second floor of its present building has been remodeled to provide private and general offices of ample capacity. The ground and other floors will be utilized for greater warehouse capacity.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A merchant firm in Sweden desires to purchase and secure an agency for machine tools and tools, machines for woodworking, tubes, belts, and all articles for mechanical and industrial works. Quotations should be given f.o.b. New York. Payment against documents. No. 32,466.

A manager of a sales company in Spain desires to secure an agency and also purchase one or two electric autotrucks, equipped complete, capacities from ½ to 7 tons, and requests that descriptions and quotations c.i.f. Corruna or Cadiz be given. Payment by New York draft in United States currency. Correspondence should be in Spanish. References. No. 32,470.

A commercial representative in Asia Minor desires to establish an American exhibit in that country of various kinds of machinery, especially electrical, road-making, and agricultural, and requests firms to forward samples for that purpose. The exhibition to be thoroughly advertised and a commission allowed to pay for same. No. 32,471.

A merchant firm in Spain desires to secure the representation of dealers for the sale of automobile trucks, to be shipped knocked down for convenience. Quotations should be given c.i.f. Malaga or Cadiz. Payment, in pesetas against documents on arrival of goods. Correspondence may be in English. References. No. 32,501.

A commercial agent in Algeria desires to secure an agency for the sale of automobiles, tires, accessories, tractors, and agricultural machinery. Quotations should be given c.i.f. African port. Payment against documents. Correspondence should be in French or Spanish. Reference. No. 32,588.

A firm in South Africa has requested that catalogs and price lists of button-making machinery be forwarded No. 32,582.

A man interested in timber property in East Africa desires to be placed in communication with firms which would be able to furnish him with machinery for felling and baking trees. He desires to know what machinery would be necessary, and the output of such machines, the power required, and the prices. No. 32,592.

A steel goods manufacturer in England desires to purchase steel plates, 1,500 to 1,550 deg. steel for pressing into automobile side rails. Quotations should be given c.i.f. Liverpool or Manchester. Information is wanted as to base price and delivery. No. 32,704.

A commercial agency firm in Mexico desires to secure agencies for the sale of hardware, tools, kindred lines, including barbed wire fencing, annealed wire, black and galvanized iron sheets, bolts and nuts, fittings, unfinished iron and steel products, scales, sprayer outfits, trace chains, water pumping outfits, calcium carbide, etc.; printers' supplies such as newsprint paper, printers' type. Quotations should be given f.a.s. New York or San Francisco. References. No. 32,703.

New Publications

Elements of Steam and Gas Power Engineering. By Andrey A. Potter, Dean of the Division of Engineering, Kansas State Agricultural College, and James P Calderwood, Professor of Mechanical Engineering, Kansas State Agricultural College. First Edition, 304 pp., 5½ x 8 in., 225 illustrations, in cloth board covers. Published by the McGraw-Hill Book Co., Inc., 239 West 39th Street, New York City. Price $2.50.

This book covers in a general way the whole field of steam and gas power engineering, treating, as its name suggests, the fundamental principles and the elements upon which these subjects are based. The book thoroughly accomplishes the purpose of the authors, as stated in the preface in the following sentences: "This book has been prepared primarily as a text book for students in engineering schools and colleges in order to familiarize them with power plant equipment before they take up the more abstract study of thermodynamics and design. The subject matter of this treatise is so prepared that it should prove of considerable value to those who are responsible for the operation of steam or internal combustion engine-power plants." The book is well suited for ordinary reference purposes.

The first and largest part of the book is devoted to the development and explanation of steam power plant principles, equipment and operation, taking up boilers, engines, turbines and auxiliaries; the second part to the treatment of gas-power engineering, involving gas producers, internal-combustion, engines and auxiliaries; while the last part deals with the application of steam and gas power to vehicles such as locomotives, trucks, automobiles and tractors. Each subject is clearly and logically developed, and, with the aid of the numerous illustrations, the reader is given a good idea of the principles and practice of engineering in power plants. The book contains such necessary tables as those showing the properties of steam, and at the end of each chapter are found problems illustrative of the subject matter. It should be remarked that, owing to the size of the book, the various subjects are not treated in great detail.

Trade Catalogs

Grinding Wheels. Abrasive Co., Philadelphia, Pa. Catalog No. 7, pp. 127, 6 x 9 in. The beginning of this catalog tells what grinding wheels are made of and also illustrates their formation. Several pages are devoted to tables for selection of grain and grade, grinding-wheel speeds and decimal equivalents. It also gives specifications and prices of its wheels for other makers of grinding wheels.

Grinders. The Blanchard Machine Co., 64 State St., Cambridge, Mass. Booklet, pp. 61, 5¼ x 7¾ in. This company has issued a small handbook of useful information for operators for the Blanchard high-power vertical surface grinding machine.

Industrial Illumination. Cooper-Hewitt Co., Hoboken, N. J. Catalog, pp. 18, 10¾ x 11 in. This is a portfolio of industrial illumination. Many photographs are shown demonstrating the Cooper-Hewitt lamp in providing "day light" conditions.

Electric Soldering Irons. The Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Catalog, pp. 4, 8½ x 11 in. This publication describes and illustrates C-H soldering irons and associated equipment, including the C-H automatic rack, C-H soldering fixture, and the C-H current regulator for temperature control.

Aerial Railway of Industry. Shepard Electric Crane and Hoist Co., Montour Falls, N. Y. Bulletin, pp. 26, 8½ x 11 in. In this bulletin the plans of two typical installations are shown, together with photographs of the machines employed. Several types of hoists are presented and detail drawings and specifications of parts are given.

Vises. O. Zernickow, 15 Park Row, New York. Circular, 8½ x 11 in. The vises shown in this circular are suitable for use on planing, milling, shaping, drilling, slotting, etc., machine tables.

The Way to Increased Production. Du Pont Chemical Co., Wilmington, Del. Booklet, pp. 32, x 6½ in. A new booklet has just been issued by the Du Pont Chemical Co. entitled "The Way to Increased Production," which gives some facts in regard to its gigantic sale of war surplus material. This booklet is a useful handbook for buyers in every line in the present state of the market.

Trucktractor. Clark Trucktractor Co., 1122 S. Michigan Blvd., Chicago, Ill. Pamphlet, 8½ x 11 in. This pamphlet shows photographs and specifications of all models of the Clark trucktractor also some illustrations showing the trucktractor at work in various industrial plants.

Photo-Micrographic and Macrographic Metallographic Bench. Holz & Co., Inc., 17 Madison Ave., New York City. Bulletin No. 22-23, pp. 20, 7½ x 10¾ in. This bulletin gives the requirements, optical and mechanical, of a satisfactory photo-micrographic outfit for metallography and the latest advance in the design and construction of such apparatus; specifications also included.

Grinders. Greenfield Machine Co., Greenfield, Mass. Catalog, No. 7, pp. 46, 6 x 9 in. An illustrated and descriptive catalog of the universal grinder for tool, cutter and general machine-shop grinding. It also shows a list of attachments and parts furnished with the equipment.

Cranes. Lane Manufacturing Co., Montepelier, Vt. This small folder illustrates and describes the Lane electric cranes.

A Hoist Below the Hooks. Shepard Electric Crane and Hoist Co., Montour Falls, N. Y. Catalog, pp. 19, 6 x 9 in. These pages are devoted to photographs of electric hoist installations in services so diversified as to range from the making of soup to the assembling of motor cars and from handling glassware to conveying coal.

Grinding Wheel Stands. Norton Co., Worcester, Mass. A 14-page booklet giving the bearings, floor arrangement, flanges, speeds, etc., of its grinding-wheel stands for machine shops.

Universal Joint. Easton Machine Co., South Easton, Mass. Circular 6½ x 3¼ in., illustrates and describes the company's A. B. universal joint.

Drop Forged Tools. The H. D. Smith & Co., Plantsville, Conn. Catalog No. 25, pp. 36, 6 x 8¼ in. This catalog contains descriptive matter and illustrations of the company's cape chisels, climbers, wire cutters, hammers, nippers, pincers, pliers, punches, wedges, etc.

The Polytechnic Institute of Brooklyn. Booklet, pp. 36, 8¼ x 11½ in. This booklet aims to indicate by means of pictures and text the growth of the Polytechnic, its facilities, its workings, and its methods of training chemists and engineers for public service.

Bench Power Presses, Foot Presses, etc. The Atlas Machine Co., Waterbury, Conn. Catalogs A, B, and C, 5¾ x 3½ in. These three catalogs describe and illustrate its various presses, general dimensions are also given.

Vises. Prentiss Vise Co., 106-110 Lafayette St., New York. Catalog, pp. 48, 9¾ x 6 in. An illustrated and descriptive list of the several models of Prentiss vises, pipe grips, repair and extra parts.

Electrolytic Gas Specialties. The Electrolab Co., Pittsburgh, Pa. Catalog, pp. 10, 10½ x 8½ in. This catalog contains full descriptions of the Electrolab products, also several half tones and line cuts showing models of oxygen and hydrogen cells and their use in some large plants.

Cone Clutch. Fletcher Works, Glenwood Ave., and Second St., Philadelphia, Pa. An eight-page pamphlet describing the Fletcher multi-cone clutch. It also contains a table of the sizes, power ratings, diameters, spaces occupied on shafts and the weights together with instructions for ordering.

Forthcoming Meetings

The Seventh National Foreign Trade Convention will be held in San Francisco, Cal., on May 12, 13, 14 and 15. Several group sessions, at which problems bearing on international trade relations, production, labor and other phases of industrial life, will be discussed by men prominent in these fields. O. K. Davis is the secretary of the National Foreign Trade Council.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association, will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

The National Association of Manufacturers will hold its annual convention in the Waldorf-Astoria, New York, on May 17, 18 and 19. A "Silver Jubilee" session will be held on the evening of May 17.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21, at the Hotel Traymore, Atlantic City, N. J.

The Industrial Relations Association will hold its second annual convention at Chicago, Ill., on May 21, 22 and 23.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The American Drop Forge Association will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25 inclusive.

May 20, 1920 American Machinist Vol. 52, No. 21

The NAVY YARD at NEW ORLEANS

by FRED H COLVIN
EDITOR - AMERICAN MACHINIST

The demand of the war made it necessary to increase the capacity of all our Navy Yards, as well as other shipyards, the yard at New Orleans being no exception. This article shows some of the work done and gives an idea of how all helped to win the war.

THE location of the New Orleans Navy Yard is particularly attractive, being on the bend of the Mississippi River, which gives the City of New Orleans its name as the "Crescent" city. The particular disadvantage perhaps is that, in common with the rest of the surrounding country, it lies considerably below the level of the river, depending upon the levee for its protection from inundation. This will be seen in some of the illustrations. For a small yard it is very well equipped and is now in command of Captain George S. Cooper, Commander John H. Walsh being senior naval constructor, while Lieutenant-Commander L. M. Bellinger is Industrial Engineer, assisted by Lieutenant Welch, who has direct charge of the shop. The headpiece shows the floating drydock with two small ships in process of repair. This dock is well equipped in every way with all necessary apparatus, including the swinging bridges by which access is had from the upper deck of the dock, to the ship. At the right, tied up along the levee are numerous tugs and sub-chasers which were built in this yard. Another interesting view in the drydock is that of one of the German submarines, U. B. 88, this being shown in Fig. 1. Except for a crumpled prow it is in good condition, this view showing the two torpedo tubes on each side opened. It also shows the gun on deck, the conning tower and the general construction.

FIG. 1. GERMAN U-BOAT IN DRYDOCK

Among the war activities of the yard was the building of submarine chasers and harbor tugs. The chasers are 110 ft. and the harbor tugs 88 ft. long. The method of building the hulls for the sub-chasers is shown in Figs. 2 and 3. The hulls, as can be seen, are built along the side of the levee on the timber foundation shown, and are launched sideways. Fig. 2 shows the keel of submarine chaser No. 444, the stem also being in position. In Fig. 3 the hull has pro-

FIG. 2. LAYING KEEL OF SUBMARINE CHASERS

gressed considerably, being what is known as "in frame." One method of launching the sub-chaser is to let the cradles in which the hull rests slide into the water with the hull. By this method the chaser is launched sideways. Another method of launching this same type of boat is shown in Figs. 4 and 5. Here the hull was built on the dock instead of on the levee and, after completion, the hull is swung into the water by means of the 100-ton floating derrick, Pelican, which can be seen to some extent in both views. This is practically the same method as used at Panama, and described in previous articles by Commander Gatewood. It requires good judgment in placing the slings, care in preventing slipping, and in hoisting and lowering. The method of holding the end slings against slipping toward the center is clearly shown in Fig. 5, where the slings are securely fastened by rope to prevent any movement toward the center. The harbor tugs already referred to are smaller than the sub-chasers, one being shown in Fig. 6. The view also gives an idea of the docks, with the back water between it and the levee and also shows how the land of the whole Navy Yard lies considerably below the top of the levee which protects it from the river. The engine for one of the harbor tugs is shown in Fig. 7. These engines were completely built in the Navy Yard shops, and, the one shown, is being tested under steam. This Navy Yard does all sorts of repair work in addition to building hulls, as shown. One of its war jobs was the repairing of the German Steamer "Gutheil," which was sunk in the Mississippi River and was under water for some months. This necessitated almost complete overhauling from stem to rudder.

FIG. 3. SUBMARINE CHASER IN FRAME

The plate shop is equipped with a large bending roll, and Fig. 8 shows how these are being utilized for making angle bends when no bending press is available. The block A is fastened around the upper roll by means of the strap B, while the heavy angle plate C rests on the lower roll. By raising the upper or movable roll, the piece to be bent is simply placed between A and C, and the roll forced down by power. This makes a very acceptable bending press of considerable range and power. Among the almost regular jobs of the Navy Yard are repairs on the Mississippi River dredges. The water of the Mississippi carries so much mud in suspension that it has a very decided scouring action on the inside of the centrifugal pump casing of the dredger and similar parts. To overcome this, the pump casing, as well as other parts which are worn away by this action, are periodically built up with the oxyacetylene torch. This is used simply to deposit new metal to take the place of that worn away by the action of the material

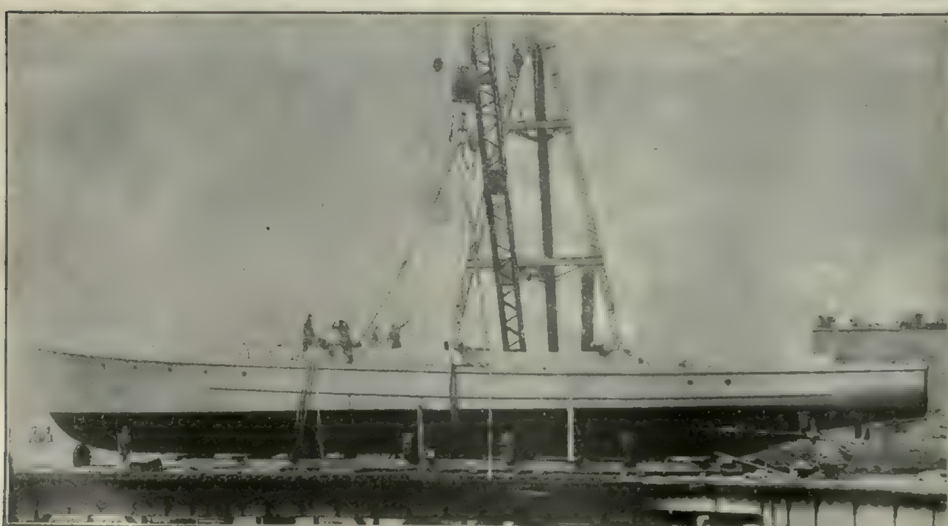


FIG. 4. ONE METHOD OF LAUNCHING

FIG. 5. SWINGING THE CHASER INTO THE WATER

FIG. 6. ONE OF THE HARBOR TUGS

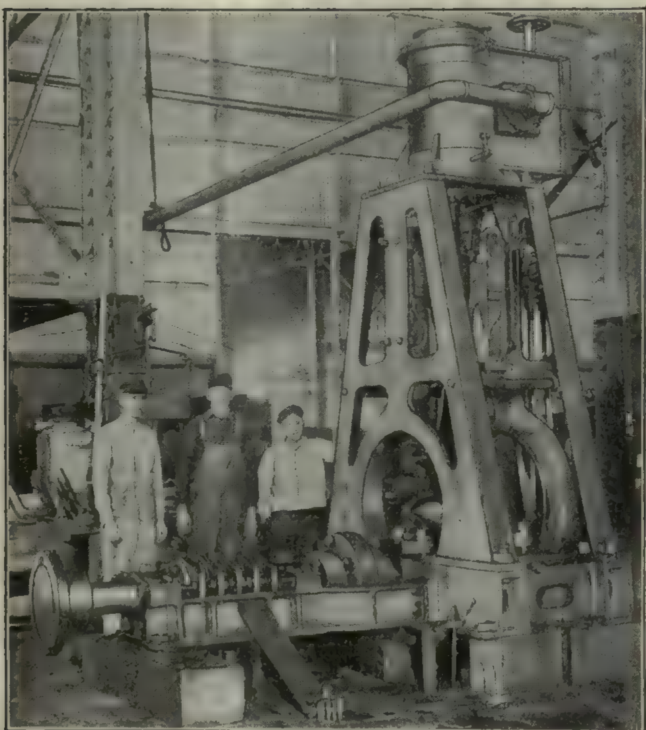


FIG. 7. ENGINE FOR HARBOR TUG

being pumped. This problem of mud in the Mississippi water also extends to the outboard bearing of propeller shafts. After considerable experimenting with various kinds of materials, it has been found that cast iron makes the best outboard bearing under these conditions.

Another interesting development in the shop is the use of California redwood for patterns in place of pine, cherry or mahogany. This has been tried in the making of patterns and is proving very satisfactory. It is reported to work fairly well and to be considerably cheaper than either of the other woods named.

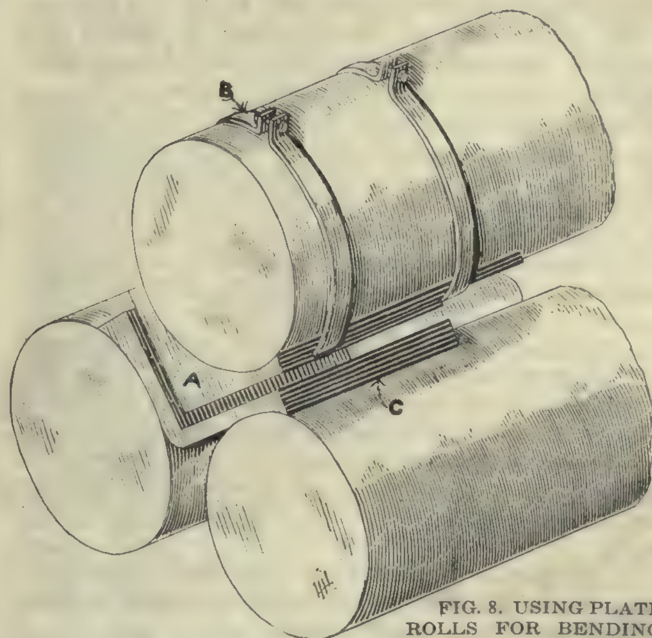


FIG. 8. USING PLATE ROLLS FOR BENDING

Quite a large variety of work can be handled in this yard, as is evident from the foregoing discussion, and it is probable that the importance of the yard will increase as time goes on. An idea of the sort of work which has been turned out can be gotten by referring to the tailpiece, which shows one of the sub-chasers fully equipped and ready for duty.

An Aid to Determine Pulley Diameters and Speeds

By Julius Klein

The accompanying table of pulley diameters and speeds will be of help to both shop men and designers. The table was worked out by the writer as a means of determining the sizes of pulleys to be used on countershafts when the speed at which the line shaft revolved was known. It is based on the formula:

$$DN = D_1N_1;$$

where, D = Diameter of driving pulley;
N = Revolutions per minute of driving pulley;
D_1 = Diameter of driven pulley;
N_1 = Revolutions per minute of driven pulley.

The belt speeds given at the tops of the columns are in feet per minute and the diameters of pulleys are in inches. The table offers a convenient means of solving pulley problems within the range given.

The two problems which follow are given to illustrate the use of the table, the method of handling the data being shown in the solutions. Solutions can be determined very quickly, since the method of operating the table is quite simple.

(1) Given an 8-in. pulley mounted on a line shaft revolving at 225 r.p.m., to find the size of pulley required to make the countershaft revolve at 90 r.p.m.

In the first column, find the 8-in. pulley diameter and follow to the right until 225 is reached. In this column, under 18-in. pulley diameter, read downward to 90 r.p.m. and then follow back on the same line to the first column and read 20 in. This is the required pulley diameter. To find the belt speed, read above the 18-in. pulley diameter just mentioned, 471.2 ft. per minute.

(2) Given a 20-in. pulley on a line shaft running at 310 r.p.m., to find the revolutions per minute of a 30-in. pulley mounted on a countershaft.

In the pulley-diameter column pick out 20 and follow to the right until 100 is reached. Read down to 66.66 in this column, which is the speed for the corresponding 30-in. pulley. Then $66.66 \times 310/100 = 206.6$ r.p.m., the speed of the countershaft pulley. The belt speed will be obtained by multiplying the speed ratio by the belt speed found at the top of the column in which 66.66 r.p.m. is: $523.6 \times 3.10 = 1{,}523.16$ ft. per minute.

Accurate Squaring Device for Planing Machine

By Harry Senior

In an article published under this caption on page 946 of *American Machinist*, E. A. Dixie describes a device used for squaring work on the platen of a planing machine and used in his shop where, he says in effect, "square" is a good deal "squarer" than it is in some other shops.

I have no especial criticism of Mr. Dixie's device, but I would like to point out an error or two in the line of reasoning by which he proves it to be superior to the standard tool; which, by the way, he designates as a "beam-square."

No doubt, a careful man could square a piece on the planing machine as accurately with Mr. Dixie's "round square" as I could with the standard article, but I stoutly maintain that he couldn't square it any "squarer." The chances of error with the new-fangled "dinguss" in the hands of a careless man are equal to or greater than with the old-fashioned instrument; while in either case it would still require the application of a regular try-square to test the work after planing.

Mr. Dixie says: "Accurate squares are not common and squares, the accuracies of which are permanent, do not exist." He might with equal point have said that sharp cutting tools are not common and cutting tools that permanently retain their sharpness do not exist. All tools have to be taken care of. It is quite as easy to test a square for squareness as it is to test a tool for dullness; indeed the act of applying a square to a job like the one he shows would, in the hands of a mechanic, supply its own test.

The edge or side of a planing-machine platen may be more exposed to abrasion than the corners of the

TABLE SHOWING THE RELATION BETWEEN SHAFT

Belt Speed	52.36	78.54	104.72	130.9	157.1	183.3	204.4	235.6	261.8	287.98	314.2	340.4	366.6	392.7
Dia., In.	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	R.P.M.													
2	100.0	150.0	200.0	250.0	300.0	350.0	400.0	450.0	500.0	550.00	600.0	650.0	700.0	750.0
3	66.66	100.0	133.3	166.6	200.0	233.3	266.6	300.0	333.3	366.6	400.0	433.3	466.6	500.0
4	50.00	75.0	100.0	125.0	150.0	175.0	200.0	225.0	250.0	275.0	300.0	325.0	350.0	375.0
5	40.00	60.00	80.00	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0	300.0
6	33.33	50.00	66.66	83.33	100.0	116.66	133.33	150.0	166.66	183.33	200.0	216.66	233.33	250.0
7	28.57	42.85	57.14	71.42	85.71	100.0	114.28	128.57	142.85	157.14	171.42	185.71	200.0	214.28
8	25.0	37.50	50.0	62.50	75.0	87.50	100.0	112.50	125.0	137.50	150.0	162.50	175.0	187.50
9	22.22	33.33	44.44	55.55	66.66	77.77	88.88	100.0	111.11	122.22	133.33	144.44	155.55	166.66
10	20.0	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00
11	18.18	27.27	36.36	45.45	54.54	63.63	72.72	81.81	90.90	100.00	109.09	118.18	127.27	136.36
12	16.16	25.00	33.33	41.66	50.00	58.33	66.66	75.00	83.33	91.66	100.00	108.33	116.66	125.00
13	15.38	23.07	30.76	38.46	46.15	53.84	61.53	69.23	76.92	84.61	92.31	100.00	107.69	115.38
14	14.28	21.28	28.57	35.71	42.85	50.00	57.14	64.28	71.42	78.57	85.71	92.85	100.00	107.13
15	13.33	20.00	26.66	33.33	40.00	46.66	53.33	60.00	66.66	73.33	80.00	86.66	93.33	100.00
16	12.50	18.75	25.00	31.25	37.50	43.75	50.00	56.25	62.50	68.75	75.00	81.25	87.50	93.75
17	11.76	17.64	23.53	29.41	35.29	41.17	47.06	52.94	58.82	64.70	70.59	76.41	82.35	88.23
18	11.11	16.66	22.22	27.77	33.33	38.88	44.44	50.00	55.55	61.11	66.66	72.22	77.77	83.33
19	10.52	15.79	21.05	26.31	31.58	36.84	42.10	47.36	52.63	57.85	63.15	68.42	73.63	78.94
20	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00
21	9.52	14.28	19.04	23.81	28.57	33.33	38.09	42.85	47.62	52.85	57.14	61.90	66.66	71.42
22	9.09	13.63	18.18	22.72	27.27	31.81	36.36	40.90	45.45	50.00	54.54	59.09	63.63	68.18
23	8.69	13.04	17.39	21.93	26.09	30.43	34.78	39.13	43.47	47.82	52.17	56.52	60.87	65.21
24	8.33	12.50	16.66	20.83	25.00	29.16	33.33	37.50	41.66	45.83	50.00	54.16	58.33	62.50
25	8.0	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00	52.00	56.00	60.00
26	.....	11.58	15.38	19.23	23.08	26.92	30.77	34.67	38.46	42.31	46.16	50.00	53.89	57.69
27	.....	11.11	14.81	18.52	22.22	25.92	29.63	33.33	37.03	40.74	44.44	48.15	51.85	55.55
28	.....	10.64	14.29	17.86	21.43	25.00	28.57	32.14	35.71	39.29	42.86	46.43	50.00	53.57
29	.....	10.34	13.79	17.24	20.69	24.13	27.58	31.03	34.82	37.93	41.38	44.82	48.27	51.27
30	.....	10.00	13.33	16.66	20.00	23.33	26.66	30.00	33.33	36.66	40.00	43.33	46.66	50.00

central T-slot. The latter is, however, by no means exempt and the former is much easier of correction. The careful man will first try this surface by placing the stock of his square against it, when, if the slightest hump appears, it will instantly become apparent through his sense of touch—the square will rock." Thirty seconds' work with a float file will correct even a bad case of abrasion and over correction is practically impossible.

If a very slight hump exists on the narrow line of contact between Mr. Dixie's device and the iron it will throw the tool out of parallel with the platen, and because of the narrow line of contact, over correction with a file is only too easy. Moreover, the tool, being cut away in the middle, will not of its own volition disclose an error in this respect while the square will.

Further, the round bar would be perfectly still with one end resting upon a hump, and the indicator point would be too far forward when turned to one side and too far back when turned the other way; thus, the instrument would register an unblushing falsehood. The longer the cross rod the greater would be the error. A careful man would apply a square in two, if not in four, positions and if the piece was correctly placed the square would lie still in all of them; if it were *not* correct the square would rock in any position but one.

The square is its own check. It would be impossible to make it lie. It would indicate error as promptly and unmistakably whether the error was in itself, the platen, or the setting. If it did *not* indicate error there would be no error.

Regarding limits of accuracy I believe any of my apprentices could set a piece to as close limits by the feel of two pieces of tissue under the blade of a square as any of Mr. Dixie's boys could by the dial gage.

Accurate work is the product of careful, conscientious workmen, not of elaborate tools.

What to Make in a Trade School

By Entropy

When a group of men start a shop it is usually for the purpose of making money out of the manufacture of a certain definite line; usually something with which they are familiar, or something with which they have seen others successful. If these men undertake to start a trade school, either public or within their own shop, their natural tendency is to do the same thing: that is, to manufacture some machine or product complete.

When people in the educational business start a new school it is usually in response to a demand for the training of boys or girls along certain broad lines, so that the graduates may accept or be eligible for positions in widely varying vocations. Such men are inclined to the idea that the difference between general education and trade education is one of breadth only. Both the above classes of people will, or should, find that their viewpoint changes after they have been in the work a short time.

Three Things Affect the Choice of Work

There are three things which affect the choice of work to be done in the shops of a trade school: Policy; educational value; and production value.

The first is of real importance in order to avoid unwarranted criticism. There are always those who fear any new step. There are mechanics of the old school, who having learned their trades under the nearly forgotten apprentice system, are sure that the graduates of a trade school will be failures, and for no other reason except that it is not the way they themselves were brought up. Such criticism is not dangerous, because it is discounted by the rising generation.

There are those who see in every particle of productive work done in a trade school, some morsel of bread snatched from some workingman's family. Their criticisms are injurious, because they make martyrs of themselves, and martyrs are always dangerous.

Then there is the manufacturer of, say, engine lathes who imagines that if the trade school builds twelve lathes in a year that the profits on twelve lathes which he might have sold were taken from his pocket. There is a bare possibility that he is right, but he can usually be convinced that the supply of skilled men made available to him by the school will more than balance these profits; and he can usually see that there is the chance that some other builder

SPEED, PULLEY DIAMETER AND BELT SPEED

418.8	445.0	471.2	497.4	523.6	549.8	575.96	602.1	638.3	664.5	680.80	706.86	733.20	759.20	785.40	Belt Speed
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Dia., In.
							R.P.M.								
800.0	850.0	900.0	950.0	1000.0	1050.0	1100.0	1150.0	1200.0	1250.0	1300.00	1350.00	1400.00	1450.00	1500.00	2
533.3	566.6	600.0	633.3	666.6	700.0	733.3	766.6	800.0	866.6	866.66	900.00	933.33	966.66	1000.00	3
400.0	425.0	450.0	475.0	500.0	525.0	550.0	575.00	600.00	625.00	650.00	675.00	700.00	725.00	750.00	4
320.0	340.0	360.0	380.0	400.0	420.0	440.0	460.0	480.0	500.00	520.00	540.00	560.00	580.00	600.00	5
266.66	283.33	300.0	316.66	333.33	350.0	366.66	383.33	400.0	416.66	433.33	450.00	466.66	483.33	500.00	6
228.57	242.85	257.14	271.42	285.71	300.0	314.28	328.57	342.85	357.14	371.43	385.71	400.00	414.28	428.57	7
200.0	212.50	225.0	237.50	250.0	262.50	275.0	287.50	300.0	312.50	325.00	337.50	350.00	362.50	375.00	8
177.77	188.88	200.0	211.11	222.22	233.33	244.44	255.55	266.66	277.77	288.88	300.00	311.11	322.22	333.33	9
160.00	170.00	180.00	190.00	200.00	210.00	220.00	230.00	240.00	250.00	260.00	270.00	280.00	290.00	300.00	10
145.45	154.54	163.63	172.72	181.81	190.90	200.00	209.09	218.18	227.27	236.36	245.45	254.54	263.63	272.72	11
133.33	141.66	150.00	158.33	166.66	175.00	183.33	191.66	200.00	208.33	216.66	225.00	233.33	241.66	250.00	12
123.07	130.77	138.46	146.15	153.84	161.53	169.23	176.92	184.61	192.31	200.00	207.69	215.38	223.07	230.77	13
114.28	121.33	128.57	135.71	142.85	150.00	157.14	164.28	171.42	178.57	185.71	192.85	200.00	207.13	214.48	14
106.66	113.33	120.00	126.66	133.33	140.00	146.66	153.33	160.00	166.66	173.33	180.00	186.66	193.33	200.00	15
100.00	106.25	112.50	118.75	125.00	131.25	137.50	143.75	150.00	156.25	162.50	168.75	175.00	181.25	187.50	16
94.11	100.00	105.88	111.76	117.64	123.53	129.41	135.29	141.17	147.06	152.94	158.82	164.70	170.59	176.41	17
88.88	94.44	100.00	105.55	111.11	116.66	122.22	127.77	133.33	138.88	144.44	150.00	155.55	161.11	166.66	18
84.21	89.47	94.73	100.00	105.26	110.52	115.79	121.05	126.31	131.58	136.84	147.36	152.63	157.89	163.15	19
80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00	20
76.19	80.95	85.71	90.47	95.24	100.00	104.76	109.52	114.28	119.04	123.81	128.57	133.33	138.09	142.85	21
72.72	77.27	81.81	86.36	90.90	95.45	100.00	104.54	109.09	113.63	118.18	122.72	127.27	131.81	136.36	22
69.56	73.91	78.26	82.61	86.96	91.30	95.65	100.00	104.35	108.69	113.04	117.39	121.93	126.09	130.43	23
66.66	70.86	75.00	79.16	83.33	87.50	91.66	95.86	100.00	104.16	108.33	112.50	116.66	120.83	125.00	24
64.00	68.00	72.00	76.00	80.00	84.00	88.00	92.00	96.00	100.00	104.00	108.00	112.00	116.00	120.00	25
61.53	65.39	69.23	73.08	76.92	87.07	84.67	88.46	92.31	96.16	100.00	103.84	107.69	111.58	115.38	26
59.26	62.96	66.66	70.37	74.07	77.77	81.48	85.18	89.88	94.58	96.29	100.00	103.70	107.42	111.11	27
57.14	60.71	64.28	67.85	71.42	75.00	78.57	82.14	85.71	89.28	92.85	96.43	100.00	103.57	107.13	28
55.17	58.62	62.07	65.52	68.97	72.42	75.87	79.32	82.77	86.22	89.65	93.10	96.55	100.00	103.45	29
53.33	56.66	60.00	63.33	66.66	70.00	73.33	76.66	80.00	83.33	86.66	90.00	93.33	96.66	100.00	30

beside himself might get the profits on a part, if not all, of these lathes if they had not been made by the trade school. He however has a claim which should be recognized.

The second consideration, educational value, is seldom met by the plan of manufacturing a given line such as would be profitable to a firm in business to make money. Take for example the thing that is done by more trade schools than any other: the building of a lot of speed lathes. There is very little work on these lathes for the beginner in the shop. He can rough out the turned parts, but there is very little drilling that he can do, and almost no milling or shaper work. The same is true of almost all other complete machines that can be made in a school that is teaching machine work. There is plenty of simple commercial work for the pattern and cabinet makers, but more schools offer, or attempt to offer, machine work than all the others combined and they are the ones toward whom this article is directed.

The educational requirement then, makes necessary a choice of work on which the beginners may have the desired training without roughing out so much work that the more advanced boys cannot possibly finish it. This is met in some cases by hiring journeymen machinists to complete the work begun by the students, but to do so is poor practice for political reasons and also because it injures the morale of the boys. So long as they see boys of their own kind, boys with whom they play baseball and go swimming, make a finished job of the work they have done, they expect to be able to do it themselves, but when they see grown men brought in to do it they become skeptical and when later they are given the job to do they fall down on it because of lack of confidence in themselves.

The third item, productiveness, needs little comment for the readers of this paper. If the product is not salable there is no way in which the boy can tell for a certainty whether his work is of value or not. He has seen favoritism practiced all through his school life and he expects to see it go right along. He has a very distinct idea that the best marks go to the best dressed boy, and to the boy that hangs around the teacher's desk just the right length of time to ask questions; but when he performs an operation on a part of a machine that must pass the inspection department of some shop a thousand miles away, he knows that no amount of blarney will have anything to do with it, and the job is accepted or not on what the gages say and on the finish that the inspector expects.

Taking all these things into consideration what is there for a trade school to make? There appears to be more than one solution. Those that I have found to be most satisfactory are the manufacture of parts of machines for other people and the repair, or rather rebuilding, of machinery. The first proposition presupposes that there are shops willing to let out the manufacture of detail parts and which have such a system of interchangeability that they can furnish gages to keep the work within definite limits.

Given such a shop, the next thing is to select such parts as require much more work which beginners can do than the more skilled work of completing the job.

The principle that the job must be finished by students is however one to which it is wise to adhere. If a hundred boys enter a school in a given class it is almost certain that but seventy-five will appear the second year, about sixty the third and fifty the fourth year, these last being the ones who will have to put the finishing touches on the completed job.

In addition to this I have found the rebuilding of machinery to be of the greatest possible value, not only for the actual work but because there is no better time to observe the value of good design than after it has been well tested out. Rebuilding should be done, not as a repair job but as a matter of good design, building up the strength of parts which have been broken and increasing the wearing surface in parts that have suffered the most. Steel gears in some instances may be substituted where the proximity of other parts will not allow of increased sizes and hardened steel for studs and shafts that have shown more than their share of wear. The very ingenuity with which these changes of design are made appeals to boys and sets them to thinking for themselves.

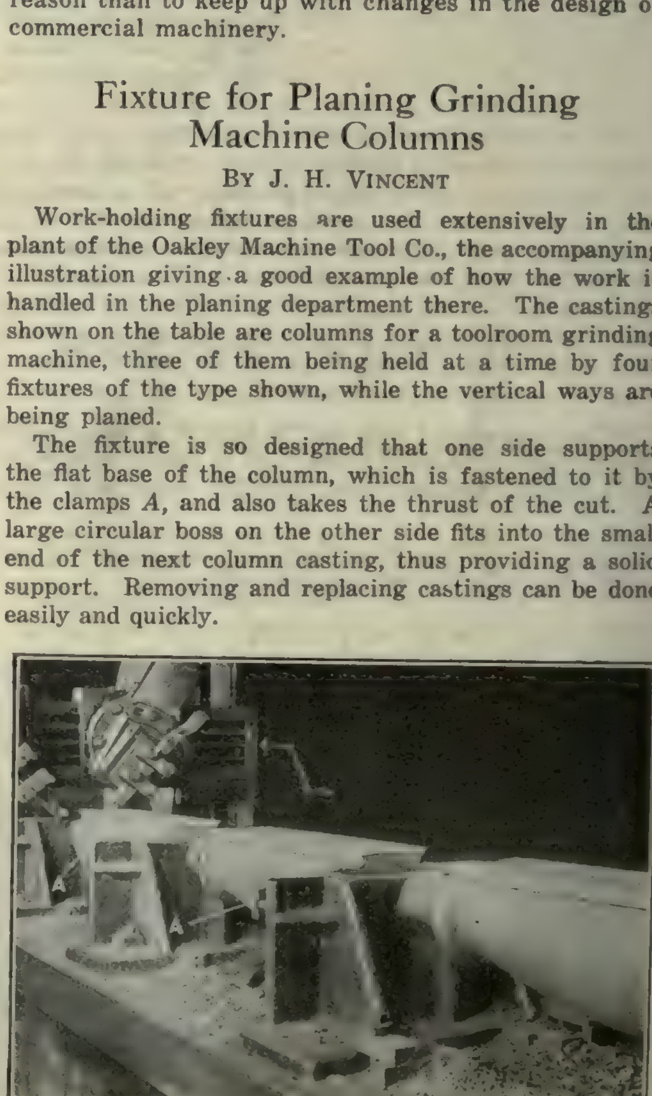
Neither of these methods violates any policy that will bring a school legitimate enemies. The parts which are made for other concerns may be sold for cash or exchanged for machinery needed for the school. The rebuilt machinery should usually be used in the school for a time, at least, as an object lesson and then exchanged or sold. There is always need of new equipment in a live school, even if for no other reason than to keep up with changes in the design of commercial machinery.

Fixture for Planing Grinding Machine Columns

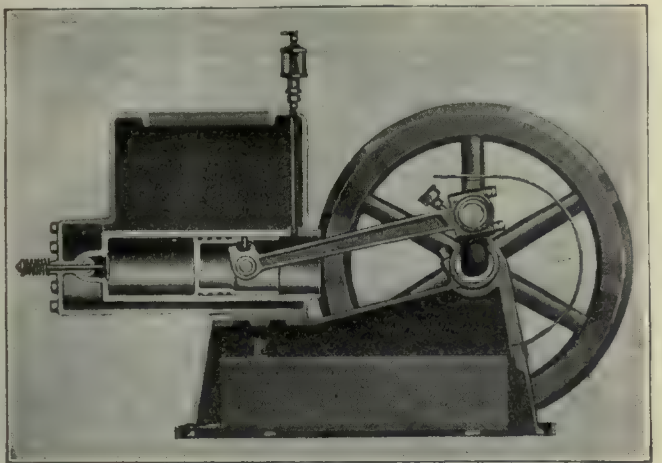
By J. H. Vincent

Work-holding fixtures are used extensively in the plant of the Oakley Machine Tool Co., the accompanying illustration giving a good example of how the work is handled in the planing department there. The castings shown on the table are columns for a toolroom grinding machine, three of them being held at a time by four fixtures of the type shown, while the vertical ways are being planed.

The fixture is so designed that one side supports the flat base of the column, which is fastened to it by the clamps A, and also takes the thrust of the cut. A large circular boss on the other side fits into the small end of the next column casting, thus providing a solid support. Removing and replacing castings can be done easily and quickly.



PLANING FIXTURE FOR HOLDING GRINDING-MACHINE COLUMNS



The Manufacture of Single-Cylinder Gasoline Engines

By J. V. HUNTER

Western Editor, *American Machinist*

If present indications are any guide to the future of the gas-engine industry, the next few years will witness remarkable strides in the commercial development of this source of power. The following article details many of the machining methods of one very successful manufacturer of gas engines.

THE Fuller & Johnson Manufacturing Co., Madison, Wis., has for many years, specialized and successfully manufactured a varied line of single-cylinder type gasoline engines which meet the demand for small and moderate sized power units. By confining its efforts to a few standard sizes, this company has been able to produce engines on an interchangeable-part basis which not only facilitates the work in its own plant but makes it possible to render the users quick service in the matter of repair parts.

In studying the methods employed in manufacturing these engines, we may well start with the machining of the engine base. In some types of engines covered in this article, the base serves as a support for the combined cylinder and water hopper and main bearings in one series, while in others, the cylinder, water hopper and main bearing supports are cast *en bloc*. The preliminary machining operations on the first-mentioned type base are shown in Fig. 1. The base is set up on an open-side planing machine and the cylinder supports, main bearing blocks and minor surfaces on the frame are finished-planed.

The mounting screw holes for the upper works of the engine are next drilled in the base. A heavy cast-iron jig, Fig. 2, of ribbed construction is used to locate the holes. The jig is positioned by means of stops mounted in the C-clamps *A* which bear against the machined surfaces of the main bearing blocks as gaging points. The jig is held in place by means of the hook bolts *B*.

In this plant the babbitting operations on the main bearings follow the drilling. The babbitting jig used for this operation is shown as applied to the base of a medium-sized engine, Fig. 3, and shows the pins *A* which locate it for position and height so that the mandrel *B* will give the correct thickness of babbitt throughout the full length of the bearings. The babbitt is prevented from running out on the ends by the flanges *C* which are held in place by the thumb nuts *D*. The molten metal is poured through the holes *E*.

One of the drill jigs for drilling the main-bearing cap-mounting screw holes is shown in the illustration, Fig 4. The jig is aligned in correct position by means of the babbitted crankshaft bearings.

Machining the Cylinders

The methods of machining the cylinders vary, depending upon the size of the engine. The larger units, which are not made in large quantities, are handled by methods requiring fewer special fixtures than are used for the smaller engines manufactured in greater numbers. A large cylinder is shown being bored on a horizontal boring machine, Fig. 5, using a special fixture *A* for holding the base of the cylinder, and clamping the crossbar *B* which extends over the water hopper *C*. A somewhat similar cylinder is shown clamped to the table of a Gisholt vertical boring machine, Fig. 6, for finishing the surfaces *A* and *B*. The upper end of the cylinder is steadied and supported by a bushing which fits in the

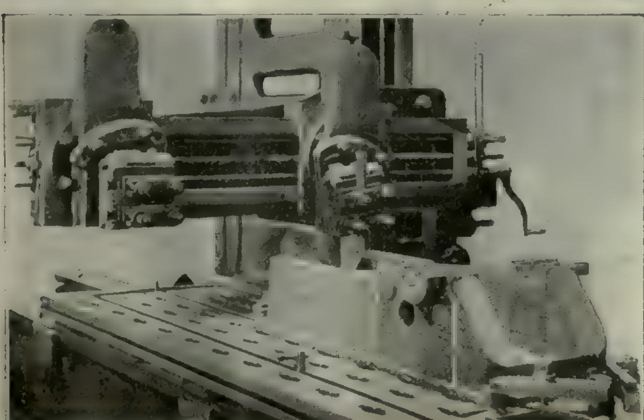


FIG. 1. PLANING A GAS-ENGINE-BED CASTING

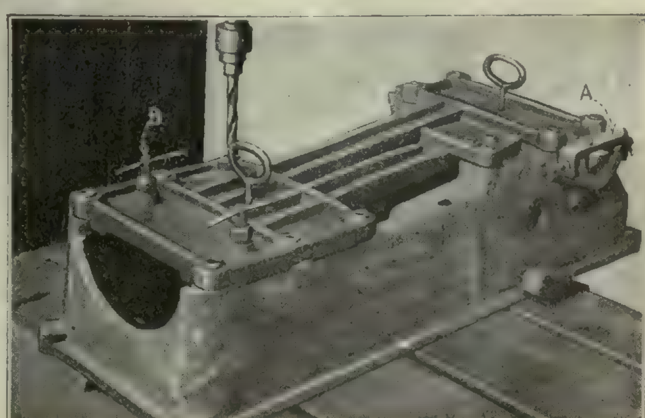


FIG. 2. DRILL JIG COVERING TOP FACE OF ENGINE BASE

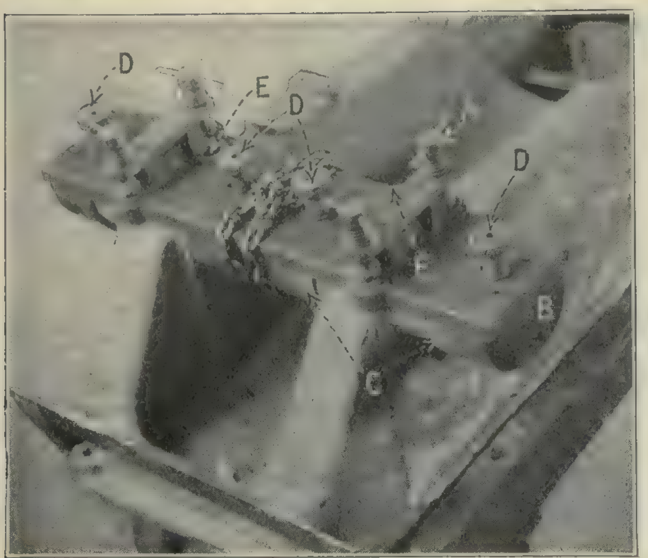


FIG. 3. BABBITTING CRANKSHAFT BEARINGS

bore of the cylinder and revolves on the spindle *C* held in the toolpost *D*.

Another type of cylinder is bored and reamed in a special Gisholt machine which has been fitted with a combination fixture and carriage *A*, Fig. 7. The main spindle is used to drive the boring bar *B*, which carries interchangeable cutters and reamers. After a rough cutter has been passed through the bore, the reamer *C* is put on the bar and a finishing cut taken. The accuracy of this reaming has not been questioned, and so far it has been found unnecessary to internally grind these bores.

A rather remarkable method has been devised for boring and finishing some of the smaller cylinders. The casting *A*, Fig. 8, is held in the large fixture *B* which is mounted on the live spindle of a turret lathe. The various tools required for boring and reaming the cylinder and facing the ends are carried on the turret head of the machine. One of the finished castings is shown at *C*.

A special Gisholt machine has been fitted up for facing the base of the cylinder and drilling the mounting holes in one set-up. The cylinder *A*, Fig. 9, is held in a fixture fixed to the lathe carriage. This fixture is provided with a mandrel which fits the finished bore and aligns the cylinder for the facing and drilling operations. The facing operation is done by the large inserted-tooth milling cutter *A*, shown in Fig. 10, which is mounted on the main spindle of the machine. The drilling of the holes is accomplished by the attachment *B* built on the headstock. This device contains six drills correctly spaced and guided by the bushed frame *C*. The frame is mounted on the sliding studs *D* and held against the work by springs. When the holes are drilled through,

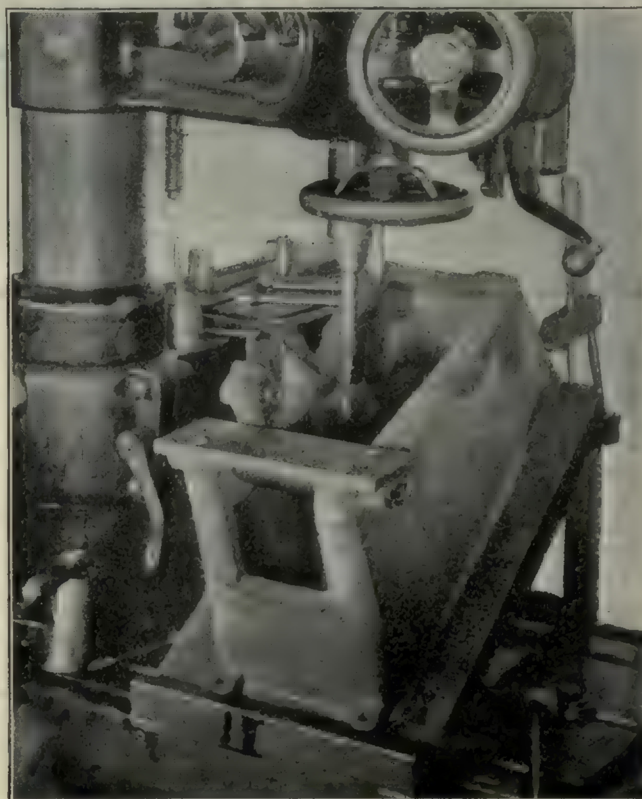


FIG. 4. DRILL JIG LOCATED BY BABBITTED BEARINGS

an automatic device trips the feed and reverses the carriage.

For drilling the small combination engine base and cylinder units, similar to *A*, Fig. 11, a rather unique jig is used. The cylinder *B* is mounted and positioned on the mandrel *C*, while the drill is guided by the bushings *D*. The small jackscrew *E* is used to support the sides of the casting during the drilling operations. Greater detail of this jig may be seen in Fig. 12. Pulling out the stud handle *A*, permits detail *B* to be slipped from the mandrel, thus allowing the easy removal of the cylinder. The leaf *C* is held in position by the pin *D* and when not in use swings upward which allows further quick loading and unloading of the jig.

In the same setting certain counterboring and facing operations on the bosses are performed. In order that the operator may know exactly how far to lower the spindle during these oper-

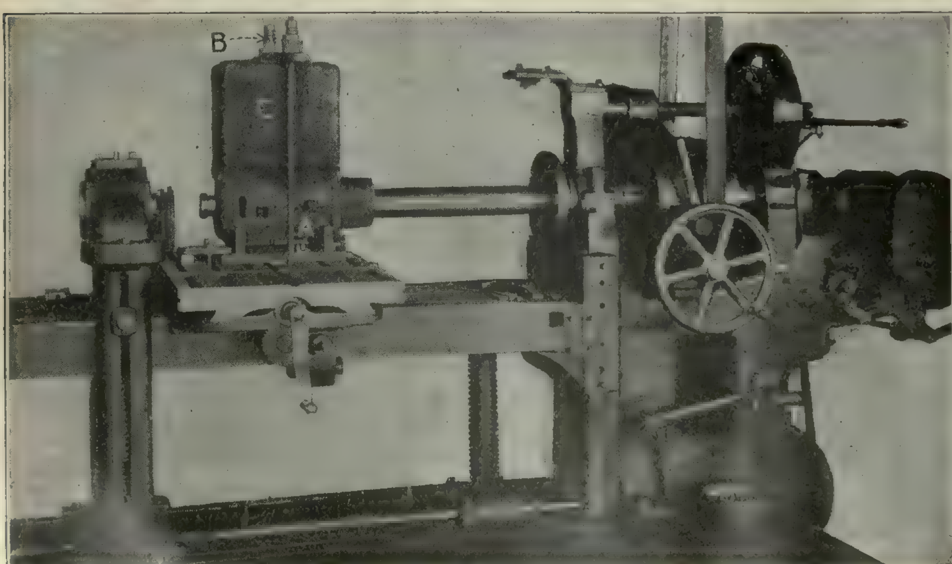


FIG. 5. BORING LARGE ENGINE CYLINDER ON GISHOLT HORIZONTAL MACHINE

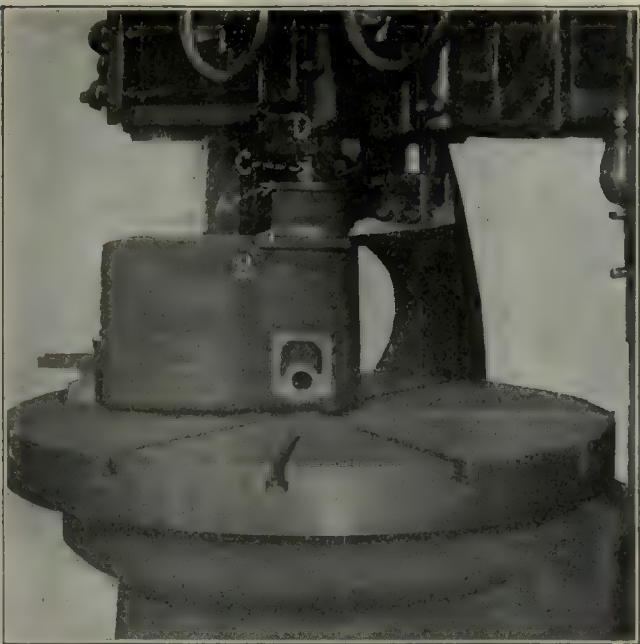


FIG. 6. TURNING OUTSIDE FLANGES OF CYLINDER

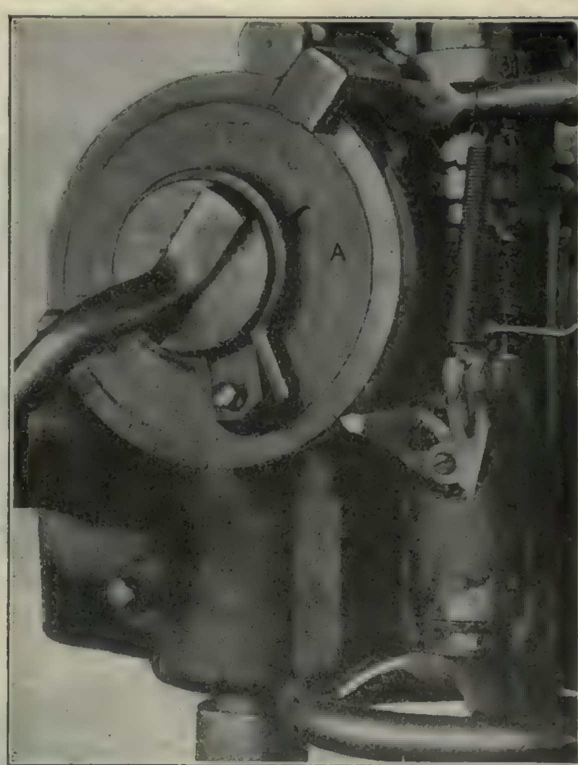


FIG. 13. DISK FOR DETERMINING DEPTH OF COUNTERBORING

ations, the shaft handle of the spindle feed rack has been fitted with a graduated brass dial *A*, Fig. 13, one complete revolution of the dial, which is graduated in 16ths, indicating a feed of 5 in. of the machine spindle.

A very serviceable fixture *A*, Fig 14, is provided for handling a drilling jig under a Fox multiple drilling machine.

The base of this fixture has two ways *B*, upon which a saddle *C* slides. This saddle is pulled back and forth by means of the continuous chain *D* which is driven over a socket by the handle *E*. The fixture is drawn to the front of the machine and the cylinder slipped over the center mandrel. This brings the base of the cylinder inside of the flange *F* which is then aligned and held in place by driving in a long taper wedge *G*. The saddle is then disposed in correct position under the drills by an indexing pin. The drills are guided by the jig plate *H* which slips over the end of the center mandrel and is held in place by a pin *I*.

After the holes are drilled the jig plate is removed and the saddle pulled back until caught by a second indexing pin which lines the cylinder up with the three tapping spindles *J*.

The cylinders of the larger types of engines are given a hydrostatic test at 100-lb. pressure to insure against the possibility of leakage Since the engines are cooled by the water-evaporation method, the hopper *A*, Fig 15,

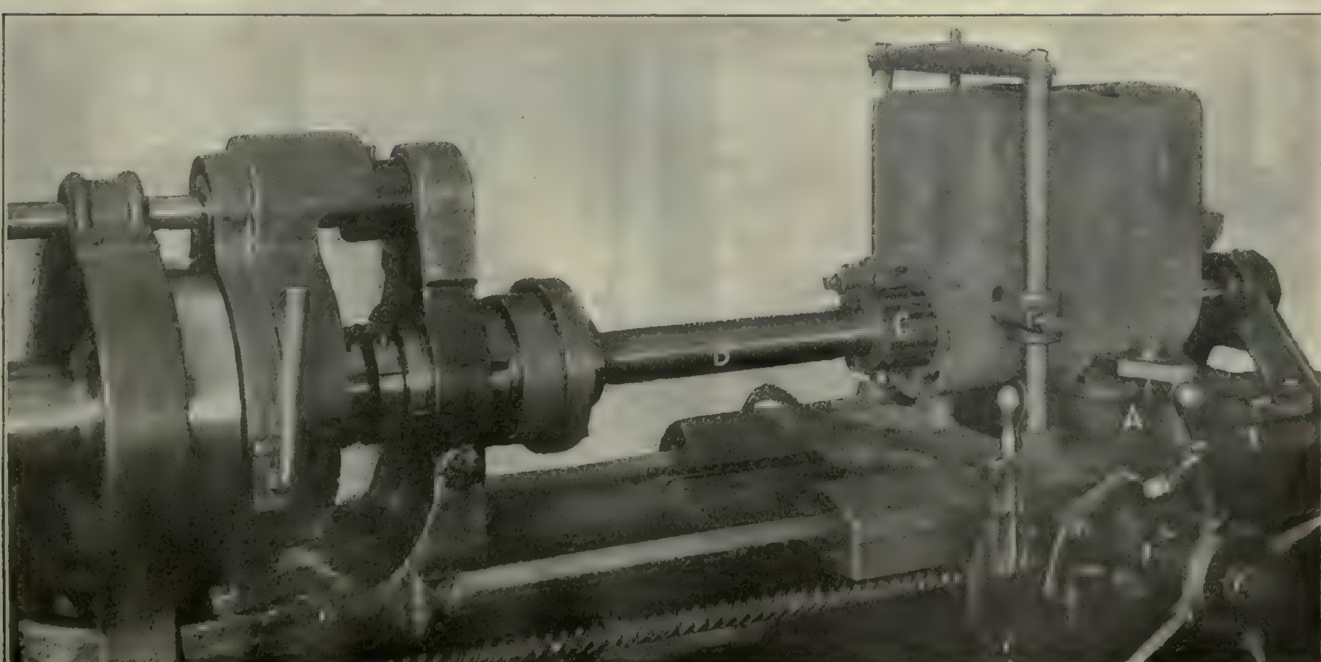
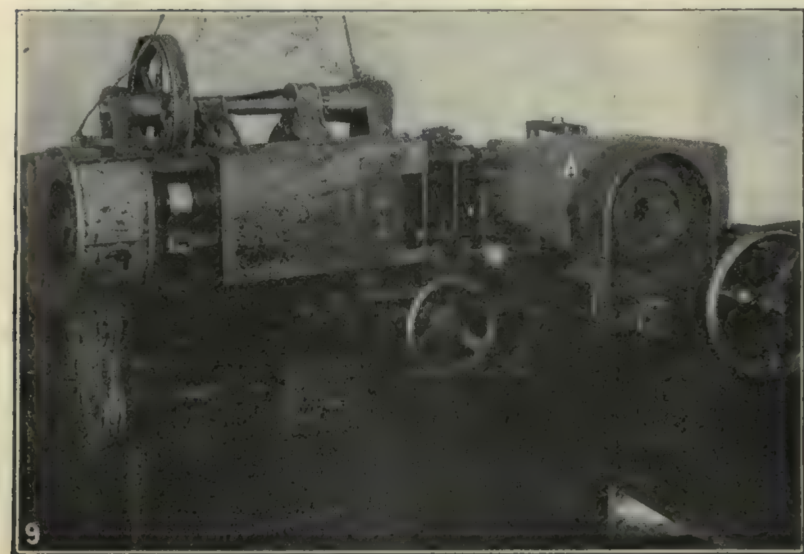
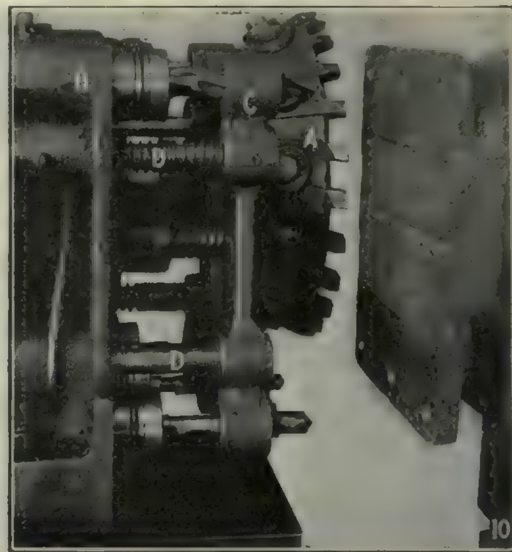


FIG. 7. SPECIAL MACHINE FOR BORING AND REAMING CYLINDERS





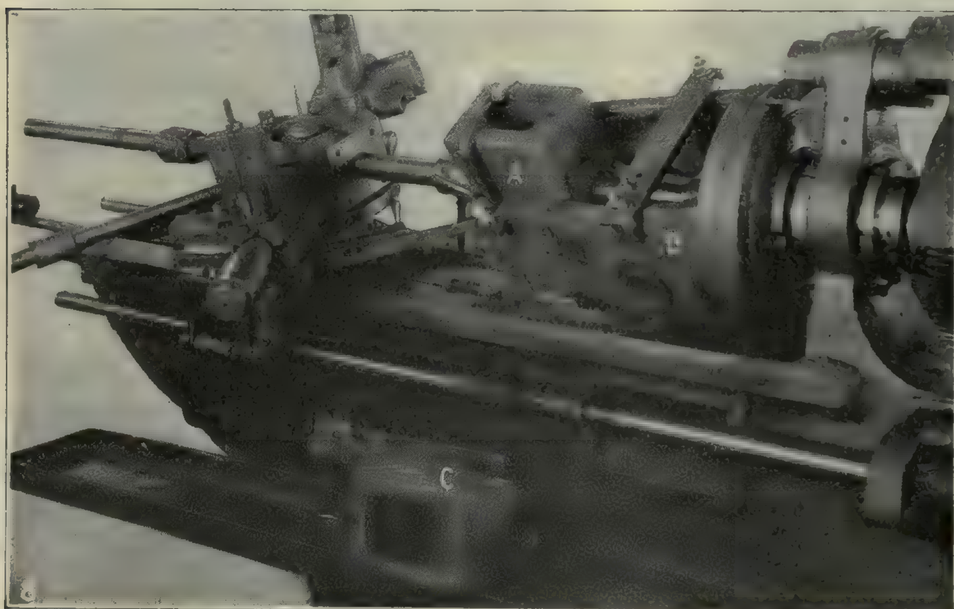


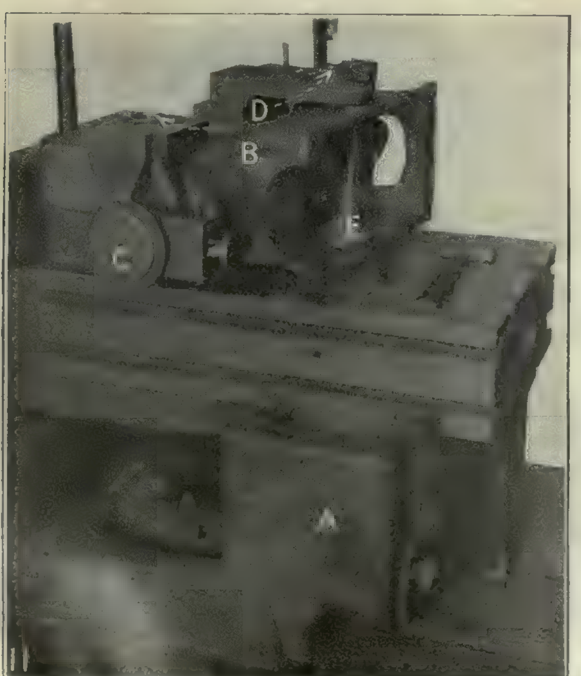
FIG. 8. BORING SMALL CYLINDERS ON GISHOLT TURRET LATHE

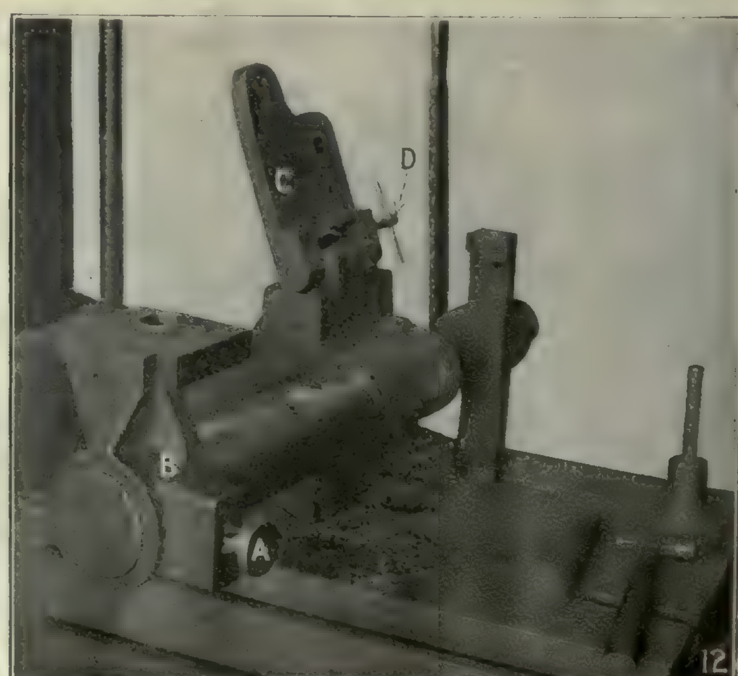
FIG. 9. MACHINE FOR MILLING AND DRILLING CYLINDER BASE

FIG. 10. DETAIL VIEW OF MILLING AND DRILLING FIXTURE

FIG. 11. JIG FOR DRILLING BASE OF SMALL ENGINE CASTINGS

FIG. 12. THE JIG SHOWN IN FIG. 11 AFTER REMOVAL OF CASTING





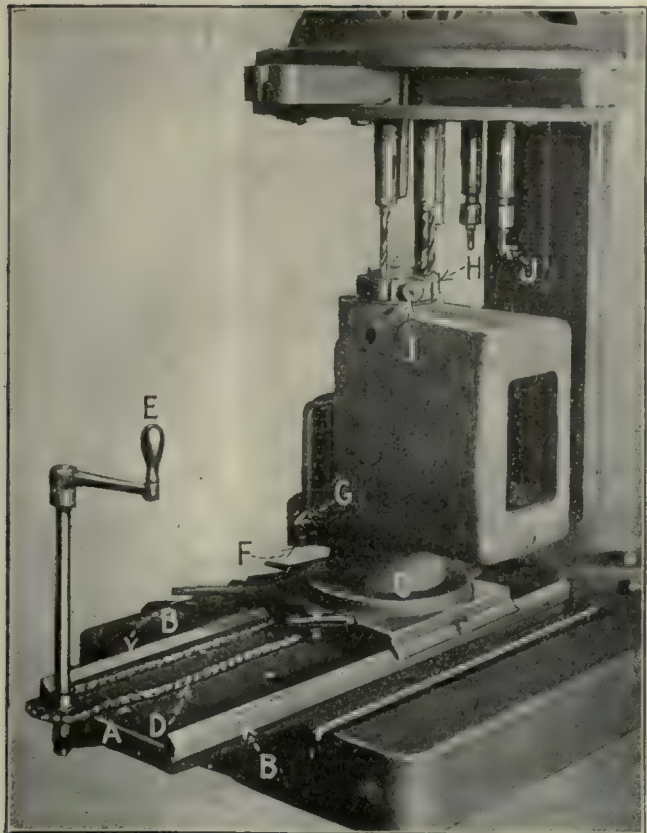


FIG. 14. SLIDING SADDLE FOR SUPPORT OF DRILL JIG

in which the cooling water is evaporated by the heat of the engine, must be tested at the same time. It is closed during the test, by a large plate and gasket *B*, in which are provided both the water inlet and air escape cocks and similarly both ends of the cylinder are closed by large flanges and gaskets *C*.

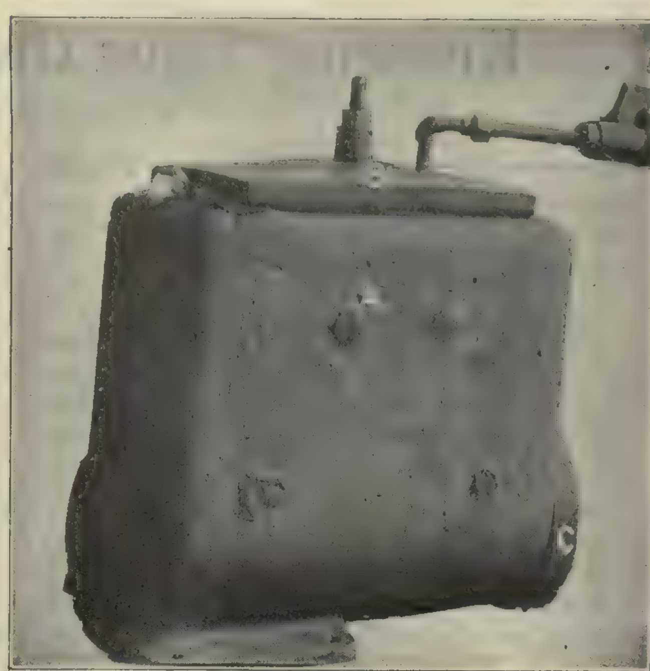


FIG. 15. TESTING CYLINDER CASTINGS FOR LEAKAGE

An Automatic Drill-Releasing Device for Barrel Drills

By Jack Finlay
Lithgow, N. S. W., Australia

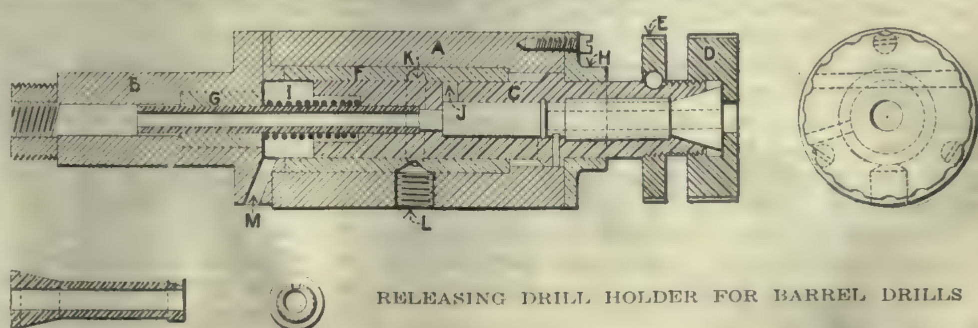
The illustration shows a releasing drill holder used on the P. & W. barrel drilling machines in the Commonwealth Small Arms factory in New South Wales. The device has been in use here for about six years, having been designed by A. C. Wright, now associated with the New England Westinghouse Rifle plant.

The body *A* of the device is of cast iron, to which is attached by fillister-head screws not shown in the drawing, the steel shank *B*. This shank fastens to the saddle of the drilling machine and its threaded end receives the fittings attaching it to the high-pressure oil supply.

The part *C* is of mild steel, case-hardened and ground all over, and is the part which receives the shank of the barrel drills. These fit in the tapered hole at the outer end, and are held by the ring nut *D* and a key in the smaller end. A knurled ring *E*, pinned to part *C*, holds it against the effort required to tighten the nut *D*. Bronze bushings *F* and *G* are pressed into the body and shank. Very accurate work is necessary in sizing these bushings and part *C*, for the reason that while the latter must turn in the bushings the joint must be capable of holding oil at the enormously high pressures used in this work.

A collar *H* fastens upon the outer end of the body *A* by means of fillister-head screws and abuts against a shoulder on part *C*. The friction of this joint (between the shoulder on *C* and the collar *H*) is what holds the drill from turning. The coil spring *I* holds these faces normally in contact, but it is the oil pressure—in these machines, something like 600 lb. per square inch—against the small end of *C* that furnishes the real holding power.

So long as the drilling is proceeding satisfactorily there is no relative movement of the parts, but if a drill "bugs" in the barrel it overcomes the frictional resistance and begins to rotate, carrying part *C* with it. As the saddle of the machine continues to advance, part *C* is pressed back against the pressure of the oil and the action of the spring *I*, until the hole *J* in part *C* coincides with the annular chamber *K* in the bushing *F* and oil under high pressure escapes through hole *L* and thus to a pressure-operated kick-off which stops the machine. The operator, his attention called by the stoppage of the machine, shuts off the oil and releases the clogged drill. A small drain hole *M* in part *C* provides for the escape of any oil that may leak past bushing *G* and thus prevents accumulation of too great pressure upon the frictional driving surfaces.



RELEASING DRILL HOLDER FOR BARREL DRILLS

Knowing Your Insurance Policy—III

BY CHESLA C. SHERLOCK

The premium paid on a policy should be proportionate to the risk, and if the risk should change the premium rate should change. This merely provides protection to the insurer. The method of payment of premiums, particularly in regard to the troublesome question of promissory notes, is fully treated. The importance of a clear and definite agreement between the insurer and the assured cannot be too strongly emphasized.

(Part II appeared in our May 13 issue.)

MUCH of the litigation that arises in regard to insurance contracts grows out of the agreement concerning the premium, the payment of it, or the failure to pay, and the multitude of questions which surround all of these considerations. The premium is in fact, the very backbone of the contract and it is here that we find most of the legal questions arising under insurance contracts centering.

Emerigon, an early authority on insurance, defines it as follows: "The premium is the price of the peril against which the insurer guarantees in case of accident to the subject insured. . . . It is the cost of insurance. The word premium comes either from the word 'praemium,' signifying 'price,' or from the word 'primo,' because formerly the premium was paid before all and at the time of signing the policy." Anderson, another authority, gives it this definition: "The sum paid for undertaking the risk in a contract of insurance."

IMPORTANCE OF THE PREMIUM

It should be remembered in the first place that the premium is the real reason for the insurer undertaking the risk; and in one sense it may be said to be the real reason for the contract of insurance itself, although, from the standpoint of the assured, the real reason is the need for protection from the risk. Since it is one of the very important or pivotal reasons for the existence of the contract of insurance itself, the law has been very jealous of it, both in placing safeguards around it, and in protecting the respective interests of the parties concerning it.

In the first place, it is required that the amount of the premium or the rate per cent shall be shown in the face of the policy itself. While it has long been held that it is not absolutely necessary for the parties to expressly agree to all the details of a written and printed contract such as a policy of insurance always is, the courts have held that the premium amount is such an important element of the contract of insurance that it must be expressly agreed to, in order to validate the contract. There is this important exception, however, that, if the premium amount, or the rate, is not expressed, it must be possible from the terms of the policy or contract itself to ascertain with reasonable certainty what it is.

Emerigon has said: "If there be neither a premium stipulated nor implied, it is certain there is not the whole of the contract or that it is a contract of quite a different kind from insurance."

It is well settled at law that the premium is not due until the risk to the insurer attaches; or, as it is usually stated, the contract is not in force until the premium has been paid.

The premium is part of the consideration of the contract. In fact, so far as the insurer is concerned, it is the consideration, and those who understand the elements of a valid contract know how important it is to have the proper consideration. If the consideration is inadequate or fails, the contract itself fails. It is a well-known fact that the courts will declare a contract of no force or effect, merely because of the lack of proper consideration. So it is in respect to the contract of insurance. Since the premium in this sense is the consideration, it follows that it must be adequate or the contract of insurance will fail.

This is the first important fact to bear in mind concerning insurance premiums. If the policy does not meet these conditions regarding premiums, or if the agent in his anxiety to do business attempts to circumvent the evident intent of the law, have nothing to do with the matter if you desire the protection that is at the basis of every attempt to secure such a policy.

THE ELEMENT OF RISK

The premium must correspond at all times to the risk. If the risk increases, then the premium must increase. Business men may be surprised at this statement, but it is grounded in ample authority. Joyce, one of the leading authorities on insurance, says: "But the premiums must grow higher as the risk increases; for, as we have before noted, the division and the distribution of liability among a large number of persons subjected to like risks minimizes the loss, and the premium must be such that it will be safe for the company to insure, and not so large that the insured cannot afford to effect a policy; so that although the insurer may undoubtedly assume the risk without any conditions upon the assured, the premium being the sole consideration, nevertheless it is for the benefit of all parties concerned that the risk be not increased during the term of insurance. An increase of risk which is substantial and continued is a direct and certain injury to the insurer, and changes the basis upon which the contract of insurance rests."

The courts long ago wisely adopted the rule that the premium should be sufficient to make it safe for the company to insure, but that it should not be so high as to prevent the assured from accepting the policy. Joyce states: "The rate of the premium should be so computed, and an adequate premium demanded, that the insurer can safely assume the risk and the assured may afford to insure." The courts have never attempted to concern themselves with rate-fixing, and we believe wisely. That is a matter entirely on the side and not involved in the broad legal principles governing such contracts. The courts have required, though, that the parties shall agree upon a rate and they have laid down, with legislative aid, certain restrictions as to how they should reach that agreement, but they have never attempted to enter the field of rate-fixing.

But one thing is very certain, and it should be written in letters a mountain high. This is that the assured,

seeking protection for his property against a certain risk, cannot increase the hazard after he has secured a policy and paid a premium on a given risk, and expect to hold the insurer liable for any damage that may arise to the property from such increased risk.

It is a fundamental proposition in the law of contracts that the entire liability of the parties rests in the meeting of the minds of the parties, presumably as expressed in the written instrument. If the parties to an insurance contract agree that the risk is such and such and that the premium on this risk is so much, that and that only is the basis of their contract. So long as the facts remain this way the parties will be absolutely bound according to the policy.

But the insurer never contemplated that he should be bound in like fashion in case the risk should be increased two-fold, we will say. He assumes that the risk will remain the same and he has a right to make this assumption. He assumes, and he has the right, that in case the risk is increased that the assured, if he has no way of preventing it, will promptly inform him and a new contract covering the new situation will be drawn up, and the increased premium on the increased risk paid.

Violation of Contract by Change of Risk

This is just what the law intends that the parties shall do; or else it assumes that they understand that, the essence of the old contract having failed, it is no longer in force and effect so far as the increased risk is concerned. Says the Connecticut court, in this connection: "The insurer undertakes, for a comparatively small premium, to guarantee the assured against loss or damage upon the exact terms and conditions agreed upon."

The stipulations and the conditions of an insurance contract are deemed a part of the consideration of such contract and the non-observance by the assured of these stipulations and conditions, or a failure by him to perform them, will release the insurer. Business men seldom stop to think of this important fact or to realize how often, in the course of a year they are really without insurance protection at all simply because they have failed in their legal obligations under the contract.

Says an Iowa case: "A contract of insurance, though unilateral in form, may contain covenants of the assured as well as of the underwriters and mutual agreements of the parties, and some of the covenants may be in the nature of warranties and conditions precedent on the part of the assured, while others may be in the nature of obligations imposed by conditions limiting or measuring the underwriter's liability. The covenants of the insurers are, for the most part, if not entirely,dependent upon the covenants or obligations of the assured, expressed or implied in the policy; and even though the policy is subscribed only by the underwriters it evidences the contract entered into by both parties."

In fact, it is a general rule among the authorities that the premium is the essence of the contract of insurance. One authority states: ". . . the premium paid by the assured and the peril assumed by the insurer are two correlatives, inseparable from each other. Their union constitutes the essence of the contract."

While the courts do not concern themselves with rate making, they are concerned that the rate shall be equitable and reasonable in view of the risk. Emerigon has said in this respect: "An equality is to be preserved between the premium paid the insurer and the peril for which he makes himself responsible. . . . The premium, says Pothier, to be equitable, ought to be a fair price for the risks which the insurer assumes."

Arnould, an authority on marine insurance, has said, speaking of this point: "The underwriter pays no loss except with reference to the sum on which he is paid a premium; the whole sum, if the loss be total, some aliquot part of the sum if the loss be partial."

Importance of the Original Agreement

Since the courts will have none of the matter of agreeing as to the reasonableness of the rates, other than to deal in specific cases and determine them on principles, they have adopted the rule that the agreement between the parties as to the rate shall govern and it will be presumed to be reasonable until contrary showing is made. In fact, in the vast majority of the cases, the agreement between the parties as to the rate will govern absolutely and the courts will not interfere with it.

In fact, one of the very first authorities on this point said: "The rate agreed upon by the parties must be taken to be a just one. . . . If at the outset the nature of the risk has been fully declared, the insurer will not be permitted to dispute the payment of the loss under the pretext of the smallness of the amount of the stipulated premium."

The fairness of this rule should appeal to all. If the assured be required to maintain the same risk or peril that he agrees to in the beginning, then there is nothing unfair in requiring that the insurer shall be required to stick by his guns and make good on the basis on which he was willing at the time to assume the risk and enter into the contract.

Most of the states have laws in which it is declared to be illegal for the insurer or his agents to discriminate in regard to rates or to offer rebates to certain persons as an inducement to insure. This is only a desire to maintain a fairness in rates to all parties concerned, to guarantee an adequate rate to the insurance company on every risk and to guarantee to the assured that he will have the maximum protection at the same price that others are paying for it. It is not, however, a discrimination to offer to rebate, if the matter goes no further than that, nor is it a discrimination to require that one seeking a mortgage loan of a company should take out a life insurance policy with the company.

Method of Payment of Premium

The payment of the premium must be in accordance with the terms of the policy or contract. If certain stipulations are contained in such contract, they govern the manner of payment, regardless of any parol understanding that the assured and the agent of the insurer may have. May, an authority, states: "When no special mode of payment is stipulated for, any mode of payment which is accepted without objection on the part of the insurer or their agent, will suffice." This seems to be generally accepted in custom, although some of the courts have been disposed to question the broadness of the assertion that "any mode of payment" would suffice. In fact, it has been held in some states, notably New York, that an insurance company may make a valid contract without requiring payment of any premium.

It is a general rule that where the policy calls for

the payment of a certain sum annually that it is to be paid in advance and not at the end of the year, although there is nothing to prevent the parties entering into a contract to the contrary. In fact, many of the marine contracts are payable only at the end of the voyage, when the ship has delivered its cargo.

Annual premiums payable in advance are not a debt, although the premium may be in some cases enforceable as a debt by the insurer independent of the forfeiture of the contract itself. In one case, it was said: "It (the company) could not have sued and recovered from him that or any subsequent year's premium; its remedy was provided against the insured by the forfeiture of all of his money previously paid and the rights under the policy."

It has been held again and again that a mere agreement to pay a premium when due is not sufficient to prevent a forfeiture of the policy. In fire and marine contracts it is generally held that the payment of the premium is not generally a condition precedent. Failure to pay on the day stipulated forfeits the policy and the rights thereunder.

The Payment of Premium by Note

The widespread use of the promissory note in the payment of insurance premiums has raised many questions as to whether or not it amounts to "payment" within the meaning of the policies and of the law. It is a general rule of law that the insurance company has implied power to accept promissory notes in payment of premiums. It was held in a Kentucky case that such payment was good even though the policy provided for payment in cash.

In an Oregon case it was held that an agent cannot, without authority therefor, receive payment of premium notes which he has received and sent to the insurer. And in Kentucky, it was held that if the insured gives a note for the first premium payable to the agent as "agent" and this is accepted by the company, it is a note received for the premium, and its nonpayment at maturity forfeits the policy, the latter stipulating that if notes for premiums should not be paid there shall be a forfeiture. It was also held that the ruling was not changed by the fact that the agent had receipted for the premiums as for a cash premium paid.

It has been held again and again that a note is not payment where it is expressly stipulated that the agent has no power to extend credit or time of payment of premium. In Maine it was held that a partnership is not bound by a note given by a member of the firm in the firm name for the premium on the insurance of such member's property, such act not being within the scope of the partner's authority to bind the firm. And in Michigan it was held that if a note is given and a receipt issued that it is sufficient payment to prevent forfeiture. A number of cases hold that there is a waiver of actual payment of the initial premium where the insurer accepts notes therefor, delivers the policy and gives a receipt stating that the premium has been paid by notes.

It is well settled that the acceptance of a premium note operates to put the policy in force from date of acceptance and that the agent is, in case of nonpayment of note, liable therefor, and that the note is to be deemed as so much cash. Where the agent pays the premium and takes the note of the assured, the courts hold that this amounts to a loan on the part of the agent to the assured.

It may, however, be stipulated that the note is not payment of the premium but merely an extension of time, and if not paid when due the company is not liable for the period that it remains unpaid. In a Wisconsin case, it was held that a condition is valid in a mutual company policy that if a note taken for a cash payment is not paid within sixty days after due, "all obligations of the company to the insured until such note is paid are suspended."

In a New York case, the court said: "But in this case it is plain that the policy provides for a lapse of it upon the mere nonpayment of the annual premium, and for a like lapse upon the mere failure to pay at the maturity any note given like this for an accrued premium; and it is plain that the parties intended that these provisions of the policy should apply to and control that part of the transaction between them represented by the giving and the taking of the note, and the extension thereby of the time for the payment of the premium.

"It is just as much the case with the contract embodied in the note as the contract embodied in the policy, that one of its conditions was that a mere omission to pay at maturity did not cause the policy to be void. The taking of such note as a means for providing for the premium was contemplated by the policy, and hence by the parties at the inception of their relation of insurer and insured, and therefore the payment of it at maturity was a consideration precedent to the continuance of the policy, for so are the terms of the policy in reference to it, and so are the terms of the note itself."

Summary

We have found, then, that the premium is the very essence of the insurance contract and that it is a correlative of the risk and inseparable from it.

The premium must at all times be adequate to the risk and the risk must not be increased so long as the premium remains the same, else the contract will fail for failure of consideration.

The manner of the payment is not so important, although the terms and stipulations of the policy will generally govern within reasonable bounds. The point is that the manner of payment is left entirely to the agreement of the parties at the time they enter into the contract, and they must make payment according to such agreement.

Notes, or any other form of payment, may be accepted and made, upon agreement of the parties, and ordinarily they will be considered as so much cash, unless a contrary arrangement is made at the time.

Maxims of the National Safety Council

Safety is the corner-stone of efficiency. The more safety the less worry—the greater efficiency.

In office, bank, factory, on the railroad, or in the mill the most valuable man is the careful man.

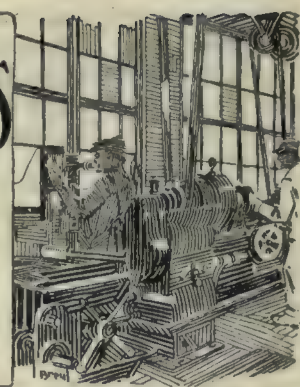
Safety First is more than philanthropy. It has now become a fundamental factor in the economics of business.

A preventable accident is a disgrace to the foreman in whose gang it happens.

A good workman at his best makes a poor doctor. Do not trust him. Go to the doctor.

MODERN PRODUCTION METHODS

By
W. R. Basset
of
Miller, Franklin, Basset & Co.



Part IV—Engineering the Product

The importance and power of the engineering department of a manufacturing enterprise is apt to vary directly with the size of the concern, and within wide limits. Here the general principles governing the conduct of a well-organized engineering department are laid down in a sane and conservative way.

PERHAPS not even a majority of machine shops have set aside office space which they dignify as "the engineering department." But in most shops it is safe to say there is someone who, as part of his duties at least, does some preliminary engineering of the product. For simplicity's sake, therefore, I shall use the term "engineering department" in this article.

In small job shops even today, the customer will sit down with the shop's foreman and describe the device he wants made—perhaps amplifying his ideas with a rough sketch. The foreman passes these ideas on to the pattern maker and to the various machinists who build the device, solving their own problems of design, tooling and so on, as they come up. Until planning began to develop, that was the general practice. In these shops, however, where production is highly planned, nothing is left to the discretion of the shop; it needs only to follow the directions issued to it. Every step has been engineered. Between these two extremes nearly every degree of preparation by the engineering department may be found.

The function of the engineering department is to study the product and the shop processes so that the design and manufacture may be most economical. It acts as a road roller, smoothing the way of the manufacturing departments. Completely accomplished, the factory will have nothing to do but perform productive work on the product. Methods will be previously determined for them.

Functions of Engineering Department

This function divides into two general classes; first, designing the product and the tools with which it will be made; and second, furnishing the data which the planning department will use in planning the production.

In some shops, of course, it is not feasible to plan the production in detail. It would be possible but not sensible. Strictly speaking, a job shop about to build a special intricate machine, which it has never made before and may never make again, *can* plan every step of the making. But the preliminary planning itself would cost more than could be saved. I only favor planning when it increases profits. It is only, as a rule, when a product, with only slight changes, is to be run in quantities that the refinements of planning pay.

Although it would obviously be foolish to plan the manufacture of a single special machine in detail, the engineering department may even here prepare the way to a certain degree, leaving much to the discretion of the men in the shop.

Among the duties of design which devolve upon the engineering department are the following:

1. To adapt the product to its use.
2. To so design it that material will not be unduly wasted.
3. To prevent labor waste due to designs which are clumsy to machine or to handle.
4. To specify raw materials and test when necessary.
5. To design the tools, jigs and fixtures which will best serve.
6. To make as many parts as possible interchangeable among several assemblies.
7. To design special machines needed by the shop and to consult on the purchase of new machines.
8. To decide whether parts shall be manufactured by the shop or purchased outside.

These are the customary duties of the engineering department, and yet they are often prominent by being neglected. I could cite hundreds of instances where attention to these items has made great savings. For instance, in one plant where a plate had originally been made of $\frac{1}{4}$-in. thick cast iron, the design was changed to copper, but the thickness was not changed. A sheet of $\frac{1}{8}$-in. copper would serve the purpose equally well and when the change was made, almost $13,000 was saved annually.

Some manufacturers take a costly pride in "making everything in their own shops." Not once, but frequently I find shops equipped with automatic machines. The small quantities of screw-machine products used require that the set-up be changed at such short intervals that it would be much more economical to buy them outside. Whether to make or to buy can be determined to a fine point by the engineering department working with the purchasing agent and the cost department.

Some Concrete Examples

Thoughtless designers waste much money by specifying a different screw or bolt for many new designs. Admittedly, screws, nuts, bolts and so on cost little. A five dollar bill will buy a lot of them, which undoubtedly was the reason that one shop for which we did work had in one year bought 37,400 screws of 184 varieties; an average of only 203 screws of each variety.

It was amusingly easy to eliminate this. We determined what sizes of screws, bolts, nuts, nails and so on were most generally used, and made those sizes standard. Then, if a draftsman wanted something that was not in stock, he had to prove that nothing else would do.

When we finished, we had reduced the asset "General Stores" from \$50,000 to \$30,000. So, in this alone, by merely reducing the varieties of sundry supplies, we so reduced the quantity that \$20,000 was released from the storeroom.

Here is another "horrible"—but not unusual—"example." This shop carried in stock nine sizes of square brass rods, thirty sizes of round and twelve sizes of hexagonal, besides much larger assortments of brass and german silver, wire and strips, most of which were unnecessary. We checked all of these items against the designs and eliminated the need for 77 per cent of them. Four of the parts alone showed this condition:

Part No.	Name of Part	Material	Stock Used	Stock Recommended
322A	Binding post screw	Brass	$\frac{11}{32}$ in.sq.	$\frac{5}{16}$ in.sq.
17B	Special nut	Brass	$\frac{3}{16}$ in.sq.	$\frac{1}{4}$ in.sq.
217A	Binding post screw	Brass	$\frac{1}{2}$ in.sq.	$\frac{7}{16}$ in.sq.
912A	Binding post screw	Brass	$\frac{1}{2}$ in.sq.	$\frac{7}{16}$ in.sq.

$\frac{11}{32}$ in. stock used in no other part than 322A.
$\frac{3}{16}$ in. stock used in no other part than 17B.
$\frac{1}{2}$ in. stock used in no other part than 217A and 912A.

Note that in three of the four cases the size of the material used was reduced. The amount of money tied up in stock was not only reduced, but a saving of a few thousand dollars a year was made due to reduced material consumption.

Very similar to this saving is the one that can be made by making the same part do for several assemblies. Too often the only difference between some of the parts common to two or more assemblies is a slight difference in a dimension which might well be the same. One shop which turns out a single type of product, to the customer's specification, formerly made every part to order. A study by the engineering department showed that more than half of the parts might well be standard. These parts are now manufactured to stock, and only a few go on special shop orders. This enables what is practically a job shop to plan a good share of its production with the ensuing economies. Some of these savings may seem small, but in the aggregate they are well worth while in most any shop. Just recently I saw an instance where nearly a hundred thousand dollars worth of new machine tools had been bought by the shop without consulting the engineering department. It was found out too late that changes in design of the product were under way which would make these tools useless in that plant. Stupidity? Not at all. That shop is unusually well run, but there was not quite close enough contact between the shop and the engineering department. Point No. 7 had been neglected. It is blunders like these which make me sure that even the obvious things may well be mentioned now and then. In all of the activities I have mentioned it is essential that the engineering department work closely with the shop and purchasing authorities. Sometimes informal contact when specific points come up will do, but this method offers chances for consultation to be overlooked.

Regular meetings of representatives from each of these departments often work well and tend to systematize the contact. When the practical obstacles which face the shop and the purchasing agent are known to the engineer, he can usually work out a design which will be a successful compromise between the ideas of the customer, the condition of the market and the limitations of manufacturing.

Frequently the shop will find it expedient to change a design slightly to fit its equipment, although with proper contact the engineering department should have foreseen this need. But if such a change must be made, the shop must notify the engineering department so that the drawings and perhaps the patterns may be changed and the obsolete ones destroyed.

A hydro-electric plant was partly shut down for several days because this had not been done in the shop which supplied its waterwheels. Here, the shop had seen fit to make a slight change which resulted in lengthening a certain part. When in operation this part failed, the hydro-electric concern wired the shop for a duplicate. The drawings had not been changed and a new part—inches too short—was made up by the shop.

Changes Should Be Reported Promptly

Unless changes are promptly reported, obsolete parts may continue to be made. This was true to a discouraging degree in one plant I know of. Here is an instance typical of dozens which turned up there.

It had seemed desirable to change the location of bolt-hole drillings in a cast-iron door frame. When we went over the stock we found that there were two different frames in stock, each bearing the same part number. To the casual observer, it would have seemed that the stock of this part was 348. As a matter of

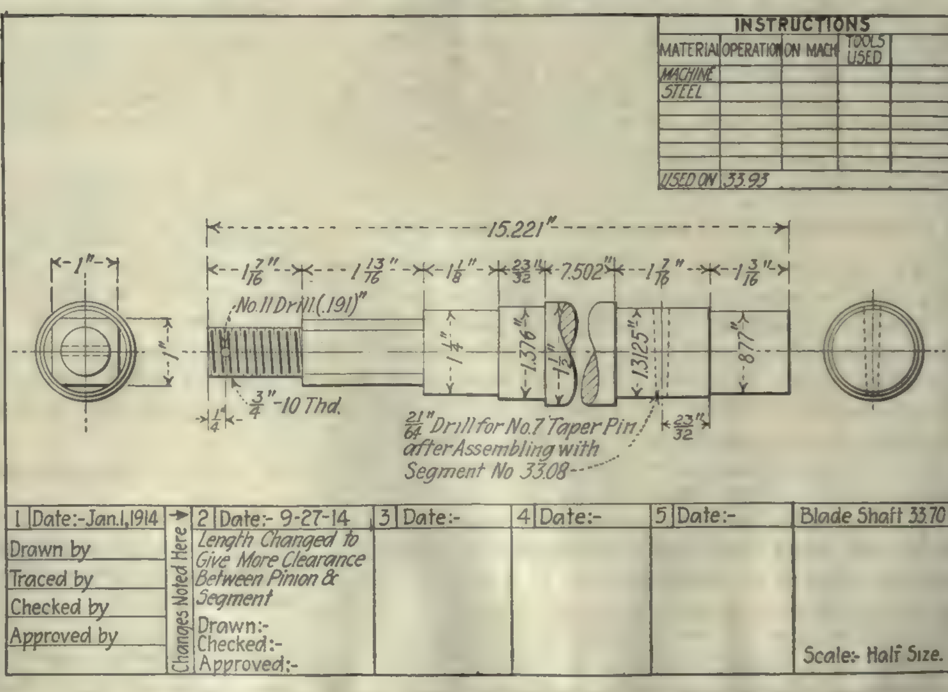


FIG. 14. DETAIL DRAWING WITH PROVISION FOR NOTING CHANGES

fact, 186 were obsolete, having been made up from the old drawings which had not been changed until months after the design had actually been changed. Not only were there 186 useless castings tying up money and taking up room, but time and again production which had been planned on the basis of the quantity shown in stock, had been delayed until a sufficient quantity of the new design could be made up.

A good form of detail drawing, with proper places to show changes, is shown in Fig. 14. For convenient handling and filing it is well to make drawings 8½ x 11 in., or in multiples of that size, the larger ones being folded to the 8½- x 11-in. size. This permits all drawings to be filed in ordinary vertical letter files, is a good size for mailing and is an economical cutting size both for drawing paper and tracing cloth.

It is customary to file blueprints in sets, all of the details of an assembly together. This is good practice, but sometimes it is well also to have a file in which all drawings of similar parts such as faucets, swivels, bolts, connecting rods, etc., will be together. This is for general reference and prevents designing a new part when an old one, or at least the patterns, tools and fixtures for making it, are already available. Before commencing to design, the engineer can review this file.

So much for the design side of engineering.

Duties of Engineering Department

When we come to the "smoothing out" phase of engineering, which prepares an order for the shop we find that the engineering department should:

1. Assign part numbers to each part.
2. Furnish lists of all parts which make up an assembly.
3. Provide detail drawings of each part.
4. List the operations and their sequence.
5. Specify the jigs, tools and fixtures needed for each operation.
6. Provide tooling instructions.
7. Provide instructions as to speeds and feeds.

With these points settled for each assembly, the planning department can go ahead and plan intelligently.

It might seem that assigning part numbers is a strictly clerical job, but actually it can only be done to best advantage by someone thoroughly acquainted with the product. If a part used in several assemblies is given a separate part number for each assembly, almost invariably several of the same part will be carried—one supply for each number. Changes, too, are apt to be made which will often require a change in part number and the engineering department is the one to know first of these changes.

Whether or not the production in a shop is closely planned, the first step when an order is received is to get from the engineering department a complete bill of material or list of the parts comprising the assembly. How often have we seen machines cluttering up the assembly floor waiting for a single part which someone forgot to order into the shop weeks before? Leaving it to a foreman to take off a list of material from a blue-print is a risky method of assuming that everything needed for an assembly will be made. Waiting for an assembly-floor shortage report to start production is an expensive procedure.

The parts list shown in Fig. 15 is used by the Warner Gear Co. which has a highly-planned shop, making automobile transmissions, gears, differentials and so forth, in large quantities to order.

This bill of material which is filled in by the engineering department for each new order shows the part number, part name, whether the part in question is to be purchased or manufactured, the number required per assembly, the kind of material, the symbol for the material and the dimensions of the rough stock. The four blank columns on the extreme right hand side of the bill, are blacked in so as to show up white when blueprinted.

The Columns Serve Various Purposes

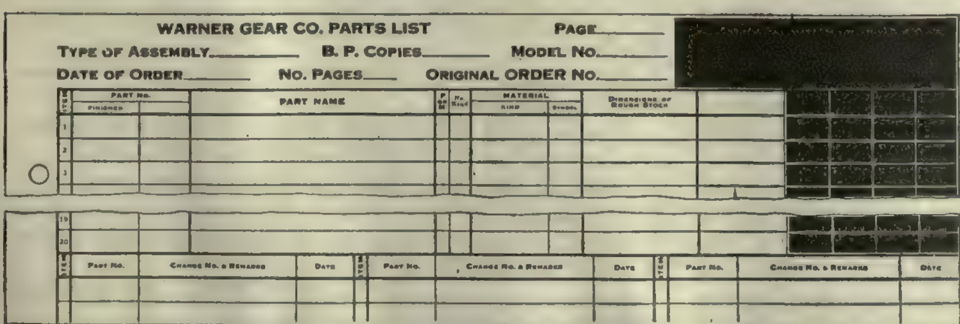
These columns serve various purposes. The production department notes in them from the stock record the number of pieces required for the order, the number of pieces on hand, and the number of pieces necessary to be purchased. They are used by the cost department for figuring the final cost of the assembly; that is, by assigning to one column, each of the following items: material, labor and the expense against each part.

On the copy of the parts list which goes to the tool-designing department—a section of the engineering department—are noted any parts which are new or which require different machining from previous parts. This aids the tool-designing department to determine what new tools are necessary.

After going over the parts list and routings for the new parts, the tool-designing department lists up all new tools required with the part and operation number on which they are required. One copy of this list is sent to the production department, in order that the date each tool is required may be known. This list after being dated is sent back to the tool-designing department to determine the sequence in which the tools must be finished.

The parts list is really the starting point for planning throughout the shop. We will see in detail how it is used in later articles.

I speak frequently of a "well-planned shop." I want to repeat that by that I do not necessarily mean "completely planned" or "rigidly planned." Some shops can be completely planned; few can safely be rigidly planned. The well-planned shop is the one which plans every operation which can economically be planned. In many shops of the job type, the planning will be confined to smoothing the way for the order and most of the plan-


WARNER GEAR CO. PARTS LIST PAGE____
TYPE OF ASSEMBLY____ B. P. COPIES____ MODEL NO.____
DATE OF ORDER____ NO. PAGES____ ORIGINAL ORDER NO.____

Item	Part No. Finished		Part Name	P or M	No. Req'd	Material Kind	Symbol	Dimensions of Rough Stock					
1													
2													
3													
19													
20													

Item	Part No.	Change No. & Remarks	Date	Item	Part No.	Change No. & Remarks	Date	Item	Part No.	Change No. & Remarks	Date

FIG. 15. A CONVENIENT FORM OF PARTS LIST

ning will be the preliminary preparation by the engineering department.

It is evident from a glance at the duties we have already listed as having a bearing on planning, that many of the preliminary activities of the engineering department are based on time studies. Both the planning department and the engineering department use the records of the time-study men, and it has always seemed to me that logically this activity should come under the engineering. It is not, however, a matter of vital importance who the time-study men report to, provided the engineering department is able to get quickly the accurate time studies that it needs.

The instructions to workmen on speeds and feeds are of course based on time studies. Where a large number of a part is to be made, it is well to take time studies, from which the best tooling instructions can be drawn up, and which will serve as a guide in designing the best jigs and fixtures.

Tools Designated on Drawings

It is not enough merely to have the proper tools, jigs and fixtures on hand. The engineering department must put in writing the ones to be used on each part. I have seen foremen and toolroom employes wasting hours at a time in a blind search for the right tools after the job is at the machine, and failing to find it, hold up work while one is made, while likely as not the ones they wanted were around somewhere.

If on the drawing, or on some instruction card numbered to correspond with the part, the tools, jigs and fixtures are listed, there can be no chance of such delays as this. I strongly recommend that the same number be given to the part, the drawing, the patterns and core boxes, the tools and fixtures. This will avoid much confusion and the delay that always accompanies confusion.

In some plants, as I have said, the activities of the engineering department are about all the planning that can be done; in others much more is feasible. In either type of plant, it is up to the engineering department to determine what must be made, the methods to be used and to provide the best tools for doing the work. The manufacturing departments are thus left free to do what they are supposed to do—make the product, and nothing else.

The Function of Clearance

By Francis W. Shaw
Didsbury, Manchester, England

In criticizing Dixie's bushing suggestion Clarence E. Silver, on page 795 of the *American Machinist* states that he does not see how the loose bushing is going to be a success for the reason (among others) that the two fits would double the clearance, making this 0.012 in. instead of 0.006 in., and that would mean more lost motion; which prompts me to ask why so much clearance?

What really is the function of clearance? Is clearance necessary merely for the purpose of lubrication? If so, why should it greatly exceed the thickness of an oil film, And how thick or thin is that? The gentleman who set out to measure the thickness of an oil film by a taper ring fitting a taper bar, found that after he had applied the oil to the surfaces the ring went farther on the bar than it did before—suggesting to him that an oil film has negative thickness.

Now I would suggest that the real office of clearance is to allow for errors in alignment and for temperature expansions. Disalignment is caused mainly by errors in workmanship. If the bushing was badly made, the outside being eccentric with the inside, the clearance allowance would necessarily be larger than where the hole and outer surface were truly concentric unless, of course, the eccentricity was in the same direction at both ends, in which case the clearance could still be small. But bushings are not likely to pass the inspector if appreciably eccentric, so we may neglect eccentricity here. All the additional clearance necessary would then be that sufficient for two oil films instead of one. I do not think that the clearance should be doubled as Mr. Silver suggests; another 0.001 in. would be ample.

A System of Limits

It seems to me that the nominal clearance can always be less where parts are made to a system of limits. Then, if work is done within the limits, the actual clearance will always be a little greater than the nominal; that is to say, it will be greater than the so-called allowance. Where the workmen are left to themselves the likelihood is that holes will be on the low side of the dimension aimed at, while the shafts will be on the high side. If so, then the allowance will always be less than the assumed allowance. For intsance—the aimed-at dimensions of a shaft and hole may be 1.000 in. and 1.006 in. respectively to give an assumed clearance of 0.006 in. To avoid the possibility of scrapping the job the workmen will tend to make the shaft a little oversize and the hole a little undersize, with the consequence that if he takes a liberty of only 0.001 in. in each case the actual clearance will be 0.004 in. instead of 0.006 inch.

When I see tables of working limits on which the allowances are very large for so-called low qualities of work, these tables always appeal to me as having been based on old practice where the clearances, as explained, always tend to become less than that assumed. Large *tolerances* are, of course, quite in order, for they permit the employment of reduced skill and equipment of less accuracy than is called for in a finer quality of work, but these large tolerances do not imply that the clearances need be much greater. They must be a little greater of course for alignments will be poorer. Naturally there are exceptions to any rule laid down. Agricultural machinery or machinery that will get careless handling and little or no attention must have large running clearances, but the tolerances need not on that account be any larger than in other work of similar quality. In these cases it is the allowance that counts, for one must not only allow for disalignment of parts as they are originally assembled but for possible greater disalignment by the stresses of heavy usage or of careless reassembling after a dismantling. Rust may also play an important rôle in the regulation of the allowance.

Textile machinery may also be instanced as a case for large tolerances.

Fragile parts when bolted to a wood floor by careless erectors are liable to spring and throw the bearings out of line. In some machines the vibration results in such a displacement of parts that journals would be jammed in their bearings at intervals during the rotation of the shaft if the clearances were small.

Summing up, it might be said that clearance is rather a function depending on errors in alignment rather than on lubrication necessities.

Basic Policies of the Employees' Magazine

BY JOHN T. BARTLETT

While frankness and broad, human Americanism are two of the principal factors that contribute to the success of the employees' magazine, one of the most important fundamentals in determining its policy is the matter of control.

SHALL the employees' magazine be maintained and controlled, frankly, by the employer? Shall it be maintained by the employer, but controlled by the workers? Shall it be strictly an employees' venture, the employer having no financial or other interest in its affairs? Shall it be ostensibly the private enterprise of an active employee, who solicits advertising, thereby apparently making it profitable, but who secretly is subsidized and controlled by the management?

In a Middle West industrial center there is a certain employees' magazine editor who has strong views on this question. Jacob Large (that of course is not his real name) has edited two kinds of employees' magazines. The first was secretly subsidized. He began its publication in a troublous labor period. He was liked by the men. He was keen; he believed he was genuinely working for the men's good; and he saw nothing either unethical or, in the last analysis, ineffective in the fact that the company head secretly O. K.'d his copy and kept the publication alive.

COMPANY HEAD O. K.'S COPY

The employees believed that there were no strings on Jacob Large except their own. They thought his few advertisements made his journalistic venture profitable. They liked the way he wrote about things. Jacob Large believed he wielded extensive influence.

The second publication he edited, and of which he still is the editor, is frankly controlled by the factory management. It carries no advertising, and there is absolutely no hocus-pocus about it.

The company head O. K's all of Jake's copy. The employees understand that published articles have the company's approval, but Jake says little about this side of the work. As a matter of fact, nobody on the outside knows just who it is that O. K's copy. While the company frankly controls the publication, it's constant idea is to tone down this control. The company head interferes as little as possible with the editor's ideas. He does so less and less, and hopes eventually to leave the entire direction in Jake's hands, except for occasional conferences as with any department head.

Jake Large is a clever, tactful and successful plant publication editor. And he is sincere. Why, then, is he a strong advocate of the secretly subsidized, camouflaged employees' magazine? As Jake views the matter, he believes his attitude as editor of the subsidized plant paper is stronger than was his attitude as the editor of a paper frankly controlled by the company, and as such paid by it.

In any discussion, Jake stands up for the camouflaged plant publication every time.

I have gone into this actual case in detail because the fundamental point involved is one which comes up again and again. In any formulation of policy, it has to be dealt with. There are perfectly serious, wholly sincere people who adhere to Jake's faith in hidden control. It is an age-old fallacy that pose is most effective, whereas all experience proves that the absence of pose is infinitely more so, in the long run. Hidden control became such a nuisance in the newspaper and general publication field that Congress passed legislation compelling periodicals to publish regular statements of ownership.

In the plant publication field, there is already sufficient preliminary experience, as well as realization by employers of the principles involved, to indicate clearly that the typical employees' magazine of the future will be frankly controlled, as it is supported by the company. This sort of actual control enables the management to see that the publication is used most effectively for the mutual benefit of all parties to the industrial relation. Moreover, it keeps to the front continually that extremely important thing, the fact of definite leadership by the industrial head. The employees' magazine properly becomes an instrument in making that leadership of a higher, better kind, and in convincing employees of its sincerity, integrity and mutually beneficial character.

In producing an employees' magazine which is likable, convincing, entertaining, elevating, and which consistently tends to improve morale, it is neither necessary nor desirable to attempt to ignore or disregard the fundamental fact that over the entire organization—including the employees' magazine—there is "the Boss."

CLEVERNESS NEED NOT CONFLICT WITH HONESTY

Cleverness in preparing employees' magazine material; tact in handling delicate subjects; effective devices to form a better, saner body of employee sentiment—all these do not conflict with a policy of honesty and frankness, but are helped by it. The employees' magazine is no place for tricks, dodges, or stunts to capture employee confidence. It is no place for camouflage. It is, however, a place demanding keen regard for things of human nature. The editor, and the executive head under whom he works, cannot be too expert in this direction. The employees' magazine has instrinsic truths to sell.

Jake Large stands up for the camouflaged, subsidized plant publication. But here are two significant facts: First, the company which employed Jake, on a secretly subsidized paper, now uses the frank, above-board type of employees' magazine. Second, Jake's present employer is quite satisfied with the results Jake is getting—with the frank, above-board type. The facts are against Jake.

Frankness on the part of both employer and employee as a constant, normal condition, not arrived at in an emergency as the accompaniment of ultimatums, is eminently desirable. Any system of shop representation which produces genuine, constant frankness and tends to fuse viewpoints rather than to keep them divorced, is worthwhile.

At a time when closer, warmer, frank relations between company and men are unusually necessary, the employees' magazine whose policies did not build in this direction would be disregarding an obvious

opportunity. As an aid to any system of shop representation, the employees' magazine helps by regular, lucid reports of committee conferences, discussions, and decisions. The grounds on which a particular decision is made are clearly indicated.

The employees' magazine is going to see that all such matters in joint discussion are clearly explained, and that the management's reasons are expressed in detail. Once the company management has respect, liking, and confidence of employees, its position in any question that comes up is going to be safe.

A belief in frankness, and a faith that no side of the industrial relation is too sacred to touch, is made basic policy in several employees' magazines on my desk. The significant and extremely encouraging thing, I think, is that the companies using these publications, in which the editorial management is tactful, but does not pussyfoot or kotow, are companies in certain instances which, in the way of labor, have had unusual obstacles to contend with during the current period of inflation.

A Western employer who maintains the frank type of employees' magazine recently talked before the metal trades association of his district, by invitation. He discussed freely the position in which his company, the backbone of that particular industry in the district, was left by the falling off of war demand. He told of his plans for the year, which included, contracts lacking, the production of his particular commodity for the open market. He said frankly that competitive conditions were such that further advances in wages could not be granted. The firm would simply have to go out of business, that was all, if a demand was made for them.

Frankness Believed

When a report of his talk was published in the employees' magazine, there wasn't any riot. The men believed him. Local observers don't expect this company to have labor difficulty the current year.

As a result of former constant and serious labor difficulties, including a serious strike and a bad spirit within the plant, this employer "took account of stock." He established a department to deal with industrial relations. While he was at it, I believe, too, he saw weaknesses in himself as an industrial leader, and deliberately set out to be a better employer. He started the employees' magazine, and set up machinery whereby the slightest grievance of employees could be handled before it grew big.

Instead of waiting until trouble came to tell workers the firm's position, he began to keep them posted month to month, through the employees' magazine. His frank statement concerning wages, before the metal trades association, was made when no demand for wage increases was being formulated. He had completely altered his labor situation—for the better—in less than a year.

In Massachusetts is a nationally famous manufacturing company which for many years has been supreme in its specialized field. Its products are a household word all over America. The founder of the business, a grand old New Englander, is now dead, but the ideals he converted into business gold are still the foundations of what is in every sense an institution.

This company makes frankness a basic policy of its employees' magazine. Employees know right along what trade conditions are. They are never given an opportunity to forget the business ideals of quality and thorough honesty on which the business is reared. In connection with subjects discussed between employer and workers in the operation of the shop representation system, there is open, straight-from-the-shoulder reply by the management. There is no hedging, glossing, or side-stepping.

At the end of 1919, this company's employees magazine—over no signature—carried a survey, written in readable language, of the past year—the problems, the unusual trade conditions, the triumphs, the difficulties wholly or only partly met. This was a broad, absolutely frank survey, how frank you may gather from the deliberate admission that quality had fallen off somewhat, incidental to rushed production. Quality is a fundamental idea in this company's plan, as I have suggested, and even in the flurry of abnormal times, the company head doesn't forget it, nor neglect to keep it firmly before the workers. The employees of this company are traditionally zealous for quality, and the management strives to keep them so, through these stressful times.

A Policy of Broad Human Americanism

A policy of frankness finds a logical running mate in a policy of broad, human Americanism. It might be said that either implies the other.

One of the most important employees' magazine undertakings in the country, the *Booster*, published monthly by the American Woolen Co., combines the two.

I imagine there is not another industrial organization in New England employing a greater variety of nationalities than the American Woolen Co. employs at its Lawrence, Mass., mills. And superficially, one would say, there is not another aggregation of employees anywhere more difficult to reach through an employees' magazine. Many of them were born overseas; some cannot read or speak English. Many of them have never been Americanized.

Associated press dispatches in the past have carried Lawrence strike stories all over the United States and Canada. A little while ago the newspapers of two countries began to print something else about Lawrence. They told about things the American Woolen Co. was doing to reduce living costs for its workers.

William N. Wood, president of the American Woolen Co., takes a broad view of the employer-employee relation. He believes that the interest and concern of the employer should extend beyond the day's work of the employee and into his life. In a statement in the *Booster*, one of the things the publication is devoted to is given as the happiness of employees. There is warmth for you! The American Woolen Co. insures workers, helps women employees in motherhood, maintains day nurseries, and does kindred work. The company is establishing a position of sincere, honest, active leadership which means not only a better product and more efficient production conditions, but happier lives for the employees.

I have said that frankness and broad, human Americanism are policies characterizing the *Booster*.

As to frankness, it is manifested in one phase in outspoken editorials on foremost economic questions of the times. The company does not temporize here nor sidestep; it expresses those fundamental economic truths on which the established system of American industry rests, and suggests why they are true. Especially does

it hammer away on that simple truth, the indispensable importance of earnest work and thrift in any scheme of life—anywhere, any time—which aims at satisfaction and happiness for the individual and the nation.

The Story of an Immigrant

A policy of broad, human Americanism, and always the same frankness, is carried into the editorial handling of news matter in the *Booster*. Here, for example, is the story of an immigrant, a faithful employee of the company for many years, who has "got on"; who owns his home and garden patch; who has attained happiness and contentment through conscientious work, thrift, and those unpurchasable things of home and family life. He likes America, believes in it. There is nothing sensational, there are no highlights, in a narrow journalistic sense, to a human story like this, but it is the story of contentment as millions of Americans have found it, and as anybody can who will. The *Booster* characteristically handles a story like this with frank approval of the subject, genuine warmth, even to the big family of boys and what the father means to do for them in the way of education.

Equality of opportunity is not theory, but fact, in America. The body of American thought appreciates the importance of those individual things of character which make for success and for happiness. A clean-cut fairness, a faith in America and Americans, a confidence in the power of the individual—these are American characteristics. They are characteristics which agitators and radicals have attacked and attempted to break down. They are characteristics which many foreigners in this country have not made their own.

The policy of every employees' magazine ought to be to adhere to a broad, human American viewpoint in handling material. It ought to sell the American philosophy of life to such American citizens as are half-hearted in it, and it ought to sell the American view of things to foreigners.

Americanization

The American Woolen Co. employs many foreigners, and Americanization is vital in its work to better conditions. One of the things it is doing in its employees' magazine is to publish, issue to issue, lessons in English. Another thing is the publication of the Constitution of the United States, serially, clarified and made understandable for newcomers to this republic. Cornelius A. Wood is the author of this, assisted with suggestions and in reviewing proof by Prof. Arthur N. Holcombe of Harvard.

Editorials on George Washington, Lincoln; quotations from patriotic utterances of Roosevelt and other great Americans—all are used, issue to issue, in sizeable volume. The *Booster* is permeated by the patriotic spirit, fairly soaked in it.

The reader is given no opportunity to forget that the company, as well as the workers, is a party to the publication, but the effectiveness of the magazine is not thereby diminished.

There was a period in the history of journalism, now much lamented, of which it is said, "An editor then actually exerted influence. He molded public opinion. He made and unmade political champions. He led public thought."

Horace Greeley is often paid tribute in this connection.

The employees' magazines of the United States and Canada have an opportunity at this time to wield an influence, in shaping employee opinion reaching millions, much more important and beneficial than the old-time American editors ever wielded. They have an opportunity to help their industrial organizations, through a clarification of thought and an intensification of endeavor, to increased working efficiency and mutual benefit. They have an opportunity to contribute vastly to the public good.

In order to do this, however, employers and editors must regard their magazine as a publication which is actively to shape thought. It is to shape thought in competition with the agitators and the radicals, the irresponsibles and the Reds. There are all the elements of an actual contest. The stake is the plastic thought of millions of employees. It is one head against another, the brains of the executive who has won out by sheer force of character and training, who is able to combine vision with judgment and pierce through to the inner truth, pitted against the brains of the labor agitator with half-baked theories, often downright untruths, but possessing perfected cleverness of appeal and shrewd knowledge of human nature.

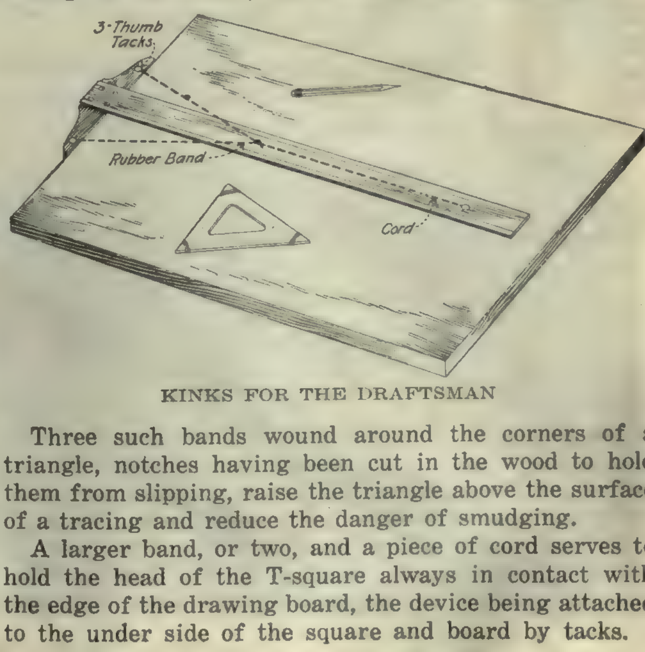
Which man is better fitted to mold employee opinion? Which man ought to, for the public good? Which man has on his side the advantage of intrinsic truth?

There would be no contest at all were it not for two things; first, that industrial management is sometimes not high-type, and second that the labor agitator is a human nature expert. The employer must first make sure that his position is absolutely sound, in respect to a genuine regard for the employees' welfare and thorough square dealing, and then turn human nature expert, too. He must dig down to fundamentals, get his bearings, and then fight it out on that line all summer. This is where the employees' magazine, and the skilled editor, fit in.

Some Drafting-Room Kinks

By Henry H. Moore

The common rubber band is a very handy and useful little accessory to the draftsman. A small band wound around pencils, penholders, etc., will keep them from rolling off the board, and saves many a broken point.



KINKS FOR THE DRAFTSMAN

Three such bands wound around the corners of a triangle, notches having been cut in the wood to hold them from slipping, raise the triangle above the surface of a tracing and reduce the danger of smudging.

A larger band, or two, and a piece of cord serves to hold the head of the T-square always in contact with the edge of the drawing board, the device being attached to the under side of the square and board by tacks.

Unusual Methods of Securing Extreme Accuracy—IV

By A. L. DE LEEUW, M. E.
Consulting Engineer

The concluding installment describes the most important and difficult operation on the cradle forging, the lapping to finish size. The article ends with a brief account of the high-pressure hydraulic test to which each finished part is subjected.

(Part III appeared in our May 18 issue.)

THE real trouble began at operation 42 which was the lapping of the small cylinder. Two thousandths of an inch had been allowed for this lapping and proved to be sufficient to remove the tool marks of the finish-reaming. It was originally thought that it would not be possible to do this lapping entirely in a mechanical way and that a considerable time would be required to instruct and train men in the art of lapping. However, it was not thought practical to attempt to train men to a point where, by the mere skill of hands and eye, they would be able to produce both the extreme accuracy required and the beautiful finish which was said to be necessary.

The following method was adopted and proved to be entirely satisfactory for producing holes of the proper finish and of much higher accuracy than required in the specifications. It is believed that the success with the recoil mechanism as manufactured by the Singer Manufacturing Co. was largely, if not entirely, due to this method of lapping.

The lapping was divided into two processes, lapping and polishing. The lapping was for the purpose of producing a hole of proper size and roundness, the polishing for the producing of the mirror-like finish. The amount of metal removed in the operation of polishing was not measurable and was probably more in the nature of a burnishing operation without much abrasive action.

Two styles of machines were used for these operations, though the style which was used for the lapping would have been suitable also for polishing. However, the fact that some machines of the second style were immediately available, and that the first style was not absolutely required for polishing, was the deciding factor in making this division. The main difference between the two machines consisted in the fact that the piece to be lapped was held in the first style of machine in an indexing fixture, and in the second style of machine was held stationary. The first style machine is shown in Fig. 54 which shows the entire machine, and in Fig. 55 which shows the feed mechanism and the holding fixture. The feed mechanism was disconnected for short-stroke lapping.

The machine consisted of a bed A on which was

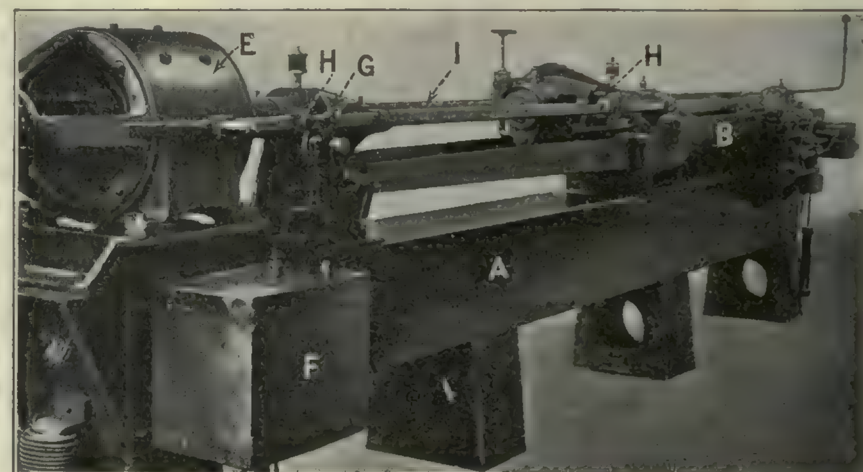


FIG. 55. DETAILS OF FEED MECHANISM

mounted the fixture B, in which the holding fixture C could revolve on trunnions D. At the outer end of the machine a motor E was mounted. This was a variable-speed motor of 10 hp. capacity, running from 600 to 1,800 r.p.m. but of which only the lower speed was used. The motor was reversing and the reversing mechanism F operated by the dogs H and the tappet G, Fig. 54, would reverse the motor in a small fraction of a second, so that it was even possible to use the machine on strokes as short as 18 in. This was an extremely exacting duty of motor and controlling mechanism, but this part of the apparatus, furnished by the General Electric Co., stood up well and did not give any serious trouble. The motor shaft was directly connected to a screw I which had $3\frac{1}{2}$-in. lead, double thread, and would give a lapping speed

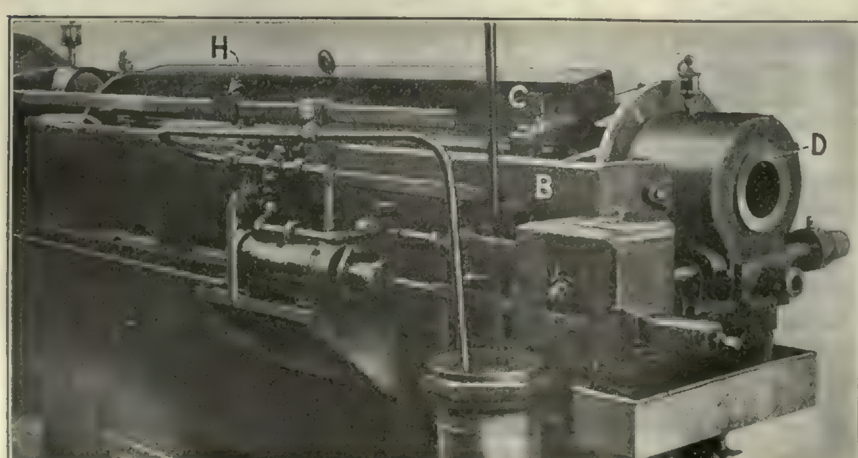


FIG. 54. THE MACHINE FOR LAPPING HOLES

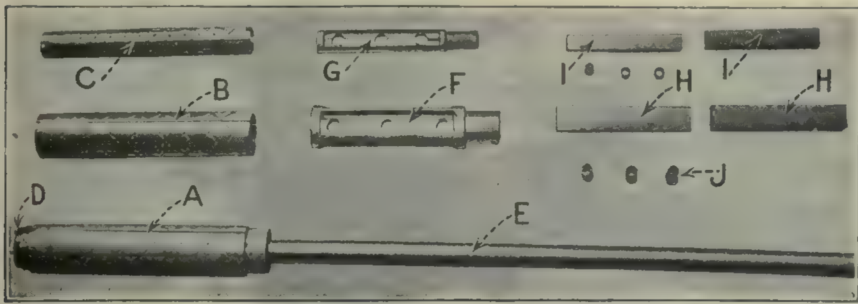


FIG. 56. THE KIND OF LAPS USED

of 175 ft. per minute. The lapping was not done, as is usually the case, by rotating but by reciprocating the lap in such a way that about half the length of the lap would project beyond the end of the piece at the end of each stroke. After each stroke the piece would be rotated through a small angle, the rotating mechanism being shown in Fig. 55.

An Interesting Feed Mechanism

The feed was pneumatic, a feed dog tripping the inlet valve so that the air can push the piston and rack to the right. At the extreme right the piston closes the inlet and opens the exhaust. A constant air pressure on the right side of the piston returns it to its position at the left, but before the end of the stroke the rack closes the exhaust valve to form a cushion. The movement is transmitted through a one-way ratchet and wormwheel with gears, with teeth so calculated as to avoid uniform positioning of the work at each stroke.

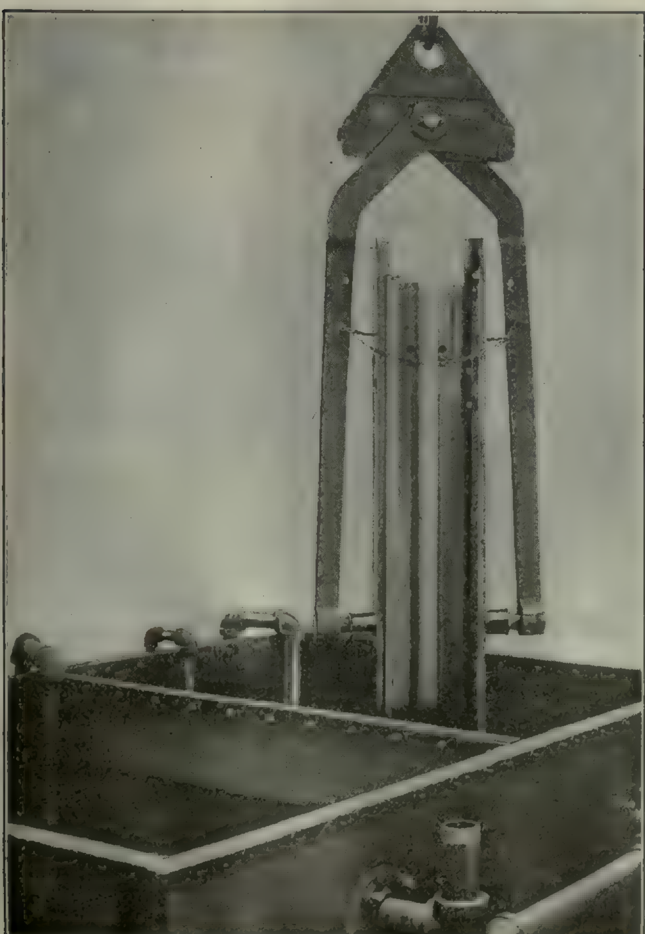


FIG. 57. WASHING HOLES AFTER LAPPING

Fig. 56 shows the tools used for the lapping operation. *A* is the shell of the lapping head quite worn out; *B* and *C* are new shells for the large and small holes respectively. *A* is mounted on a head with taper wedges for expanding the shell by means of the nut *D*; *E* is the hollow bar to which the head is attached.

The lapping compound consisting of No. 4 F carborundum and vaseline was forced through the hollow bar by means of a little force pump. It was squeezed through the small holes visible in the shell and carried by the right- and left-hand spiral grooves of the shell to the work. As the piece and not the bar revolved, or rather indexed, every part of the hole was subjected to exactly the same action. The result was that the hole became round. The fact that all of the outside surface of the shell carried lapping compound made the action relatively easy.

After lapping, the cradle was washed in soda and hot water as shown in Fig. 57. It was then put on the second type of machine as shown in Fig. 58. In this machine the piece was held stationary, and the lapping bar reciprocated and was also indexed. The reciprocating motion was obtained by a planing-machine drive and the feed by means of ratchet pawl and dogs. In this machine the same style of lapping bar was used but with an entirely different lapping head. In this case the lapping head was made of aluminum and of the shape as shown in *F* and *G* respectively in Fig. 56. The stones *H* and *I* were placed in the recesses of the aluminum head, spread apart by the springs *J* and kept in position by a piece of twine before they were inserted in the hole. The stones used were made of the so-called "water-of-Ayre" stone. This stone is exceedingly soft and being absolutely free from grit, does not produce any scratching. Great care had to be taken, however, to wash all of the abrasive material out of the hole before going over to the polishing operation; a grain of carborundum left from the lapping might imbed itself

FIG. 59. REAMING THE TRUNNION

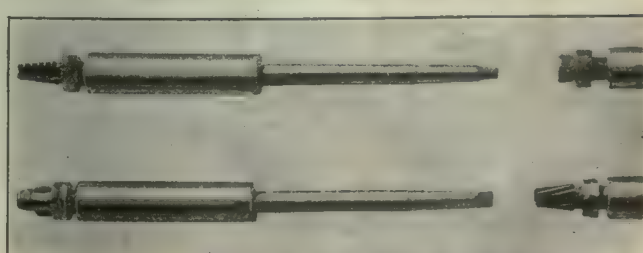


FIG. 60. TOOLS FOR REAMING TRUNNION

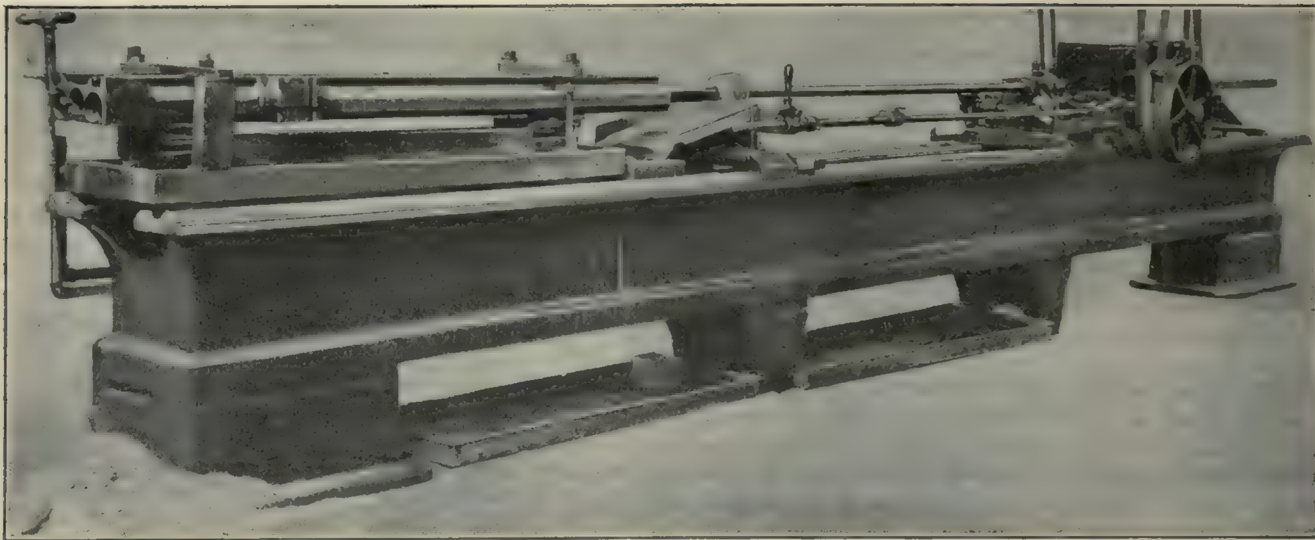


FIG. 58. MACHINE FOR POLISHING THE HOLES

in the water-of-Ayre stone and scratch the surface. The reason why it was not so important to have the work indexed during the polishing lies in the fact that this polishing did not remove a measurable amount of metal.

In the original method of lapping, but which was not followed by the Singer company, a lapping head was used similar to the one used for polishing. Carborundum stones were used as abrasive material with thin oil as lubricant and the lapping bar was indexed while the work was held stationary. This was satisfactory so long as the two stones were in a vertical position, but when the stones were horizontal the weight of the head and bar would cause the stones to rub in the hole with a wedging action and gradually cause the center of the hole to drop. In other words they had a tendency to produce an oval instead of a round hole. In the machine which was originally designed for this purpose, the lapping bar was supported close to the work. This in the opinion of the writer may be classed among many other good intentions, and led in the same direction as good intentions are generally said to lead. This support caused the lapping bar to overhang very little at one end of the stroke and very much more at the other end, so that the tendency to wedge, and to cause an oval hole, was not the same during the entire length of the hole. The result was that the hole was not only out of round, but that it did not have the same section throughout.

FIG. 61. MILLING TRUNNION THREAD AND DRILLING

The pieces which have to move into these holes have to be packed with extreme care and this packing must conform to the section of the hole. If the hole was oval but of uniform section, the packing might adjust itself gradually to this oval form and thereafter work satisfactorily. But if the hole is of non-uniform section, then the packing must assume a different shape every time it moves along the inside of the hole, and this would certainly lead to failure in the function of the mechanism. It was for this reason that it was thought absolutely essential to have the work rotate and to have the bar entirely free and without support. In addition to turning trunnions on the outside, they are also bored and threaded with the aid of special attachments and devices. One of these is shown in Fig. 59, where the trunnion is being reamed with the taper reamer shown. The fixture for holding the work by the outside of the trunnion is plainly shown, as well as the long bushing which guides reamer into its correct position. Fig. 60 shows the taper reamers, as well as the tools for counterboring for the thread.

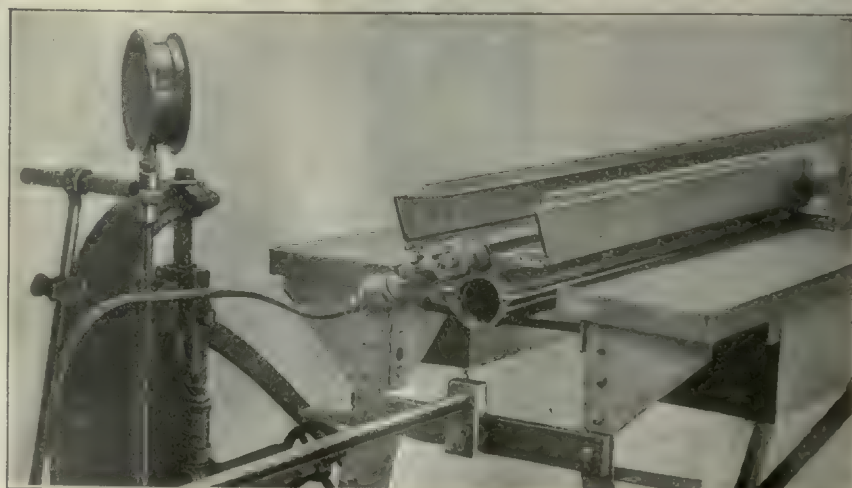


FIG. 62. TESTING THE FORGINGS AT HIGH PRESSURE

In Fig. 61 is another special machine built to mill the threads in the end of the trunnion, and also to line-ream the brackets which carry the sighting mechanism after it has been assembled in place. The thread-milling is done by the nearest spindle, while the one in the background reams the two holes to insure their correct alignment. After the cradle is completed, the holes, which are threaded at the ends, as shown in Fig. 62, must be plugged and tested to be sure the steel is of the proper strength. The kind of connection used is shown in Fig. 62, where the small hole is being tested. This is tested to a pressure of 5,100 lb. per square inch.

Graduating Range Finder Sights

By I. B. Rich

The range-finding device used in naval anti-aircraft gun sights contains a sheet-metal drum shown at *A* in the three illustrations. This is of fairly large diameter with the edge turned over to receive the graduations, as can be seen. In order that these graduations may be plainly visible both day and night, the numbers are drilled through the rim and a small lamp on the inside makes them easy to read after dark. The method of drilling these holes involves the use of a high-speed sensitive drilling machine and the graduating device shown. The drum *A*, Figs. 1 and 2, is mounted on the other end of the spindle which carries the index plate *B*. This index plate, in connection with the stop *C*, locates the drum in its various positions, ready to have the proper numbers drilled through the periphery.

In order to drill the holes forming the desired numbers, it is necessary to move the work under the drill so as to bring it in the proper position for the hole. The positioning is controlled by the master plate *D*, this being held in the slide *E* and positioned by the stop *F*, which brings the individual number to be drilled in the proper position.

The work and indexing wheel are carried on the floating table *G*, which is free to move in either direction by means of the universal guide *H*. The rod *I* is connected to the floating table by means of the ball joint *J*, and is held between the two uprights by the universal joint *K*. By this means any movement of the upper end of *I*, no matter what its direction, is transmitted to the floating table and to the work, moving it to any desired position under the drill.

The guide *L* is knurled on the outside and forced down by a light spring. The point of *L* fits into any of the holes of the master guide plate *D* and holds the work in a corresponding position while the hole is being drilled. In Fig. 3 the first hole is being drilled in number 7. After this hole is drilled the operator will raise the index pin *L*, move it to the next hole in plate *D*, and in so doing, will move the whole mechanism in one point toward the drilling-machine column. After the third hole is drilled the operator will start to drill

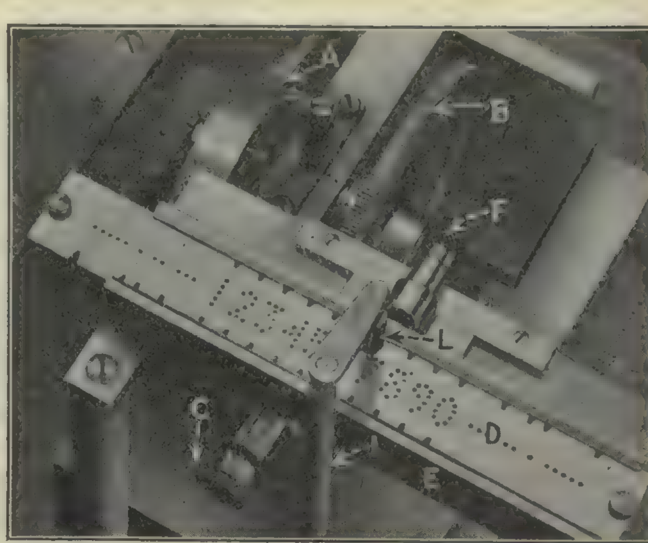


FIG. 3. VIEW FROM TOP, WITH GUIDE PLATE IN POSITION

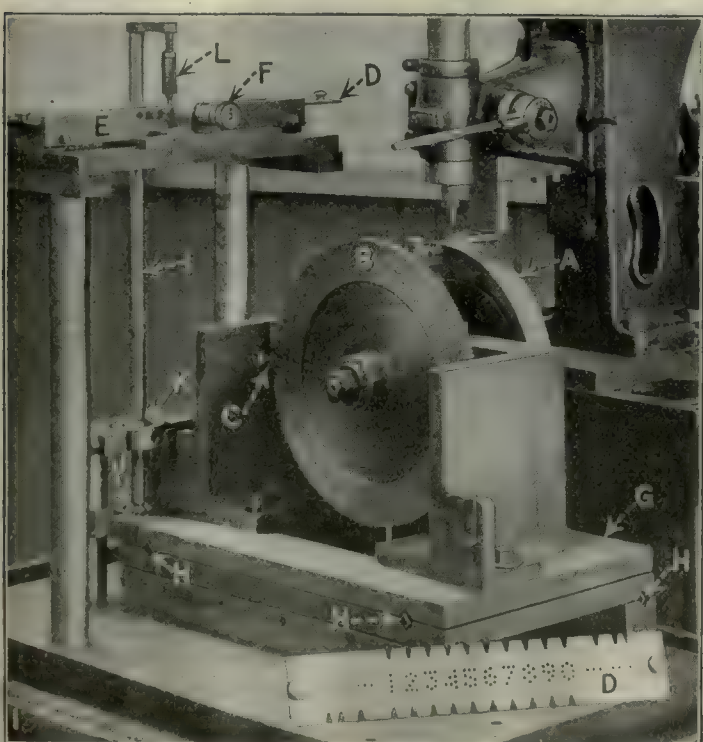


FIG. 1. DEVICE FOR GRADUATING RANGE-FINDING DRUM

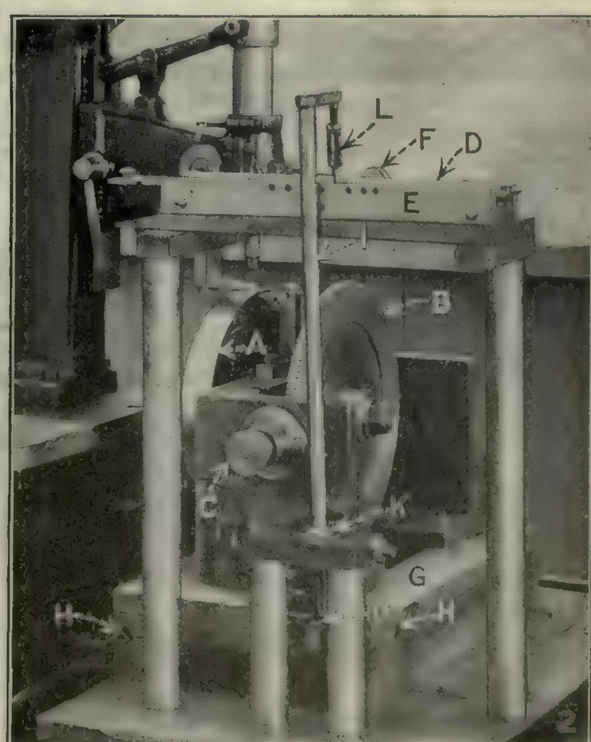


FIG. 2. BACK VIEW, SHOWING MULTIPLYING LEVER

down the stem of the number, which will move the whole work-holding device sideways and, at the same time, a little away from the drilling-machine column.

By moving the master guide plate *D* to its proper position it is possible to drill any sequence of numbers on the rim of the drum. These numbers vary from 1,000 to 8,200, jumping by hundreds to 3,500, by fifties to 6,500, and by twenty-fives for the remainder of the scale.

Such a device as this can be applied to the drilling of small holes of various kinds in any sort of design desired, and affords a rapid way of securing any desired pattern. In the device shown the multiplication is about four to one; this of course depending on the relative distance between *K* and *J*, Figs. 1 and 2, and between *K* and the point where the index pin on *L* fits into the master guide plate. This device was designed, built, and used by the Russell Motor Car Co., of Buffalo, N. Y.

Safety First in Handling Gasoline

By I. E. Pearce

Do you use a belt-driven pump of any kind in your plant for pumping gasoline, naptha, or any other highly inflammable liquid? If so, it would be well to make sure that the pump and belt are well grounded.

Two serious accidents recently occurred which were the result of pure carelessness. A certain manufacturing establishment used a large quantity of benzine for cleaning purposes, which was stored in underground tanks. The benzine was pumped by a belt-driven pump installation, as shown in Fig. 1. The belt had just been repaired by a millwright, who neglected to replace the ground which was made from thin sheet copper and connected to an earth ground by a wire. As any one knows, a moving belt generates no small amount of static electricity and, in this case, a stray spark caused a serious explosion which wrecked the building and injured several employees. The illustration shows a safe arrangement.

The other accident, in another plant, was caused by pouring gasoline through a funnel in which a chamois skin was used as a strainer. The gasoline was being pumped from a portable tank, Fig. 2, and when the metal nozzle touched the funnel, which was highly charged with frictional electricity caused by the gasoline passing through the chamois skin, the result was a serious fire, a score or more workers idle, and one man blinded for life. A wire "Y" connected as shown

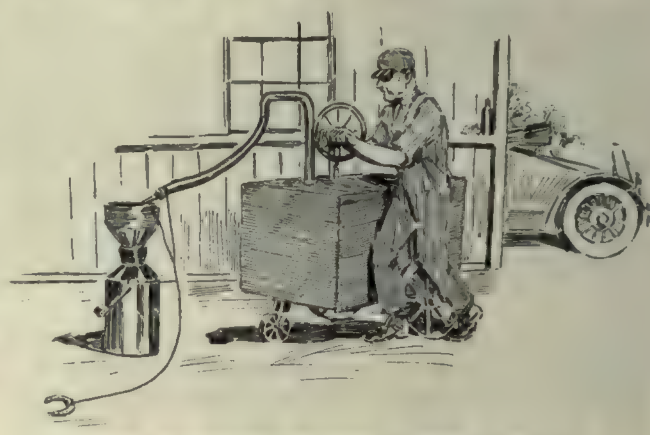


FIG. 2. HOW TO PREVENT AN EXPLOSION BY GROUNDING THE FUNNEL AND NOZZLE

to the funnel and nozzle, and grounded to a convenient water, steam or gas pipe or an electrical conduit would have avoided this accident.

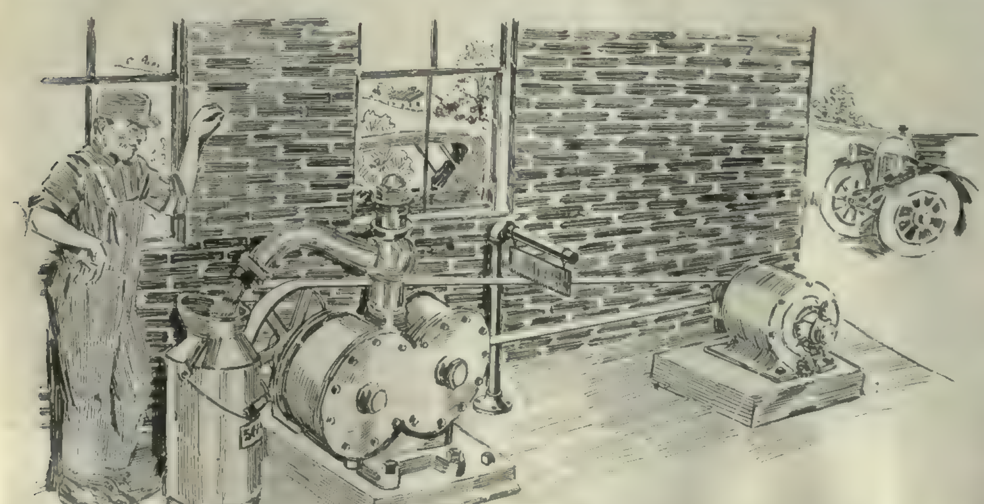


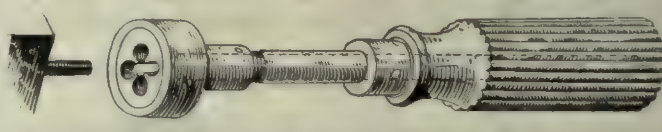
FIG. 1. A GROUNDED PUMP INSTALLATION

A Handy Die Stock

By Richard F. Ward

A handy die stock for use by electrical and other repairmen who have to do with small screws in restricted spaces is shown in the cut.

The body of the tool is made from a piece of cold-



ELECTRICAL REPAIRMAN'S DIE STOCK

rolled steel to take the commercial sizes of round dies. The shank is a piece of $\frac{3}{8}$-in. gas pipe of any length desired, with a turned wood handle at the end. A pin through the ferrule fastens the handle to the pipe, the pin being offset so as not to obstruct the central hole, which is carried through the handle.

The object of the central hole being clear through is to allow the threading of long wires held in the chuck of a speed lathe.

The particular field of usefulness for this tool is the re-threading of binding post and similar screws on electrical machinery and appurtenances when the thread has become jammed. Because of the close quarters in which such screws are usually located, an ordinary die stock would be inconvenient, to say the least.

Machining Molds and Cores for Auto Tires

By W. O. FRANCIS

In the automobile-tire industry the machining of the molds and cores, which are used during the building-up and vulcanizing processes, has assumed large proportions, and many tire factories have large departments engaged in this work. Outside jobbing shops are also doing considerable of the work for the tire makers.

THE modern tire mold consists of three principal parts; the two halves of the mold and the core, as shown in Fig. 1 and in greater detail in Fig. 2. The core is usually made in three sections (particularly so in the larger sizes of tires) to facilitate its removal from the tire after vulcanizing. To hold these sections together while the canvas layers are being placed and all of the building-up work is being done on the tire, steel rings *B*, Fig. 2, are fitted into tapered grooves in each side and drawn together tightly by a series of bolts *C*, thus clamping the portions of the core together.

During the operations on the tire, the core is held on a spider chuck, *A*, Fig. 1, which has expanding arms with sharp V-shaped ends that are forced into the grooves *B* in the inside rim of the core. The spider is mounted on a shaft, supported by a bracket from the floor, and the entire core and tire may be turned freely by the workman while building-up the tire. However, as these V-shaped ends on the arms cause considerable wear in the grooves, it is the custom of some makers to line the inside of non-collapsible cores with a steel ring *C*, which has better wearing qualities than the cast iron and also may be renewed. The two halves of the mold are not actually applied to the tire while the core is on the spider in the position shown, but the core and tire are usually laid in one half and the other laid over it and clamped on, while being forced together under extremely high pressure.

The clamping pressure together with the vulcanizing heat causes the rubber to flow out into the interior of the molds and fill all impressions such as are found on the non-skid type of tires, as well as the lettering on the sides.

In making tire molds and cores for auto tires, the first consideraton is to secure proper castings; these must be good close-grained iron and homogeneous in every respect. Slight blemishes or slag holes which may appear on the surface of the core after machining are apt to prove fatal to its usefulness unless they can be properly plugged. The danger of such blemishes lies in the fact that the inside layer of fabric may be forced into them while vulcanizing, and this would form sufficient grounds for the rejection of a first-class tire when inspected and its classification as a "second." Core castings for tire sizes of 30 x 3½ in. and smaller are cast solid, with a section similar to that shown in *A*, Fig. 3; while in the larger sizes the cores are cast hollow, as at *B*, leaving a wall ½ to ⅝ in. thick after the core has been machined to finished size. Hollow cores are cast with three chambers, Fig. 4, and are later divided into three sections so that they can be easily removed from the tire after vulcanizing. Smaller sizes of tires are stretched to strip

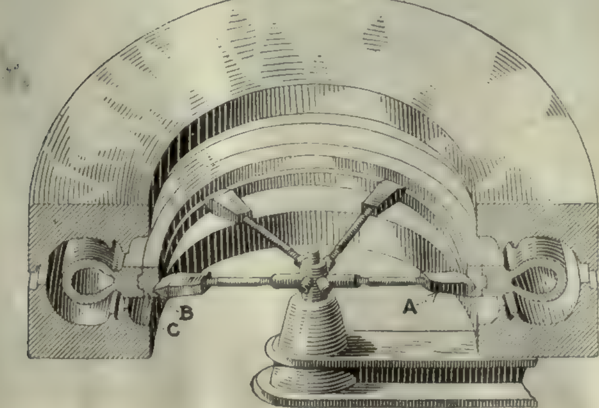


FIG. 1. PRINCIPAL PARTS OF TIRE MOLD, CORE AND SUPPORT

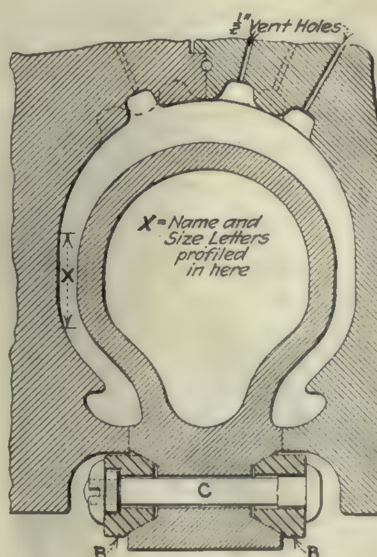


FIG. 2. SECTION THROUGH A TIRE MOLD AND CORE

AUTOMOTIVE CONSTRUCTION

them from non-collapsible cores. It will be noted that the part *A* tapers with the large end toward the center, so that it can be pulled inwardly, and the other two parts can then be easily removed.

In machining a core for small sizes of tires, the rough casting is first placed on a vertical boring mill, chucked

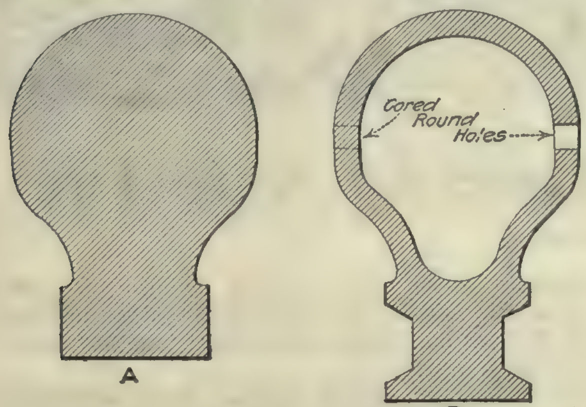


FIG. 3. SECTIONS OF TIRE CORES

from the outside, bored to size and a straight roughing cut taken from the top, Fig. 5, so that it will lie flat for the second operation. For the latter, it is chucked from the inside by jaws which do not protrude above the finished dimension of the top of the section, where the bead of the tire will lie, Fig. 6.

Any type of boring mill may be used for the first operation, but a boring mill with a side head, upon which may be mounted a former attachment, is recommended for the second and third operations, and a King boring mill equipped for the operation is shown in Fig. 7. The side and outside diameter are roughed by means of a round-nose tool held in the side head and controlled by the former, which controls the tool so that it follows the shape of the outside surface of the core. Each side is then finished by a form tool held in a goose-neck holder, Fig. 8. The core is then ready for fitting the

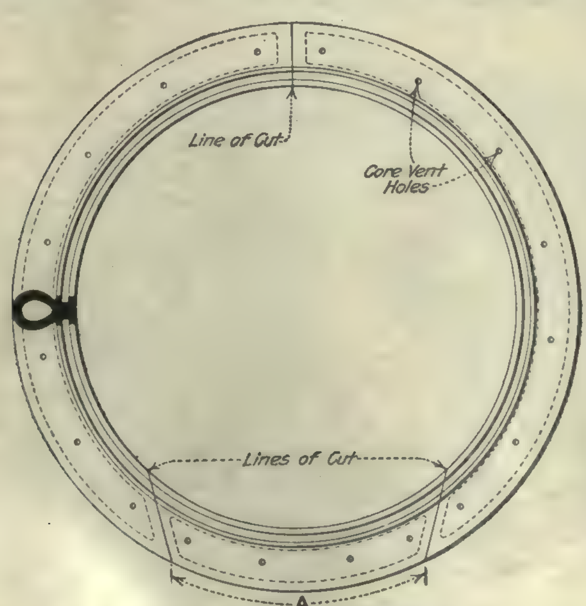


FIG. 4. OUTLINE OF HOLLOW CORE SHOW

internal steel ring, previously mentioned, which is used to take the thrust and wear from the arms of the supporting spider.

The ring is made from a suitable size of steel stock, generally $\frac{15}{16}$ in. square. The stock is cut to length and the ends are scarfed for welding. The bar is heated to a low red heat so that it may be worked without unnecessary scaling, and is bent on a roller type of ring former, with the scarfed ends laid for a side weld. The scarfed ends are brought to a welding heat in an oil-

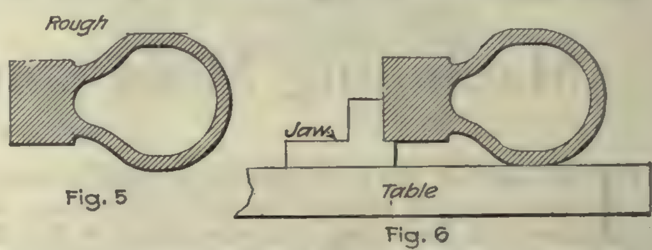


FIG. 5. TRANSFORMATION OF FIRST BORING-MILL OPERATION. FIG. 6. SECOND OPERATION SHOWING HOLDING JAWS

heated furnace and the weld is made under a steam hammer.

The welded ring is rounded up on a cone former, and flattened on a surface plate. After cooling it is again straightened and is then ready for machining.

For machining, the ring is clamped in a boring-mill fixture, Fig. 9, with drawing-down screws which support it at many points to prevent springing, and arranged to permit the boring and facing of one side in the first operation. For finishing, the ring is slipped over another fixture, Fig. 10, which holds it from the inside, and the face and outside are then finished with a tongue as indicated at *A*.

The finished rings are cut across diagonally at one place at an angle of 45 deg. so that they may be sprung into place in the groove of the core casting, where they are held by pins. The core and ring are then placed on a boring mill and the V-groove is cut in the inside of the ring.

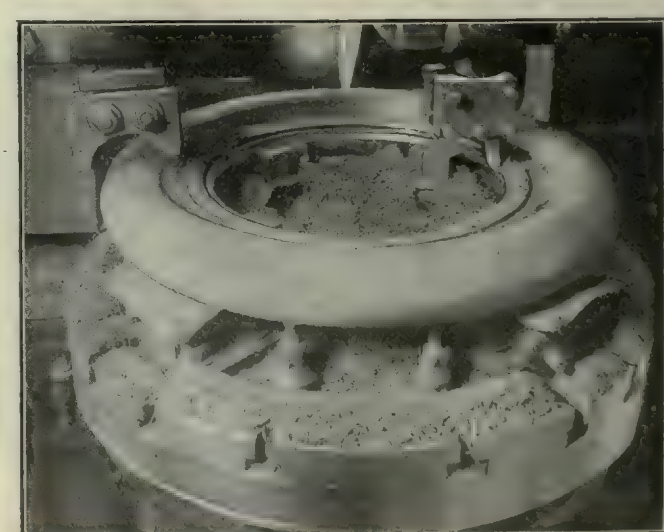


FIG. 7. BORING MILL EQUIPPED FOR FINISHING CORES

AUTOMOTIVE CONSTRUCTION

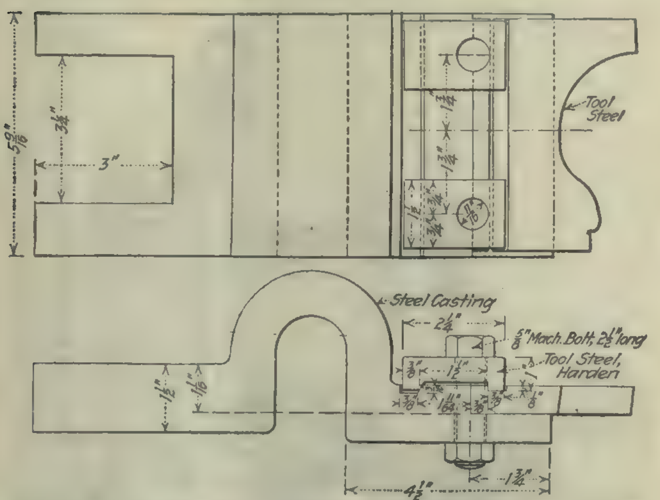
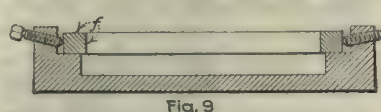


FIG. 8. GOOSE-NECK TOOLHOLDER USED ON BORING MILL

The machining of the collapsible cores proceeds in the same manner as with the solid ones until the end of the third operation, when the V-groove is cut directly in the casting, and the grooves are also finished in each side for the steel retaining rings. They are drilled for the retaining ring bolts, using a jig which spaces the holes to avoid the spots where the division sections are cut later. The retaining rings are drilled by a corresponding jig to insure interchangeability.

The cores are cut into three sections to leave a gap that will finish from ¼ to ⅜ in. in width. The ends are then fitted with steel plates, Fig. 11, which prevent wear, the plates being provided with keys, fastened in one and fitting in a keyway in the other, which assure alignment of the sections when they are reassembled. The core sections are assembled and bolted together with the side rings, and the projecting corners of the plates are finished to the contour of the core. The assembly rings are made in the same manner as the internal rings except that they are not cut diagonally in the manner mentioned. Mention has been made of the fact that the large cores are cast with three hollow chambers, and, consequently, the foundry cores are furnished to the molder in a corresponding form. In the foundry, the cores are supported in the mold by round projections or lugs and the holes left by them are reamed out, and through them, after machining the casting, the chambers are filled with cement mixed with water only. Before the cement has set, steel plugs are driven into these holes and after the cement has set the protruding portions of the plugs are filed to conform with the contour of the finished casting. The tire cores are cast hollow, principally to secure closer grained castings, and it is claimed the cement filler serves to overcome the expansion of the iron core when it is put into the vulcanizer.



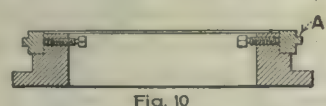


FIG. 9. FIXTURE FOR BORING AND FACING CORE RING. FIG. 10. FIXTURE FOR FINISHING OUTSIDE AND FACE OF CORE RING

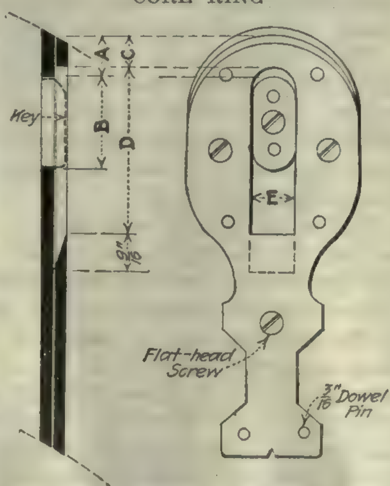


FIG. 11. STEEL PLATES FOR ENDS OF CORE SECTIONS

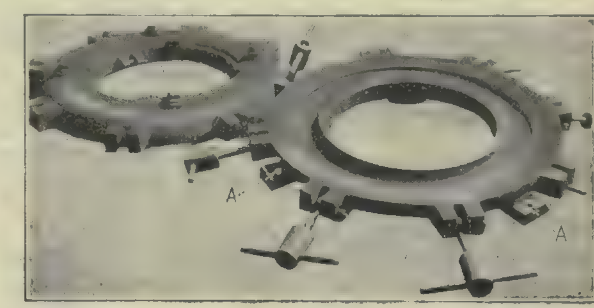


FIG. 12. A PAIR OF TIRE MOLDS WITH CLAMPS

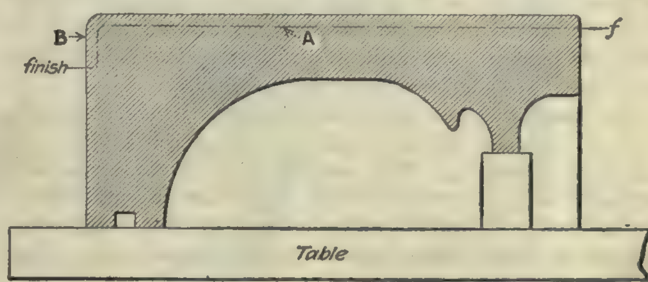


FIG. 13. TRANSFORMATION OF FIRST CUT ON BACK OF MOLD

Tire molds also must be made of close-grained iron, and in addition to this, it has been found desirable to make them with a chilled surface. The wear exerted by the tread compound of the tire when it flows during the vulcanizing process is very deteriorating on the molds, and unless they are made of particularly tough and close-grained iron, they will wear very rapidly. The iron

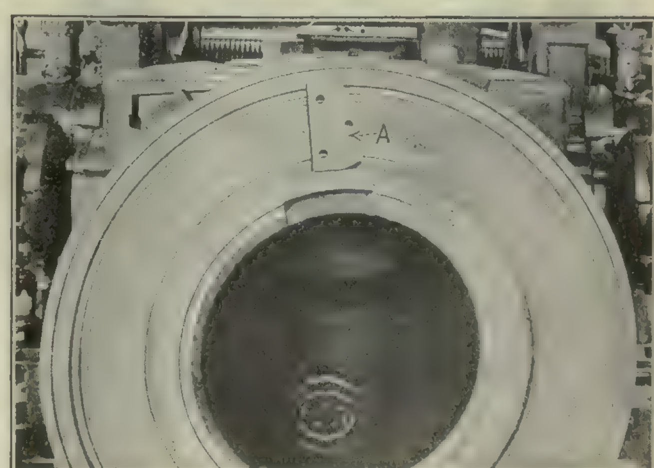


FIG. 14. TIRE MOLD SHOWING FORM-CUTTER TOOL

AUTOMOTIVE CONSTRUCTION

used for this purpose does not take a hard chill and remains soft enough so that it may be properly machined.

Some foundries put the chill and pattern together in the flask and ram them up in the mold, then draw the pattern leaving the cast-iron chill in the sand until the mold has been poured. This method is liable to cause pit-holes or chill-balls on the surface due to the fact that

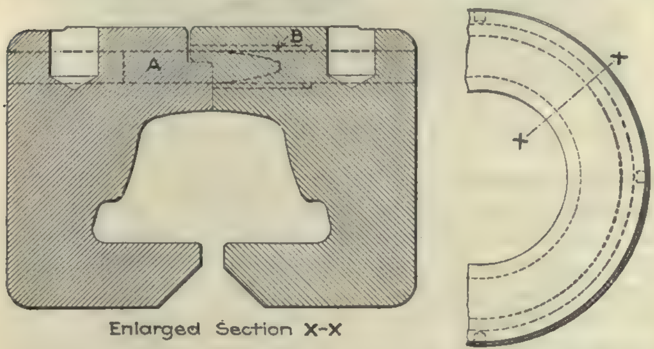


FIG. 15. SECTION OF MOLD FOR SOLID TIRE

the cold cast-iron chill collects moisture and when the molten iron strikes it an imperfect surface is the result. It is better to have the pattern made with a print to take the place of the chill, and not place the chill in the mold until just before it is ready to pour.

The mold castings are first drilled with four holes *A*, Fig. 12 (which shows a pair of completed molds), to facilitate handling. The castings are placed on a boring mill with the cavity down, and a smooth cut taken on the back, *A*, Fig. 13, and about 1¼ in. down the outer surface *B*, to facilitate future chucking operations. The mold is turned over and the cavity and joints are roughed with a round-nose tool and then the cavity is finished smooth with a form tool, *A*, Fig. 14, held in a goose-neck holder similar to the one shown in Fig. 8.

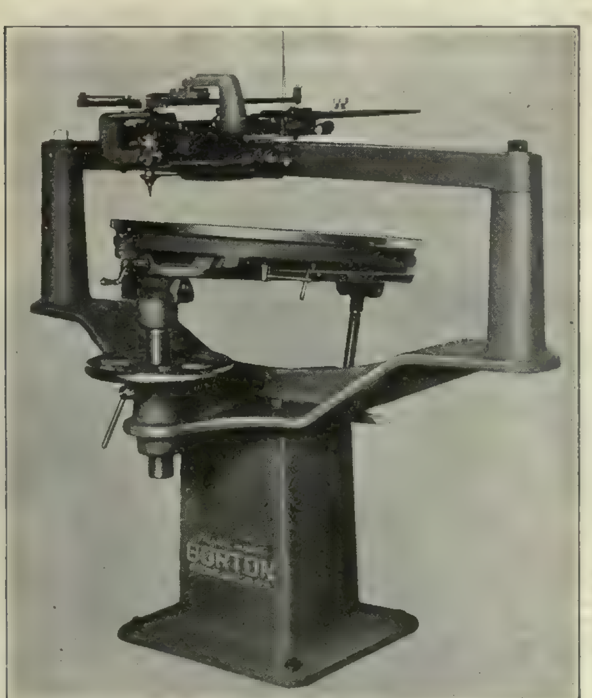


FIG. 16. ENGRAVING MACHINE USED FOR TIRE LETTERING

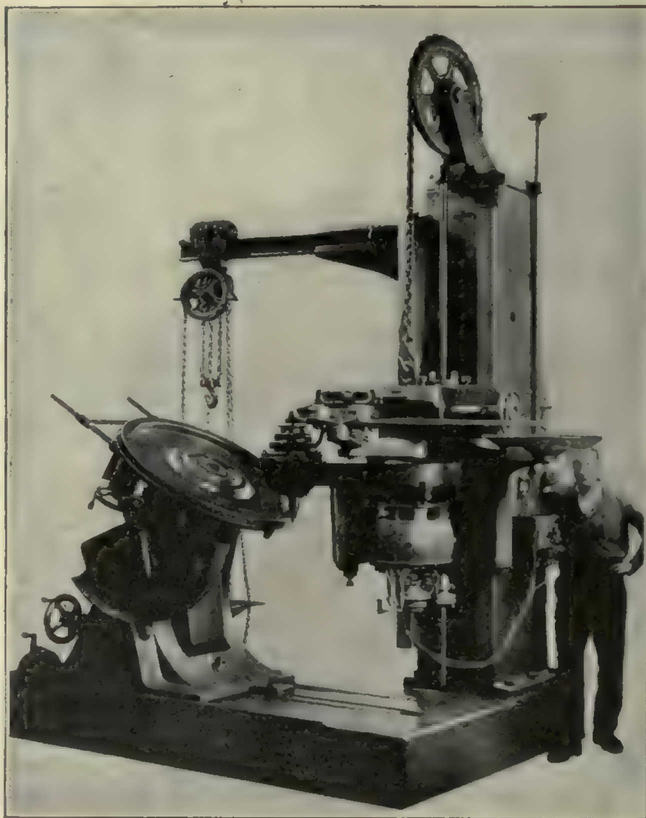


FIG. 17. MACHINE FOR ENGRAVING NON-SKID TREAD

All form tools are drilled and planed to templet, to fit the goose-neck holder, which makes them interchangeable and permits quick setting of the tools.

Molds which are intended either for plain tread or for solid tires, Fig. 15, also have each half completed as in the operation described previously. Any defects in the castings are plugged and smoothed. The molds are then placed on an engraving or profiling machine, such as the Gorton engraving machine shown in Fig. 16, where the size and name of the tire are cut in, using a templet guide for the cutter.

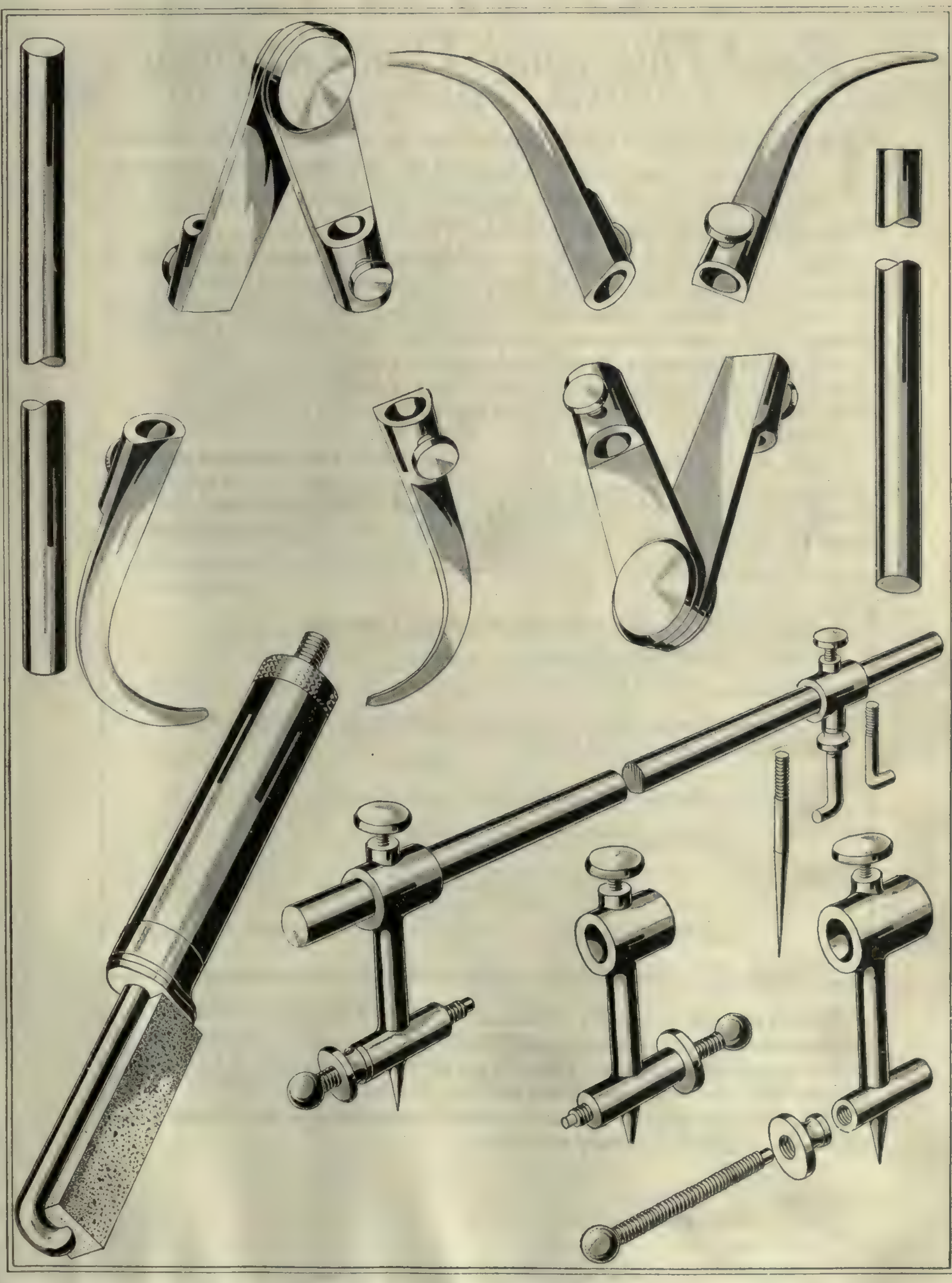
The cavities which are required to be cut in molds for the non-skid type of tires have this work done on a much larger type of engraving machine, such as the one shown in Fig. 17, which also uses templets.

Some firms require ⅛-in. vent holes to be drilled in each cavity of the non-skid tread for the overflow of the rubber, while others do not. All sharp edges and tool marks in the cavities must be filed smooth and round; otherwise they will tear the rubber when the tire is removed from the mold.

The halves of the mold are put together and located so that the designs in the tread register properly, and are then drilled for three steel dowel pins and bushings. These must be unequally spaced, so that the two parts of the mold can only be assembled in one position. The holes are drilled so that the pin *A*, Fig. 15, will have a drive fit, and it is driven through one half and into the other part way. The hole in the latter portion is then enlarged by a three-lip drill sufficient for a drive fit for the bushing *B*, which is reamed to fit the pin after it has been driven in place.

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



CARDS—

Put them in your shop literature

Don't be misled by reports being circulated that no compulsory metric bill had been introduced into Congress. It is a fact that none has—and we have never said there had been—BUT—there WAS—not so very long ago—a VERY grave danger of such a bill emanating from the House Committee on Coinage, Weights and Measures.

There is practically no danger now of such a bill being introduced into THIS session of Congress, but as long as the One-Man World Trade "Club" keeps up its tactics there is always danger. And—

It is up to all of us to see that the Chairman of the House Committee on Coinage, Weights and Measures, is supplied with enough ammunition to offset the gas attack of our opponents.

We must make our position so overwhelmingly strong that the One-Man "Club," or the combined compulsory metric advocates, will be unable to make a successful attack.

This can only be done by keeping up the fight and carrying it to them on their own ground.

We have all the men who really KNOW industrial conditions on our side, but we must put these men on record.

Read the opposite page which is reprinted from our issue of March 25 and April 15, and then send for your cards for the fight is not over yet.

A good suggestion, is for you to include a card in each piece of shop literature which you send out.

One firm alone sent to us for 22,000 cards to be used in this way. Others have ordered from five to seven thousand each.

GET YOURS NOW.

Ethan Viall

Editor

Crescent Vacuum Chucks and Pumps

THE ignorance of the mechanic who attempted to hold a piece of non-magnetic material on a magnetic chuck was matched by a man of my acquaintance who built a cast-iron fixture to hold an odd-shaped piece by the same method. The fixture short-circuited the magnetic lines of force so that the work was not energized. Possibly both men could have accomplished their purposes with the Crescent vacuum chuck which is being manufactured by the Crescent Pump Co. and marketed through the Crescent Sales and Engineering Co., Detroit, Mich.

This chuck was designed for holding such classes of material as cannot be held by a magnetic chuck. Among the materials which may be mentioned in this connection are brass and bronze, stellite, manganese steel and glass.

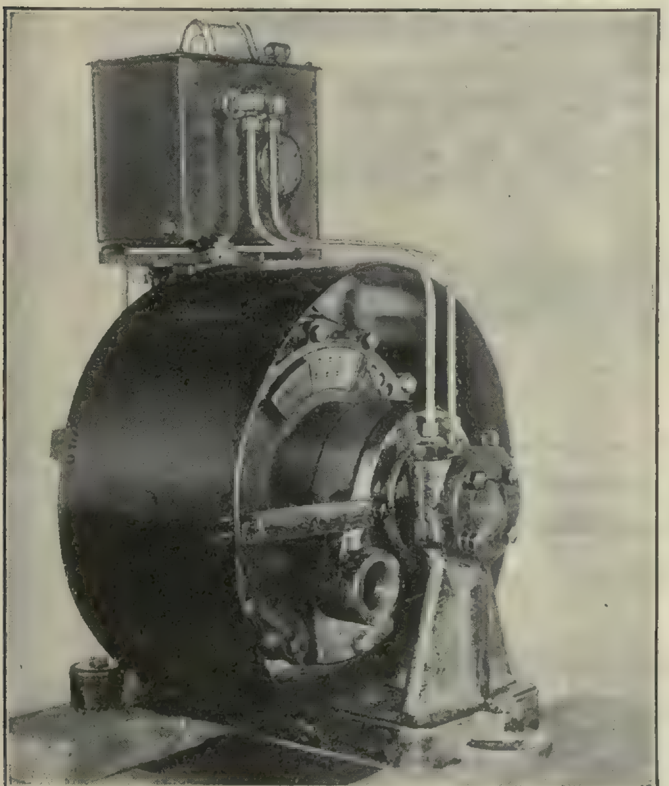


FIG. 1. INLET AND OUTLET CONNECTIONS OF PUMP

The vacuum is created by a Crescent rotary pump Fig. 1. This pump can be used either as a vacuum or pressure pump, and it is claimed that a pressure of 15 lb., or a vacuum of 28½ in. can be attained.

The intake of the pump is through the hollow center-shaft, and the outlet is through the opening seen to the left of the shaft. In the main body or case is a rotor which revolves about a stationary shaft.

The Vacuum Chuck

The interesting feature of this system to the shopman is the vacuum chuck shown in Fig. 2, as mounted on the table of a small surface-grinding machine. It consists of a hollow cast-iron body finished square and parallel on its several faces, and provided with suitable lugs so that it may be bolted to the machine table. In one end is a pipe connected by a flexible hose with the vacuum system maintained by the pump described.

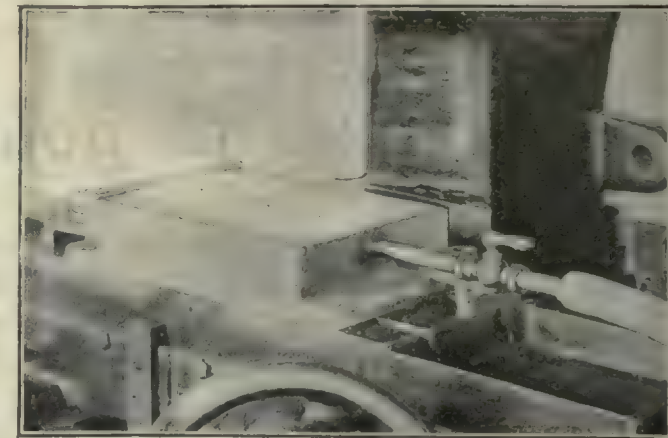


FIG. 2. SMALL SIZE OF VACUUM CHUCK PLATE WITH SINGLE GASKET

How the Chuck Works

Through the top face of the plate are drilled a series of tiny holes leading to the vacuum chamber inside. The holes may be drilled in any order depending upon the character of the work for which the chuck will be used, as in Fig. 2, or with a greatly increased number of holes for many pieces as illustrated in Fig. 3. A thin gasket, of any soft paper, is used to insure against leakage between the work and the chuck. A gasket for a single piece is shown in Fig. 2 and a larger gasket on a larger chuck plate to hold twenty-one pieces at a setting in Fig. 3.

The chuck is shown loaded with work in Fig. 4. Spaces which will not be used for the work are blocked off by laying a piece of paper over the air holes. Thin

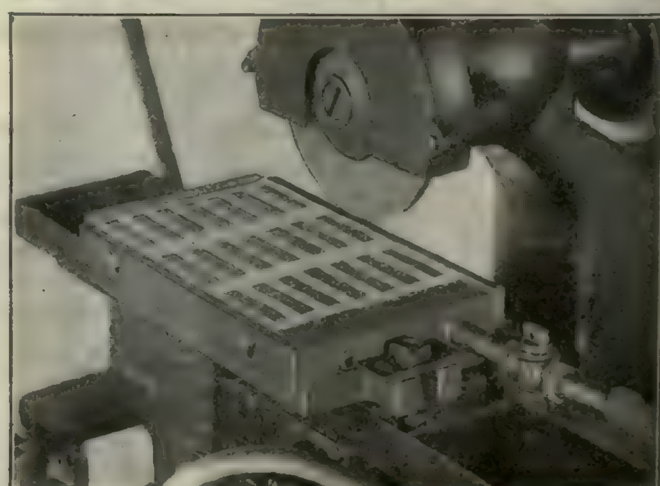


FIG. 3. LARGE CHUCK PLATE WITH GASKET FOR MULTIPLE PIECES

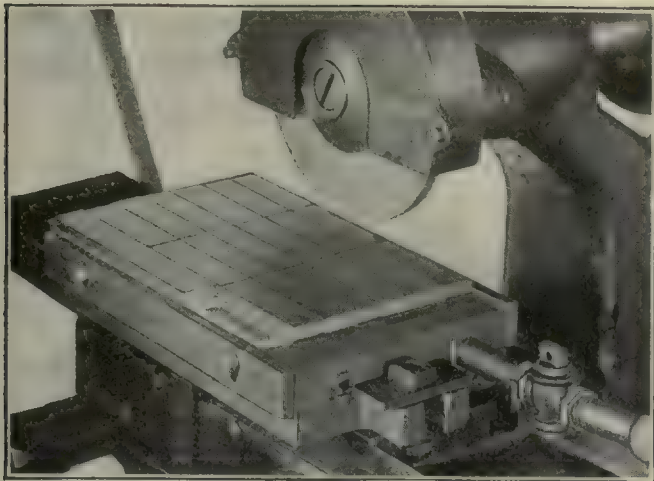


FIG. 4. CHUCK LOADED WITH PIECES FOR GRINDING

plates which are already slightly sprung can be drawn down the vacuum so that they will lie level and thus be ground to an even thickness.

New Instructional Plan at the Harvard Engineering School

The Harvard Engineering School has adopted a new plan of instruction for the junior year of the engineering course whereby students will hereafter be given an opportunity to combine classroom work with six months of active engineering practice and industrial training.

According to the new plan, which will be inaugurated in June and will apply to the instruction in mechanical, electrical, civil, sanitary, and municipal engineering, every student who wishes to take the industrial training work will spend half his time during his junior year working in industrial or engineering plants within easy reach of Cambridge. A schedule has been arranged which will enable these men to secure the full amount of regular classroom instruction and also to spend three separate periods of two months each in the industrial work. The schedule of work for the freshman, sophomore, and senior years will remain approximately what it is now, so that students in the engineering school will fully retain during at least three years, and also during part of the junior year, the advantages of life in the college surroundings which the school now affords.

The plan has received the support and encouragement of the Associated Industries of Massachusetts, comprising some 1,400 industrial and engineering concerns.

It is expected that the students who go into this work will be paid current wages for the periods in which they work in the plants and that they will be able to earn sufficient money to pay their expenses during these periods, so that the experience, if not actually profitable, will at least not be a financial burden. The plan will be optional on the part of the student.

Students will be placed in industrial plants, engineering works, and public service companies. They will be engaged in the making of steam and gas engines and auxiliary machines, of electrical machinery, of textiles, of rubber and leather goods, of paper and paper pulp. They will be employed by railroads, traction companies, and contracting firms, and will work in foundries, machine shops, and electric light and power plants.

Professor Hector J. Hughes, chairman of the administrative board of the engineering school, today explained the purpose and development of the new plan as follows:

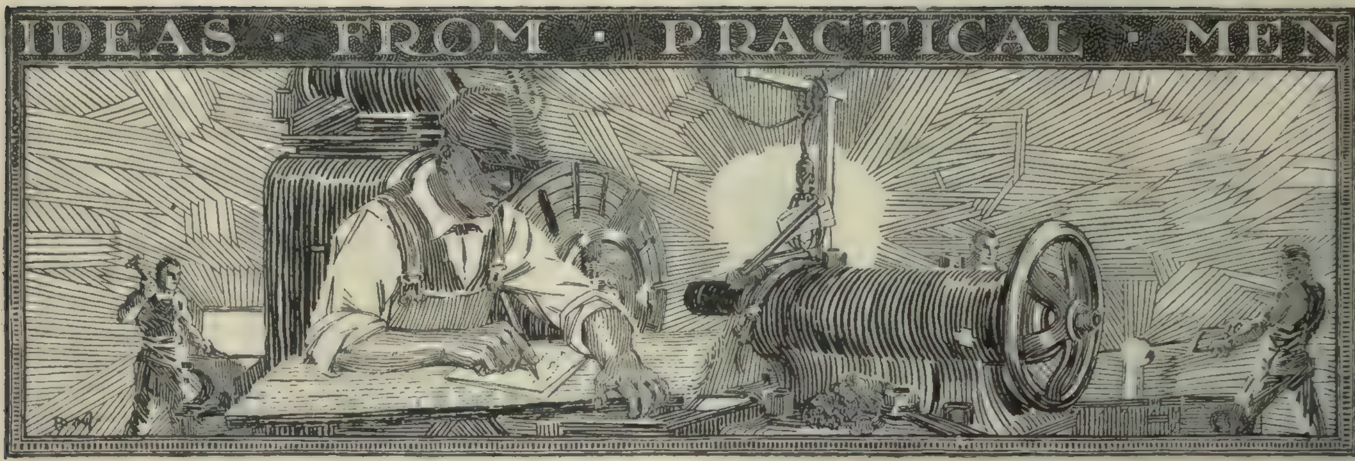
"One of the first problems which the staff of the new engineering school set itself to solve was to find an effective way of getting the new school and its students into closer relations with industrial and engineering work before they graduate. The need for such relations has been increasingly evident in the past few years. The object of such co-ordination is manifold: To stimulate interest in the classroom work; to keep the teaching staff well-informed of the needs of industry and how to train engineers to meet them; to give the students some intimate knowledge of the great problems of labor and industry which they have to meet after they graduate, and thus to anticipate to some extent the period of initiation which all students must go through and better to fit them to begin their careers; to give them an opportunity to discover how intricate and interesting the basic industries are and to what extent scientific knowledge may be used in work which is too frequently looked upon as non-technical; in other words, to find out how many kinds of careers are open to technically trained men and how wide is the opportunity for such men. Another object of the new plan is to stimulate the interest of the industries themselves in the adaptation to their special needs of education in engineering.

"To sum up, the object of such co-ordination is to give our students the chance to find themselves.

"The most promising solution of this problem seemed to the staff to lie along the lines of the highly developed and successful plan of industrial co-operation which was initiated by Dean Schneider at the University of Cincinnati and has been carried on there so successfully for many years, and has been applied in a modified form at the University of Pittsburgh also. This plan has been modified still further to meet the different conditions and needs at Harvard. It is significant that other universities are now moving in the same direction, and within only a few days a large movement has been inaugurated to put such a plan ultimately into effect in most of the large technical schools.

"After a thorough study of the situation, the staff came to the conclusion that it would be highly desirable to offer our students an opportunity to get some industrial experience and engineering practice while undergraduates but without sacrifice of classroom instruction and without depriving them of the many advantages which attach to residence and study, under teachers interested in other subjects than science, and among students of widely differing interests. In other words, we feel that our students should have as many as possible of the benefits which we know will come from connection with the college, while they are at the same time carrying on their engineering studies. For this reason and because it does not seem desirable to lengthen the period required for a first degree beyond four years, we shall be limited at the outset to less industrial experience than perhaps would be desirable. The amount offered, however, should be looked upon as a minimum and we have no doubt that many of our students will be glad to avail themselves of the opportunity to take more of this work after the plan is in operation.

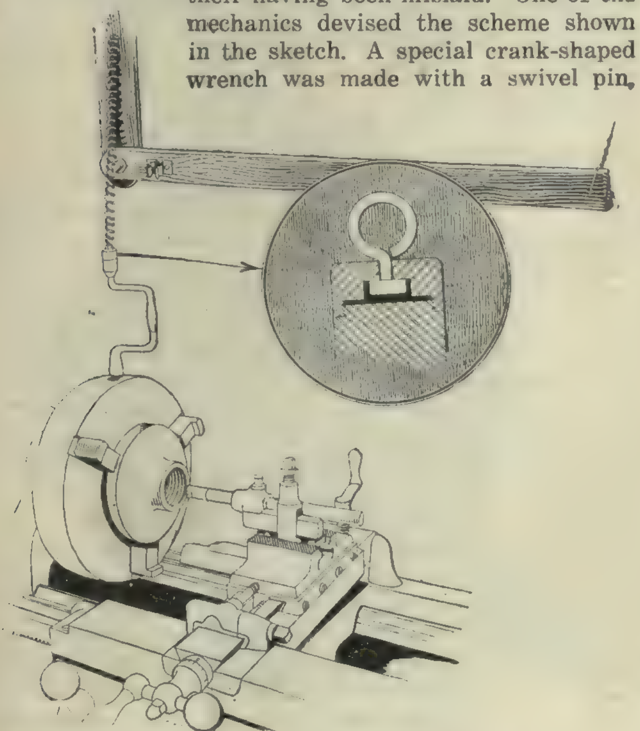
"Mr. H. V. Drufner of the University of Cincinnati has been secured to take active charge of the technical work of putting the new plan into operation."



A Handy Chuck Wrench

By C. H. Willey

In a repair shop where several lathes were in use with interchangeable chucks there was considerable time wasted hunting for the chuck wrenches due to their having been mislaid. One of the mechanics devised the scheme shown in the sketch. A special crank-shaped wrench was made with a swivel pin,



KEEPING TRACK OF THE CHUCK WRENCH

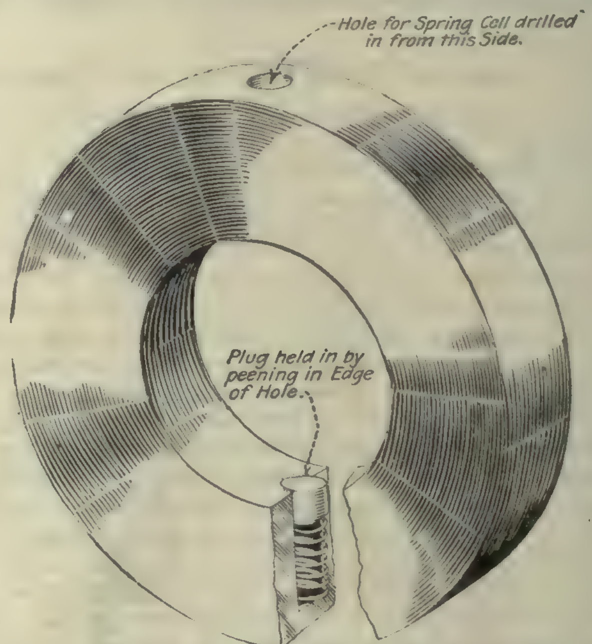
shown in enlarged section, in the top. The upper end of the spring was secured on the vertical shipper bar. When not in use the spring raised the wrench and the operator would place it in the spring clips indicated. This idea is a labor and time saver that has proved very handy and valuable.

Device for Babbitting Bearings

By Richard H. Kiddles

We have a device for use in babbitting bearings that has been in service for a long time and which, we think, is handier than the one shown by John Vincent on page 305 of the *American Machinist*.

Instead of separate springs to hold the collars together we have a stiff coil spring set in a cell in each collar. Wherever the collar may be placed on the arbor, it is held with sufficient friction to withstand any pressure that may be brought to bear on it when pouring



COLLAR FOR BABBITTING BEARINGS

small bearings, and yet is readily adjustable by hand without the use of a wrench or other loose part.

The illustration shows the manner in which it is made and its action is obvious.

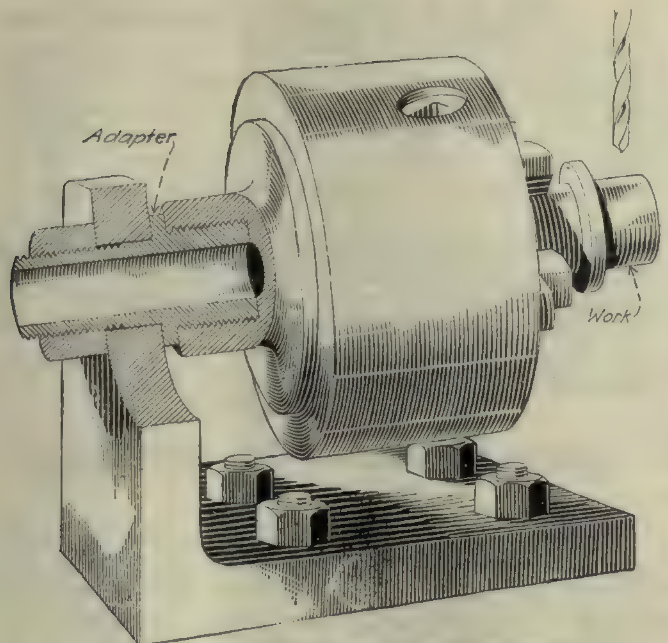
Adapter To Hold Lathe Chuck on Angle Plate

By H. H. Parker

Some pieces of work of the character shown in the sketch are difficult to hold for drilling, either in V-blocks or in a vise.

A convenient way to hold such work is to turn a piece of cold-rolled steel and thread both ends, one the same as a lathe spindle nose and the other to take a nut to hold the adapter to an angle plate. If the adapter is drilled through the center the same size as the lathe spindle hole, long pieces may also be held.

If it is not already drilled, the angle plate is provided with a hole through its upright face to take the adapter.



ATTACHING CHUCK TO ANGLE PLATE

For ordinary small work the chuck will probably screw up tight enough without any special means being necessary to hold it in place.

Quick-Acting Machine Vise

By H. W. Belmont

After searching the market without success for a quick-acting machine vise of large capacity we decided to design and make one to suit our requirements. Inasmuch as this vise proved very satisfactory we thought that other readers of the *American Machinist* would also have use for it, as the quick-action features are also adaptable to jig and fixture work. The body has a dovetailed slot up to the rear jaw and a rectangular hole through the jaw. The member *A* slides in the body, the movable jaw *B* sliding with it. The vise operates as follows: Insert work; push up the member *A* until the movable jaw is against the work; then turn the screw to the right, this action driving the cam *C* to the right through the friction drive, throwing the plunger *D* into the ratchet *B;* after which another eighth of a turn tightens the work. To remove the work, simply turn the screw to the left, turning with it the cam, thus allowing the spring to raise the plunger from the ratchet and the sliding member *A* to be drawn back.

The friction drive of the cam is accomplished through the spring *E* which forces the cam against the collar of the screw. The cam has eight drill spots in it as shown in section *A-A* and eight pins *F* ride in the drill spots, making an efficient drive for the cam and allowing the screw to continue to tighten the movable jaw. The sliding member *A* is dovetailed into the body and the movable jaw is dovetailed into the sliding member. *G* is a pin to prevent the ratchet plunger *D* from turning. This vise is used on milling and shaping machines.

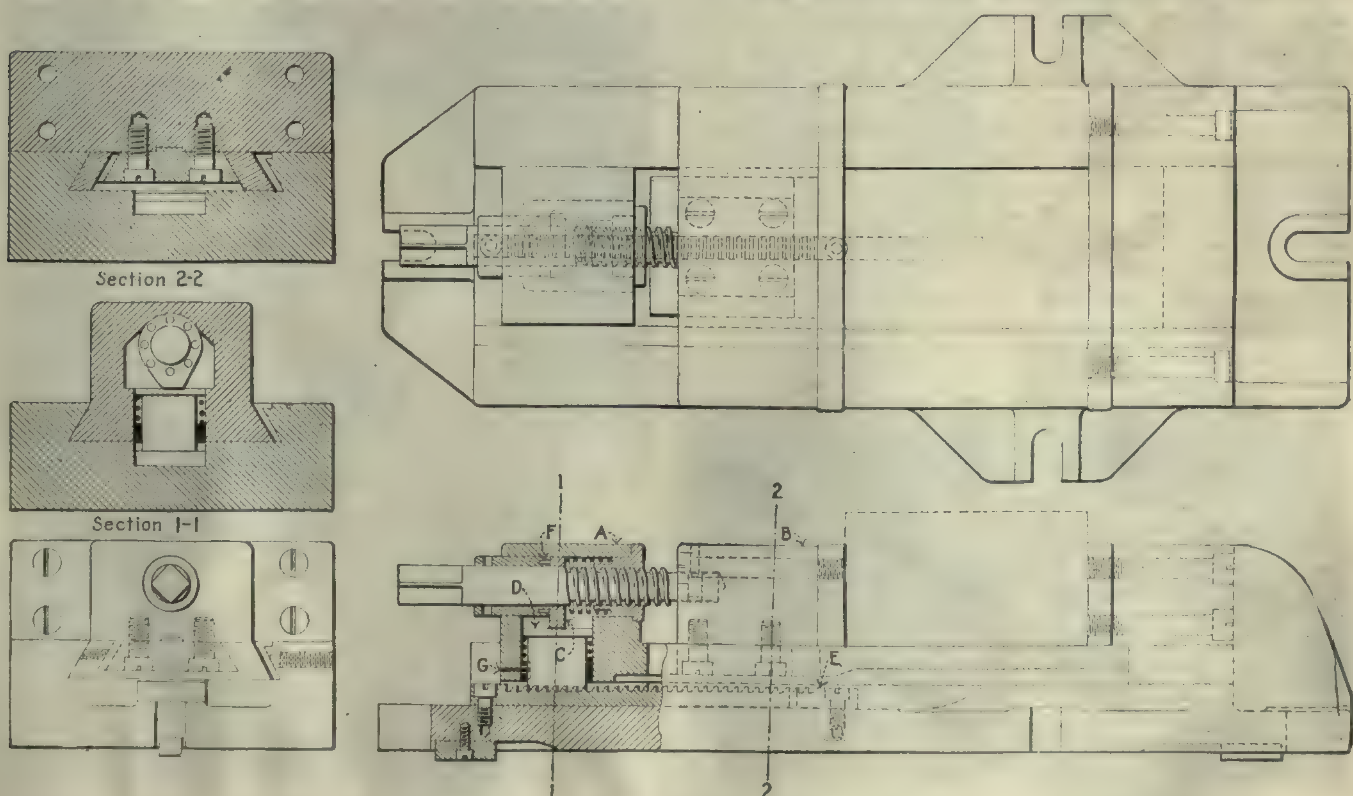
Novel Way of Making a Pattern

By A. Briechle and Max Schuppe

A small number of cast covers for a certain instrument were wanted. They would ordinarily have involved the making of a drawing and the usual form of a wood pattern and entailed an expense that would have made the cost of the job practically prohibitive.

A novel idea was evolved and put into practice. A block of wood was made to conform to the size and shape of the desired cover and a sheet of lead about ⅛ in. in thickness was drawn and molded over the block, the joints being carefully soldered and scraped.

The block of wood may be seen at *A* Fig. 1, and the



QUICK-ACTING VISE FOR MILLING MACHINE

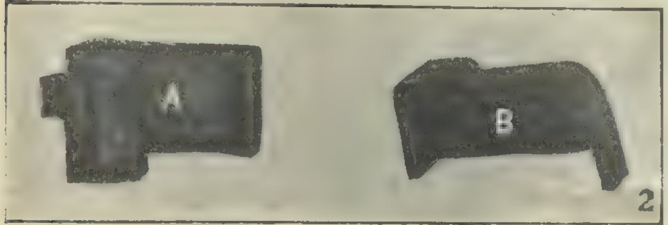


FIG. 1. WOOD BLOCK AND LEAD CASE. FIG. 2. LEAD PATTERN AND RESULTING CASTING

sheet lead pattern at *B*. In Fig. 2, *A* is the lead pattern and *B* the casting made from it.

Using this lead casting as a pattern, some remarkably clean castings were obtained, and the pattern could with care be used over and over again, whereas a wood pattern as thin as this would be extremely liable to injury.

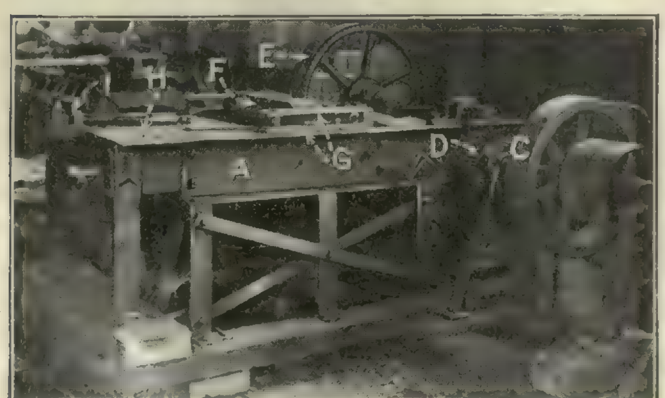
The cost of the lead pattern was about one-third that of a wood pattern, and it possesses the additional advantage that after it has outlived its usefulness as a pattern it may be made into sinkers.

A Home-Made Bending Machine

By H. J. Ventner

A machine and forge shop in one of our large cities had a limited amount of bar bending to do for use on ornamental railings and constructed the home-made bending machine shown in the illustration to handle the work. Nearly every piece used in making this machine was picked up from the scrap pile in its own yard.

I-beams, *A*, lined with a stiffening channel are used on each side to form the bed. These are braced in position by heavy flat bars which are also used for legs extending to the timber foundation. The crank was made of a heavy piece of shafting, forged with a throw in its center to give it the required amount of travel to the crosshead. The ends of the shaft and the crank bearing were then turned so that they would run true.



A HOME-MADE BENDING MACHINE

The driving shaft, in addition to the pulleys, carries a fly-wheel *C* to aid in carrying the crank over center when bending. The reduction gearing *D* from this countershaft is again augmented by a second reduction to the gear *E*. The diehead *F* is probably the only casting made especially for this machine. It slides between guidebars *G* which are bolted to each side of the frame.

The stationary die is bolted to the plate *H* on the bed and backed up by a thrust block *I* which has an adjusting screw that can be set up against the die. One of the recent jobs successfully bent on this machine was the bars for the railing of one of Chicago's new bridges.

Keeping Mosquitos Out of the Shop

By Frank C. Hudson

If you are bothered with mosquitos breeding in standing water round your shop it is worth while to try the plan they use in Panama and other places. The picture is from the Navy Yard at New Orleans and shows how little apparatus is required.

The apparatus consists of an old tomato can tied to a stick, the stick being driven down into the mud, preferably at an angle as shown, and a wick which runs from the bottom of the can out through a small hole near the top and down into the water.

Fill the can with kerosene or almost any sort of oil that will feed the wick and the outfit needs no attention so long as the oil lasts; the oil feeds gradually from the can to the surface of the water and soon covers it with a film of oil. It only takes a very thin film of oil to discourage the breeding of mosquitos, but it must be kept up for they are persistent critters and seem to lie in wait for a chance to get busy again. This has proved an effective method of extermination.

THE ANTI-MOSQUITO OIL CAN

WHAT *to* READ

—*for the man in a hurry*

Suggested by the Managing Editor

TO PROVIDE a little variety we are leading off this week with a Navy Yard story — this time a short account of the yard at New Orleans and its work during the war. Being a relatively small yard it had more intimate acquaintance with submarines and subchasers than with dreadnoughts and battle cruisers. Much repair work is done here and the equipment is correspondingly diversified.

> *Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.*

The current installment of "Modern Production Methods" is called "Engineering the Product," and begins on page 1087. Mr. Basset takes up briefly the functions of a well-organized engineering department and also points out its limitations. As usual he uses concrete examples to prove his statements. This article should appeal both to engineers and to general managers.

Another article dealing strictly with management problems is the one on page 1091 by John T. Bartlett concerning employees' magazines. Most of us have seen house organs of promise spring up like mushrooms and last but little longer. The management may have had the best intentions in the world and the editor may have been as conscientious as he was clever but still there was something missing and the result was failure. Mr. Bartlett takes up policies for employees' magazines in a broad gage way that merits close attention.

The third installment of Sherlock on insurance policies starts on page 1084 and takes up the matter of premiums and their importance. For some months we have run solid pages of illustrations showing shop and drafting room kinks, and just after the armistice a few on mechanical hands and arms for disabled shop men. One appears on page 1103. These were drawn by J. A. Lucas who was recently made head of the illustration department for all McGraw-Hill papers. Instead of photographing Lucas we thought it more appropriate to have him drawn from life by Breul whose desk faces Lucas' and who consequently had a fine chance to complete the job without Lucas knowing anything about it. Lucas was born in Toulon, France, and graduated from the Paris Polytechnique. He has been in this country thirteen years, eight of which have been in the employ of the McGraw-Hill Co., Inc., and its predecessors. A critical analysis of the sketch will indicate to the careful observer that Lucas is—not fat, for a Frenchman could never be that—but that he inclines to embonpoint, or in other words carries around with him somewhat more avoirdupois than might be considered essential by some people. He is responsible for the perspective sketches and drawings which are used to such a large extent as illustrations for our practical letters. His experience as a machinist and expert photographer has stood him in good stead.

The Theory and Practice of Lubrication—The Germ Process*

BY HENRY M. WELLS AND JAMES ED SOUTHCOMBE

If costly bearing friction can be greatly decreased through the application of improved lubricant, and the cost of the lubricant itself reduced by the use of hitherto so-called impurities, we shal have taken another big economic stride.

IN THE early days of the mineral lubricating oil industry, it was considered that the perfection of lubrication lay with the production of the purest possible hydrocarbon oils, and it is a monument to the skill and efficiency of oil producers and refiners that this search for better lubricants and more scientific methods of refining has resulted in placing upon the market an enormous range of highly purified lubricating oils of every conceivable viscosity, gravity and color. This has certainly very materially conduced to lubricating efficiency and has been instrumental in assisting forward to the greatest possible degree the development of engineering design. Nevertheless, we find that for many purposes, particularly those cases requiring lubrication of bearings, etc., carrying heavy loads at relatively slow speeds, these pure mineral oils have not been ideally successful. And the need for adding to mineral oils, animal and vegetable oils to increase their "slipperiness," has been forced upon users in all countries. To take a few examples out of many, the specification for lubricating oils of the United States railways, drafted at a recent conference, recommends the addition of 4 to 8 per cent of fatty oil, and in Great Britain many large consumers of lubricating oil, the railway companies and the Government departments, emphatically specify oils containing up to as much as 20 per cent of pure rape, olive, lard, or cocoanut oils. The fact that such compounded oils possess exceptional friction-reducing properties has been shown by a large number of trials and experiments on mechanical testing devices and is supported by the observations in practical lubrication on many hands.

An Extensive Industry

There has grown up with the development of mineral oils an extensive industry for the production of fatty oils to be used in compounding with hydrocarbons. Here again, the demand for greater purity and freedom from acidity of glycerides has been insistent and has seen the marketing of expensive acidless tallow oils, acidless lard oils, etc. It is our object in coming before you to show that such highly refined oils are not only unnecessary but are positively ineffectual in securing the highest possible degree of friction-reducing efficiency.

We were forced to the conclusion that the only property which was of importance and which had previously not been adequately studied, was capillarity or surface tension. Consider the case of two eccentric glass surfaces which are being forced together with a drop of oil or mercury between them. Now, since the mercury does not wet or spread over the glass, the meniscus in this case will be convex to the liquid, while in the case of oil which wets the surface, the meniscus will be concave. In the first case, the tendency on capillary grounds will be for the liquid to gather itself up into a drop and to pull the liquid film away from the narrower constricted area of greater pressure. In the case of oil, the opposite will be the effect. The oil, owing to its meniscus, will tend to force itself into the narrow spaces. This is exactly what is required in a lubricant, namely, that it shall penetrate into the narrow spaces between journal and bearing and from the above considerations, one clearly sees that liquids which do not wet solid surfaces cannot be described as lubricants. Only the liquids which wet the solid surfaces possess lubricating power in the generally accepted sense. This confirmed to us that a measure of the surface tension would shed considerable light on the problem and to this end we now devoted our attention.

It was found that the interfacial tension against water, and also against mercury, of the fatty oils and compounded oils, was much *lower* than was the case with any mineral oil.

What Investigation Showed

After a great amount of investigation, we definitely proved that this difference was due to the presence in the fatty or compounded lubricants of small quantities of free, fatty acids which are absent in the great majority of mineral oils. This was a most surprising result since it indicated that the virtue of fatty oils arose simply from the fatty acids which they contained, as impurities. We then went a step further in that we artificially prepared oils consisting of 99 per cent mineral oil with only 1 per cent of free fatty acid. These oils gave a low surface tension. On the other hand, we removed the fatty acid from fatty oils and found that the pure fatty oils gave a high surface tension. We drew the deduction, therefore, that the friction-reducing properties were due solely to the fatty acid content and that it should be possible to obtain the desired result by adding minute quantities of fatty acids to mineral oils. At this point it became essential to confirm the results by direct experiments on bearing surfaces.

The broad set of tests and results from the four machines were these: The oils used by way of illustration were a pure mineral oil, the same mineral oil plus ½ per cent commercial fatty acids, the same mineral oil plus 1 per cent and 2 per cent fatty acids. These were tried out against rape oil containing 2.4 per cent of free fatty acids and neutral rape oil from which the fatty acids had been completely removed in the laboratory. In every case, on each machine the frictional resistance, when 1 per cent of fatty acids was used, was reduced by 20 to 26 per cent and to achieve this reduction by the use of pure neutral rape oil it was necessary to employ as much as 60 per cent. Further experiments made with olive oil showed that

*Extract from paper delivered at the meeting of the National Petroleum Association at Pittsburgh, Pa., April 22, 1920.

the addition of 2 per cent of commercial fatty acids lowers the friction 30 per cent below that of a mixture containing 40 per cent mineral and 60 per cent olive. To put the matter in a nutshell, the *frictional resistance shown by any mineral oil can be most definitely reduced by the addition of about 1 per cent of commercial fatty acids.*

This is in complete conformity with the latest views of pure science. All recent work points to the fact that it is the chemically reactive and unsaturated constituents of lubricants which promote "oiliness" and that they do so by forming new "composite" films on the surfaces lubricated, with lower surface energy and opposing less resistance to shear. The great activity of organic acids is quite in accordance with this theory.

Growing Use of Germ-Process Oils

We have hitherto confined our remarks to the effects of acids on the friction-reducing properties of oils, but there is another aspect of the matter of very utmost importance. In practical use in the power house or factory, lubricating oils are not used under ideal conditions, and in many cases they become admixed either accidentally or deliberately with water. In some cases it is necessary that when the oil comes in contact with water, it shall mix with the water or emulsify as we say. Such cases are, of course, the bearings of marine engines and the guides and rods of locomotives, etc. In other cases, it is essential that the oil shall not mix or shall separate readily from the water.

We found also that it is possible to choose suitable acids which will confer upon the mineral oil these particular and valuable properties. By the addition to the mineral oil of one class of fatty acids, we induce a tendency to de-mulsify, while other groups of acids have a powerful emulsifying influence. We are therefore enabled to change the character of the mineral oil.

Germ-process oils have been extensively tried out by the British Admiralty, Government Departments, Steamship and Railroad Companies, without a single failure being recorded.

On large gas and oil engines, especially big horizontal units, where previously 10 per cent fatty oil was used, we have been able to substitute germ oils with 1 per cent fatty acid and achieve complete success.

"Germ-process" oil, incorporated in very small proportions with the correct mineral cylinder oil, gives equally good results on engines with Corliss valves up to over 3,000 hp., working at 160 to 170 lb. per square inch pressure, superheated 480 to 500 deg. F.; on horizontal engines with Corliss valves up to 750 hp. up to 160 lb. pressure without superheat. Various mineral cylinder oil bases to correct "germs" in different but small proportions give thoroughly good lubrication on vertical and horizontal engines of many types, sizes and pressures.

For a good heavy marine engine oil it has always been considered necessary to use from 10 to 25 per cent thickened or blown oil—as a rule, thickened rape oil. This gives great viscosity, also very good "lathering" properties to the oil.

The standard specification for marine bearing oil for one of our semi-government departments is a compound of about 20 per cent of fatty oil; but the total fatty acid content must not exceed 1 per cent. This has now been successfully replaced by germ-process marine-engine oil.

The germ process gives to a mineral oil of *fair* merit, that property lacking for some purposes, while it increases the lubricating value of a good oil, making it still better. In all cases they become more economical.

One excellent illustration of this may be of interest: On a Navy ship of the cruiser class the port engine was run on a straight mineral oil and the starboard on a germ-process oil. It was found possible to reduce the oil feed on the starboard engine and the engineer officer reports that he would be quite willing to run the engines on the germ oil with a reduction of 17 per cent consumption.

We should mention here that this process has been protected by patents in all countries.

Conclusions Reached from Tests

Our task is to estimate how the industry will be affected by the following two factors: One technological, one psychological. The first is the technological factor; namely, the demonstration of a new set of facts. In our previous remarks we have given the conclusions to which we were led by exhaustive research in the laboratory followed up by convincing measurements of frictional coefficients and confirmed by thorough trial for many months in commercial practice on the largest and most varied types of bearing surfaces. These conclusions are briefly:

(a) That 1 per cent of free fatty acid will lower the frictional coefficient of a pure mineral oil by 26 per cent.

(b) That although such germ-process oils are only fractionally dearer than pure mineral oil, their value as lubricants is the same as, or better, than that of heavily compounded oils or straight fatty oils.

(c) That a logical reason has been given for the superior oiliness of compounded oils over mineral oils; namely, that the fatty acid present as impurity lowers the frictional coefficient.

(d) That there is no more danger of corrosion when using germ-process oils containing limited amounts of fatty acids than when using compounded oils, and in many cases the danger is much less.

(e) In a word, these new facts may be summarized by saying that it is now possible to combine the oiliness of fatty oils with the cheapness of mineral oils.

The psychological factor is this: That the oil user has now found that one of his most cherished prejudices has gone by the board; namely, the old bogey of free fatty acidity. At the meeting in London, large oil users were present. They admitted that the new process produced oil of superior friction-reducing properties and they were in no way perturbed by the presence of a minute quantity of free fatty acid in controlled amount. The user is therefore now prepared to reconsider the whole question of specifications for lubricating oil and to revise his old standards.

Economic Possibilities of New Process

We suggest that this will help the refiner. He will now find that the user will listen to his views and will co-operate with him in using the lubricant best suited for its work. The refiner will now be in a position to modify the properties of his oils at will. It is as if he were presented with a key which unlocked many doors. If he wishes to reduce friction, he can do so. If he wishes to make an oil emulsify, he can do so. If he wishes to prevent an oil from emulsifying, he can do

so, and these modifications can all be made with minute quantities of substances which are cheap, are universally soluble in all oils, and impart their beneficial effects between bearing surfaces of all metals so far investigated.

The producer will now be able to make cheaper mineral oils do the work of the more expensive ones, because he can rely less on *high viscosity*, and more on the addition of *fatty acid*.

It seems clear that there are great economic possibilities in a process which yields oils which the consumer will insistently demand on account of their higher efficiency, certainty and economy, and achieves these results while facilitating the task of the refiner by enabling him to utilize cheaper products for higher-priced purposes, and securing greater control over the properties of the finished product.

Machine-Tool Safety Standards for Pennsylvania

The Industrial Board, Commonwealth of Pennsylvania, will hold public hearings upon rules relating to the operation, use and maintenance of machine tools, at Philadelphia, Hotel Bellevue-Stratford, on May 24, and at Pittsburgh, Headquarters of the Department of Labor and Industry, Public Safety Building, on May 28. The following is a tentative draft of the rules:

Section 1. Administration

The rules set forth in this standard shall apply to every establishment within this Commonwealth.

(a) No person or persons shall remove or make ineffective any safeguard, safety appliance or device attached to machinery except for the purpose of immediately making repairs or adjustments; and any person or persons who remove or make ineffective any such safeguard, safety appliance or device for such repairs or adjustments, shall replace the same immediately when such repair or adjustments are accomplished.

(b) Every employer or person exercising direction or control over such person or persons who remove such safeguard, safety appliance or device, or over any person or persons for whose protection it is designed, shall have the safeguard, safety appliance or device so removed promptly and properly replaced.

(c) Every employe shall be responsible for carrying out all standards which may concern or affect his conduct, and shall use all safeguards, safety appliances or devices furnished for his protection.

Section 2. Definitions

For the application of these rules:

(a) The term ESTABLISHMENT shall mean any place within this Commonwealth where work is done for compensation to whomever payable, supervision over which has been given by statute to the Department of Labor and Industry.

(b) The term MACHINE TOOL shall mean any power driven machine which employs a tool for working on metal.

(c) The term HAZARDOUS shall mean that the location of an object is so accessible as to permit of contact which may result in injury.

(d) The term GUARDED — ENCASED — ENCLOSED shall mean that the object is so covered, fenced or surrounded that contact which may result in injury, at the point of danger, is remote.

(e) The term DEPARTMENT shall mean the Department of Labor and Industry.

(f) The term BOARD shall mean the industrial Board.

(g) The term COMMISSIONER shall mean the Commissioner of the Department of Labor and Industry.

(h) The term APPROVED shall mean approved by the Industrial Board.

Section 3. Specifications

NOTE: E-I—Existing Installations
N-I—New Installations
A-I—All Installations

RULE 94. (A-I) Each machine tool shall be provided with a starting and stopping device accessible to the the operator, such as belt shifter, clutch, switch, etc., which affectively controls the machine tool. (Machine tools that are part of a unit where the starting or stopping of one machine would interfere with others of the unit, are excepted.)

RULE 95. (A-I) Clutches and couplings shall be of the safety type with nuts and bolts countersunk or protected by a flange.

RULE 96. (N-I) All face plates, chucks and collets shall be cylindrical with no projecting parts beyond the rim.

RULE 97. (A-I) All openings in bed frames on planers and boring mills shall be covered with a sheet metal apron substantially fastened in place. All openings in housing shall be guarded.

RULE 98. (A-I) All planers shall have not less than twenty-four inches clearance at both ends of travel of the planer table, the work being machined and its chucking. When the clearance is less than twenty-four inches the space shall be guarded with standard railing.

(a) Balconies or runways of machine tools shall be considered working platforms and so guarded.

RULE 99. (A-I) Material being worked on hollow spindle lathes shall be guarded full length back of chuck while revolving.

RULE 100. (A-I) Cams shall be guarded.

(a) Counterweights which present shearing or crushing hazard when exposed to hazardous contact shall be guarded.

RULE 101. (A-I) Chip guards shall be provided at machine tools where there is an eye hazard from flying chips or cuttings.

RULE 102. (A-I) The practice of changing stops (dogs) is prohibited while the planer table is in motion.

(a) Oiling of moving parts of machine stools is prohibited.

(b) Cleaning of machine tools while in motion is prohibited.

(c) Riding upon machine tool table is prohibited.

RULE 103. (A-I) Revolving setscrews, coupling, clutches, keys or other projections not encased by the housing of the machine, when exposed to hazardous contact, shall be guarded.

(a) The covering of setscrews with leather or wood blocks is prohibited.

(b) All spoke pulleys shall be guarded.

Violation of these rules would entail a punishment of fine or imprisonment. Arrangement is intended whereby the Industrial Board may be petitioned to modify or suspend any rule. It is intended that the provisions of all safety standards not specifically covered by the standard under consideration shall apply in all matters involving the life, limb, and health of the worker.

We received several drums of plastic molding material that had an excess of moisture, and having a large steam-heated tank for vulcanizing under pressure I desired to use it for drying the molding material in vacuum. I therefore ordered the millwright to connect up a pump to the tank as quickly as possible.

He said he would rush the work; and in a few hours he was back saying, "I have her all connected up; but where shall I put the other tank? "What other tank?" says I. "Why the tank to pump the vacuum *into*."

E. F. Creager.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT NEWS
A weekly review of modern designs and equipment

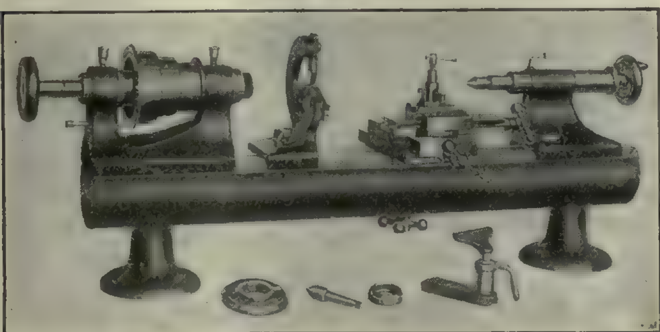
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

CONDENSED CLIPPING INDEX
A continuous record of modern designs and equipment

P. M. C. Precision Bench Lathe

The Package Machinery Co., Springfield, Mass., has brought out the precision bench lathe shown in the illustration. The special features of this lathe are: Ball thrust-bearings in headstock; split-nut clamp in tailstock, and adjustable nuts on the compound-rest feed screws.

The countershaft can be furnished with either bench or wall hangers. Two sets of tight and loose pulleys are furnished, permitting two speeds. The large pulley for driving, milling and grinding attachments is made of aluminum, thus reducing the inertia of the countershaft.



P. M. C. PRECISION BENCH LATHE

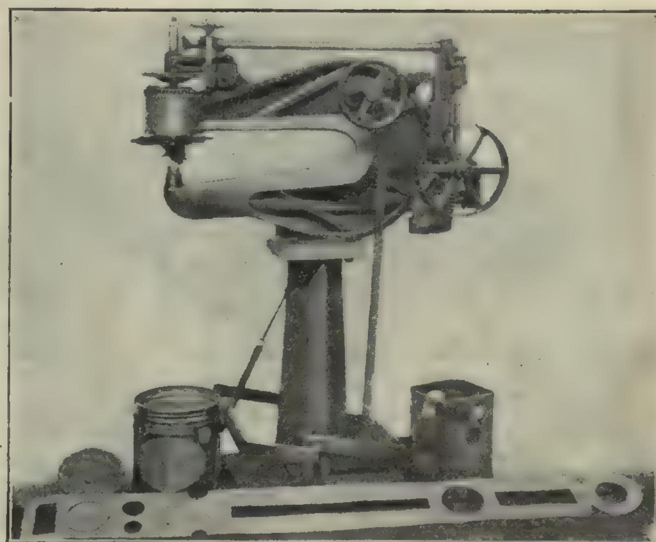
Specifications: Length of bed, 36 in. Distance between centers, 16 in. Swing over bed, 8½ in. Collet capacity, ⅝ in. Diameter of spindle nose, 8½ in. Thread on spindle nose, 12 per inch. Speeds (6), 350 to 1,200 r.p.m. Bench space, 6 x 39 in. Weight, net, including countershaft, 235 lb., boxed 295 lb.

Gray's Turret Rotary Shear

A rotary shear that cuts openings of any shape without cutting in from the edge and without turning the sheet, is being introduced by the Southwark Foundry and Machine Co., Philadelphia, Pa., and is illustrated herewith.

This phase of sheet and plate shearing is made possible by a turret, carrying the upper cutter, which while cutting, can be revolved about the lower cutter. The simultaneous driving of both cutters automatically pulls the sheet through the shear. The line to be cut is accurately followed by turning the guide wheel which controls the turret. This operation can be performed from either side of the machine. It cuts openings in widths equal to double the throat depth and without limit on length.

The cutting of circular and oval shapes is done in a continuous operation. In cutting angles the clutch is thrown out by means of the treadle, the upper cutter is moved to a new position on the converging line, the power is thrown in and the new cut is made to the first line. The cutting of zig-zag lines and small radii



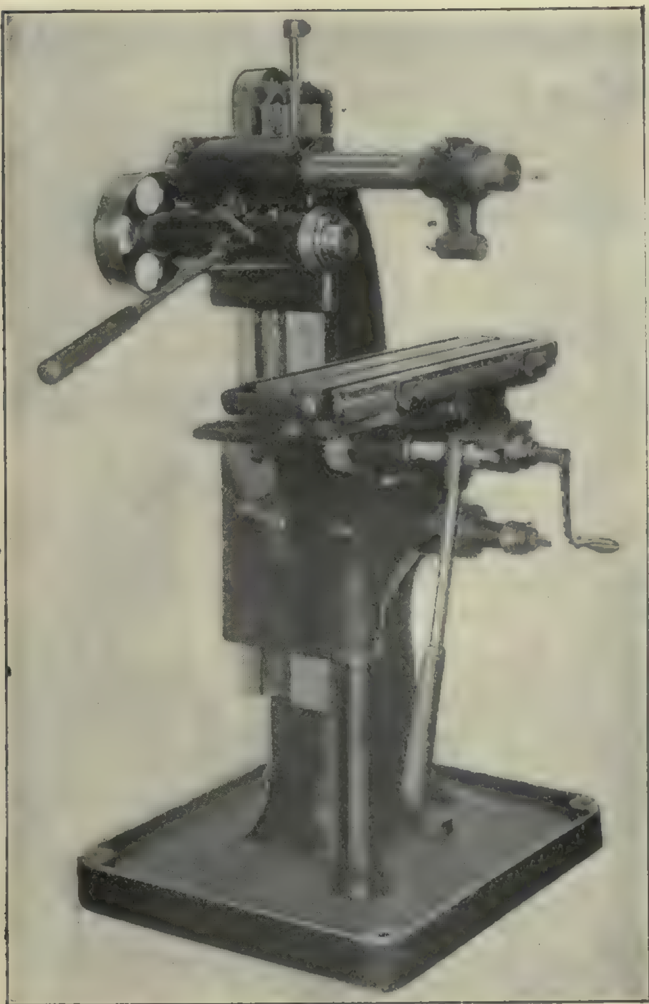
GRAY'S TURRET ROTARY SHEAR

is made possible by a sensitive clutch controlled by the foot lever. The clutch is engaged by a mechanism that can be stopped and started within $\frac{1}{32}$ in. of feed.

The machine is built in five sizes. The three smaller machines will cut metal of 18, 16 and 10 gage, respectively, while it is stated the two larger sizes will shear plate up to 1 in. thick. The throat depths are from 18 to 36 in.

Superior No. 1 Hand-Milling Machine

The No. 1 hand-milling machine shown in the illustration is being manufactured by the Superior Machine and Engineering Co., Detroit, Mich., and is the design of Richard T. Wingo. This machine is intended for accurate work and is designed for both rigidity of construction and ease of handling. The spindle-slide and knee are fitted to flat guiding ways on the column, the guiding surfaces being long in proportion to their width, so that the slides will move without cramping. The weight of the spindle slide is counterbalanced by means of a spring arrangement inside of the column. The spindle bearings run in bronze boxes which are adjustable for wear.



SUPERIOR NO. 1 HAND-MILLING MACHINE

Specifications: Table, surface, 22 x 4¼ in.; T-slots, ⅝ in. wide; longitudinal travel, 6 in.; traverse travel of saddle, 6 in.; vertical travel of knee, 12 in. Spindle, No. 10 B. & S., taper in nose; vertical travel, 4½ in. Overarm, 2¼ in. dia. Distance from center of spindle to underside of arm, 3⅝ in. Driving pulley, dia., 10 in.; width of face, 3⅝ in.; speed, 300 r.p.m. Spindle has 12 speeds, from 150 to 600 r.p.m. Speed-change pulleys, 4½, 6¾, 8 and 9 in. dia. for 2⅜-in. belt. Floor space, 34 x 41 in. Net weight, 860 lb.

The machine was designed for single-pulley drive direct from the mainline shaft, no countershaft being required. The driving pulley is inclosed in a housing at the back of the machine and is fully protected. Belt drive is employed from the driving-pulley shaft to the spindle, and suitable idler pulleys are provided for tightening purposes. If so desired, the machine may be furnished motor driven, with a 1½-hp. motor mounted on a bracket fastened to the base of the machine.

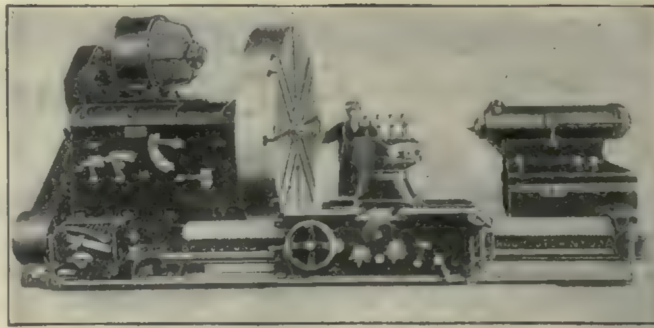
Betts-Bridgeford 60 and 72-in. Lathe

An all-geared-head lathe to swing 60- and 72-in. has been designed by the Betts Machine Co., Rochester, N. Y., and is shown in the illustration herewith.

The headstock is of the all-geared enclosed type, and is driven through an expanding-ring friction clutch operated from the apron. The same movement which disengages the clutch automatically applies a friction brake, thereby stopping the machine almost instantly.

There are twelve spindle speeds in geometric progression, any one of which can be obtained instantly, controlled by conveniently located levers at the front of the headstock.

All speed changes are obtained through hardened-



BETTS-BRIDGEFORD 60- AND 72-IN. LATHE

steel sliding gears and positive clutches running in oil. No two speeds can be engaged at the same time. All shafts and gears are located in the lower part of the headstock. All shaft bearings are bronze-bushed and all bearings are lubricated by means of chain oilers. When the machine is motor driven the motor is mounted on top of the headstock cover and connected direct through gearing to main driving shaft.

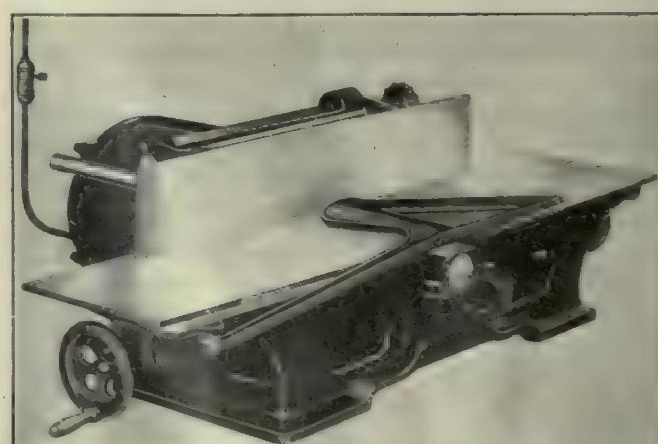
There are thirty-two changes of feed and leads obtainable through quadrant gearing and a quick-change gear box to lead screw.

Feeds and leads are interlocking, so that only one can be in use at one time.

The apron is of the double-wall unit-casting construction, there being no overhanging studs. All shafts have a bearing on each side, the gearing running in oil. Power angular feed to the compound rest is driven from the cross feed friction, a slip gear being provided for the cross feed or power angular feed. Both feeds and leads may be reversed either at the headstock or at the apron. Power rapid traverse is obtained by means of a friction clutch in the quick change box and operated by a lever at the apron. The movement which engages the rapid traverse clutch automatically disengages the feed and lead.

Wallace Bench Jointer

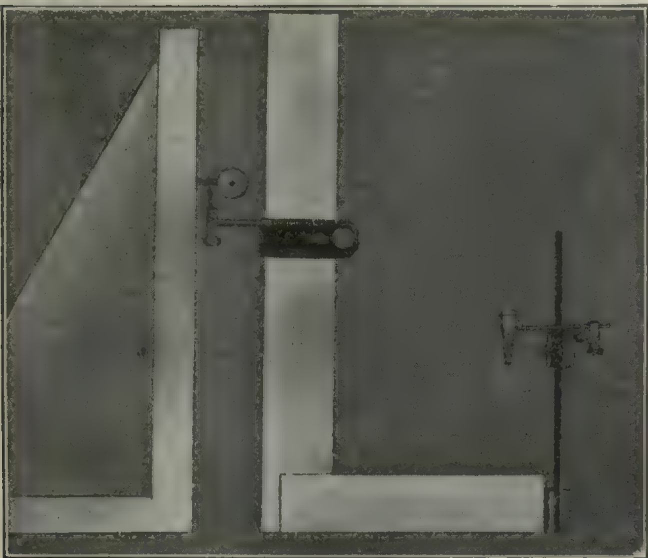
The jointer shown in the accompanying illustration has lately been brought out by J. D. Wallace & Co., 1401-1405 W. Jackson Boulevard, Chicago, Ill. The machine is portable, the idea being to take the machine to the job, rather than the job to the machine. It is equipped with a ½-hp. motor, ball-bearings, safety cutter head, rabbeting ledge, adjustable fence and tables, flap and shutter guard, and can be operated from a lamp circuit.



WALLACE BENCH JOINTER

"Correct" Indicator Holder

The Guldager & Jantch Co., 460½ Lenox Ave., Detroit, Mich., has brought out the indicator holder shown in the illustration. The device is made to fit the blades of



"CORRECT" INDICATOR HOLDER

squares and is adjustable for widths of blades from 2 to 3 in. Steel balls are used for sliding contacts allowing an easy movement up or down the square blade. A thumbscrew at the back is used to lock the holder in any desired location. The indicator is not included with the holder.

A Point in Cost-Finding

By Arthur B. MacAttammany

Many producers and manufacturers in this country today find themselves in the predicament of the commercial concerns in Germany, which, following the signing of the armistice and the re-entry of that country into the commercial arena of the world, sold tens of thousands of tons of material at prices which, according to slipshod calculations, afforded them abnormal profits —their computations being based entirely upon the initial cost of the raw materials that existed before the war. After these Teutons had disposed of a great accumulation of commodities, at quotations which they thought yielded an inordinate profit, they were dismayed to find that two or three times the amount of their receipts would be required to replace their stock of materials for future manufacture.

Costs Should Be Based on Existing Market Values

Manufacturers who adhere to the suicidal policy of basing their selling prices on the actual cost of raw materials as paid in the past, instead of at market values gaged at the time of the actual sale of the finished product, are bound to be much upset when market prices for raw materials go downward. Then such producers have on their hands high-cost raw materials in a declining market, and consumers will certainly not pay these producers on the basis of the actual cost of the materials bought in a high market. It is the market value prevailing at the time of purchase that should be the criterion. Even if the seller pleads that the raw materials which went into his finished product cost him considerably more than raw materials would at the time of sale, the buyer does not feel inclined to pay for the manufacturer's error in judgment, namely, that of purchasing raw materials at the wrong time and therefore at the wrong price.

It is obvious that the only equitable way in which manufacturers of commodities that are made up from raw materials subject to fluctuations, due to the H. C. L. or to speculative influences, can safeguard themselves is by taking advantage of the safe and secure law of averages. If makers of merchandise are fortunate enough to have low-cost raw materials on hand at the present time, they are, in justice to themselves, compelled to consider whatever profits arise out of this fortuitous circumstance as a reserve fund against the day when they will have high-cost raw materials on hand in a market that is tending downward.

Difficulties Arising from Careless Cost Keeping

The trouble here lies in the fact that those who have made a sufficient study of the character of their business and know that the principle herein outlined is fundamental to success and who will, therefore, not deviate from the steadfast adherence to it, are suffering from the competition of those who have never been able to grasp the vital importance of this policy, although they are surely well intentioned in their mercantile methods. Manufacturers in many lines are finding it more and more difficult to meet the ruinous competition of those who do not know how to figure, with a view to both past and present costs, what their products represent in actual value.

Retailers in many lines are often criticized, because, when pursuing price-cutting tactics, or even when operating on a normal price basis, they fail to calculate the cost of rent, clerk hire and lighting in striking a price for their merchandise. Some manufacturers seem to be just as lacking in analytical power. Even in these times of rising prices, entirely too many manufacturers calculate their costs on the actual price paid for raw material in the past. True they do make a profit, calculating on the past, but they are actually losing money when they come to replace their stock of raw materials —that is the point which this article aims to point out. Those who do not recognize it are inviting disaster by their shortsightedness.

The science of cost finding has undergone a complete change since the sharp upward tendencies of raw materials, particularly those subject to speculative influences, or others dependent upon a changing status of supply and demand.

To some trades the example set in maintaining the policy previously outlined by the executive managers of the brass-rolling mills of this country is worthy of emulation. These men adjust their prices speedily, upon any rise or decline in the copper market, for that metal is a basic ingredient of their manufactures. The reserves of copper and zinc which these mills carry are so large that very often the mills work through a prolonged period of high-priced copper on metal which they bought in an abnormally low market. By doing that the guiding executives of the brass mills are enabled to lower their prices consistently when the copper market goes down, in spite of the fact that they may have copper on hand which cost them considerably more than they will receive for their finished product.

SPARKS FROM THE WOR

Valentine Francis

Orville Wright Awarded John Fritz Medal

Speakers Sketch Wright Brothers' Lives from Boyhood Until Their Early Success

The presentation of the John Fritz Medal to Orville Wright, airplane inventor and honorary member of the A. S. M. E., was made in the auditorium of the Engineering Societies Building, 29 West 39th St., New York, on May 7, 1920. Many men prominent in the four big engineering societies attended, among whom were two John Fritz Medal holders—Dr. Elihu Thomson and J. Waldo Smith.

Charles F. Rand acted as chairman in the absence of Benjamin B. Thayer. He opened the meeting telling of the origin of the John Fritz Medal and how the board of award—comprising sixteen men, four from each of the National mechanical, civil, mining and metallurgical, and electrical engineering societies—chooses one man each year to be presented with the medal. He also read the list of former medalists—from 1902 up to the present year—who are as follows:

The first award of the medal was made to John Fritz at a dinner given to him on his eightieth birthday, August 21, 1902; 1905, to Lord Kelvin for his work in cable telegraphy and other scientific attainments; 1906, to George Westinghouse for the invention and development of the air brake; 1907, to Alexander Graham Bell for the invention and introduction of the telephone; 1908, to Thomas Alva Edison for the invention of the duplex and quadruplex telegraph, the phonograph, the development of a commercially practical incandescent lamp, the development of a complete system of electric lighting, including dynamos, regulating devices, underground system protective devices and meters; 1909, to Charles T. Porter for his work in advancing the knowledge of steam engineering and in improvements in engine construction; 1910, to Alfred Noble for notable achievements as a Civil Engineer; 1911, to Sir William H. White for notable achievements in Naval Architecture; 1912, to Robert W. Hunt for his contributions to the early development of the Bessemer process; 1913, no award; 1914, to Professor John F. Sweet for his achievements in machine design and pioneer work in applying sound engineering principles to the construction and development of the high-speed steam engine; 1915, to Dr. James Douglas for notable achievement in mining, metallurgy, education, and industrial welfare; 1916, to Dr. Elihu Thomson for achievement in electrical invention, in electrical engineering and industrial development, and in scientific research; 1917, to Dr. Henry M. Howe for his investigations in metallurgy, especially in the metallography of iron and steel; 1918, to J. Waldo Smith for achievement as engineer in providing the City of New York with a supply of water; 1919 to General George W. Goethals for achievement as builder of the Panama Canal; 1920, to Orville Wright for achievement in the development of the airplane.

Major General George O. Squier, Chief Signal Officer, U. S. A., made an address on the Government's dealings with the Wright brothers in the purchase of the first plane. General Squier was on the Government board at the time—beginning in 1907—and he related many humorous incidents. One of the things the Board insisted on was that there should be no gas bags attached to the plane. The Government specifications were as follows: The plane must stay in the air for one hour; make a speed of 36 miles; hold sufficient fuel to go 125 miles, and carry an extra passenger.

When the test was finally held the Board, ignorant of the art of flying, selected a stretch which was densely wooded and impossible of landing. Luckily, no forced landing was made and the machine met all the specifications. The Wright brothers' final duty in the Government deal was to teach two Army men to fly.

Colonel Edward A. Deeds, formerly a member of the Aircraft Production Board and a close friend of Orville Wright, was the next speaker. In "machine-shop English," as he termed it, he told of the life of the Wright brothers from their boyhood days.

The Wright brothers' first mechanical venture was a printing press which they built themselves and from which a small juvenile newspaper was printed. Later, they experimented with bicycles and built racing bicycles.

They first became interested in the possibility of flying when Bishop Wright, the boys' father, brought home a small flying toy. They experimented with this toy and built some so large that they would not fly. From this toy they switched to kites and thence to gliders. The brothers took their work seriously and studied every known book on wind and aeronautics published at that time. Their first glider was completed in 1900 and instead of soaring into the wind it was blown backward. In fact, they turned it around and made better results by using the rear end forward. Not being satisfied with the results obtained, another glider was built following closely all the printed data and theories they could find. This plane was ready in 1902 and it did not work as well as the first.

Though they had no funds at the time the brothers refused to become discouraged and they went ahead, knowing then that the printed theories were wrong. That year they built the first wind tunnel and made an elaborate study of the effect of wind on surfaces. After considerable experimenting they built a glider which was satisfactory.

With the glider built the problem of its control presented itself. They found that an airplane rudder worked opposite from that of a ship and after other similar experiences, solved the problem of plane control so well that their system remains practically unchanged today. Step by step they forged ahead, and their next problem was to build a motor and propeller. They worked on the propeller with the theory that it was a plane surface moving in a spiral. This, too, presented serious problems. They finally used two propellers turning in opposite directions and being run by chains and sprockets. At first difficulty was experienced with bolts becoming loose; they overcame this by using tire cement spread in the threads of bolts.

The last step was to obtain a motor, and this also, they had to build themselves. Back in their old bicycle shop they designed and built a four-cylinder (the cylinders were not vertical—they were sideways), eight-horsepower engine.

On Dec. 4, 1903, on the side of a hill, Orville, on the first tryout, let the machine get away without being in it, and it crashed.

On Dec. 17, 1903, the machine was repaired and Orville was the first man to fly (it was his turn—the brothers took turns in flights). The flight lasted twelve seconds and he flew through 540 ft. of wind.

From that time on the brothers learned to fly. They crashed again and again in experimenting with tail spins, turns, etc. Truly, the most remarkable thing about their lives was that they lived through their experiments.

Colonel Deeds added that Orville missed a chance of a lifetime when he took the Crown Prince for a flight in Germany and didn't push him off. This was long before the war.

Comfort A. Adams, past president of the American Institute of Electrical Engineers made the presentation speech. He said that the medal was awarded not only to Orville Wright in body but to Wilbur in spirit.

Orville Wright made a short response, giving credit to his predecessors. He said that he appreciated the honor particularly because it came from the four great engineering societies.

Benicia Arsenal Appropriation Urged Before Senate Committee

Improvement of Benicia Arsenal and an appropriation of \$2,500,000 to make a great manufacturing Army and Ordnance plant has been vigorously urged by Senator James D. Phelan before the Senate Military Affairs Committee. A bill by Representative Curry for the appropriation has been pending in the House for several years and at every session Pacific Coast Congressmen have advocated the measure. These requests have been refused because the War Department, on recommendation of the General Staff, which claims the arsenal is too close to the sea and therefore liable in time of war to be destroyed or seized by an enemy from the Pacific, has invariably refused to agree to the improvement, despite the recommendation of Colonel E. P. O'Hearn, the commandant.

An effort was made by Mr. Curry at this session to secure the appropriation in the House Army bill but the House Military Affairs Committee refused to include the appropriation in the measure.

Senator Phelan presented to the Senate Committee an elaborate argument for the big appropriation in an effort to refute the War Department claims.

Rail Head Takes Action Against Compulsory Metric Laws

B. A. Worthington, president of the Cincinnati, Indianapolis & Western, is sending a letter to railroad men opposing compulsory metric system legislation.

United States Civil Service Examination Ordnance Research Engineer

The United States Civil Service Commission announces an open competitive examination on June 22, 1920, for ordnance research engineer. A vacancy at the Frankford Arsenal, Philadelphia, Pa., and vacancies in positions requiring similar qualifications, in the Ordnance Department at large, or other branches of the service, at \$4,000 to \$5,000 a year, or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

The entrance salary within the range stated will depend upon the qualifications of the appointee as shown in the examination, and the duty to which assigned.

All citizens of the United States who meet the requirements, both men and women, may enter this examination; appointing officers, however have the legal right to specify the sex desired in requesting certification of eligibles.

The duties of this position require the services of a highly trained engineer with considerable experience in machine and forge shop and metal-manufacturing methods and especially the working of the copper alloys. His services will be used in the design and development of experimental ammunition such as fuses, shell and other components of artillery ammunition.

A knowledge of interior ballistics is very desirable.

Competitors will not be required to report for examination at any place but will be rated on the following subjects which will have the relative weights indicated on a scale of 100: (1) Education and training 25 (2) Preliminary and responsible experience 75.

Competitors will be rated upon the sworn statements in their applications and upon corroborative evidence.

Applicants must have graduated in mechanical or electrical engineering from a college or university of recognized standing; and have had (a) at least five years' practical experience in the design or manufacture of metal products especially the copper alloys, of which not less than one year was in a responsible position with a manufacturing concern making artillery ammunition, or (b) three years' experience in a position of responsibility in the design and development of experimental ammunition, with a manufacturing concern.

Applicants will be admitted to this examination regardless of their age; but at the request of a department making appointment certification will be made of eligibles who are within reasonable age limits, except in the case of persons entitled to preference because of military or naval service, to whom age limits do not apply.

Applicants must submit with their applications their unmounted photographs, taken within two years, with their names written thereon. Proofs or group photographs will not be accepted.

Photographs will not be returned to applicants.

Applicants should at once apply for Form 1312 (stating the title of the examination desired) to the Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, or Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Cal.; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone, or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R.

Applications should be properly executed, excluding the medical and county officers certificates, and must be filed with the Civil Service Commission, Washington, D. C., prior to the hour of closing business on June 22, 1920.

Reiley Heads Davis-Bournonville Co.

DeWitt V. D. Reiley, formerly vice president of the Davis-Bournonville Co. of Jersey City, N. J., was elected president of that company at a recent meeting of the directors. Mr. Reiley succeeds Augustine Davis, who resigned last November. Charles B. Wortham, treasurer of the company since its organization, was elected vice president, and William G. McCune secretary and treasurer.

The directors are DeWitt V. D. Reiley, Charles B. Wortham, William G. McCune, Augustine Davis, Charles J. Mayer, Daniel E. Evarts and H. Rowntree.

LD'S INDUSTRIAL FORGE

News Editor

Republic of Poland to Campaign $50,000,000 Loan in U. S.

The campaign to sell the $50,000,000 loan of the Republic of Poland in the United States has been endorsed by the directors of the American-Polish Chamber of Commerce and Industry in the United States, of which Francois de St. Phalle, vice president of the Baldwin Locomotive Works, is president. The entire proceeds of this loan will be expended in the United States for raw material and merchandise necessary to aid in rehabilitating the Polish Republic. The resolution follows:

Whereas, the American-Polish Chamber of Commerce and Industry has been formed to promote trade between the United States of America and Poland, and

Whereas, under present circumstances, it is extremely difficult for purchasers in Poland to establish credits in the United States and in order to permit the establishment of such credits, the Polish government is now taking steps to float in the United States a loan of $50,000,000 to be applied as a first installment for settlement of purchases in the United States of raw materials and machinery amounting to over $250,000,000 during the next year, and

Whereas, it is greatly to the interest of Poland and the United States that such purchases take place and the exchange of commodities be created, and

Whereas, the Republic of Poland has obtained stability and succesful government insuring full protection for the loan contemplated; therefore, be it

Resolved, that the American-Polish Chamber of Commerce and Industry desires in every way to facilitate the success of said loan and calls the attention of American manufacturers, merchants and bankers to the advisability on their part of giving full co-operation in order to attain success.

The steady successes of the Polish armies in their repulse of the Russian Bolshevists mean a peace in the near future according to American foreign-trade authorities. When war ceases, Poland can devote its entire attention to restoring the country to its former agricultural and manufacturing importance. American merchants are arranging to exchange raw materials for the finished textile products of the factories at Lodz and other manufacturing centers, and American companies are active in developing the Galacian oil fields, the second largest in Europe, being surpassed only by Russia.

Proposed Anglo-American Standards for Rolled-Steel Shapes

It may not be generally realized that approximately 75 per cent of the world's demand for steel is specified to either American or British standards, but unfortunately the standards in vogue in these two countries and their dependencies have hitherto varied to such an extent as to introduce annoying difficulties in the way of interchangeability. The rolled-steel shapes used in building structure, bridges, railroad cars, and ships are notable in their points of difference, for not only do their contours and ranges vary, but a different language is used in dimensioning their thicknesses. While some steps were taken during the great war looking to the adoption of international standards for shapes used in shipbuilding, these were primarily of an emergency nature and did not attempt to cover other branches of industry.

During the year 1919 the British Engineering Standards Association undertook the revision of its standards for rolled-steel shapes, and following a visit of its secretary to this country it sent a formal invitation to the American Engineering Standards Committee to cooperate in the possible adoption of Anglo-American Standards for these shapes. Under the auspices of the American body the following organizations were requested to confer on the proposed standardization: United States Navy, Association of American Steel Manufacturers, American Bureau of Shipping, American Society of Civil Engineers, American Railroad Association, Society of Naval Architects and Marine Engineers and the Railway Car Manufacturers' Association.

All of these organizations accepted the invitation with the exception of the American Railroad Association which is not able to act at this time but may do so later on. The Canadian Engineering Standards Association has also been invited to co-operate, but has so far not been able to do so actively. A number of conferences have been held and on April 27 the committee formulated a complete preliminary report for transmission to the British Engineering Standards Association as a basis for discussion on common Anglo-American standards.

The representatives of the various organizations are known as the "Sectional Committee on Steel Shapes" of the joint sponsor bodies—the American Society of Civil Engineers, the Association of American Steel Manufacturers, and the Society of Naval Architects and Marine Engineers—and they are very anxious to get a full and free discusion of the whole subject by anyone interested.

Criticisms or suggestions will be cordially welcomed by the committee. Communications should be addressed to Dr. P. G. Agnew, secretary, American Engineering Standards Committee, No. 29 West 39 St., New York City.

March Exports of Metal-Working Machinery

Exports of metal-working machinery during March, 1920, and the revised figures for March, 1919, as compiled by the Bureau of Foreign and Domestic Commerce, are as follows:

	March, 1919 Value	March, 1920 Value
Metal-working machinery:		
Lathes	$1,012,847	$1,079,793
Other machine tools	870,663	1,943,230
Sharpening and grinding machines	485,959	475,248
All others	2,646,295	1,652,604
Total metal-working machinery	$5,015,764	$5,150,875

There were only twelve machine tools imported during March. These were valued at $7,741.

Philadelphia Foundrymen's Association Meeting

At the two hundred and ninety-seventh meeting of the Philadelphia Foundrymen's Association, held at the Manufacturers' Club, Philadelphia, May 12, Thorsten Y. Olsen, of the Tinius Olsen Testing Machine Co., gave a lantern-slide talk on the "Recent Developments of the Testing Machine and the Testing of Material as Related to the Foundry." The illustrations covered plain and autographic machines for tension, compression, endurance, fatigue, bending, etc., including a machine for testing the cutting properties of cutting tools and cutting compounds. The Matsumura Repeated-Impact Testing Machine, the first testing machine of Japanese design to be introduced into this country, was described.

Wm. H. G. Walker of the H. G. Trout Co., Buffalo, talked on foundry conditions in Buffalo.

Franklin Institute Awards Medals

The Franklin Institute of Pennsylvania, Philadelphia, held its stated meeting on May 19, 1920, at 4 p.m. Two Franklin Medals were awarded. One was presented to Sir Auckland Geddes, British Ambassador, for the Honorable Sir Charles A. Parsons, Newcastle-on-Tyne, England. The other was presented to W. A. F. Ekengren, Minister of Sweden, for Professor Svante August Arrhenius, Nobel Institute, Stockholm, Sweden.

Papers read were: "Some Reminiscences of Early Days of Turbine Development," Sir Charles A. Parsons, K.C.B., C.B., M.A., LL.D., D.Sc., F.R.S., and read by Charles Day of the Institute: "The World's Energy Supply," by Prof. Svante August Arrhenius, Ph.D., M.D., D.Sc., LL.D., and read by Allerton S. Cushman, Ph.D., also of the Institute.

T. C. Allen Now With The Penn Seaboard Steel Corporation

T. C. Allen, formerly comptroller of the Tacony Steel Co., has been appointed assistant to the president of the Penn Seaboard Steel Corporation.

Mr. Allen was one of the early members of the Tacony organization, which he joined as comptroller of the Tacony Ordnance Corporation on January 1, 1918. Previous to his coming to Tacony he had been for two years assistant comptroller of the Remington Arms Co., of Delaware. He had also been auditor of the Maryland Coal and Coke Co. for five years prior to that.

When the Tacony Ordnance Corporation consolidated, with the Tacony Steel Co., Mr. Allen became comptroller of the consolidated organization with full supervision of all general and cost accounting.

Industrial Review of Great Britain

Situation in Scotland Continues Good—Shortage of Raw Material in Birmingham Acute

GLASGOW

The industrial situation in Scotland continues pretty good. The employment of disabled men on a percentage basis under the National Seal of Honor scheme has now been undertaken by 940 Scottish firms, and under the interrupted apprenticeships training scheme the total number of agreements concluded is over 9,000. The Clyde Valley Electrical Power Co. has just put to work at Yoker the largest generating set at present in operation in Scotland, the output being 25,000 hp. on continuous rating. It is expected that the steam consumption on full load will not exceed 11½ lb. per kw.-hr. Electric power supply conditions in the Yoker area compare favorably with those elsewhere in Britain. All the engineering works at Linwood, and nearly all those in Johnstone, now derive their motive power from this station, at rates making the retention of former steam and gas plants out of the question, except as emergency standbys.

Scotch shipbuilding returns for March were disappointing, the output for the first quarter of the year, though showing some improvement over the same period of last year, falling considerably behind many first quarters in prewar years. Shortage of plates, and other material, has probably had much to do with the low output. In all, sixteen vessels of rather less than 29,000 tons were launched, the Clyde contributing eight vessels of a little over 25,000 tons. Repair and overhaul work continues very plentiful and makers of large internal combustion propelling plants are increasingly busy. Campbell & Calderwood, Ltd., Paisley, has been formed with a capital of £50,000 to carry on as engineers and shipbuilders.

Danger of a stoppage in the coal industry appears to be averted and the output from Scotch mines has recently shown improvement. Very busy conditions are the rule in all branches of the iron and steel industry. The demand for pig iron exceeds the supply, foundry qualities being particularly scarce at present. Hematite was advanced by 10s. a ton at the beginning of the month. Workmen in the bar iron industry have had their wages advanced 17½ per cent on basis rates, owing to the average net selling price of bars having been over £24 a ton.

Iron founders have far more work than they can overtake, and have various difficulties to hinder output. It is reported that castings of the better sort, such as are required for internal combustion engines, are now being ordered in Holland to a considerable extent. The Scottish Aluminum Co., Ltd., Govan, has been formed with a capital of £25,000.

In spite of continued government sales of tools and general engineering plant, Scotch machine-tool makers almost without exception keep well engaged, with solid inquiries and good orders coming steadily to hand. W. D. McKendrick & Co., Motherwell, is doing good business with its four-speed radial drills with spindle speeds of 180 to 500 r.p.m., and feeds of 3 to 6 in. per minute, with the spindle at the highest speed.

At Govan the Shafting Co. is sharing in the general activity and G. & A. Harvey, Ltd., is fully engaged on 18-in. all-gear lathes and boring and facing machines up to 6 ft., with a special run just now on the 3 ft. size. They are also putting through several 16-in. center locomotive axle lathes to take work 9 ft. 6 in. long, and have just completed several surface tables measuring 15 ft. to 18 ft. by 7 ft., all for local firms. Ready for shipment to Japan is a 5-ft. boring and facing machine driven by a variable-speed 15-hp. motor. A larger machine, arranged for turbine boring, has a bed 29 ft. long and a front table 60 ft. long, and is provided with a boring bar, 16 in. in diameter by 58 ft. long, fitted with facing arms and spiders, etc. This machine is driven by a 40-hp. variable-speed motor and weighs all complete rather more than 100 tons.

BIRMINGHAM

The position in regard to raw material is becoming increasingly anxious. A shortage which was partly disguised during the dislocation caused by the molders' strike has suddenly become much more apparent. All the industries which depend on iron and steel are involved in varying degrees, and under pressure of the competition for supplies the upward movement of prices continues almost uninterruptedly. Officially declared rates very soon cease to have

any relation to actual selling values, because for anything that comes on the market harassed consumers, at their wits' ends for the means of keeping plants running and fulfilling their engagements, are willing to pay substantial premiums if only they can get deliveries. There are few manufacturers who can get the production at which they aim with the raw material assigned to them under their regular contracts.

As for specifications which are out of the ordinary routine, or which do not yield the maximum profit with the minimum of labor, they simply are not considered or if accepted they are deferred indefinitely in favor of more attractive work. "Production program is dictated by labor now," the writer was told in reference to the steel rolling mills: very much the same applies in other departments. When the eight-hour day came in the available labor only sufficed to operate about two-thirds of the plants and it was concentrated on those which afforded the best return. The automobile makers are now complaining that they are not getting more than half the tonnage they require of light plates for chassis construction while heavy material is being supplied to the shipbuilding yards faster than it can be used. So serious has the position become that the automobile trade has taken its grievance to the Board of Trade, whose intercession has brought about some slight improvement, but not enough.

At present there is little promise of escape from this dearth of raw material. The make of pig iron is nothing like what it ought to be, owing to continued shortage of fuel. One or two additional furnaces are being lighted in the Northamptonshire district. On the other hand, two Black Country furnaces are being dismantled. Those in blast are only a comparatively small proportion on the whole and they have frequently had to be damped down or to go on slack blast because coke was not available. The position as regards transport is better than it was without being satisfactory.

Work is proceeding fairly regularly in most of the engineering branches. The question of negotiations on payment by results, on which a number of the trade unions are now balloting, excites only a tepid interest. On no occasion when a declaration has been challenged in the past has an aggregate vote been cast in favor of the system. Yet, in actual practice, it has almost displaced time rates in this district. It is stated that in Coventry 90 per cent of the whole of labor is employed on piece work rates. In the Birmingham district the general average is not quite so high, though some of the big firms apply payment by results to 95 per cent of their operatives.

The equipment of the Brolt factory at Oldbury is now complete and the firm has begun to turn out its specialties in automobile lighting and starting sets on mass production principles. In this enterprise the Brolt Co. and the G. H. Alexander Engineering Co. have joined forces. The Oldbury site has an area of six acres and the present factory floor space covers 45,200 sq.ft. The immediate program approximates to 1,000 sets per week.

An International Trade Fair organized by the town council is to be held in Cologne on Sept. 20 next, and thereafter in the spring and autumn of each year, the purpose being to encourage the import of raw material into Germany from overseas. Masson Seeley & Co., Ltd., 121, Victoria St., London, S. W., is dealing with the matter in Great Britain.

The Fair opened in Brussels on April 4 is, a correspondent informs us, a real success, attracting a considerable number of visitors. We understand that some 50 or 60 British firms are showing and that machine tools are included. Henri Benedictus Brussels, for example, is displaying a number of American tools, including Norton, Le Blond, Pratt & Whitney, Allen and other productions, and has a stand of about 1,200 sq.ft. The Fair is being held in a central position, in the Park of Brussels.

Resolutions Against Metric System

By the Society of Naval Architects and Marine Engineers

WHEREAS, A bill for the adoption of the metric system in the departments of the Federal Government has been favorably reported to the House of Representatives:

WHEREAS, We consider that the only effect of such a law will be the creation of a government metric system and the continuation of the existing system in ordinary trade and industry:

WHEREAS, The confusion resulting from such a condition of things would be intolerable;

WHEREAS, We believe the adoption of the metric system of weights and measures by the people at large to be impracticable, therefore be it

RESOLVED, By the Society of Naval Architects and Marine Engineers assembled in annual meeting, that we condemn all legislation intended to promote the adoption of the metric system in this country

By the American Gear Manufacturers' Association

RESOLVED, That the American Gear Manufacturers' Association in convention assembled, hereby declare themselves as opposed to any change in our present system of measurement.

RESOLVED, That a copy of this resolution be forwarded to The World Trade Club, Woodrow Wilson, President of the United States of America, British Premier, the Right Honorable David Lloyd George, and the American Institute of Weights and Measures

Trade Currents from New York and Chicago

NEW YORK LETTER

While there were more inquiries out this week for machine tools, business in this section is reported to be slower than in the New England states. The inquiries indicate, however, that more large industrial plants will soon be in the market for additional shop equipment. There remains a steady demand for all types of presses and a good market for turret lathes and milling machines.

The time of delivery is emphasized in current inquiries. Small machines can be promised in three or four weeks, while orders for many of the heavier types of tools are accepted for delivery next Fall.

The export demand remains the same as last week for machine tools, although many inquiries are being received from Russia and the Scandinavian countries. The inquiries from Russia are for equipment to be used in various construction work, while those from other countries embrace the entire list of machine tools.

The Lord Construction Co. has a list out for thirty-four machine tools, including lathes, grinding and milling machines, boring mills, punches and drills. The machines will be used in the construction of a shipyard at West New York, N. J.

The General Electric Co. is also in the market for equipment for its plant in Baltimore. Several lathes, etc. for the Bridgeport, Conn. factory were purchased this week. This company will later be in the market for new machine-tool equipment for the plant at Ft. Wayne, Ind.

The Mitsubishi Co., of 120 Broadway, is asking for catalogs and quotations on machine tools for a shipyard in Japan. No orders will be placed until the requirements are definitely determined.

George W. Goethals, Inc. of 40 Wall St., placed its last order this week for machine tools for the Automatic Straight Airbrake Co. Several turret lathes were bought by the S. S. White Dental Co., of Long Island City and by the Axel Co., of Pottstown, Pa.

The New York, New Haven & Hartford R. R. has been buying journal lathes, and it is reported that the Long Island R. R. has a small list in preparation.

CHICAGO LETTER

Chicago business in actual orders placed continues fairly steady, at a rate approximately 30 per cent less than during the first three months of this year. With the exception of the automobile industry, which has virtually disappeared as a buying power, there has been no decided slump in any particular line, the letdown in business seeming to be effective in about the same proportion in all lines of industry to which the machine-tool dealer looks for business. This uniform reduction is taken by some to indicate a more healthy state of business. Its effect has been to cause dealers to strengthen their selling department. For the first time in many months salesmen are now preparing to cover their territories with a view to soliciting orders.

The transportation situation in Chicago continues about the same as was reported last week. Conditions are improving, but very gradually. Chief difficulty still lies in getting direct shipments through from the factory to the customer, with less trouble being experienced in securing goods for Chicago stock or in making shipments from Chicago stock. The railroad strike, as a labor problem, seems to have disappeared, and it is now merely a question of time before the roads get back to a normal basis.

The strike among machinists in Cincinnati continues. The different concerns interested, however, seem very optimistic, the impression being that the current week will see the end of the strike or a resumption of operation regardless of the strike. The demands of the striking workmen are said to cover the 44-hour week, 8-hour day, time-and-a-half for overtime or time-and-a-half for all time put in after 4 p. m., the closed shop and a voice in the management of the shop. As these demands are wholly impossible of fulfillment by the manufacturers and as it is felt that the workers cannot stay out much longer on account of the present high cost of living, a speedy end of the difficulty is anticipated.

The tendency toward steady and even higher prices continues. On May 1 a 10 per cent advance was made on one general line of drills. Collections are reported not quite so satisfactory as heretofore. The situation in this connection is not such as to cause more than passing interest, and it is felt to be largely the outgrowth of delayed shipments.

Employees of the Cincinnati Milling Machine Co. Vote Against Strike

An anti-strike organization was formed by the employees of the Cincinnati Milling Machine Co. consisting of a committee of sixty-eight men. This committee called a meeting of all the shop employees of the company on Thursday afternoon, April 29, to arrange for a secret ballot to be taken by the employees to indicate how many were in favor of striking and how many were opposed to striking.

At this meeting the committee of sixty-eight read the following resolution, same having been unanimously adopted by that committee at a previous meeting. The resolution read as follows:

"*Whereas*, The employees of the Cincinnati Milling Machine Co. have formed a committee of sixty-eight to deal with the impending strike situation, and

"*Whereas*, This committee believes that the Cincinnati Milling Machine Co. has been fair and square in all its dealings with its employees at all times, and

"*Whereas*, The Cincinnati *News*, the official organ of the machinists' union, has in its issue of April 28, made claim that Fred Geier has stood against the progress of the city, that he prevented the policemen, the firemen, and the teachers from securing their increase in pay, and

"*Whereas*, The official records of the Board of Education and the Mayor's office show facts to the contrary, and

"*Whereas*, This situation has resolved itself into a question of following the leadership of a man who has done a great deal for our community, and especially his employees, or following the leadership of a man who, to our knowledge, has done nothing for the betterment of this community, therefore be it

"*Resolved*, That this committee, after careful consideration and debate, believes itself in honor bound to stand by the Cincinnati Milling Machine Co. in the impending emergency."

This same resolution had been adopted and signed by the anti-strike committee of the night force, consisting of thirty men.

The result of the strike ballot of the entire day and night forces of the company resulted as follows:

Opposed to strike	912
In favor of strike	142
Total number voting	1,054

Percentage of total opposed to strike, 86½ per cent.

The Carborundum Co. Acquires New Plants

The Carborundum Co., of Niagara Falls, N. Y., has acquired from the Alien Property Custodian the plant formerly owned and operated by the Didier-March Co. at Perth Amboy, N. J. The plant will be taken over at once and converted to the manufacture of a complete line of Carborundum refractories.

The principal business of the Didier-March Co. was the manufacture of special refractory clay products and practically all of its equipment is well adapted for the processes of the manufacture of Carborundum refractories.

The plant is located on a site of twenty-four acres facing the Raritan River near Perth Amboy, and is well provided with wharfing facilities and railroad connections. It consists of a modern clay working and refractory plant with a capacity of over 100 tons per day and covers a floor space of about 300,000 sq.ft. The buildings are of substantial brick, steel and concrete construction, and there is also included office buildings, laboratories and ample housing facilities for employees.

In addition to this property, the Carborundum Co. acquired sixty acres of high-grade fire-clay lands and a clay excavating plant in operation at Bonhamton.

Advance Furnace and Engineering Co. Organized

The Advance Furnace and Engineering Co., of Springfield, Mass., has been organized and capitalized at $200,000 to manufacture and sell gas and oil-fired metallurgical furnaces, gas burners, oil burners, gas-burning and oil-burning systems, tanks, pumps, blowers and compressors and all accessories. It has purchased a factory on Warehouse St. which will be immediately remodeled and enlarged. About 75 skilled mechanics will be employed.

Wm. F. Scully who for ten years has been with the Gilbert & Barker Manufacturing Co. the last five years as manager of the furnace department is president of the new company. The secretary and treasurer is J. H. Keegan, for the past eight years with the Gilbert & Barker Manufacturing Co., and more recently the assistant manager of sales and engineering. W. A. Buechner is vice president. He has been connected with the Gilbert & Barker Manufacturing Co., and also represents the E. F. Houghton & Co., of Philadelphia, Pa. The chief engineer is H. A. Kunitz, who for the past year was chief engineer of the furnace department of the Gilbert & Barker Manufacturing Co. J. Frank Scully is assistant secretary and treasurer.

DOMESTIC EXPORTS OF METAL-WORKING MACHINERY FROM THE UNITED STATES BY COUNTRIES DURING MARCH, 1920

Countries	491 Lathes	492 Other Machine Tools	493 Sharpening and Grinding Machines	495 All Other
Austria	....	$907	....	....
Azores and Madeira Islands	$978	....	....	$1,237
Belgium	63,895	62,385	$21,143	61,838
Bulgaria	....	334	....	....
Denmark	2,373	22,067	821	7,243
Finland	....	14,110	1,197	4,006
France	155,343	435,864	71,886	394,449
Greece	1,000	1,812	186	....
Iceland and Faroe Islands	1,650	....	....	....
Italy	3,971	152,001	8,861	75,216
Netherlands	....	14,834	854	21,077
Norway	921	7,039	980	125
Poland and Danzig	5,041	4,265	344	....
Portugal	6,736	10,451	3,355	2,364
Roumania	....	416	....	....
Russia in Europe	4,333	600	450	....
Spain	99,422	61,759	6,388	68,473
Sweden	11,560	6,640	12,299	17,961
Switzerland	2,237	4,534	120	15,798
Turkey in Europe	....	232	....	....
England	386,645	299,120	172,980	294,218
Scotland	....	4,938	10,113	23,156
Ireland	118	681	....	48,555
Canada	103,811	231,598	48,813	174,499
Costa Rica	85	311	....	....
Guatemala	822	245	....	254
Honduras	6,300	88	....	....
Nicaragua	....	....	100	....
Panama	22	331	14	17,875
Salvador	....	38	143	119
Mexico	14,300	33,300	21,055	17,922
Newfoundland and Labrador	....	28	....	571
Jamaica	....	99	....	2,468
Trinidad and Tobago	23	2,532	68	....
Other British West Indies	235	....	....	40
Cuba	29,588	74,264	3,553	15,126
Virgin Islands of U. S.	....	10	....	....
French West Indies	....	145	....	168
Haiti	....	163	45	....
Dominican Republic	....	1,102	53	765
Argentina	8,255	40,837	2,532	7,187
Brazil	22,618	27,495	1,915	13,230
Chile	1,063	6,603	2,833	59,253
Colombia	7,364	1,900	507	780
Ecuador	1,180	1,714	207	2,211
British Guiana	....	1,941	170	1,347
Dutch Guiana	....	168	....	....
Paraguay	....	7,646	....	....
Peru	9,237	5,460	186	915
Uruguay	22	1,282	182	2,206
Venezuela	....	287	12	145
China	10,228	21,795	1,748	12,571
Kwantung	....	203	....	406
Chosen	....	4,197	....	....
British India	6,663	94,018	4,189	11,831
Straits Settlements	....	3,818	....	....
Other British East Indies	....	632	....	....
Dutch East Indies	11,979	5,451	1,576	27,489
Hongkong	2,200	403	19	2,275
Japan	57,869	161,961	60,714	217,108
Russia in Asia	....	....	50	....
Siam	....	130	....	....
Turkey in Asia	....	....	45	....
Australia	8,281	61,129	8,957	12,277
New Zealand	2,314	7,388	2,078	588
Philippine Islands	10,164	7,239	85	3,554
Belgian Kongo	....	....	....	1,736
British West Africa	625	....	....	2,875
British South Africa	18,322	21,488	1,374	5,617
British East Africa	....	426	48	....
French Africa	....	35	....	....
Morocco	....	21	....	1,317
Portuguese Africa	....	5,571	....	....
Egypt	....	2,749	....	108
Total	1,079,793	1,943,230	475,248	1,652,604

Ordnance Salvage Board Auction Sale

The Baltimore Ordnance Salvage Board will hold an auction at the Bartlett-Hayward Park Plant, Columbia Ave. and B. & O. R.R., Baltimore, Md., Friday, May 28, beginning at 10 a.m., at which time all the machinery, equipment and materials at this plant will be sold. M. Fox & Sons Co., auctioneers, 20 South Paca St., will conduct the auction.

Leffingwell Speaks on Economic Evils

A terrific arraignment of the reaction and waste which have seized on the American people as a cause for the present economic evils now threatening the nation was made recently by R. C. Leffingwell, assistant secretary of the Treasury in an address before the Academy of Political Science at New York. Liberty Bonds and Victory Notes, he declared were never meant to be used as spending money and their misuse in that way is the primary reason for the fall in price of those securities.

"Since Armistice day," he said, "the world has not only failed to make progress toward the restoration of healthy economic life but in fact has receded further from a sound position. We have failed to restore peace and peace conditions in Europe and in America, unsound economic ideas have in many instances prevailed and the effort is being made first here and then there to improve the condition of some of the people at the expense of all of the people.

"At this most critical moment in the history of Europe—when our own financial and economic stake in Europe's affairs is so great that disaster there could only mean disaster here—many or our own people have turned gamblers and wasters. For plain living and high thinking, we have substituted wasting and bickering. We enjoy high living while we grumble at the high cost of living—of silk stockings and shirts for the poor, of automobiles for men of small means, and of palaces for the profiteer and the plutocrat."

Regarding the depreciation of the market price of Liberty Bonds and Victory Notes, Mr. Leffingwell said, "In the history of finance, no device was ever evolved so effective for procuring saving as the Liberty Loan campaigns. A year ago, it was freely predicted by financial authorities that Victory Notes would shortly go to a premium and that Liberty Bonds would be selling at or near par within a year of two.

"Every one knows why these sanguine expectations have not been realized. With the armistice and still more after the Victory Loan, our people underwent a great reaction. Those who bought Liberty Bonds as a matter of patriotism but not as investors, began to treat their bonds as so much spending money. Those who had obeyed the injunction to borrow and buy Liberty Bonds ignored the complementary injunction to save and pay for them. A $50 bond in the hands of a patriot turned spendthrift was to him a $50 bill to be spent Saturday night, or to her a new hat, and if the $50 turned out to be $45 bill—small matter. This was the first and most immediate cause of the depreciation of Liberty Bonds."

Mr. Leffigwell declared that inflation since the armistice is attributable to world inflation and the internationalization of prices, heavy expenditures by our Government and reaction and waste among the people.

"Our own prices are being inflated," he continued, "and our own banking and currency position expanded by feverish speculation in European currencies, credits and securities. The Government of the United States has been slow to realize upon its salvageable war assets and to cut down expenditures.

"Instead of telling the people frankly and boldly that prices are high because they are wasting, we fix prices and prosecute profiteers in order that the people may buy more and pay less. Instead of telling the people that Liberty Bonds have depreciated because they are treating their bonds as spending money, we clamor that the rate of interest upon the bonds is too low and urge a bonus to bondholders disguised as a refunding operation.

"We must get together, stop bickering and face the critical situation which confronts the world as we should a foreign war. We must cut our Government expenditures to the quick, adjure bonuses and realize promptly on all salable war assets, applying the proceeds to the war debt. We must have a national budget with teeth in it.

"And above all we must work and save. We must produce more, but more important still, we must consume less.

"It might be added that it is not enough to save unless those savings are safely and profitably invested and it is for this reason that the Treasury Department has adopted the issue of savings securities, War Savings Stamps and Treasury Savings Certificates, as a permanent policy."

A dispatch from Montreal reports that shareholders of the Dominion Bridge Co., at a special meeting, unanimously approved the plans of the directors to form the Dominion Engineering Works, Ltd., for the purpose of taking over the present bridge subsidiary, the Dominion Engineering & Machinery Co., Ltd. The present subsidiary is engaged chiefly in the manufacture of paper-making machinery for which extensive contracts are under way.

Personals

H. H. Edge is severing his connections with the Locomobile Co., of Bridgeport, Conn., having been in its employ for nine years, four as factory superintendent and five as general works manager.

H. W. Fielden, auditor of the Penn Seaboard Steel Corporation, has been appointed comptroller of the Tacony Steel Co., Philadelphia Pa.

C. F. Jemison, treasurer of the Penn Seaboard Steel Corporation has been elected treasurer of the Tacony Steel Co., Philadelphia, Pa.

C. J. Steen, chief engineer of the Tacony Steel Co. has been appointed chief engineer of the Penn Seaboard Steel Corporation, Philadelphia, Pa. He will have supervision of all engineering and designing of the Penn Seaboard and Tacony plants.

Harry A. Hey has been appointed manager of sales in the Eastern territory for the Illinois Tool Works, of Chicago, manufacturer of milling cutters, hobs and reamers. His headquarters will be in New York. Mr. Hey was formerly connected with the Singer Manufacturing Co., and is a member of the A. S. M. E.

Charles H. Brennan has been appointed sales manager of the Jefferson Forge Products Co., Detroit, Mich.

John St. George, of the Bristol, Conn., plant of the New Departure Manufacturing Co., has been selected as production supervisor of the new plant "D" of the company, now being finished at Meriden, Conn. Mr. St. George was formerly production manager in the Meriden branch of the Colt Co., of Hartford, Conn., and has also been with the New England Westinghouse Co.

F. A. Calhoun, formerly sales engineer for Tate-Jones & Co., Inc., in the New York District, has resigned to accept a position as Eastern representative in the New England and Middle Atlantic states for the Standard Fuel Engineering Co., Detroit, Mich., for its line of heat-treating furnaces. Offices are located in the Lincoln Trust Co. Building, 76 Montgomery St., Jersey City, N. J.

Obituary

John Wesley Hyatt, inventor of the Hyatt roller bearing, died on May 10 of heart disease. Death occurred at his residence, Windermere Terrace, Short Hills, N. J. He was eighty-three years old, and was born at Starkey, N. Y.

Emil Stephany, for many years secretary and treasurer of the F. Wesel Co., manufacturer of printing machinery, died at his home 1095 Prospect Pl., Brooklyn, N. Y. He was sixty-seven years of age. He had been a resident of Brooklyn for more than twenty-five years and was well known in engineering circles. He was a member of the Manufacturers' Association and also of the Machinery Club.

William Oesterlein, President of the Oesterlein Machine Co., Cincinnati, Ohio, died at his home on May 10th. (Obituary notice will be published in the next issue.)

Samuel Harris, president of Samuel Harris & Co., manufacturer of machinists' tools and supplies, died recently at his home in Chicago. Mr. Harris was a Civil War veteran and escaped a death sentence at Libby prison by the intervention of Winnie Davis, the confederate president's daughter.

New Publications

Technical Writing. By T. A. Rickard, Editor of the *Mining and Scientific Press*, San Francisco. 174. 5 x 8 pages. Published by John Wiley & Sons, Inc., New York.

Though it was written for mining engineers by a man who is himself a mining engineer as well as a technical journalist, this book is not only valuable to all who aspire to write for the technical press but to men in all branches of engineering whose duty it is to make written reports, prospectuses, etc., or to convey information of any kind relating to their business through the medium of written language. Examples abound, taken principally from engineer's reports that have come under the author's observation both as an engineer and as editor, and the errors and commonly encountered faults are clearly pointed out.

If any adverse criticism is deserved, it is that the author is too much inclined to treat language as an art, ironbound by rule and convention through which no man can break without exposing himself to the stigma of ignorance, instead of a tool to be suited to individual needs.

Business Items

The machinery and other equipment of the Argo Mills plant at Gloucester City, Pa., is being dismantled and packed for shipment to Japan.

The stockholders of the Aetna Foundry and Machine Co., Warren, Ohio, at a recent meeting voted to increase the capital stock of the company from $50,000 to $300,000. Of this sum $100,000 of the increase will be issued at once, which will triple the present outstanding capital. Of the first issue, $60,000 of the proceeds of the sale will be used for additional working capital made necessary by the large increase of business. The second issue of $40,000 will be used for improvements to the plant and for additional equipment.

The Canadian Steel Foundries Co., Welland, Ontario, Can., will reopen its plant. The principal products to be manufactured are steel bars and angles.

The Knickerbocker Motors Co., Poughkeepsie, N. Y., will install about $25,000 worth of new machines.

Incorporation papers have been filed with the county clerk at Newark N. J. for the Hope Foundry and Machine Co., 525 Main St., East Orange, N. J. The incorporators are Harry H. Pisking, S. E. Lynch and Gordon Grand.

J. E. Duff Co., 249 Center St., New York, machine-tool dealers, has leased an adjoining showroom, thereby doubling its showroom size.

Announcement is made of the partnership of Richardson & Gay, consulting engineers, 220 Devonshire St., Boston, Mass. Mr. Richardson, formerly of Richardson & Hale, consulting engineers, went overseas with the 26th Division and was discharged from the U. S. Army in 1919 as Lieutenant-Colonel, Field Artillery. Mr. Gay has been for the past nine years in the Boston office of Stone & Webster, division of construction and engineering.

The Black & Decker Manufacturing Co., Baltimore, Md., announces that its Cleveland office has been moved from 6523 Euclid Ave. to more spacious quarters at 6225 Carnegie Ave. The new office has a showroom as well as a completely equipped service station for the convenience of users of Black & Decker electric air compressors, portable electric drills and electric valve grinders. G. A. Dodge is in charge.

The M. A. Palmer Co. has moved its steel warehouse and offices to larger quarters at 383-385 Atlantic Ave., Boston, Mass.

The American Compound Co. has moved into its new office and factory at 383-386 Atlantic Ave., Boston, Mass.

The Federal Tool and Alloy Steel Co. will consolidate its main office now in the Woolworth Building, New York, with its warehouse at 60-66 Rutledge St., Brooklyn, N. Y., retaining a sales office at the old address. The company specializes in carbon and high-speed steel, swedish iron, etc.

The Davis-Bournonville Co., Jersey City, N. J., manufacturer of oxy-acetylene and oxy-hydrogen welding and cutting apparatus, has acquired a new and larger factory location for its Canadian plant which will be moved in June from Niagara Falls, Ontario, to Toronto. The Toronto sales office will be moved from its present location on King St. West, to quarters in the new factory building at 32-34 Eastern Ave. The location is adjacent to the immense harbor development now under way, convenient to rail and water terminals, and readily accessible to the business center. The company's Montreal sales office will be moved about June 1 from Craig St. West to quarters in the Coristine Building, St. Paul and St. Nicholas Sts., Montreal.

The Dalton Manufacturing Corporation announces a change of address of the New York office to 50 East 42d St. Customers wishing prompt service are requested to note this change.

The Detroit office of the Gale-Sawyer Co., tool manufacturers has been changed to 289 Jefferson Ave. This office will continue under the management of E. N. Anthony.

Catalogs Wanted

The Department of Agriculture of the Mexican government is inquiring for catalogs, price lists and other descriptive literature pertaining to machinery and agricultural implements. Large quantities of these goods are being imported into Mexico through this source and there is an increasing demand for more.

The Cleveland Twist Drill Co., Cleveland, Ohio, has announced a revising of its catalog library. They would be pleased to receive catalogs and circular matter illustrating any product that might be of possible interest to them.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

The American representative of firms in China desires to get in touch with exporters for the sale of coal mining and handling machinery, cement plants, chlorination works, sugar machinery, flour-milling machinery, match-making machinery, cotton spinning and knitting machinery, and rubber-plantation machinery. No. 32,561.

The Dhengle & Co., Fort Bombay, India, wishes to establish agency connections with a dealer in second-hand machine tools.

A mining corporation in South Africa desires to purchase electrical furnaces for the annealing etc., of drill steel, the furnace to be made of highly refractory material. Quotation should be given f.o.b. New York or nearest port of shipment. Payment, cash against documents. References. No. 32,689.

The American purchasing agent for a firm in Sweden desires to purchase machinery designed and constructed to grind a large number of axes automatically and simultaneously. References. No. 32,717.

A company in Norway desires to purchase machine tools, including punching, bending, and shearing machines, for heavy work. A description of the machines required were forwarded and may be had upon application for this opportunity number. Payment will be made through banks in Norway and in New York. References. No. 32,727.

Agents and firms in France desire to be placed in communication with manufacturers and exporters for the sale of automobiles, motors, construction material, electrical supplies, gas and electrical fixtures, machinery, metals, motorcycles, paper industry and machinery supplies, oils and greases, tools. No. 32,728.

An automobile garage firm in South Africa desires to purchase engineers' machine tools of a light type, bench and fine tools, motor accessories and sundries, and garage fittings and appliances. All are required immediately. It is also desired to secure agencies for the sale of agricultural implements, pumping plants light gasoline engines, windmills, galvanized pipe, cylinders, working heads, and pipe fittings. References. No. 32,696.

Forthcoming Meetings

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21, at the Hotel Traymore, Atlantic City, N. J.

The Industrial Relations Association will hold its second annual convention at Chicago, Ill., on May 21, 22 and 23.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The Railway Supply Manufacturers Association will hold an exhibit on Young's Pier at Atlantic City, June 9 to 16, in conjunction with the annual mechanical conventions of the American Railway Association. Many of the leading machine-tool builders of the country will be among the 330 or more exhibitors.

The American Drop Forge Association will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25 inclusive.

May 27, 1920 American Machinist Vol. 52, No. 22

The Evolution of Wage and Price Levels

By H. H. MANCHESTER

The relation between wages and their purchasing power has varied greatly throughout the centuries, some large fluctuations having taken place in recent years. This discussion traces the gradual rise in both wages and prices from the earliest records which we have of ancient times up to the present. The article tells a human-interest story about the betterment of the status of the workers, the conditions at each period being illustrated by examples of wages and prices.

THE epoch-making rise in wages and prices which has been caused by the World War brings up the whole question of wage and price levels in the past. What previous levels have existed throughout long periods? What revolutions in standard wages and prices have taken place in the past? What has produced them? Have they been transient or lasting, and why has one been persistent and the other only evanescent? Is the present revolution temporary or permanent, and if only temporary, how long may it be expected to continue?

"Demosthenes' father had at that time a sword or knife-making shop"

In this case, as is often the fact, it is easier to get a correct view of the present movement if we throw it into perspective with similar ones of the past, than if we try to judge it so close at hand that we can see only the details. There is no question that similar movements have taken place. For example, only six centuries ago the price of wheat in England averaged but 18 cents a bushel, and this was three times as much as the pay of the skilled artisan per day. This gives room for several economic revolutions before the present levels could be reached, but it was itself an entire change from the standard wages and prices of the Roman Empire. The fact is, that the only way we can get a reasonable view of the present situation is to begin with the earliest known economic level and observe the great epoch-making steps which have introduced each new economic level. This may assist us to make up our minds whether we are on the mountain top merely for the time being, or have just arrived upon a plateau never before known.

It is a surprising fact that we can start the story of price and wage levels practically with the dawn of history. When the laws of Hammurabi, king of Babylon, were discovered in 1901, they were found to contain a list of wages that he had established. They date from about 2200 B.C., or more than 4,000 years ago.

According to this code, wages were to be about 42 cents a month from April to August, when the days were long, and about 35 cents a month from September to March, when the days were shorter. A carpenter was to receive about 1 cent a day, and a metal worker or other skilled artisan about 1⅛ cents a day. These are of course astonishingly low wages, but prices were also on a low level. Wheat was worth only about 5 cents a bushel, but even at this low price a skilled workman could have bought only from 1½ to 2 bushels for his week's work.

At this period the Egyptian economic level seems to have been even still lower; but, as that country had as yet scarcely any monetary system, it may be left out of consideration.

A few recently discovered accounts enable us to fix the economic levels in ancient Greece with reasonable certainty. In 408 B.C. carpenters, sawyers and metal workers in Athens all received a drachma or 20 cents a day. At that time wheat was worth 40 cents a bushel.

It will be noted that in that period wheat was about eight times as high as it had been under Hammurabi, and wages from seventeen to twenty times as high.

In 363 B.C. when Demosthenes was twenty years old, wheat had risen to about 70 cents a bushel, while the wages of the skilled workman had advanced to 10 obols or about 33 cents a day. Demosthenes' father had at that time a sword- or knife-making shop. The work was done by 32 or 33 slaves who had cost him approximately \$3,800, and who yielded a profit of about \$600 a year. This was equivalent to about \$18.42 each per annum, or some 5 cents a day.

At the time of Cicero, 70 B.C., wheat ranged between 60 and 80 cents a bushel, which was about what it had been in Demosthenes' time, three centuries before. Labor, however, received only about half as much, for Cicero remarked that it took a workman a full day to earn a modius, or peck, of wheat. The metal worker at that time seems to have received from 15 to 20 cents a day, and would have had to work 4 days to earn a bushel of wheat.

This drop in the economic condition of the workman was very probably due to the increasing number of slaves in proportion to the freemen. The crafts, trades, and even the medical profession were carried on either by slaves or by persons who had formerly been slaves. As a consequence, the free artisan had to compete with slave labor, and his wages were reduced to the slave standard. In compensation for this the state attempted to satisfy the citizens by the distribution of grain at half price from 123 B.C. to 58 B.C. and after that date by free grain to those most in need.

In the time of Claudius, 41 A.D., there were in Italy about 20,000,000 slaves and 7,000,000 free persons. But in the lack of any power-driven machinery, one man, even though he worked at his best, could earn little more than a living; and it required the labors of many slaves to satisfy the expensive tastes of the luxury-loving nobles of the period.

Wheat continued to rise, and from Nero to Trajan, 54 to 117 A.D., ran between 80 cents and $1 a bushel. Wages, however, remained about 20 cents a day, so

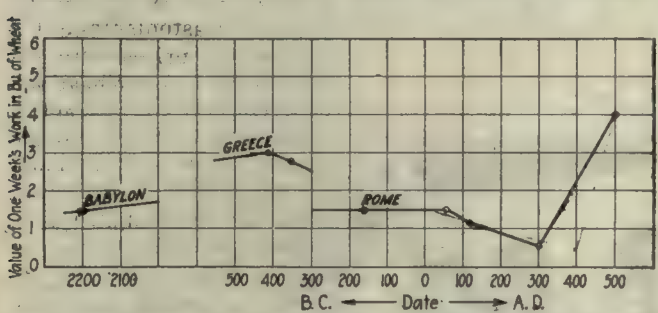


FIG. 1. CHART SHOWING THE EARNING POWER OF THE ARTISAN AT DIFFERENT DATES IN ANCIENT TIMES

that it took a skilled artisan 4 or 5 days to earn a bushel of wheat.

In 300 A.D. there seems to have been a wide-spread tendency toward a higher level, for the Emperor Diocletian issued a decree vigorously declaiming against the profiteers. The important part of the decree to us, however, is that he gave a long list of prices which he considered fair and which constitutes the most complete record on this subject in ancient times.

According to this decree, rye, spelt and pounded millet were worth 100 copper denarii (40 cents) a modius (peck), or $1.60 a bushel. Oats were listed at 96 cents a bushel. The value of wheat, which is in part obliterated in the decree, was probably about $2 a bushel. Thus the price of grains was about twice what it was under the early Empire.

Wages, however, remained about as they had been for the previous four centuries. Diocletian allowed the iron smith 50 copper denarii or 20 cents a day. The same amount was listed for the carpenter, the chariot maker, and the builder of river boats. The shipwright on sea vessels, however, was given 24 cents a day.

Comparing the value of grain and labor it will be seen that it would have taken the skilled workman 8 days to have earned a bushel of rye, and 10 days for one of wheat. The fact is that the slave system had fallen down in agriculture, and if it had not been for the free distribution of grain, bread and even bacon, the skilled artisan could not have eked out a living. The products of grazing, however, where the slave system had always been more successful, were not so disproportionate in price to wages. Leather, for example, was cheap, and shoes from 40 to 60 cents a pair, at which rate it would have taken the skilled workman two or three days to earn a pair.

The worker in the softer metals, or those that could be easily cast, was paid by the pound. He received 8 copper denarii or 3 cents a pound for working in bronze, and 2½ cents a pound for working in copper and ductile brass, or making vessels for domestic use. The maker of small images received even less, or only 1⅝ cents a pound. The armorer received 10 cents for restoring the edge of a sword or for polishing a helmet. For repairing an ax he was allowed 2½ cents, and for similar work on a double-headed hatchet was given about 3 cents. The new sheath to a sword was worth only 40 cents, which suggests that it was considered about 2 days' work to make it.

As compared with the economic level of 1914, the grains in Diocletian's time were worth about twice as much, while labor received less than 1-15 as much as just before the World War. In this way the artisan was about 1-30 as well off under Diocletian as in the United States in recent years. The economic failure in Diocletian's time led to a gradual depopulation of southern Europe; and we read of various laws to encourage population, and even of barbarian tribes being invited from without to settle in the Empire.

The Economic Revolution in the Dark Ages

The barbarian conquests of Rome caused a great revolution in prices. In a way the barbarians settled the Empire, the great grazing estates being divided among the vassals and given over to farming. The serf system largely superceded the slave system. This amazingly reduced the price of wheat, and in comparison left wages not very much below what they had been. During the reign of Theodoric in 500 A.D., for example, 15 bushels of wheat were sold as low as a solidus or $3.33. Thus wheat was worth only about 22 cents a bushel or about 1-9 of its value in Diocletian's day.

There are very few statements from which wages in the early Dark Ages can be deduced, but the earliest figures in Italy seem to suggest that they were about 15 cents a day. If this were true, the condition of the workman was at least 5 times better than in the later Roman Empire. It must be understood, however, that the conquests of the northern tribes destroyed the routes of transportation and commerce, and that because of this prices and what few wages were paid under the serf system varied widely in different districts.

Era of the Black Death

In the middle of the fourteenth Century a great plague swept over Europe causing a revolution in prices and wages fully as striking as that of recent date. The plague appeared in 1348 in France, Italy and England, and raged until the fall of 1349. Its ravages were so terrible that a third of the population of Europe is believed to have perished from it.

Its effects on wages and prices were felt in each district soon after its appearance. In Albi, France, for example, wheat had been 55 cents a bushel in 1347, which, in short, had been the average price in France. In 1348 it reached $1.56 at Rouen; and in 1350 leaped to $3.08 in Albi, and to an average of $2.10 throughout France. The next year it receded to $1.17 in France, and in 1353 dropped down to 33 cents, which was even less than the average for the preceding century. Thus the pestilence multiplied the price of wheat in France

4 or 5 times, but its effects lasted only about three years.

Other commodities also rose in value, but the data available are not complete enough to show the effects year by year. We know, for example, that iron which had been about 1½ cents a pound in 1344 greatly increased in price, and in 1359 was about 3 cents a pound.

Wages were similarly affected; in fact in 1350 the King was prevailed upon to issue ordinances to fix a standard rate for the year in different trades. Iron workers and metal workers in 1347 averaged about 19 cents a day, but in 1350 they were averaging about 37 cents a day. A few years later, however, we find them back near the old figure. Carpenters, who in 1346 received 16 cents a day in winter and 24 cents in summer, were in 1350 allowed by the King 26 cents a day in winter and 32 cents in summer. In 1356 they were paid 37 cents in Paris, but 3 years later the rate had dropped back to 29 cents in the same city. Thus in France the black death sent wages up about 100 per cent, but in the next decade they receded nearly to where they were before it. It will be noted, however, that prices dropped first.

Black Death Affected England's Wages

In England the price and wage revolution caused by the Black Death was just as striking as in France, and in the case of wages more permanent.

Between 1331 and 1340 wheat had averaged about 14 cents a bushel, and in 1348 before the Black Death it was 12 cents a bushel. The next year it rose to 17 cents, in 1350 to 25 cents, and in 1351, when the effects of the Black Death were most noticeable, to 30 cents. It then began to recede and by 1353 dropped to 12 cents again. In 1369 there was a lighter recurrence of the plague which sent wheat up to 35 cents for the year. But by 1371 it had dropped back to 21 cents. Thus the Black Death in England more than doubled the price of wheat, but it returned within 3 or 4 years to not far above the previous prices.

Iron products rose fully as much, and retained the rise much more permanently. This was perhaps due to the fact that the Hundred Years' War, which was carried on intermittently between 1337 and 1453, increased the demand for iron and steel manufactures. Raw iron, which was 90 cents a hundredweight in 1347, rose to $1.20 two years later, and averaged $1.80 between 1351 and 1360. Horseshoes rose from $1 a hundred in 1347 to $2 a hundred the next year, and retained the rise. Horseshoe nails jumped from 32 cents a thousand in 1348 to 50 cents the next year, and averaged 67 cents between 1351 and 1360. Broad nails, which were 6 cents a hundred in 1348, rose to 10 cents in 1349, and to 12 cents in 1350. Plowshares rose from 21 cents a dozen in 1348 to 45 cents two years later, and retained most of the rise. Plain wheels increased in price from 64 cents in 1349 to $1.40 in 1350, averaging $1.05 between 1351 and 1360. Thus, in general, iron products in England were doubled in price by the plague, and retained the increase in value.

Wages in England went through a similar revolution at this period. Before the Black Death the iron worker and carpenter had received about 3d. or 6 cents a day, which would have let them earn a little more than two bushels of wheat with their week's work. In 1349 the wages of the skilled workman rose to about 9 cents a day, and averaged about this rate between 1350 and 1400. This rise took place and was maintained in spite of many laws passed to hold down wages to their former standard. Thus in England at this period, the grains rose in price more than a hundred per cent but soon dropped back to normal, while permanent increases took place of 50 per cent in wages and 100 per cent in iron and certain other manufactured products.

The discovery of America by Columbus and of the new route to India around the Cape of Good Hope soon presented new opportunities for promising enterprises, and in general stimulated commercial activity. This caused a general rise in prices and wages throughout the Sixteenth Century, and especially toward the close of the century.

This tendency upward has been laid to the increase in the supply of silver, due to the discovery of the mines in the New World. But the first great mine of South America, at Potosi, was not discovered until 1545, and the most productive mines of Mexico were not opened up until three years later. Much of the general increase in prices took place before this silver could possibly have got into circulation.

In England an artisan received about 12 cents a day between 1500 and 1530; 14 cents between 1531 and 1550;

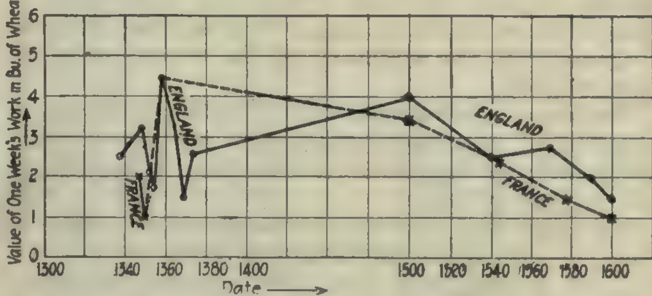


FIG. 2. CHART SHOWING THE APPROXIMATE EARNING POWER OF THE ARTISAN IN MEDIEVAL TIMES

21 cents between 1550 and 1582, and 24 cents during the rest of the century.

The rise in prices was much more striking. Wheat, for example, which was about 17 cents a bushel at the beginning of the century, rose to 23 cents between 1521 and 1540; 32 cents between 1541 and 1550; and to 46 cents between 1551 and 1560. It averaged about this price until 1582. In the next decade it leaped to 71 cents a bushel, and in the last decade to $1.04 cents a bushel. Thus the price was multiplied by six during the course of the century. It was more than maintained and in fact averaged $1.38 throughout the succeeding hundred years.

Other commodities rose, but to a lesser extent. Raw iron, which had averaged about $1.28 between 1400 and 1550, increased to $3.06 between 1551 and 1582. Wrought iron which was $4.20 a hundred weight between 1541 and 1550 leaped to $8.88 between 1551 and 1560, though it did not retain all of the increase. Lath nails which had been about 23 cents a thousand between 1400 and 1550 rose to 30 cents in the next decade, and only slightly increased in value during the rest of the century. Their comparative stability may be due to the fact that they were made in the spare time of the smith.

On the surface, at least, the new industrial plane was a hardship for the workman. At the beginning of the century he could have bought about 4 bushels of wheat for his week's work, but at the end of the century he could have earned only about 1½ bushels a week.

On the other hand it must be remembered that the period around 1600 was one of new enterprises and new opportunities. These attracted many a workman from his occupation, and many a son from the trade of his father. In other words, as is usually the case in such times, the workman bettered his condition by changing his vocation.

Price Increases Larger Than Those of Wage

In France as well as in England, while wages rose in the Sixteenth Century, prices increased far more. The carpenter and metal worker received about 16 cents a day between 1501 and 1525. This was increased to about 20 cents a day between 1525 and 1550, a rate which was not very much changed throughout the century. Wheat on the other hand, which was about 28 cents a bushel from 1501 to 1525, rose to 49 cents between 1526 and 1550, to 84 cents between 1551 and 1575, and to $1.40 between 1576 and 1600. Thus it was five times as much in the last quarter of the century as it was in the first.

In the meantime wrought iron at Orleans had increased from 2.7 cents a pound in 1528 to 6.4 cents a pound in 1579. The price of horseshoeing more than doubled between 1556 and 1590, rising from about 19 cents to 40 cents. Large pins which had been 30 cents a thousand at the beginning of the century were 90 cents in 1570.

There are not enough data to list such prices year by year, but all commodities experienced increases in price which extended anywhere from doubling to multiplication by four or five.

The same thing was true of the prices and wages in Germany as listed in the records at Xanten.

It will be seen that during this economic revolution the changes were more gradual and better maintained than at the period of the Black Death. This was probably because they were due not to any one temporary cause but to a general expansion resulting from permanent causes. And just for the reason that the causes were permanent the resulting economic changes endured.

The Period of the French Revolution and Napoleonic Wars

The next great change in wage and price standards took place during the French Revolution.

In France before 1790 the carpenter, iron worker and locksmith received about 25 cents a day, at which rate they could have purchased only about 1½ bushels of wheat a week. In 1789 a journeyman cartwright or horseshoer received about 10 cents a day and his board. But soon after the Revolution wages and prices both began to go up. In 1805 a skilled artisan was receiving about 57 cents, and in 1810 about 62 cents a day. In the meantime wheat had jumped from about 89 cents a bushel in 1792 to $2.10 a bushel the next year. During the rest of the century it was held down in France by legislative enactment to less than $1.10 a bushel. After this restriction was removed, it rose to $1.52 between 1801 and 1805, and reached $1.77 in 1816-20. After this it began to recede, but averaged just under $1.40 a bushel for many years. Even at this price the artisan could have earned almost 3 bushels a week, which was twice as much as before the Revolution.

In England the price of grain was not held down by government regulation, and advanced to great heights during the war. Between 1783 and 1792 it was about $1.50 a bushel; in 1795 it leaped to $2.82 a bushel; and after receding for a few years mounted to $3.45 a bushel in 1799; and to $3.54 in 1800. It was $3.12 in 1804; and $3.66 in 1812. After the Battle of Waterloo it slowly began to recede, and reached $1.74 in 1819, which was less than its average of $2 during the next 10 years.

Wages in England followed a similar course. The artisan in 1790 was receiving about 60 cents a day, at which rate he could have purchased about 2 bushels of wheat a week. In 1795 the wages of the mechanic, turner and carpenter were about 72 cents a day. At the beginning of the century they had reached 84 cents a day; and 10 years later had risen to $1.20. In 1813 the carpenter seems to have received $1.44. These wages remained pretty well in force even after the war was over. In 1817, for example, the carpenter received $1.32; and in 1820 the turner earned about $1.04 a day At these rates the skilled artisan in England could have purchased 3 or 4 bushels of wheat a week, which was

"A metal worker or Artisan - received approximately 54 cents a day in 1790."

1½ times as much as he could do just before the French Revolution.

Some of the metals well illustrated the rise of prices at the time. Copper, which was $20 a hundred weight in 1785, rose to $30 in 1796; $40 in 1801, and $50 in 1806. In 1815 it was still $35, but by 1821 it had dropped back to $25. In the same way tin, which was $21 a hundred weight before the war, reached $44 in 1814, and dropped back to $20 in 1821, six years after the Battle of Waterloo.

Thus it may be said that in England wages doubled during the war, and retained at least two-thirds of the rise; while prices multiplied two or three times, but dropped back within four or five years after the war, until they were only about one-third higher than the previous standard.

The United States was similarly affected. A metal worker or artisan, who received approximately 54 cents a day in 1790, which was then equivalent to about 3 bushels of wheat, averaged 67 cents in 1793, and 75 cents the next year. By 1805 the wages of the skilled workman reached $1.46, and two years later $1.50 a day. In 1812 they were $1.40, but in 1816 soon after

the war, dropped back to $1 a day, which was about the average for the next decade. It is worth noting that this would have enabled the workman to have bought about 6 bushels of wheat a week, which was twice as much as in 1790.

Prices in the United States at this period were very irregular, and depended largely upon the possibility of shipment. In 1791 wheat in New York was about $1 a bushel. In 1812, the year of our entrance into the war, it was $1.94 a bushel; and in 1816 was still $1.75. But four years later it dropped to 75 cents, which was even lower than it had been before the French Revolution.

In Philadelphia hammered bar iron, which had been $77 a ton in 1794, reached $144 a ton in 1815, and then gradually declined until it was $90 in 1821.

Thus, even though the United States was not one of the main participants in the Napoleonic Wars, wages here were doubled and retained most of the increase, and prices were doubled but receded to their previous level within four or five years after the war.

The Period of the Recent World War

No sudden world-wide revolution in prices and wages took place in the century between the Napoleonic Wars and the recent World War. In general prices and wages remained rather stationary between 1830 and 1850, and then slowly increased until 1874. The crisis of 1873 brought down both wages and prices to some extent, but a few years later wages began a gradual rise which was continued throughout the century. The price of manufactured articles, however, slowly declined until 1896. These contrary tendencies were no doubt produced by the same cause—the increased production following upon improved machinery and more scientific methods.

The revolution in the economic level which was produced by the World War is too recent to require more than a remark. In the last year of the war prices in France were 297 per cent of those in 1913. In England they were 245 per cent; in Japan 222 per cent; in Canada 213 per cent, and in the United States 203 per cent.

In some of the South American countries, however, prices were very irregular, and depended principally upon whether shipment could be made to meet the European demand. Thus in Argentina various commodities even fell in price, and the average was only 25 per cent higher than in 1913.

The application of all of this to the present situation is comparatively simple. Wages, as has regularly been the case, will stay up pretty close to where they were at the close of the war in the non-munition making industries. Practically the only thing that will bring them down to any great extent is a crisis. On the other hand the causes which forced prices up were temporary —the demands of the war—for goods in the quickest time at any price. There has been no great new permanent field for exploitation opened to keep up the demand, unless possibly Russia and the Mohammedan East develop into such a field, or unless demand is stimulated by the war being renewed. As a consequence prices may be expected to recede. It is simply a question in each different industry as to when the supply will catch up with the demand, and at what prices the two will be equalized. As a rough guess, the historical facts suggest that this will take place in 1922, and that prices will become reasonably stable at about one-third higher than they were in 1914.

Unusual Bending and Forming Dies

By Frank A. Stanley

The article produced with the dies shown in the accompanying illustration, is a chute for a coin-operated machine made by the American Coin Register Company, of Oakland, California.

A drawing of this part is shown in Fig. 1. The part is made of sheet metal 0.035 in. thick, and the over all

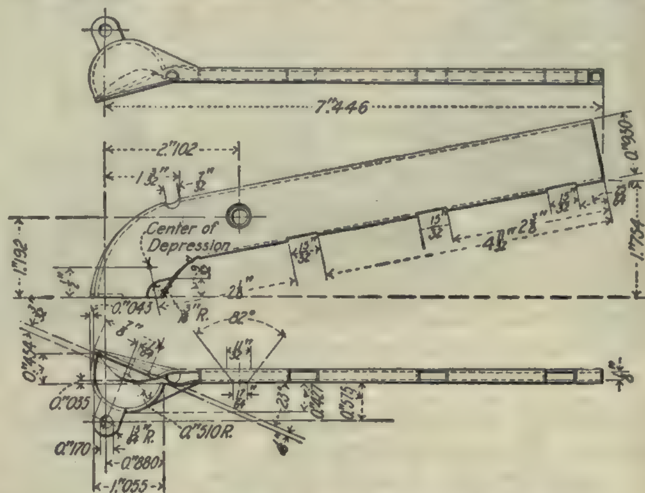


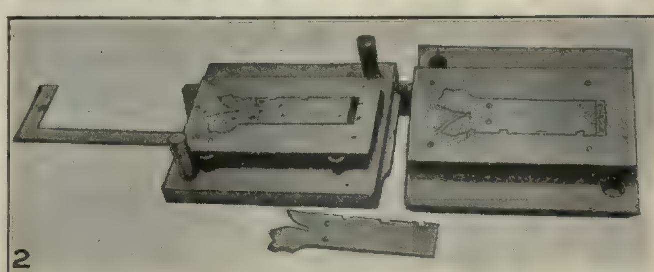
FIG. 1. THE CHUTE BLANKED AND FORMED

length of the finished work is about 8 in. The stock width for the blank is 3¼ inches.

The body of the part is formed into a rectangular tube with inside dimensions ⅛ x 0.860 in. The tube is produced with clean, sharp corners and the entire piece forms a particularly neat example of press work.

The blank is produced in a set of compound dies, Fig. 2, which pierce the holes and cut the side notches simultaneously with the blanking of the piece. A blank is shown at the front of the dies in this illustration. The dies are of the usual compound construction and require little description. They are of the pillar type with two corner posts at obliquely opposite corners.

The second operation consists in forming the two depressions in the forked ends of the blank; this is accomplished in the dies shown in Fig. 3. One of these



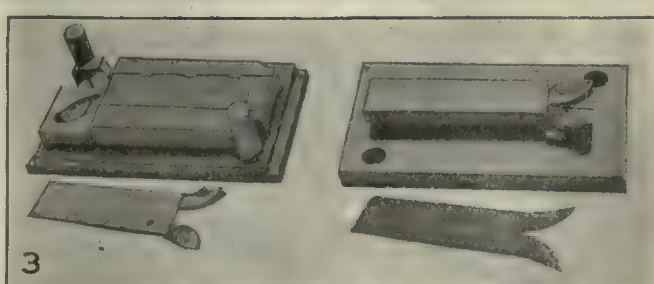
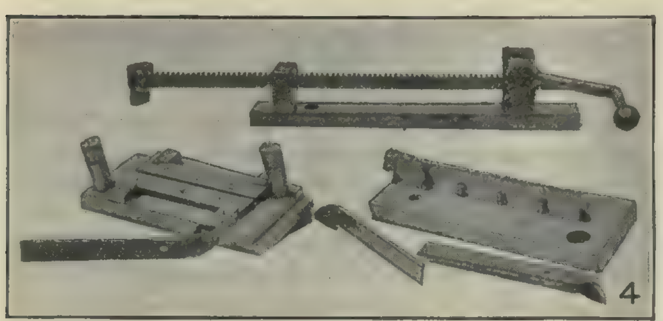


FIG. 2. THE COMPOUND BLANKING AND PIERCING DIES
FIG. 3. DIES FOR FORMING THE END DEPRESSIONS



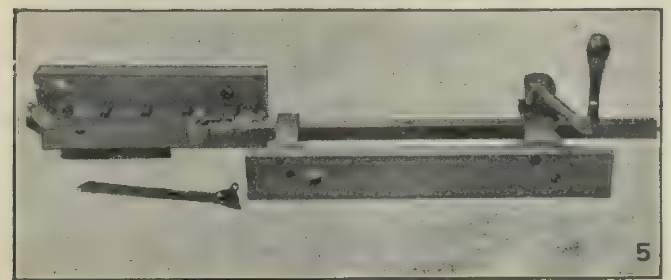


FIG. 4. THE TUBE FORMING DIES. FIG. 5. ATTACHMENT FOR REMOVING THE FORMED WORK

depressions is hemispherical, with a radius inside of 0.510 in. The opposite depression, which is concaved in the same direction, is much shallower, as will be noted from Fig. 1. The operation of forming the two depressions consists in slipping the blank into the nesting plate on the die, which locates the work by the edge and the notches blanked therein. The die proper is sunk in a separate block of steel attached by screws and dowels to the left end of the die shoe, as indicated by Fig. 3. The corresponding punch sections are formed on individual blocks secured to the punch head with a long pressure pad attached to the head immediately at the side of the punches, so that the blank is held securely throughout its entire length during the forming operation. This operation also flanges one edge to form one narrow side of the tubular body.

The forming of the rectangular tube section is done in the dies shown in Figs. 4 and 5. Here the die is made up of a pair of hardened jaws with a gap between, equal to the outside thickness desired for the tubular section which is to be formed. Back of each jaw there is a pair of stop gages for locating the blank accurately. The punch is a rectangular bar, pivoted near one end to allow a certain amount of movement up and down; for, it will be seen, the work must be closed around it in the forming of the tube and provision is necessary for horizontally stripping the completed piece from the end of the punch.

The construction of this punch and an attachment for removing the formed work are brought out by Figs. 4 and 5. As the punch descends, the work is forced down between the die jaws and then folds up over the punch itself. It is then removed endwise by the attachment shown at the rear of the view in Fig. 4 and at the right of Fig. 5. This attachment consists of a rack and pinion, crank operated and carried by a baseplate which is attached to the side of the press. The outer end of the rack carries a dog which is adapted to be dropped over the formed work, and when the crank handle is operated the rack acts in connection with the dog to slide the formed tube off the punch. The device is so located at the side of the press as to be directly in line with the punch when the press completes its upstroke and the sliding off of the formed piece is easily accomplished.

Classification and Compensation of Engineers with Respect to Municipal Service in New York City

In an address before the Municipal Engineers of the City of New York, April 28, on the subject "Classification and Compensation of Engineers with Respect to Municipal Service in New York City" (by referring to the reports of investigations made by the committees of Engineers Council and the Municipal Engineers), Arthur S. Tuttle shows that the average annual compensation, as of July 1, 1919, for 1,528 professional and sub-professional employees of the City of New York, was $1,970—an increase of 9 per cent over the average of July 1, 1915.

This rate is compared with the rates of other cities of over 100,000 showing that New York's is slightly higher. It is also compared with an estimate by the Bureau of Labor Statistics of the U. S. Department of Labor, that $2,200 represented the minimum expense of sustaining, in comfort and respectability, a family in Washington, and also with the recently estimated minimum budget of $2,221 submitted by the Harbor Boatmen's Union as necessary for the maintenance of a harbor worker's family.

Applying the tentative schedule which appears in the Engineering Council committee's report, the conclusion is reached that the professional class of the New York Engineering Service should receive, as a whole, 52 per cent more compensation, and that 27 per cent additional should be paid to the sub-professional class.

The argument is advanced that while these increases apparently mean an addition of $1,300,000 annually to New York's payroll, they would be partially offset by attracting men of ambition and attainment and that the remainder would be well invested to set up new standards in engineering responsibility and efficiency.

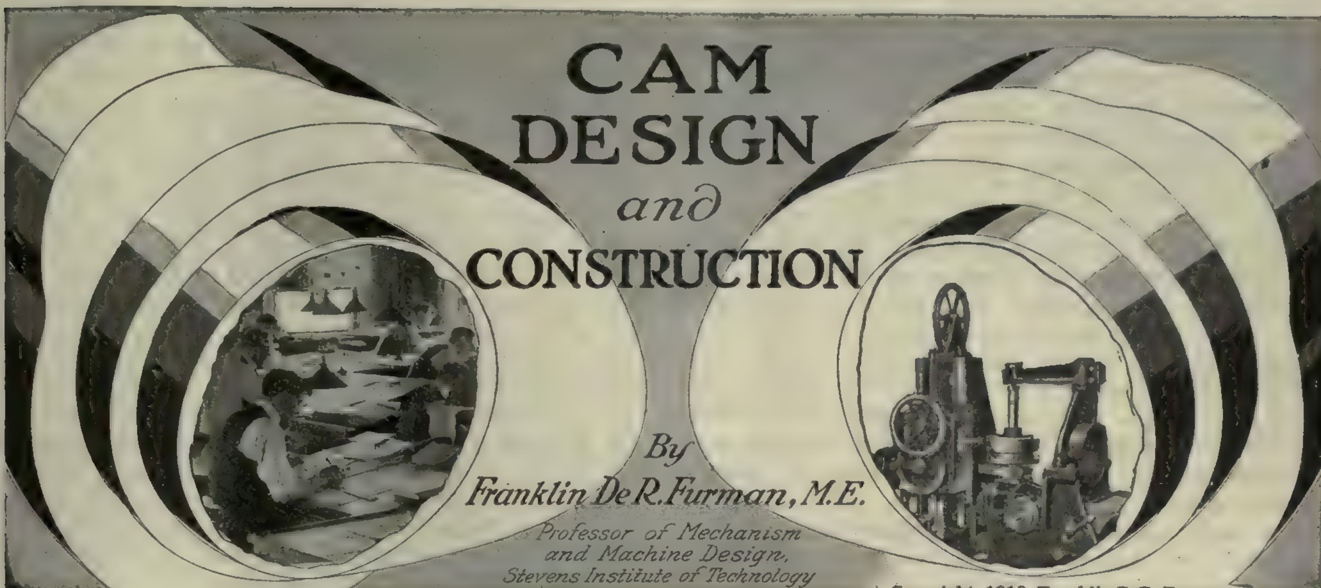
What Is a Machine Tool?

By J. A. Raught

On page 548 of the *American Machinist*, F. J. Deacon brings up a somewhat debatable question in the matter of determining just when a kitten becomes a cat. I would suggest that this occurs about the time the kitten leaves his basket behind the stove and joins his pals on the back-yard fence. As to the dividing lines between machine tools and other machines I contend that any piece of machinery that performs a function what would have otherwise been done by a hand tool, is a machine tool.

I consider a sewing machine just as much a machine tool as I do a milling machine. I once had a catalog on power punch presses, shearing machines, bending and straightening rolls, trip hammers and bulldozers, that was called a catalog of machine tools; then why should we be scandalized at calling wood-working machines the same.

It seems perfectly natural to think of a trip hammer as a machine tool for it does the work of the sledge or hand hammer. A cultivator and gang plow are machine tools for they take the place of the shovel and the hoe. I also look upon the Goodyear welt stitcher, the McKay stitcher, the heeling machine, the sole-nailing machine, and several others used in the shoe factory as machine tools.



An analysis is made of the results secured by introducing a swinging transmitter arm for the partial purpose of eliminating the side pressure that exists in ordinary radial cams where follower rollers are used, showing that the lowest sliding velocity and highest pressure due to acceleration between the cam and the swinging arm may be made to occur at the same time and so operate to best possible advantage. Other characteristics of this type of construction are pointed out and comparisons made with the roller follower type of construction. Other topics treated are: A special case of a single-disk periphery cam giving positive drive, cam surface on follower instead of driver, and finally an exceptionally small cam obtained by means of a specially driven camshaft. This concludes the series of articles on "Cam Design and Construction."

(Part XI was published in our May 6 issue.)

XII. Effect of Swinging Transmitter Arm Between Ordinary Radial Cam and Follower

IN FIG. 161 let *BCDEF* be an ordinary radial cam with straight sides as at *BH* rounded off by circular arcs with center as at *G*. Let *IJK* be the swinging transmitter arm with the working surfaces at *J* and *K* as arcs of circles with centers at *L* and *M* respectively. Let *NN'* be the center line of the follower rod which moves straight up and down.

In order to reach a useful understanding of the action of this type of cam construction it will be necessary to learn the rate of change of velocities in the follower parts so as to judge the accelerations and retardations which cause the most trouble at high speeds, also to learn the rates of sliding at *J* and *K*, and then to balance these against the pressure angle produced by the same radial cam with an ordinary direct roller-end follower.

The method of analyzing the cam action in Fig. 161 will be pointed out by using six equally spaced construction points during the period that the surface *BC* is in action, the cam turning as shown by the arrow. To obtain the positions of the six points for analysis one cannot divide the subtended arc *BP* of the working surface arc *BC* into six equal parts where a swinging follower arm is used. Instead, it is convenient for analytical construction purposes to revolve the swinging follower arm around the cam with uniform angular velocity while the cam remains stationary. The detail work necessary to accomplish this is done first by drawing an arc of a circle through *I* with *A* as a center, finding where *I* is on this arc at the beginning and end of action while the arm *IJ* slides on *BC*, and then dividing the arc of swing of *I* into six equal construction parts.

The initial position of *I* is found by laying off the distance *LJ* from the point *B* on the radial line *AB*, thus obtaining the point *O*; then using *O* as a center and a radius equal to *LI* draw a new arc to intersect the arc through *I* at I_1. This will be the position of *I* when the swinging arm is tangent to the cam at *B*; in a similar manner I_6 will be found to be the position when the arm is tangent at *C*. With the arc I_1I_6 obtained and divided into six equal parts it is no longer necessary or convenient to consider the center *I* as revolving about *A*, and it will therefore be considered as fixed in further work, the next step of which will be to find the six corresponding positions of the point *L*. This is readily done by drawing an arc through *L* with *I* as a center and then taking *IL* as a radius and the point I_4, for example, as a center and drawing an arc such as one of the short ones shown at O_4. Then with a radius equal to *LJ* find by trial a point on the arc just drawn which will be a center for an arc that is tangent to *BC* of the cam. This center is shown at O_4 and the tangent arc is shown at B_4. With *A* as a center draw an arc through the point O_4 until it cuts the arc through *L* already drawn, as at L_4. In the same manner the six points on the arc through *L* are found, and the corresponding points of tangency on the cam outline *BC* are obtained as shown from *B* to *C*.

The locus of the point of contact may now be found, as at RJR_6, as follows: To find for example the point R_4 draw two intersecting arcs, one having *LJ* for a radius and L_4 for a center and the other having AB_4 for a radius and *A* for a center. Similarly other points on RJR_6 are found.

With the above points known the angular velocity curve for the swinging follower arm may be readily found and its acceleration and retardation judged. Let ST represent the linear velocity of a point S at radius AS on the cam. Then a point at B_4 on the working surface of the cam has a linear velocity of S^1T^1, and this value is laid off at R_4T_2 where the point B_4 is in action. The component of R_4T_2 that produces rotation in the swinging follower arm is R_4T_3 perpendicular to IR_4, and this reduced to a radius of IS_4 equal to AS, for purpose of comparison with the cam rotation, is S_4T_1. This value is laid off on the fourth ordinate in the velocity diagram in Fig. 162 as at S_4T_4. In a similar manner other values are obtained in Fig. 162 and the curve BQC drawn. This curve shows the rate of change of angular velocity in the transmitting follower arm, while the straight horizontal line DE shows the uniform angular velocity of the driving cam. The length BC of the base line of the velocity diagram may be taken any length and then divided into six equal parts to locate the various ordinates of the velocity diagram.

The amount of sliding of the cam may readily be found, for example, by first breaking up the velocity R_4T_2 of the point R_4 on the cam in Fig. 161 into its normal and tangential components, the former being shown at R_4T_5 and the latter at R_4T_6, and, second, by breaking up the velocity R_4T_3 of the corresponding point on the swinging arm into the components R_4T_5 and R_4T_7. The difference T_6T_7 in the tangential components will be the rate of sliding at that phase, and this difference is laid off at ST in Fig. 163. Similarly other points on the curve DTF are found. The rate of sliding when the circular surface of the cam BFE is in action, providing there is no stop rest for the follower arm, is BD, equal to ST in Fig. 161, and when the surface CD is in action it is CF.

A velocity curve showing the up-and-down motion of the follower rod NN' will give some indication of its acceleration and retardation and the relative strength of spring required to operate it in comparison with the results secured by an ordinary roller-end follower. The first step in this construction consists in finding the six positions of the center M of the upper curved surface of $K'K''$ of the swinging arm. This is readily done because the points M, L and I are fixed relatively to each other, and therefore the point M_4, for example, is found by taking IM as a radius, I as a center, and drawing an arc at M_0M_6. Then with LM as a radius and L_4 as a center draw another short arc intersecting the first, as at M_4. With MK as a radius and M_4 as a center draw the arc passing through K_4. The point K_4 is on a vertical line through M_4. The horizontal line tangent to the arc at K_4 will have the position of the bottom of the follower rod at phase *4*. In a similar way other points on the curve K_0K_6, which is the locus of the point of tangency, are obtained. The distances between the horizontal lines drawn through the points K_0, K_1, etc., will show the amount of vertical travel of the follower during each of the six equal time periods.

The velocity diagram for the vertical follower rod is quickly obtained by first laying off the same angular velocity for the swinging arm at K_4 as was found at R_4 and finding the vertical component of the velocity of the point K_4. This is done in detail by taking the unit radius IS_4 together with the linear velocity S_4T_4 at this unit radius both of which have already been found, and transferring the disance S_4T_4 *to* S_8T_8. This will represent the linear velocity of the point S_8 on the radial line IK_4. The resultant linear velocity of the contact point K_4 on the swinging arm is found, as shown, to be equal to K_4T_9. The vertical component K_4T_{10} of this resultant velocity for the arm gives the actual upward velocity of the rod NN'. This value is laid off at ST_{10} in Fig. 164 and is an ordinate on velocity curve BQC.

The corresponding ordinate SU_3, Fig. 164, for the velocity curve of the follower rod, if it had an ordinary roller end with a roller radius equal to BB' of Fig. 161, may be found first, by drawing the pitch surface line $B'C'$ of the cam; second, by dividing the arc BP into six equal parts; third, by drawing a radial line through the fourth point P_4 *to* B'_4; fourth, by revolving B'_4 to N_4 and obtaining the full linear velocity N_4T_4 and laying it off at B'_4U; fifth, by finding the radial velocity B'_4U_2 by drawing the line UU_2 perpendicular to the normal B'_4U_1. The length B'_4U_2 will then represent the velocity of the follower bar if it has a roller end, and this length is laid off at SU_3 in Fig. 164. Similarly other ordinates of the curve BU_3C are found.

Comparing the velocities of the follower rod NN', when a transmitting swinging arm is used and when an ordinary roller end is used, it will be seen that the follower rod attains a higher velocity in the former case as shown by the greater height of the curve BQC over the curve BU_3C. Also the acceleration of the follower rod NN' on the upstroke will be greater with the swinging arm as is indicated by the greater steepness of the curve from B to Q over that of the curve from B to U_3.

The sliding action of the surface $K'K''$, Fig. 161, of the swinging follower arm on the bottom of the rod NN' has a maximum value of about one-fifth of that of the cam surface BC on the lower face of the swinging arm. This is readily determined by making use of work already done as, for example, by simply measuring the line T_9T_{10} in Fig. 161, which is the horizontal, or sliding, component of the resultant velocity K_4T_9 when the point of driving contact is at K_4. The distance T_9T_{10} is laid off at ST_{11} in Fig. 163. Other points of the curve $BT_{11}C$ are found in the same way. The ordinates of this curve added to those of the curve DTF would give a measure to the total sliding action at any instant when a swinging transmitting arm is used.

If an ordinary roller follower instead of a swinging transmitting arm were used the pressure angle which would exist with a cam of the size used in Fig. 161 and with a radius of roller equal to BB' may also be readily determined from work already done. For example, when the center B' of the roller is in action the roller will be pressing against the cam in the direction of the normal B'_4U_1 relatively to the cam, and the follower rod will be moving in the direction of the radial line B'_4U_2 relatively to the cam. Therefore the pressure angle at phase *4* would be *a* which is equal to 29 deg. and this value is laid off on the fourth ordinate as at SV in Fig. 165, thus obtaining a point on the pressure angle curve which, it will be noticed, has a maximum of about 31 deg., a very easy angle for general use.

If it is desired to know the actual rubbing velocities in feet per minute of the cam on the swinging arm and of the arm on the follower rod and the linear velocity of the follower rod NN' it may quickly be obtained from the velocity diagrams now drawn, for any given problem. For example, let it be assumed in this problem that the short radius AB of the cam in Fig. 161 is

1⅛ in. and that the cam is making 600 revolutions per minute.

For the data just assumed the point B on the cam will be moving with a velocity of $\frac{1.125 \times 2 \times 3.14 \times 600}{12}$ = 353 ft. per minute. This then would be the velocity represented by the line ST in Fig. 161. Since all the velocity lines shown in the drawings have been found and laid down without any change in the scale of the drawing it is only necessary to compute the distance on ST that represents 100 ft. per minute, and to make that distance the unit for the velocity scale for measuring the curves in Figs. 163 and 164. If AS measures 1⅛ in., ST will be found to measure 1.48 in. to the same scale. Then 1.48 in. represent 353 ft. per minute or, in other words, 0.419 in. represents 100 ft. per minute. In Figs. 163 and 164 the distance BA is 0.419 in. to the same scale on which AB was measured in Fig. 161, and this distance becomes the unit measurement for 100 ft. per minute in the velocity diagrams.

By drawing the scales as above described it will be noticed in Fig. 163 that the maximum rubbing velocity of the cam on the lower face of the swinging arm is about 560 ft. per minute and that the maximum rubbing velocity of the upper face of the swinging arm on the bottom of the follower rod is about 110 ft. per minute.

The maximum velocity of the follower rod NN' in Fig. 161 may also be read off directly in Fig 164 after the scale has been laid down as above described. This maximum velocity, it will be noticed, is about 460 ft. per minute. Had an ordinary roller follower been used on the end of the follower rod the maximum velocity of the rod would have been appreciably less, or about 380 ft. per minute. This consideration has an important bearing on strength of the moving parts in the general design of cam work. Its comparative effect, as for example in the strength of spring required to return the follower parts, may be definitely obtained by constructing an acceleration and retardation diagram from the velocity curves shown in Fig. 164, as explained in detail in Article IX.

In a cam design where there is a sliding follower, as in Fig. 161, it will be of advantage in making provision for lubrication and for wear to know not only the rubbing velocities as found above, but also the limits of the surfaces on which the rubbing takes place and the positions on the surfaces where the rubbing velocities are highest and the pressure due to acceleration is greatest. With respect to the cam in this problem the conditions are ideal, because the accelerations of the follower parts are greatest when the rubbing velocity is least. This combination occurs on the portion of the cam surface between B_1 and B_2, as may be pointed out as follows: (a) In Fig. 164 the velocity curve BQ is steepest between the phases *1* and *2*, and consequently the acceleration of the follower rod NN' is greatest; (b) in Fig. 162 where the angular acceleration of the swinging arm is greatest also between *1* and *2*; (c) and in Fig. 163 where the sliding velocity is lowest between *1* and *2*. The condition for the swinging arm I is not so good. In the first place the total wear on the lower surface of the arm on the up stroke takes place between J' and J_6, as found by drawing the dash-line arcs through the extremities R, R_3 and R_6 of the path of action, taking I as a center in each case; second, the portion

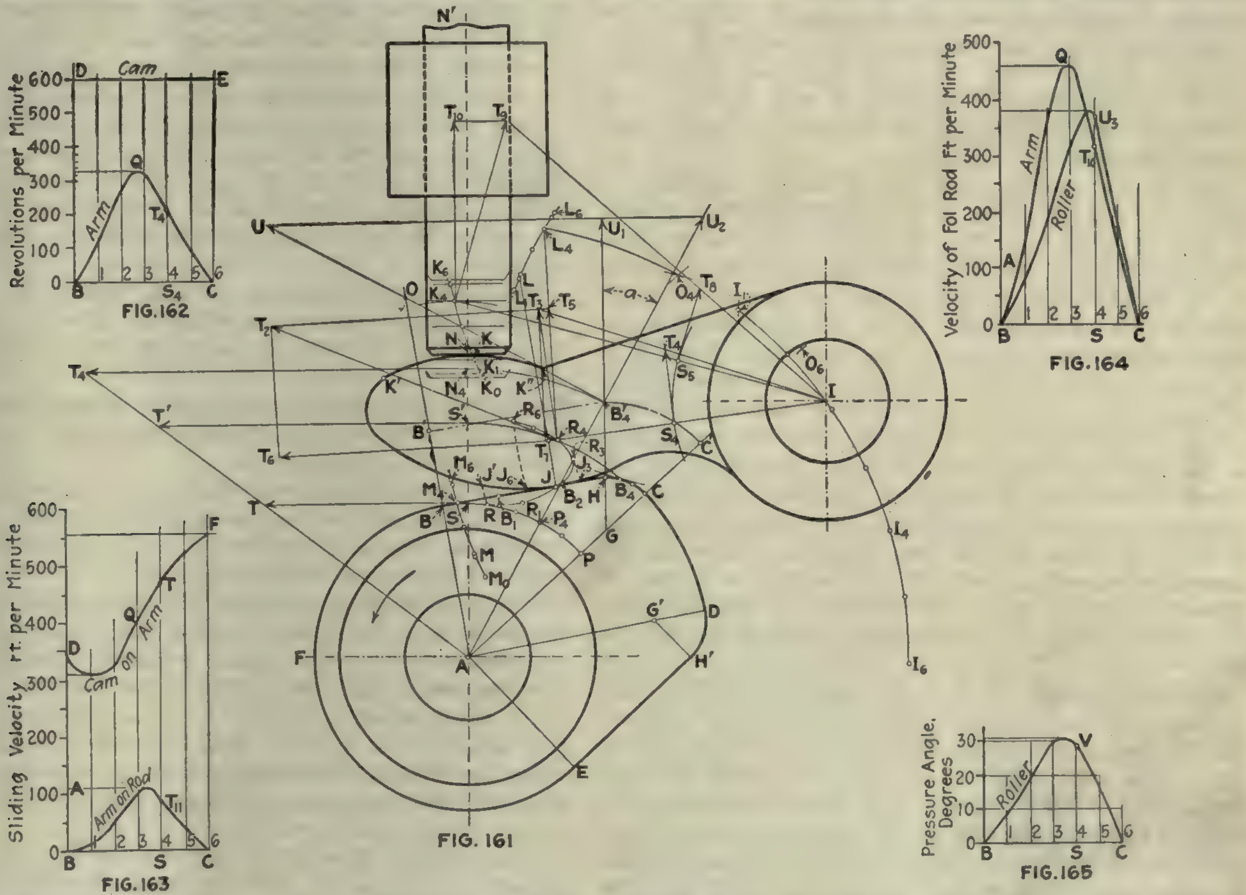


Fig. 161—Swinging transmitter arm with sliding action. Fig. 162—Angular velocity diagram for cam and swinging arm. Fig. 163—Sliding velocity diagrams of cam on swinging arm and of arm on follower rod. Fig. 164—Linear velocity of follower rod, with transmitting arm and with ordinary roller follower. Fig. 165—Pressure angle diagram, with ordinary roller follower.

of the surface from J_6 to J_2 is rubbed over twice on the up stroke or, in other words, it receives twice as much wear as the part from J' to J_6; third, the rubbing velocities are highest while the doubly worn surface from J_2 to J_6 is in action, as indicated by the higher part of the curve from Q to F, Fig. 163; fourth, the part of the swinging-arm surface just to the right of J_6 is also under the most intense pressure due to acceleration as well as being subjected to double wear and high velocity, as may be noted by the fact that J_6 lies between the phases J_1 and J_2 and that between these phases the accelerations are greatest, as indicated by the steepness of the curves between the ordinates *1* and *2* in Figs. 162 and 164. The points J_1 and J_2 are not shown in Fig. 161, but they may be readily found by drawing arcs through R_1 and R_2 with I as a center. The point R_2 is on the path of action just above the point B_2.

All of the velocity and sliding curves obtained as above for the cam with a transmitting swinging arm, it will be noted, are for the action that takes place while the follower rod NN', Fig. 161, is on its up stroke or, in other words, while the part of the cam surface from B to C is in action. While the follower is on its down stroke the surface of the cam from D to E is in action and the velocity and the sliding curves will be different and should be obtained by similar methods where full information for specific practical application is desired. It may easily happen, according to the forms of the acting faces of the swinging arm, that the velocities and the accelerations and retardations may be quite different on the two strokes. Hence the information regarding both strokes should be known in order to properly judge the friction and wearing characteristics and also to judge the strength of parts to be used.

The disadvantage of the side bearing pressure that accompanies the ordinary roller-end follower and the disadvantage of the high rubbing velocity that accompanies the swinging transmitter arm which is illustrated at IJK in Fig. 161, may both be overcome by using a roller at the end of the swinging arm to take the place of the sliding head JK. In this case a roller would be used at the end of the follower rod NN'. The side pressure produced by the slope of the cam is thus taken up by a tensional strain in the swinging arm instead of a side strain in the follower rod NN', and a smoother and easier cam action should result, although there will be an increased number of parts in the cam mechanism.

Oscillating positive-drive single-disk cam.—This cam, illustrated in Fig. 166, might be compared with the yoke cam having a swinging follower instead of a reciprocating follower. Its method of construction, however, differs from that of the yoke cam. In the illustration the oscillating cam LKM receives its motion through the link FG, the point F swinging through the arc F_1F_6. The follower piece $CBDE$ swings about the fixed center B through the angle E_1BE_6. The pitch surfaces C_6C_1, D_6D_1 of the cam are found by considering the cam to remain stationary while the follower revolves around it in such a way as to retain its relative working position at all phases. The detail construction necessary to do this is as follows: Through the point B draw the arc B_1B_6 to include the same angle as the arc F_1F_6. Divide arc B_1B_6 into a number of equal parts if the shaft A is to turn with uniform angular velocity; six parts are used here. With points B_1, B_2 as centers and distance BC as a radius draw short arcs as indicated at C_1, C_2, etc.

If it is desired that the follower move with angular acceleration and retardation similar to that produced by the crank curve draw the semicircle having CJ for a radius, Fig. 166; divide it into the same number of parts as B_1B_6 was divided (six in this case) and project the division points J_1, J_2, etc., to the arc $C'C''$, which has B for its center. Carry these last points around, with A as a center, until they meet the corresponding arcs which have been already drawn and which have B_1, B_2, etc., as centers. Thus the points C_1 to C_6 of the pitch surface will be obtained. The points D_1 to D_6 of the companion pitch surface are obtained in the same way. Taking the radius of the roller to be DP the working surfaces K_6M and K_1L are obtained.

Cam surface on reciprocating follower rod—In Fig. 167 a follower rod GK has a cam surface formed at the left-hand end from E to E', and it is driven by a simple crankpin represented at F so as to secure a desired or known motion. In the illustration let it be desired:

First—That the follower rod shall remain at rest at the head end of the stroke while the driving crankpin turns 45 deg. (22½ deg. on each side of the center line AF).

Second—That the follower will be moved to the left a distance GN with uniform acceleration while the crankpin turns 67½ deg.

Third—That the follower shall move the remainder of the stroke from N to P while the crankpin turns 90 deg.

Fourth—That the follower rod shall move in reverse order on the return stroke from P to G.

Before starting the solution of this problem it should be stated that one cannot always secure useful results in cams of this type where arbitrary distance and motion assignments are given, as in this illustration. It is nevertheless advisable to solve the problem on the basis of the desired data, because one can then make the necessary modifications with a sure knowledge that the least departure has been made from the theoretical or assigned conditions.

The method of solution for the above data is as follows: Assume the driving crank length AF and draw the crankpin circle FJM. Lay off the angle FAC equal to 22½ deg. The circular arc FC will then be part of the pitch line of the follower cam head, and while the crankpin F is moving through this arc the follower rod will not move at all. To secure uniform acceleration of the follower for the distance GN divide GN into nine equal parts and mark the first and fourth division points as indicated at *1'* and *2'* in the figure. This will be the first step in securing the uniform acceleration called for, because the distance from G to *1'* will be one unit, from *1'* to *2'* will be three units, and from *2'* to *3'* will be five units. By dividing GN into three parts as here described three construction points will be secured on the cam curve. If more construction points are desired GN may be divided in 16 equal parts, and the first, fourth and ninth intermediate division points taken, thus obtaining four construction points on the part of the pitch surface of the cam from C to E. Likewise if five construction points are desired GN would be divided into 25 equal parts, and the first, fourth, ninth and sixteenth division points taken.

Since the motion from G to N is to take place while the crankpin moves 67½ deg., as called for in the data,

and since three construction points have been used in this illustration, the 67½-deg. arc from C to J is now divided into three equal parts, as indicated at I and II in Fig. 167. At I draw a horizontal line and make the distance I-R equal to $1'$-G; at II make the distance II-S equal to $2'$-G, and at J make the distance III-E equal to $3'$-G. A curve through the points C, R, S and E will be the pitch line for the cam surface on the follower rod for uniform acceleration from G to N.

The part of this pitch curve from R to E is shown by a dash line and is not practical because of the sharp curvature from S to E which would produce too large a pressure angle, and this in turn would give a large bending moment on the follower arm and large side pressure in the bearing H. This part of the curve should therefore be modified, and a good plan on which to effect the modification is to start by making the pressure angle as large as is practically allowable and then to keep the new curve as near to the old as possible. A maximum pressure angle that is safe under all ordinary circumstances is 30 deg., and therefore the first step in the modification will be to draw a vertical line through E, the end of theoretical curve, and make an angle of WEV equal to the maximum practical pressure angle of 30 deg. The line VE is then produced until it crosses the dash curve, and a smooth curve is next drawn so as to connect the straight line and the original curve. That will leave in this case ET as a straight 30-deg. line, TR as a new assumed part of the pitch curve and RF as the portion of the original curve that remains. If the cam is to turn slowly, or if the load on the cam is not large, a greater pressure angle

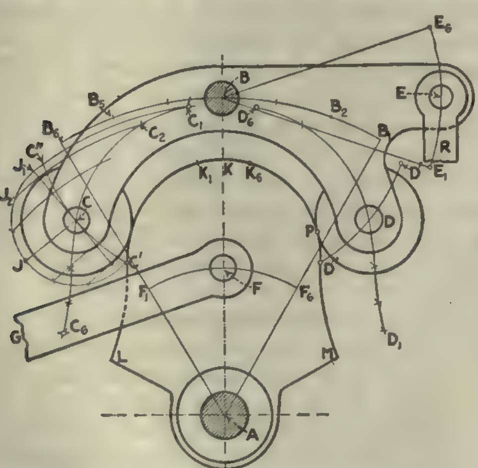


FIG. 166. OSCILLATING POSITIVE-DRIVE SINGLE-DISK CAM

could be taken at WEV and then the arbitrary new curve would come closer to the original or theoretical curve.

The practical pitch line of the cam is now found to be $FCRTE$. The cam will run smoothly and the variation in the motion of the cam from the originally desired motion may be partly indicated by pointing out that the end G of the follower will be at 2 instead of $2'$ and at 4 instead of at $4'$ as originally intended. This variation may be most completely shown by a velocity diagram which will be taken up in a succeeding paragraph.

The pitch curve FTE, it will be noticed, has been constructed to give a definite practical action to the follower from G to N. Since the curve FE is now determined, and since the crankpin must drive through the same cam slot from E to F while it turns through the remaining arc JQ, it follows that the motion of the rod from N to P cannot be assigned and that it must be taken as it comes. To find out in a general way what this motion will be it is only necessary to pursue in reverse order the methods already used; i.e., to lay off the distance T-IV, Fig. 167, at G-4, the distance R-V at G-5, etc. By noting the distances N-4, 4-5, etc., which the follower rod travels in uniform periods of time some useful idea of the retardation,

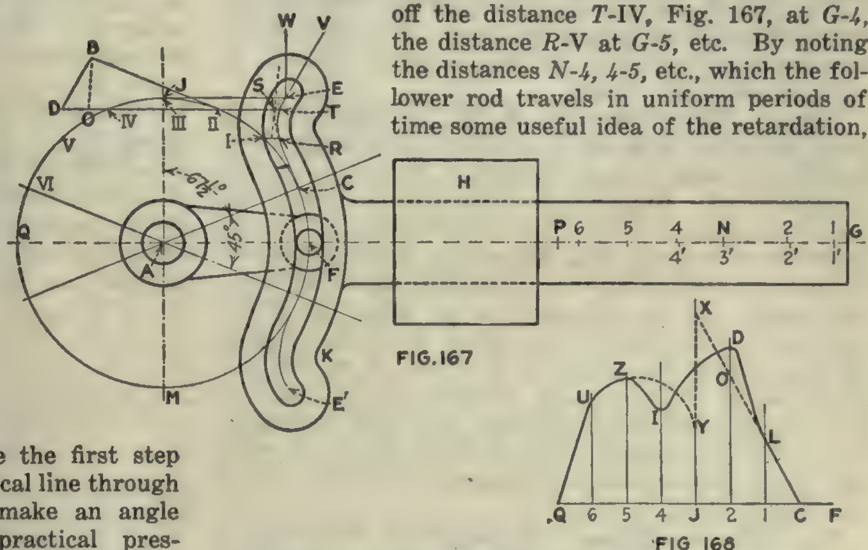


FIG. 167. CAM SURFACE ON RECIPROCATING FOLLOWER ROD

FIG. 168. TIME-VELOCITY DIAGRAM FOR RECIPROCATING FOLLOWER ROD SHOWN IN FIG. 167

and consequently of the smoothness of action of the cam, may be obtained as it approaches the inward end of its stroke. In the illustration the follower rod will slow down perceptibly from N to 4 and will have slightly higher but a fairly uniform velocity from 4 to 5 and from 5 to 6. It will retard rapidly from 6 to the end of the stroke.

The lower part of the pitch curve from F to E' will be made symmetrical with the upper part from F to E in this problem, thus making the action of the follower on the return stroke the reverse of what it is on the forward stroke. If it were desired, the curve FE' could be constructed by the methods described above to give the same characteristic motion to the follower on the return stroke as it did on the forward stroke.

An exact knowledge of the effect of arbitrarily changing the theoretical curve FSE, Fig. 167, to FTE may be readily obtained by a time-velocity diagram construction, as illustrated in Fig. 168. In the latter figure let the length of the base line FQ represent the time necessary for the crankpin to make a half revolution from F to Q, Fig. 167. Since the crankpin is assumed to travel with uniform velocity the line FQ, Fig. 168, is divided into eight equal parts, the same as is the semicircle FQ in Fig. 167. The velocity of the follower at each of the construction points is then found as follows:

At the point II, for example, draw the tangential line II-B of any desired length. This line will represent the velocity of the crankpin in feet per second, which may be readily computed, for, if the crank AF is 4 in. long and makes 120 revolutions per minute the point F will be moving with a velocity of

$$\frac{4}{12} \times 2 \times 3.14 \times \frac{120}{60} = 4.19 \text{ ft. per second.}$$

Through the point B draw a line BD parallel to the line that is tangent to the cam pitch curve at T. The line VE, continued, is tangent to the cam curve at T because it will be remembered that the practical curve from R to T was taken so as to be tangent at its upper end to the straight line ET. The distance II-D will represent the velocity in feet per second with which the follower rod is sliding through the bearing at H. This velocity is laid off in the time-velocity diagram in Fig. 168 at *2-D*. In a similar manner other points on the solid-line curve may be found. This curve shows at a glance just how fast the cam follower is moving at every phase of its stroke.

The dash-line construction in Fig. 168 shows the follower velocities called for in the original data but abandoned, as explained above, because of the large pressure angle involved. The point O on the dash curve is found by drawing the line BO, Fig. 167, through B parallel to the short straight dash line which is shown tangent to the theoretical curve at S. Then II-O would represent the velocity of the follower bar at phase II if the original data were used. As a check on the accuracy of the construction the points C, L, O and X in Fig. 168 should all be on a straight inclined line, because CX is a velocity line and it must show uniformly increasing velocity for the follower as the follower moves, in order that there may be uniform acceleration as called for in the original data.

The difference between the solid and dotted parts of the velocity diagram in Fig. 168 shows the effect on the follower of arbitrarily changing the theoretical cam curve RSE, Fig. 167, to the more practical cam curve RTE.

Cam surface on swinging follower arm.—When the cam surface is on the follower and it is desired that the follower shall have a swinging motion instead of a rectilinear reciprocating motion as it had in Fig. 167 the method of construction will vary in detail, as illustrated in Fig. 169. The data for Fig. 169 are that the driving crank AC with a crankpin roller at G shall swing the follower shaft B through an angle of 30 deg. counterclockwise with uniformily increasing and decreasing angular velocity while the driving shaft turns through 60 deg. with uniform angular velocity in the same direction.

The method of locating points on the curve CF of the follower cam surface, Fig. 169, is as follows: Divide the assigned 30-deg. arc CE into any number of parts, say six, which are as to each other as *1, 3, 5, 5, 3, 1*. This will provide for the uniformly increasing and decreasing motion to the shaft B. Divide the assigned 60-deg. driver arc CD into six equal parts. The method of locating the point L, which is the second construction point on the cam curve, will be taken for explanation purposes. Other points are found in the same way. Draw a radial line $B2$ through the second construction point, continuing it to J, which is on an arc which passes through II on the arc CD. Lay off the arc JK at II-L, thus obtaining the point L on the cam curve. This form of cam has positive action. When it is allowed to reach a dead-center position, as shown in Fig. 169, auxiliary action will be required in starting.

Small cams with small pressure angles secured by using variable drive.—By giving the camshaft a variable angular velocity very quick follower action may be secured with a relatively small cam without appreciably increasing the pressure angle. To illustrate, the same data will be taken as were used in problem 3 of Article III except that the follower is to move up the given three units in 45 deg. instead of 90 deg. The complete statement of the present problem is as follows: Required a single-step radial cam to move a follower three units in a 45-deg. turn of the main shaft with uniform acceleration and retardation; to similarly return it in the next 45 deg. and to allow it to rest for the remainder of the cycle.

Let N, Fig. 170, be the center of the uniformly rotating main shaft of the machine to which the cam is to be applied. Assume any length for the driving arm NP and draw the two 45-deg. angles PNT and TNQ. Draw the circle whose radius is NP and divide each of the arcs PT and TQ into six equal parts. Connect the points Q and P, thus obtaining the point O on NT, which will be the center of the auxiliary or camshaft. Attach a slotted arm OH to the camshaft, making the shorter working radius of the arm OJ equal to OT and the longer working radius OH equal to ON plus NP. Assume the diameter of the driving pin at P, which

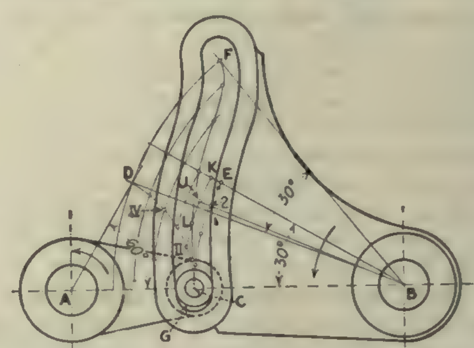


FIG. 169. CAM SURFACE ON SWINGING FOLLOWER ARM HAVING UNIFORM ANGULAR ACCELERATION AND RETARDATION

works in the slotted arm, and make the length of the slot a little greater than JH to allow for clearance.

Variable drive by the Whitworth motion.—From the preceding paragraph it may now be seen that the arm OH, Fig. 170, and the camshaft to which it is keyed will turn through 90 deg., while the main machine shaft turns through 45 deg. The mechanism thus far described for producing this result is equivalent to the Whitworth slow-advance and quick-return mechanism, but any other type of slow-advance and quick-return mechanism that gives complete rotary motion could be used instead.

To construct the cam compute the size of the pitch circle in the same manner as in an elementary problem, but using the 90 deg. that the cam will turn during the outward motion of the follower instead of the assigned motion of 45 deg. that the main shaft will turn. Thus the diameter of the pitch circle will be found to be

$$\frac{3 \times 3.46 \times 360}{3.14 \times 90} = 13.2.$$

Lay this value off at DS, Fig. 170, and draw the pitch circle with O as a center. Lay off the assigned motion of three units of the follower symmetrically about D as at AV. Assuming six construction points for finding the cam pitch curve divide AD into nine equal parts and take the first, fourth and ninth division points; do the same with VD. Divide the arc QT into six equal parts and draw radial lines through each division point, as indicated OE and OK. Carry the division points on VA around to their corresponding radial lines by means of circular arcs, as indicated at $4K_1$. Then the curve

through the points A, K_1, etc., will be on the pitch surface of the desired cam.

The size of the roller AB is taken the same as in Fig. 32, problem 3, Article III, so that the two working cams may be compared, it being recalled that the present cam does the same work in half the time of the one shown in Fig. 32, and it is no larger. It is of different shape, however, and its maximum pressure angle is a little greater, being approximately 33 deg., as indicated at L, Fig. 170, instead of 30 deg., as in Fig. 32. The camshaft O will have widely varying angular velocity, ranging between values which vary from $\frac{1}{OJ}$ to $\frac{1}{OH}$. At the phase of the mechanism shown by the object lines in Fig. 170, the driving shaft N and the

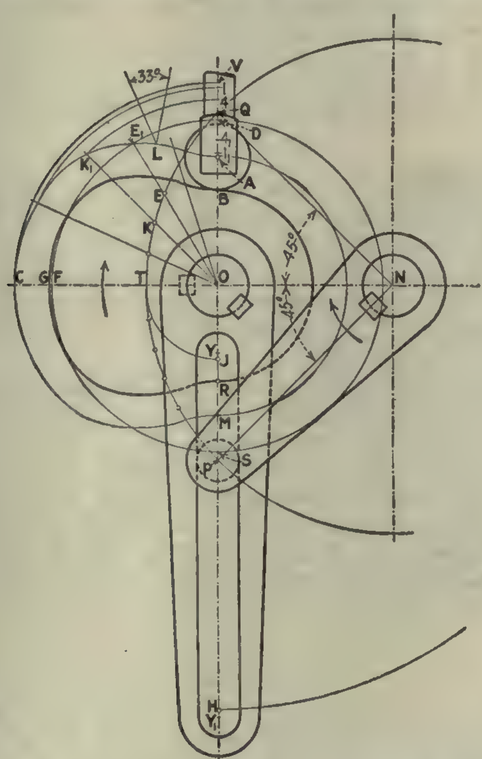


FIG. 170. SMALL CAM AND LOW PRESSURE ANGLE SECURED BY VARIABLE VELOCITY DRIVE

camshaft O have the same angular velocity, and this is true for this phase no matter what length of driving arm is taken at the start. The cam will have its greatest angular velocity when NP is in the position NT, but at this phase the pressure angle will be zero and it will be comparatively small while the cam is approaching and receding from this phase. Had a cam been constructed in the regular way, that is without variable drive of the camshaft, to give three units motion in 45 deg. under the condition of this problem it would have required a cam with a pitch-circle diameter of

$$\frac{3 \times 3.46 \times 360}{3.14 \times 45} = 26.4$$

units instead of 13.2 as here used.

A good way to settle the metric system debate would be to have all Congressmen who can state the number of millimeters in a foot and the number of quarts in a liter vote yes, the rest no. After that, the only way the bill could get by the House would be on a motorcycle.—F. R. SALVO

Sweeping Back the Tide

BY ENTROPY

If I were a manufacturer of piano cases, or high-grade furniture, or any product requiring especially well-seasoned wood, I would most naturally buy my wood some few years in advance and store it and season it myself. If I found myself suddenly cut off from my source of supply of green and cheap wood, I would not wait until my supply was exhausted without making any move to replenish it, or if I did, I would not waste any time looking for sympathy from other and more provident competitors. I would look about for other supplies of the same kind, or I would look for sources of seasoned wood among those whose business had not kept up, or I would look rather carefully into the matter of substitutes.

But being an employer of unskilled labor, I sit tight and watch the labor supply cut off for five years, without making any particularly visible effort to do any one of the three things mentioned above. Instead I sit around wailing to high Heaven to witness that the earth is coming to an end and that confusion and destruction are upon us, because no one wants to do heavy manual labor. There is exactly the same hope that we can turn the history of the earth backward, that there was that King Canute could reverse the tides by royal edict, and no more.

Instead of belly-aching, why not look the problem squarely in the face. We know that men do not like to do menial work. We rather have to admit that we do not like to do it ourselves. More than that there is no particularly good reason why we should hold our persons any more sacred than those of other people. We do say, of course, that having the gift of executive ability that it is uneconomic for us to stop directing the work of others in order to do laboring work ourselves, but we know that the other reason, that we do not like it, is the outstanding one. We would want to be paid quite a little larger salary for pushing a broom or a wheelbarrow in the shop than we would for doing the important thinking which forms our daily task. If it were put up to us that as a patriotic duty we must dig so many tons of coal per year, we would immediately try to get substitutes, but if we found that we had to pay more for the substitutes than we got for our work we would do it ourselves. It is certain, however, that if we found it paid to do laboring work ourselves we would immediately endeavor to find ways in which to

reduce the amount of the work, or to find ways in which it could be done by power. We are careless in our shops and yards. Our cost department may show us that handling coal has cost us a dollar a ton, but it is very seldom that the cost department can tell us that it cost one sum for handling a part of it by dumping it through a trestle and another sum several times as great to shovel it out over the side of a car. If we knew the latter we might be so impressed with the waste of money that we would buy a hoist and use it for everything except the little in the corners of the car. When we see five men stand around while one man picks out a four by six timber sixteen feet long, and then they

When the last Liberty Bond has been sold at a discount.

solemnly pick it up and carry it a hundred yards to a swing saw and stand while he waits for someone to get done using the saw, and then put it on the saw bench and watch him cut it off and then carry one piece back to the pile and the other piece to its destination, we feel that a little two-wheeled truck costing ten dollars (war price) might be a paying investment. Then we look at the type of men that will take these jobs, and we are sorry we have to put them on the job at all, and just merely hope they will not burn the shop down tomorrow.

But after all, is there anything to worry about? Men have money now who never had it before. It is burning holes in their pockets, and must be spent. It is a pity that so much of it is so utterly wasted, but until the disease has run its course there is no more use worrying about it than there is about the tides. When the money is spent, when the last Liberty bond has been sold at a discount and all the bonds are in the hands of those who will ultimately cash them at maturity, then we may safely look for men to go to work with a will. There are so few men who work for any other reason than because they have to, that it is safe to say that necessity alone will stop our present orgy of spending. There is no surer way to bring necessity to our doors than to spend. Spending does not mean that there is any less value in the world. It simply means that the people who used to have the money are going to get it again. Normality consists in having this money in the old hands and the present possessors are doing the best they can to get it there at once.

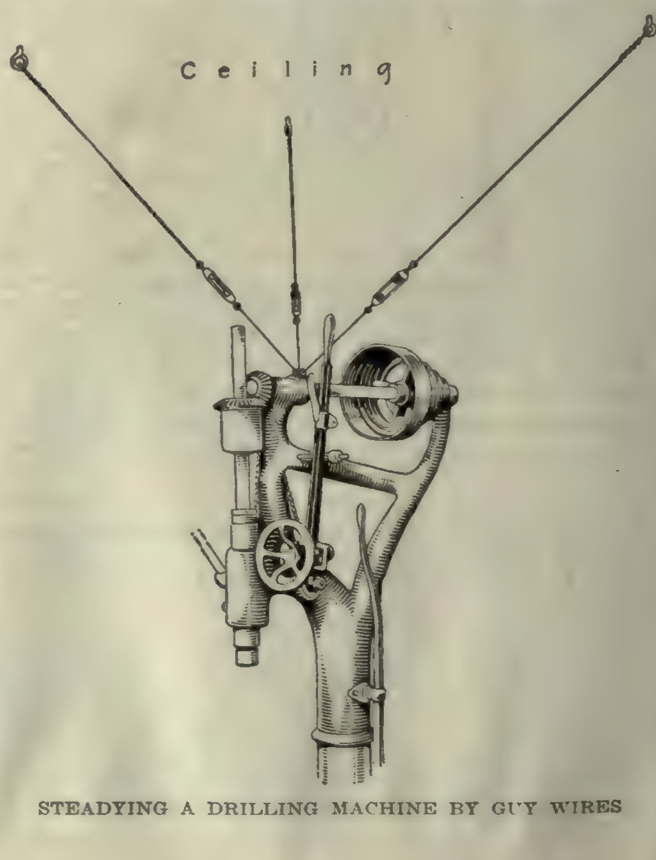
But even then fewer people are going to be content as mere laborers. Many who never dreamed of ever being anything else than laborers have been forced by circumstances to learn to do operations that they never hoped to do. In the future mental deficients will be the only ones anxious to do the strictly manual work, and there will not be enough of them to do the work required. Beyond that there is the choice as to whether we will invent and install labor-saving machinery to do the rough and laborious work of the world or whether we will pay more for getting it done than the usual rate paid for skilled labor. It will occasion us surprise if we have to pay a substantial premium for getting disagreeable things done. However, it will be increasingly profitable to invent and build labor-saving devices for doing, not so much the semi-skilled work of the world, but the drudgery. It is just a question of economy, that's all.

Steadying a Drilling Machine

By I. B. Rich

The shop was in rather an old building and the floor was not particularly substantial. The drilling machine was evidently somewhat out of balance, particularly at high speed, so that it was impossible to run small drills fast enough to cut properly without causing undue vibration which, of course, affected the other machines badly.

The disease was cured by putting substantial screw-eyes into the ceiling beams overhead and letting three supporting wires down to the top of the machine as shown. Small turnbuckles made it easy to secure even and sufficient tension on all three wires, and this so steadied the machine that no further difficulty was experienced. It is quite possible that a remedy of this kind might be applied in other similar cases.



STEADYING A DRILLING MACHINE BY GUY WIRES

A Bonus Plan That Works

By FRED H. COLVIN
Editor, *American Machinist*

This article tells about a plant which withstood the stress of labor agitation during the war, and a plan which has worked well without elaborate machinery. As might be expected, it is based first of all on the square deal and the whole plant wears the air of democracy without any special plan for putting this into effect.

WITH evidences of industrial unrest on every hand, the methods of management used in plants which are running smoothly assume an added importance. Regardless of the kind of work or of the theory on which the plant is run, it is the part of wisdom to study the situation carefully and with an open mind. This is particularly true when we find a plant which has been able to keep steadily at work in a city where strikes are frequent and where unrest is rampant.

Such a city is Bridgeport, Conn., and such a plant is that of the Bullard Machine Tool Co., which had the enviable reputation of being the only large plant in the city which was able to run uninterruptedly. The spirit of co-operation which exists between management and men was further made evident by the men volunteering to work on Labor Day, in order to help out the war activities which were then under way. Realizing that the rapid production and maintenance of quality are dependent on skill and acquaintance with the work in hand, and that in order to have successful and economical manufacturing, the experienced men must be retained, the prevention of labor turnover became one of the first problems, and the reasons for such turnover were carefully studied. This led to the conclusion that an organization could be built up and maintained only on the foundation of such principles as would permit satisfactory relations between employer and employee, and which would insure stability of labor and true efficiency.

The Principles Involved

These principles have been summed up as follows:

Respect and confidence between employer and employee must be established and maintained.

A proper and equitable incentive must be provided for both.

There must be established a measure for determining the rate of wage.

The rate of wage must be definitely related to the energy, skill, experience and knowledge required to perform the work.

The establishment of the first principle was probably made easier by the fact that all the chief executives of the company had been through the shop, had learned the trade in the old-fashioned way, and not only understood the work but what was even more important, they understood the men, their ideas, their ambitions and all their human qualities, which have so much to do with all personal relationships. The long-established policy of this company of promoting from the ranks aided largely in securing the confidence of the men, and also of retaining them against the lure of temporarily increased remuneration. When a man knows that it is the policy of the company to promote men from the ranks, and when he finds this exemplified by the make-up of the executive staff, the chiefs of departments, and the foremen, he is bound to feel that his opportunities for advancement are as good as can be expected.

The organization service established a first-aid system for caring for occupational accidents, a system of medical supervision and direction under the guidance of one of the foremost medical men of the city, group and compensation insurance covering both health and accidents, all of which helped to make the men feel that they were part of the family.

The company tells the men frankly that its incentive lies in the demand for its products and the profit which this brings.

This means, of course, that manufacturing costs must be kept down and that manufacturing methods be efficient. For the worker who is employed directly on production, the incentive is divided into three separate and distinct units.

The basis is an hourly rate of wage, bearing an equitable relation to the energy, skill and knowledge of the individual, as well as to the cost of living. There is also an incentive to prompt, regular, and continued attendance, for only in this way can both sides reap the full benefit of employment. Idle machines not only fail to earn money but are an expense to the company. This attendance bonus adds 10 per cent to the regular weekly earnings, and has proved remarkably attractive in every way.

The Maxi-Pay Bonus Plan

It is further recognized that the close application to work with an accompanying increase of skill, and, more than this, the *desire to produce,* merits an additional reward commensurate with the increased output obtained. This is taken care of by what is known as the Bullard Maxi-Pay Production Bonus Plan, which is based upon the allotment of an established standard time for unit production. This plan provides for the

payment of an increasing bonus without limit, for increased efficiency and reduction of time required for the actual performance of the work in hand. The inefficient worker, whether the inefficiency be due to his lack of effort or lack of ability, loses nothing except the opportunity for increased earnings, advancement and retention, as his established hourly rate is paid without regard to his calculated efficiency.

This plan has proved extremely attractive to the workers and has been highly satisfactory to the management. By it, the worker is financially rewarded for the extra effort and skill required in increasing production, and the management obtains an increased productive capacity from the same plant and equipment, which, of course, means an increased return on its investment.

The hourly wage rate is based upon individual productive capacity, the cost of living, and the question of supply and demand. Individual productive capacity bears a paramount relation to the other factors; it directly affects the cost of manufacture and therefore the salability of the product in question. To arrive at an intelligent conclusion by combining these factors requires experience, judgment, and, above all, a fair and equitable mind. Needless to say, this is the crux of the whole situation, and on it the success or failure of such a plan depends. It must be remembered, however, that the hourly rate must be sufficiently high to insure a contented state of mind in the worker.

Where Confidence Counts

Critics will immediately point out instances where what seemed to be very liberal bonus plans failed to insure harmony and continued production. Strikes and lockouts have resulted under what appeared to be liberal bonus plans and profit-sharing methods. If, then, these plans succeed in some places and fail in others, we can only draw the conclusion that the success or failure must depend to a considerable extent *on the way in which they are applied* and on the personal element to a very large extent. When any method of management succeeds in the face of difficulties and disturbances in adjoining plants, there can be no question as to the management having established confidence of a square deal in the minds of its men. And this cannot be done by proclamation; it must be the result of actual practice.

Setting Fair Standard Times

This plan necessitates the setting of standard rates of efficiency which are a direct reflection of the energy, skill, experience and knowledge of the worker, by which each can be judged and from which promotions can be made. Here is where the principle of the square deal plays a very important part. No individual's judgment is infallible, and no hard and fast rules can be entirely successful in preserving harmony and good feeling. Men of exceptional experience and character are detailed for the work of setting standard time, this being just the reverse of some former practices, where young and inexperienced college men were chosen for this work.

The management realizes that it is practically impossible for any man, no matter how broad his experience, to figure accurately and equitably in every instance—particularly on complicated work. It is therefore the policy of the company to put new work, or old work with new equipment, into operation on the basis of a trial time. In this connection it is thoroughly understood that the management relies upon the operator to put forth his best effort and to be absolutely on the level. Knowing that the management plays fair with him, the workman responds in practically every instance, and it is the exceptional case where any attempt to influence time setting by soldiering has been attempted.

Knowing that it is out of the question to expect perfection in time setting or anything else, means are provided for making special adjustments which may be found necessary. Conditions occasionally develop which are entirely beyond the control of the operator or the time setter, such as exceptionally hard castings, a run of castings or other material which must be rejected for defects which appear only after machining, and sundry other causes. On the other hand, the confidence that a square deal is always forthcoming makes it possible to adjust standard times downward as well as upward when equity demands.

Efficiency of the Average Man

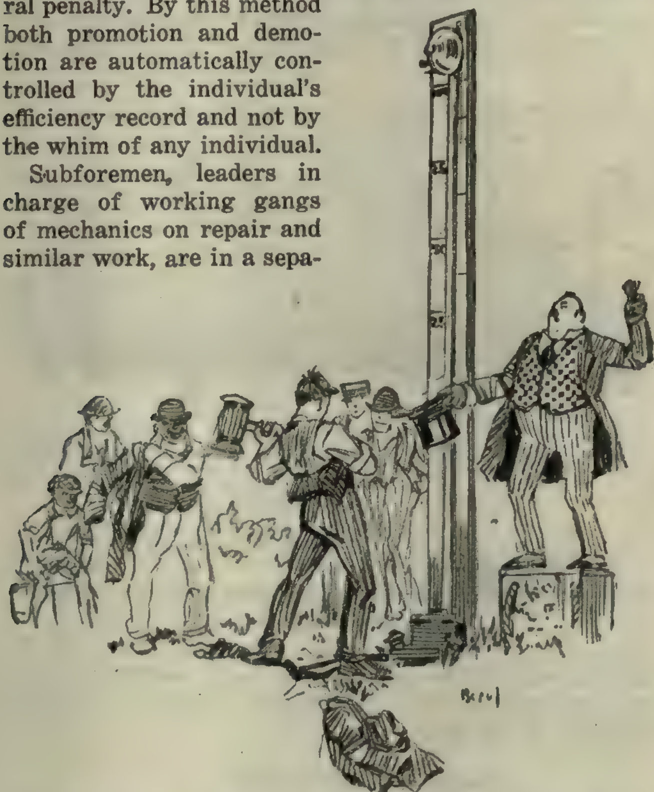
The system of figuring time assumes that the average man on a workday basis, and with average application, will be 75 per cent efficient, while a high-grade man, under the same conditions, will produce approximately 100 per cent. This enables the average man to earn the hourly rate of the class to which he belongs, and for every 1 per cent he increases his efficiency over 75 per cent he obtains a similar increase in wages. Thus, the 100 per cent man gets 25 per cent bonus on his wages, this bonus being paid monthly.

There are two exceptionally good features about the whole plan, especially about the way in which it has worked. It has helped to make men contented when all of the rest of the city was in more or less turmoil, and it has increased production and reduced the cost

of manufacture in a manner which is extremely gratifying to the management. The figures are almost unbelievable and would make many shop managers green with envy.

The average man or the man with 75 per cent efficiency must maintain this in order to be considered a desirable addition to the working force. For promotion from this class to the one higher, he must attain an average efficiency of 90 per cent for three months. An average efficiency of 100 per cent places the worker in the highest class, which, of course, carries the highest hourly rate. In order to maintain standing, the workman must keep his average performance up to the percentage of efficiency required for that class, demotion after a reasonable period being the very natural penalty. By this method both promotion and demotion are automatically controlled by the individual's efficiency record and not by the whim of any individual.

Subforemen, leaders in charge of working gangs of mechanics on repair and similar work, are in a sepa-



rate class, and are rated at a somewhat higher figure than the 100 per cent workers. This group is made up of men with wide experience and employees of long standing, and from them, foremen and shop executives, so far as possible, are selected.

Confidence the Keynote

The real success of this plan is, as before stated, the mutual confidence which exists between the management and the men. Channels are provided by which complaints or suggestions of all kinds can reach the management without delay, and the human way in which these matters are handled makes for the success which comes from co-operation. The same methods handled in a cut-and-dried manner, and without human sympathy or understanding, would probably fail.

One incident, in closing, will serve to show the broad manner in which questions of management are handled. A newcomer, who was evidently a natural disciple of unrest, started a petition for some sort of a change in working hours or shop conditions. He was invited into the office and told that there were regular channels by which matters of that kind could be brought to the attention of the management. In a quiet talk the general manager outlined the endeavor to maintain harmony by means of the square deal, after which he was told to report to his foreman. The main thing

which impressed the new man, however, was the fact that he was not summarily dismissed, but that he was courteously treated and given another chance. This is one of the great secrets of success in this plant.

Sorting Small Parts on the Floor

By Peter F. O'Shea

One of the simplest methods of sorting a mixed collection of different kinds of pieces is to spread them on the floor and sort the like parts into separate piles. This method was successfully used during a shortage of tote boxes in a large New England factory, where castings for various small parts came up from the cleaning room all mixed together, after having been handled in large lots for quantity pickling and cleaning. The heap was dumped out of the truck or barrel upon the floor of the sorting room. Each style of piece was then placed in a separate pile and a circle drawn around the small heap with a piece of chalk, this being a sufficient substitute for a bin. The pieces were later shoveled into tote boxes to move them to the desired departments.

In most cases the job of sorting consists not only in separating all the different kinds of pieces, but also in re-grouping those kinds of pieces which are used in the same group assembly and are to go to the same department as part of the same complete order. For this purpose the supplementary parts are piled in neighboring little heaps. A large circle is then drawn around the group and the number of the department to which it is to go is chalked on the floor inside the circle. Some of the tote boxes are subdivided by partitions so that all the parts in a group may be put into one tote box, and yet the kinds of parts be kept separate. The truckman shovels all of the little heaps into the same tote box, and takes it off to the department indicated. If there is more than one group of parts to go to the same department each group circle is marked with a sorting letter also, as "239 A" or "239 B." The A and B group go into separate tote boxes.

This procedure gives a rough and ready method of economizing on the use of tote boxes and it should prove of especial use at inventory time.

A Comparative Test of High-Speed Steels—II

By A. J. LANGHAMMER, M. E.
Industrial Engineer, Thompson & Black, Engineers and Accountants, New York and Detroit

Conditions entering into the testing of a tool for cutting, listed by Taylor, are discussed. Detailed information is given as to the method of eliminating most of the variables from a comparative test for the efficiency of several brands of commercial tool steel.

(Part I was published in our May 6 issue.)

As is well known, the Packard Motor Car Co. was the pioneer manufacturer of Liberty airplane motors for the United States Government during the war. In building Liberty "12" airplane motors, one of the most intricate problems was that of machining the steel cylinders. At the start of the manufacturing program, this unit was made of a solid billet, which practice fortunately was rendered obsolete by the most opportune invention of the Ford Motor Co. The Ford method permitted the making of these cylinders from steel tubing at greatly reduced initial cost and with an additional huge saving in labor (boring of billet) and tool costs. The material used was heat-treated mild carbon steel, subjected to rigid Government inspection for both composition and physical properties before it entered the machine shop. The result was, therefore, a product of unusual uniformity, thereby furnishing a material of exceptional merit for testing purposes. Since it was not only essential to get a product of highest quality machined to extremely low tolerance and limits but also vital to obtain a maximum production of airplane engines, a test was decided upon to determine the high-speed steel which would meet these difficult requirements. The following article describes that test in detail.

Elements Entering Into the Cutting Speed of Tools

Dr. F. W. Taylor in his "Art of Cutting Metals" gives twelve elements th-t affect the cutting speed of tools. To this must be added one more, the human element, thoroughly recognized by Dr. Taylor but emphasized by Prof. A. L. Jenkins, professor of mechanical engineering at the University of Cincinnati. As every test of cutting tools that is to be of any value must take full cognizance of these elements, they are listed below in abbreviated form:

1. Quality of metal to be cut.
2. Chemical composition of the tool steel and its heat treatment.
3. Thickness of shaving (feed per revolution).
4. Shape or contour of cutting edge of tool.
5. Type of coolant used.
6. Depth of cut.
7. Duration or length of cut.
8. Lip and clearance angles.
9. Elasticity of the work and of the tool, i.e., degree of chattering.
10. Diameter of work.
11. The changes of speed and feed possible in the machine tool.
12. The pulling and feeding power of the machine tool.
13. Human element.

To simplify the test and make the results more positive, as many elements as possible were made constant. Each variable as it affected the test in accordance with the above classifications will be discussed briefly.

Cutting Speed

In determining the proper cutting speed,[1] the depth of cut, feed, and the machine tool flexibilities had to be considered most carefully. The depth of cut was first determined and then with the aid of special tools, not included in the test proper, several runs were made and a cutting speed of 35 ft. finally chosen. This value was

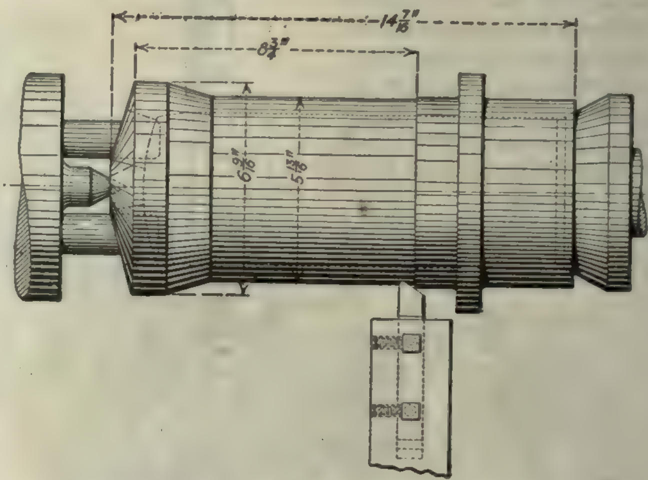


FIG. 1. SHOWING THE MATERIAL CUT AND SET-UP USED IN TESTS

used throughout the test in all runs and maintained at a constant value, thereby eliminating the factor "cutting speed" as a variable.

Quality of Metal to Be Cut

The metal cut was a mild carbon (0.40 to 0.50 per cent) heat-treated stock. Fig. 1 shows the cylinder in the rough before any machining operations have been performed. Every cylinder used in the test had to show a hardness between 217 and 255 Brinell (scleroscope 36 to 43) before it was accepted by Government inspectors. As there were thousands of cylinders to choose from, only those were actually selected for test purposes whose scleroscope range was within these points. Each cylinder was also carefully inspected for out-of-roundness, eccentricity, variations in diameter, fins, and excessive scales or rust formations, any unsatisfactory specimen being summarily rejected. Attention is invited to these exceptional conditions by which the test was favored because such a desirable material would hardly be found available in ordinary practice. The factor of "quality of metal to be cut" was perforce a constant.

As a matter of record the metal being cut may be noted to be the so-called "Aircraft Standard Steel," or S.A.E. 1045, known to the trade as 0.45 carbon machine steel.

[1]See "Art of Cutting Metals," F. W. Taylor.

TABLE II. COMPOSITION AND HEAT TREATMENTS OF TOOL STEELS TESTED

Chemical Composition *								Heat Treatment				
Brand	Carbon	Tungsten	Vanadium	Nickel	Chromium	Cobalt	Uranium	Preheating	Hardening	Quenching Medium	Drawing Temperature	Remarks on Heat Treatment
A	0.79	12.8	1.74	0.10	3.78	None	None	All tools slowly preheated to 1550-1600 F.	The temperature in the hardening furnace was maintained at practically 2300 F. The tools were withdrawn and quenched when the condition of sweating was satisfactory to the expert representing the steel company which produced the brand being hardened.	Oil	1050	Cyanide on tip of tools during hardening.
B	0.64	16.9	0.92	0.10	2.42	None	None			Lead at 1050 F	1100	"B" tools withstood the high heat very well.
C	0.40	18.00	0.51	Tr.	3.53	None	0.11			Lead and kerosene.	1050	Tools 0 and 1 quenched in lead. Tools 2 and 3 quenched in kerosene
D	0.62	14.86	1.05	Tr.	3.59	None	0.10			Lead at 1050 F	1100	One-half of tool immersed in lead. Relatively short heat.
E	0.49	17.35	0.23	Tr.	2.78	None	0.14			Lead	1100	
F †	0.67	19.70	0.99	0.21	3.78	None	None			Oil and lead	1100	Tools 0 and 1 quenched in lead. Tools 2 and 3 quenched in oil.
..	0.65	15.79	0.49	0.24	3.44	None	.....					
G	0.62	18.26	0.75	Tr.	3.70	None	None			Oil	1050	
H	0.66	18.30	0.45	None	4.17	None	None			Lead at 1050 F	1075	
J	0.68	18.12	0.48	Tr.	2.63	None	0.10			Oil and lead	1050	Tools 0 and 3 were immersed half way in oil; then they were placed on the floor and thus drawn.
K	0.59	13.34	0.95	Tr.	3.64	None	0.15			Oil	1075	
L	0.76	21.92	1.05	None	5.27	None	None			Lead at 1050 F	1050	
M	0.69	16.95	0.75	0.18	3.09	None	None			Oil and kerosene	1100	Tool 2 quenched in oil. Tools 0, 1 and 3 quenched in kerosene. "M" tools withstood the high heat very well.
N	0.66	13.55	2.20	0.10	3.59	None	None			Oil	1050	
O	0.67	13.50	0.99	0.20	4.30	None	None			Oil and lead	1100	For tool 0 only. Tools 1, 2 and 3 were not drawn.
P	0.38	15.27	0.05	0.20	2.85	None	0.14			Lead	1100	Blistered on heating.
R	0.65	17.08	0.58	0.20	2.78	None	0.10			Oil and lead	1075	Tools 0 and 2 were quenched in lead. Tools 1 and 3 were quenched in oil.
13, 14‡	0.75	11.12	2.10	0.32	5.13	None	.....			....	None	

The samples for chemical analysis were obtained from the same section of the bar of which the tools were made.

The lead bath used in quenching was maintained at a temperature of 1050 F. The tools were immersed in the molten metal for about 3 min., and then allowed to cool in the air.

* Phosphorus and sulphur below 0.04 per cent in all cases.
† The second analysis under F gives that of a second bar obtained subsequently.
‡ This steel was not tested, but its microstructure is shown in Figs. 13 and 14.

The chemical composition follows:

	Per Cent	
Carbon	0.40 to 0.50	(0.45 desired)
Manganese	0.50 to 0.80	(0.65 desired)
Phosphorus	0.045	maximum
Sulphur	0.05	maximum

Ordinary heat treatment given the forgings consisted of a quenching in oil or water from 1,500 to 1,550 deg. F. (820 to 845 deg. C.) and a drawing at 1,150 to 1,200 deg. F. (620 to 650 deg. C.).

After such treatment the physical properties were:

Elastic limit (approximately)	67,000 lb. per sq.in.
Tensile strength (approximately)	98,000 lb. per sq.in.
Elongation	20 per cent
Reduction of area	56 per cent

Chemical Composition of the Tool Steel and Its Heat Treatment

In the first few columns of Table II are given the chemical composition of each set of tools of the separate brands, as determined by actual analysis. This composition supposedly represented the standard practice of the steel manufacturer. If the company made more than one grade of high-speed steel, the best or "superior" grade only was specified, as will be pointed out in more detail in the next paper.

The heat treatment of each tool likewise is shown in Table II. "Chemical composition" therefore was a variable.

Thickness of Chip

Experience has taught that the finer feeds are not adapted to test work because slight imperfections either in the cutting edge of the tool or in the material cut affect the tool in a manner more disastrous than a coarse feed. In shop practice, too, medium or heavy feeds are generally used and if the test conditions approach normal practice the results can be more easily interpreted by shop men. A feed of 0.054 in. was used in our "first-run" and 0.090 in. in the "second run." As each value of feed was adhered to throughout the individual runs the "thickness of chip" was a constant.

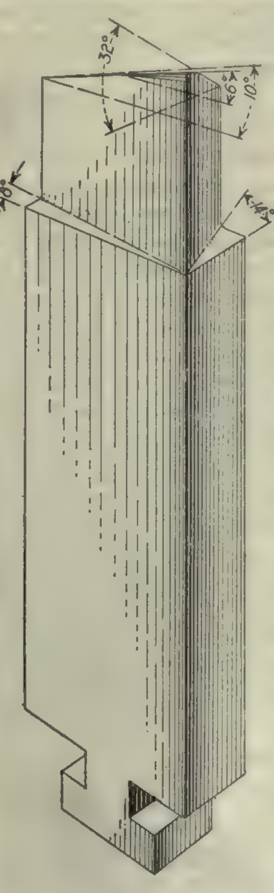


FIG. 2. LO-SWING LATHE TURNING TOOL

Shape or Contour of Cutting Edge of Tool

Fig. 2 shows the type of tool used in the test. Each individual tool was machined, rough-ground and finish-ground. This particular design of tool is adaptable for a "Lo-Swing Lathe," because on such a machine the cut is generally started by "feeding in" the tool to the desired depth and then engaging the feed, rather than "setting" the tool to the desired depth before engaging the power feed. (See Fig. 1 for the illustration of this point.) Also on most work a "gang" of tools is used, some of which must cut right up to a shoulder or flange, necessitating the side cutting edge of the tool being parallel with the shank. All grinding was performed by an expert on a Taylor automatic tool grinder and every tool inspected after the final operation. A nose of $\frac{1}{16}$-in. radius or $\frac{1}{8}$-in. "rounding" was ground on all tools for the first run, while a $\frac{1}{8}$-in. radius or $\frac{1}{4}$-in. "rounding" was adopted during the second run. The radius was increased during the second run, because with the given designs of tool this procedure necessitated the minimum grinding and thereby reduced the

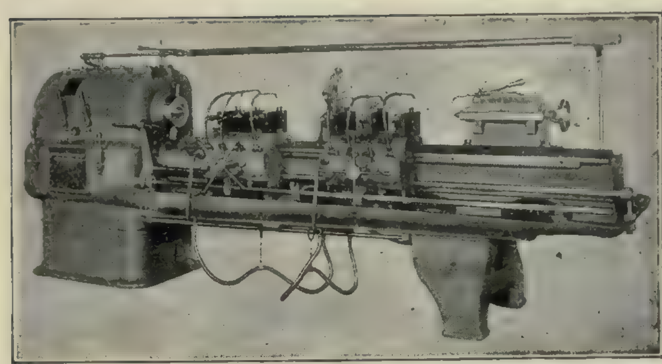


FIG. 3. TYPE OF MACHINE TOOL USED IN TESTS. EIGHT-INCH LO-SWING LATHE

chances of harming the tool during the grinding operation. As the stated values of the radii were uniform for each run and the shape of the tool was rigidly inspected after grinding, the "shape or contour of cutting edge of the tool" was made constant.

Type of Coolant or Cutting Compound

The use of a coolant in itself introduces several variables (such as uniformity of material, pump trouble, misguidance of the cooling stream, etc.), adds considerably more work, and provides for possible inaccuracies. As it was desired to determine only the comparative and not the maximum attainable life, no coolant was used, thus making this factor, "type of coolant or cutting compound," zero.

Depth of Cut

Once either the feed or the depth of the cut has been decided upon, the other factor in conjunction with the cutting speed can be determined by the time limit set for failure to occur, and by the power and flexibility of the machine tool employed. In this case the depth of cut was established first, because the material cut had to enter the regular production when the machine work was finished. This, then, limited the diameter to which the specimen could be reduced, and thereby automatically established the depth of cut, $\frac{5}{32}$ in. in this instance. The value of the depth of cut, like the feed, should in all cases approach the normal for ease of interpretation, and the figure stated checks very closely with the amount of stock removed in the average roughing operation on a simple drop forging. A snap or external limit gage that held the turned diameter to a variation of 0.005 in. was used to measure the depth of cut (the rough diameter of the material had been previously checked, as already described at length under "Quality of Metal to Be Cut"), so that the "depth of cut" was reduced to a constant.

Duration or Length of Cut

The duration of cut in a test on cutting tools is an item that requires very careful consideration. When too short a time limit is chosen, the results are questionable, if not valueless, because the heat generated at the working point of the tool is so great as to cause unjustifiable and wide variations in duration of cut. Too long a time is somewhat less objectionable, as it entails increased difficulties with respect to securing homogeneous material and possibly induces general inaccuracy. Therefore, for the first run, a duration of about 25 per cent less than the standard practice on that particular class of work was chosen. On the second run, however, a value which caused an average good tool (as determined by experiment with tools made up especially for this purpose) to fail within 20 min. was applied. Of course the time limit, other things being equal, depends on the cutting speed, feed, and depth of cut. As the depth of cut was predetermined due to the fact that the material used was a "production part" and the feeds and speeds of the machine tool used, an 8-in. Lo-Swing Lathe, Fig. 3, were limited, it was decided to change the feed only to vary the duration of length of cut. The element of "duration or length of cut" was perforce a variable.

Lip and Clearance Angles

At the beginning of the test the design of tool and all clearance angles were decided upon. The various clearances and slopes were as follows: 6 deg. clearance at the nose and 10 deg. clearance at the heel, 14 deg. side slope, no back slope, 32 deg. horizontal clearance, 8 deg. vertical clearance, 84 deg. lip angle and 90 deg. cutting angle. See Fig. 2 for a perspective representation of this tool and the values given. As these values were identical on each tool, the elements of "lip and clearance angles" were of necessity constant.

Elasticity of the Work and of the Tool, or Chattering

Chattering affects both the cutting-speed and finish of the work and is caused by incorrect design of cutting tool, incorrect method of clamping and driving the work, poor design and ill fits in the machine tool, synchronizing of the effects of defective elements and loose fittings in the machine and the set up, or a combination of these. By inspection of Fig. 2 it will be seen that the design of tool was such as would discourage chattering. In the same way Figs. 1 and 3 show an unusually rugged and positive drive with a good set up, so that chatter from this source was eliminated. Attention is invited to Fig. 4, which shows the particularly rugged tool block that was used. It is to be noticed that fully 80 per cent of the total length of the tool rests solidly on its base and that setscrews are provided for securing absolute rigidity both horizontally and vertically. The choice of machine tool provided a unit that was very adaptable to the work of the test, so that "chattering" as it affected the cut-speed was made a constant, approaching zero.

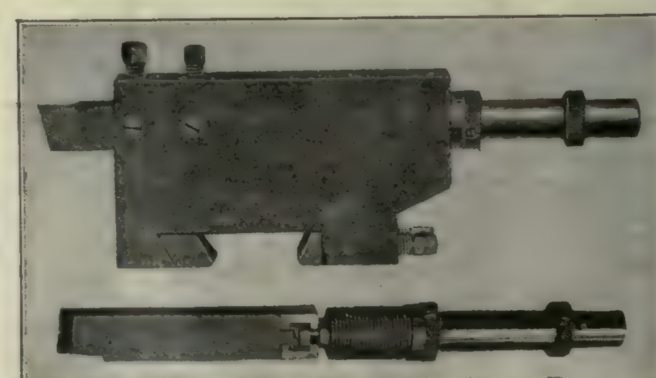


FIG. 4. DETAIL OF THE METHOD OF TOOL HOLDING, TOOL CLAMPING AND TOOL FEEDING

Under "Quality of Metal to Be Cut" it was pointed out above that all forgings were carefully inspected for variations in diameter. As a huge amount of stock was available, nothing but perfect specimens were ac-

cepted, so that the "diameter of work" was easily made a constant. This, too, was a feature that cannot easily be duplicated under ordinary conditions. Also the value of the diameter was such that it provided for easy interpretation in general shop practice.

The range of speeds and feeds are given in Table III.

TABLE III. CHARACTERISTICS OF MACHINE TOOLS USED

Spindle Speeds for 500 R.p.m. of Pulley	Feed per Revolution, Inches
25	0.166
45	0.120
75	0.090
120	0.054
200	0.040
325	0.030
...	0.018
...	0.013
...	0.010

A belt- and not a motor-driven machine was used, so that the choice of feeds and speeds to secure failure of the tool within a given period was somewhat limited. By establishing the cut-speed and depth of cut at the onset, a proper fed was, however, readily determined so that the "change of speed and feed possible" was eliminated as a contending factor.

Pulling and Feeding Power of the Machine Tool

Inspection of Fig. 3 will show a lathe of rugged construction. The geared headstock is of good strength, and the heavy bed, carriage, and feed mechanism provide for rigid support and taking of heavy strains. As a matter of fact, the load applied in the test did not at any time approach the possible duty of the machine. The unit used was a new machine that had only been "limbered up" preparatory to the test. No variations were therefore introduced due to the "pulling and feeding power of the machine tool."

It is generally conceded that in any undertaking the human element presents a very complex problem. This factor, therefore, received due attention and the personnel was made up not of one but of two operators who, in addition, were not only lathe hands but tool makers as well. Both men worked under constant supervision of a competent observer who was a technical graduate with years of practical experience. To further insure the accuracy of the test, other engineers checked the data and operations at frequent intervals so that the "human element" was made constant in so far as it was possible.

Variable Factors in the Tests

By a review of the above thirteen elements and the brief discussion of the manner in which they affected the test, it will be seen that only two—chemical composition of the tool, and duration or length of cut—remained variables. This condition, then, formed the basis of the test.

Possibly it will occur to the reader to ask, "How long did it take to run this test?" To answer this the following data are submitted:

The time that elapsed from the date on which it was decided to run the test until the work was all completed and the data compiled was five months, in round figures. The actual number of cylinders turned with the test tools was 1,251 while another 150 were machined by special tools in determining the correct feed and duration of cut for the test proper. All told, then, 1,400 cylinders, or 1,690 ft. of 5¾-in. medium-carbon steel, were machined in this test.

Employees' Want Ads Add to Interest in the Plant Paper

By Frank H. Williams

When a manufacturing concern issues a house organ or plant paper ostensibly "by and in the interests of our employees" the attitude of the editor is often too much that of an outsider looking in instead of an insider making the wheels go round. The editor puts into the publication what he thinks the employees should be interested in. And because his thinking is, quite frequently not correct, the employees have no interest in the paper; it is seldom read and is practically a waste of money.

Now the way to issue a plant paper "by and in the interest of the employees" is to put into it the material the employees want put into it. If they don't care a snap of their fingers about the opinions of the editor regarding this, that and the other thing, then, by all means, cut out all such stuff. But if they are interested in their own personal, intimate problems, then get some of these problems into the publication as quickly as possible.

One of the most effective and successful methods of giving a personal, intimate touch to the plant paper is by the use of free want ads by means of which the employees can offer for sale such things as they wish to dispose of.

Such acts will invariably arouse interest among the employees. Jim Smith wants to see what Bill Jones has to sell and Bill Jones is interested in seeing that Walter Brown is offering for sale the very thing he is looking for. In the very nature of things man's innate curiosity regarding his fellowmen and, particularly, his curiosity regarding his fellow employees, will make such a department read from beginning to end.

Furthermore such a department has a warmth and interest which column after column of admonitions to be careful in the use of tools and the values of punctuality, could never have.

But what sort of things would employees advertise for sale in such a department?

Well, here's a typical lot of want ads taken bodily from a department of this sort conducted in a plant paper:

FOR SALE—Child's iron bed, springs and mattress. Inquire of William Schulte, Sundries Stock Room.

FOR SALE—One Duntley Pneumatic Sweeper, in good condition, $2.00; one Richmond Vacuum Cleaner, A No. 1 condition, $25.00. If interested see Sundries Dept.

FOR SALE—Walter Mead used to be a chicken fancier, but for some unknown reason he has developed a strain of non-layers; consequently he has decided to quit the business. If you need a good fat hen for Sunday dinner, let him know.

FOR SALE—A large quantity of old nails, various sizes, one cent per pound. See the Sundries Scrap Dept.

FOR SALE—Bull terrier pups. See Harold Crudes, Factory office force.

FOR SALE—The motorcycle you have seen me come to work on during the past year. I have bought a Ford. W. E. Jenkins, Boiler Shop.

FOR SALE—Since the death of our infant son my wife and I have decided to break up housekeeping and go to boarding. We will sell all our household furniture. F. R. Smith, Pattern Shop.

Want ads like these give a lot of better insight into the doings of the employees signing the ads than would almost any number of "personals" in the daily papers. They have a real pull, a very real reader-

interest. In addition, of course, they are of a very decided benefit both to the advertisers and to the parties contemplating purchase of such goods as are advertised.

Want ads of this character are one way of giving the employees the things they want to get in the plant paper. It is one way of issuing the paper "by and in the interests of the employees." And the more things of this sort the editor of the plant paper can inject into the publication, the more interest the employees will take in the publication and the more they will respond to any suggestions that are made to them through the paper.

The "outside" attitude in the conduct of a plant paper is fatal to its success. It is the "inside" attitude—the attitude of working right with the men and trying to help them through the stuff that is put into the paper—that makes the employees wait with expectancy for the publication date and grab the paper with a real thrill when it does come out.

Preaching, nagging and suggesting from the men higher up never gets a plant paper anywhere, except into the ash heap. It never makes the employees feel anything but unkindly toward the paper, the editor and the people responsible for getting it out. So the farther away the editor gets from the preaching proposition the more of a success he will make of his task.

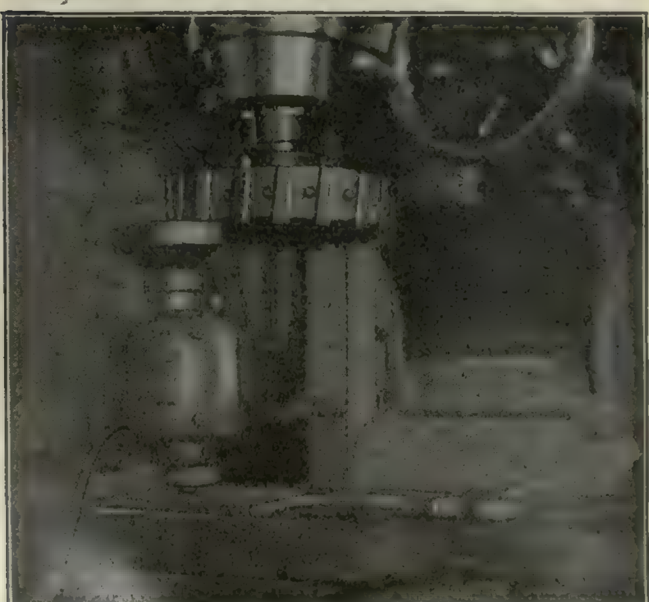
Try the "free want ad" column in the plant paper. Work it up by personal talks with the men, if necessary. Soon it will prove so useful to the men that it will need no assistance. And then watch how much more interest the employees take in the paper than they ever have before.

Grinding Milling Cutters in Place

By F. C. Hudson

The illustration shows the use of a portable electric grinder for sharpening the teeth of inserted milling cutters in place on the machine. The grinder is mounted in the milling machine vise with the wheel uppermost. Adjustment to and from the cutter is made by moving the knee of the machine up or down.

This enables each tooth to be ground to an even length and then the clearance is readily ground by tilting the grinding head to the desired angle. Feeding the table in and out on the knee grinds the clearance across the whole face of the tooth. This is one of the ingenious devices seen in the new shop of the Davenport Machine Tool Co., Rochester, N. Y.



GRINDING MILLING CUTTERS IN PLACE

Choosing Teachers for Vocational Schools

By William T. Elzinga

Vice Principal and Machinist in Charge Tamalpais Vocational School, Mill Valley, Cal.

The Tamalpais Vocational School was one of the first to be organized in the West under the Smith-Hughes act and has been in operation since 1917.

The following trades are taught: General machinist, toolmaking, electrical machinist, electrician, carpentry, joinery and mill work, and machine and tool drafting and design.

The machine shop produces special tools and attachments for firms in nearby cities and does many odd jobs for truck repair and jobbing shops, thereby giving its student apprentices practical commercial work and greatly reducing the net cost of conducting the school.

Tamalpais students do not worry about the amount of "credit" they will get for their school training, for they are much in demand in general machine shops, tool and die shops, garages, etc., and by gunsmiths, and instrument repairmen.

The organizers of the Tamalpais school, believing that the field for vocational training lay to a greater extent along the line of machinery building and the metal trades than any other, placed a machinist in charge; and it is in this respect, the writer believes, that other schools are making a mistake.

The old idea of the manual training school has persisted and many of our vocational schools, in this part of the country at least, are in charge of the same class of men as were at the head of the former schools—excellent builders of tabourets and coat hangers, but hardly possessing the broad vision and intensive mechanical training that is essential to success as a teacher of youth in the more intricate trades that make up the curricula of the vocational schools.

The object of the manual training school was not to teach a definite trade but to impart a degree of manual dexterity and inculcate a habit of application; the foundation, so to speak, upon which definite trades could later be built. For this purpose the wood worker was qualified, provided he possessed the knack of imparting information to others and the necessary personality to attract and hold the respect and attention of his pupils, but at best the effect of manual training, unless later supplemented by the teaching of a definite trade, was a smattering of knowledge of things mechanical and a tendency upon the part of the school graduates to develop into a jack-of-all-trades.

That the gravitation of this class of men toward positions of responsibility in vocational education, though natural, is, in the writer's estimation, a condition that is not likely to bring about the best possible results, and if we wish to reap the greatest benefit from the new law it behooves us all to use our voices and efforts to place in charge of these institutions the men who, by training and education, are best fitted to teach the trades the vocational schools are designed to impart.

Wheelbarrow Standards

By ELMER W. LEACH

This is not a story about stakes or standards for wheelbarrows or how they are made. Wheelbarrow standards may not be the same in all machine shops. Some men do their work as though they were pushing wheelbarrows; and they ought to be. Other men do their work only to the accuracy with which wheelbarrows are made; they too ought to be pushing wheelbarrows. Sometimes the boss is the instigator of such standards; he ought not to push a wheelbarrow, he should dig post holes—it's less abstruse.

EVERY mechanic or worker about a manufacturing plant who has ambition enough to be seriously looking forward to something better latter on has doubtless said to himself a thousand and one times, "Believe me, when I get into that little shop of my own, I'm going to run things a lot different from the way they're run around this place."

While we are still working for someone else, we constantly acquire knowledge which will assist us to a successful career when we do launch out for ourselves; and, if we keep our eyes open we also observe many systems, and practices which, in our opinion, "aren't just right." My partner and I had worked together in a large manufacturing plant for five years before we started in business for ourselves with a similar yet original line of machinery. During the time I had been in the war my partner had held a responsible position in a large factory devoted to war work. When I returned, and we worked out the details of carrying into reality the plans we had made long before, I, with army discipline and thoroughness still showing its effects, said, "We must be systematic" and my partner, profiting from his experience in meeting the exacting requirements in the manufacture of 155's and other ordnance, said, "We must be particular."

"Asking the men what they had been doing."

Our former employer had often made the remark to me, "Why should a fellow make wheelbarrows with the same precision as though they were Elgin watches?" He might have been right, if he had been making wheelbarrows, but his line of machinery was something far more complicated.

I have never been in a wheelbarrow plant, but I do not expect the men use micrometers or dial indicators in making the parts. And the entire force of some 200 men in this plant seemed to have caught the boss' idea of "wheelbarrow standards."

Working Without Blueprints

They were neither particular nor systematic. Their line of machines required about 600 different castings and 200 steel parts; and yet, with all this variety, not a single man in the shop had ever seen a blueprint of one of those several hundred parts. Instead of machining the parts as they should have been machined, the men were permitted to be content with turning them out "b'guess and b'God." And instead of assembling the machines as such work should have been done, they merely "slapped them together."

The men had no "mikes" because the foremen did not require them to work to such close measurements; and as for limits, the only limits I was ever able to observe were "the same as the last batch."

The time-keeping and cost-keeping department employed four or five people. One young man did nothing but write shop orders. A machinist would come to him and say, "I'm going to start in on 500 clutch pulleys now"; whereupon the young man would write out an order to machine 500 clutch pulleys. Along would come another fellow with the story, "I'm just starting in to mill 1,000 clutch dogs," and promptly he would get an order for the 1,000 dogs. Now every time a clutch pulley went onto a machine a clutch dog went also, and yet no one had ever assumed the responsibility of inquiring why a man should tie up the milling machine for two days, working on 500 more clutch dogs than there would be pulleys for when the parts got back to the assembly floor.

Another young man who ranked as time-keeper made several trips through the plant during the day asking the men what they had been doing and putting the dope down on yellow time slips. In this way he got a yellow sheet for milling the clutch dogs and two more for the two turning operations on them. He would wait a couple of days for safety and then compute the cost of a clutch dog.

But usually about a week later another yellow slip would come straggling in showing up a drilling opera-

tion on clutch dogs. There was the rub! He had waited until no more yellow sheets came in on clutch dogs and so supposed the parts were finished. No one had ever assumed the responsibility of learning just how many operations there were in machining a clutch dog and just what they were.

I suggested once to the boss that we get after just that information, and he threw up his hands in holy horror and exclaimed, "What! on 800 different parts? Why it would take ten clerks to get the dope and ten more to keep it up to date."

Things That Are Right and Things That Are Wrong

And so all along down the line the plant was permitted to run along in that easy-going, slip-shod manner.

Men, that sort of thing is wrong, all wrong. Those people have been successful not because of themselves but in spite of themselves. Right down the center of this whole universe is a straight line, and on one side of it are things which are right, and on the other side of it are things which are wrong. Old Kaiser Bill tried to mix up the system and put some of the wrong things over on the right side, and he got himself "in Dutch" both figuratively and literally. And men who are satisfied to run perfectly good machine shops on half production or less by being content with "wheelbarrow standards" are deliberately mussing up the system by trying to make something right out of something that is unmistakably wrong. Temporarily those people are fooling themselves, but they aren't fooling their customers. I know—for I've sold their goods on both coasts. And that was the plant where my partner and I "grew up" in the manufacturing game. No wonder we want to be systematic and particular in our own shop.

"I give him that card to-gether with a blue-print."

We have now been in the game for ourselves for nearly a year, and we have five men on the payroll besides ourselves. Just a small shop, you see, but we've got a shop that we are proud of, and we've developed a business which has sent our goods all over this country and overseas too.

Common-Sense System

What bits of system we use in our plant I like to call "common-sense system." Some day I plan to write a book on "Sensible System for Small Shops." It would at least have a pretty title. But seriously, I have tried to make our methods sensible and very definite so we would always know just where we stood and where we were getting; or, in other words, so we could tell what the men were doing, when they had done it, and how much it had cost us.

In the first place, on our sixty or seventy-five different parts we know just how many operations there are to each one, and on just what machine tools they are performed. Now, from our job cards we know what the operations are costing, and when a man falls very far below the average we find out what the trouble is.

It is an easy matter to order the castings from the foundry in the proper quantities to complete a specified number of machines, and the individual jobs for each man and each machine tool are laid out for days ahead so that the stuff will come to the assembly benches in the right order, in the correct amounts, and at the right time.

Under our system if we were to machine 500 clutch dogs, I would make out a card which I call a Factory order and on which the four operations would be listed with places for dates completed and cost of each. Four job cards would then be made out, one for each operation, and filed on a rack according to the machine tool on which the job is to be done.

So the milling machine man doesn't come to me and tell me he is going to start in on some clutch dogs. When he comes for a job I see what card is on top on the milling file, and I give him that card together with a blueprint mounted on sheet metal and protected from dirt and grease with a good coat of shellac. When a man turns in a job card, I check it off on the factory order and put down the cost of each piece. When we want to know what is holding up certain parts we can tell at a glance just what has been done on them to date. On the clutch dogs, supposing we made such pieces, when four job cards had been turned in and checked off we would know definitely that the clutch dogs were finished. Now there may not be another shop that could handle its job routing and time keeping exactly as we do; but here is the idea—it's clean-cut, and it's definite.

Man-Hours Can Be Computed

Then too, by knowing the various operations, we are able to compute the man-hours for each machine tool for any desired production. When we were making but one machine, I figured that there were 80 man-hours of milling machine work for each hundred machines made. Our shop runs 54 hours a week, so I knew we could not possibly turn out more than 270 machines a month.

Consequently, when we desired to increase our production beyond that figure we didn't blindly buy two or three new lathes with a vague idea that they would help us get out more machines. We knew exactly what to do. The milling machine had to be relieved, so we bought a small shaper and turned some of the milling machine work over to it.

As for our being particular, our drawings give measurements in thousandths and show allowed limits on all finished surfaces. The men set up the jobs with indicators and measure their work with micrometers.

It pays many times over when the parts come to the assembly benches, and the assemblymen know for certainty that the parts will surely fit without a lot of filing and grinding and cussing.

Men do not go into business for the fun of it. In fact, there isn't so much fun in being in business as there is work—and downright, honest, hard work at that. No, men go into business to make money.

So we would not bother with any system at all nor hold our men to any degree of exactness if we were losing money by it. We're not losing money by it—we're saving money.

It shows up all down the line. As soon as the men get the idea they take pride in their careful work and in the neat, exact machines they turn out. And our customers are intelligent enough to notice the quality of our products.

"Built up to a standard, not down to a price," is the little expression we have taken as our slogan, and it is not an advertising idea alone, but the definite policy and guarantee of our company. We have shipped out hundreds of machines in the past year, and not a single one of them has ever come back.

Now there is a lesson in this little article to every single individual who may chance to read it, no matter whether you are in business for yourself, or whether you are working for the fellow who is in business. Just take a little tip from one who has gone through the experience and has seen the results. Be systematic. Be particular. You'll find it's worth while.

Packing Machinery for Export

By B. Caldwell

Probably the most often-repeated complaint of foreign users of American machinery is that the manufacturers do not properly pack their machines for export. Stevedores in loading vessels are apt to handle heavy crates of machinery rather roughly and when lowered to within two or three feet of their resting place in the vessel's hold are prone to let them come down with "a run." Then, too, slings are not always put around crates in the proper places and when the crates are badly balanced it is not uncommon to have them slip out of the slings. This and the breaking of slings is severe on the strength of the package and the method of packing.

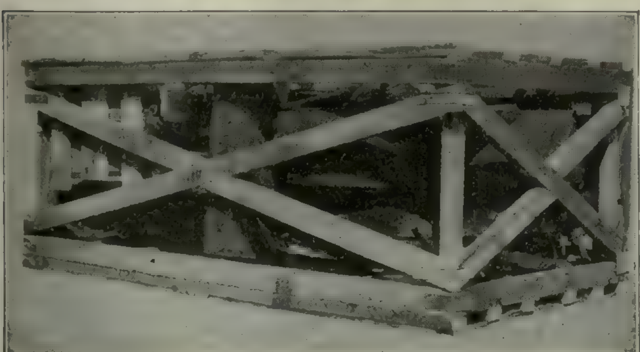


FIG. 1. TRACTOR IN SKELETON CRATE

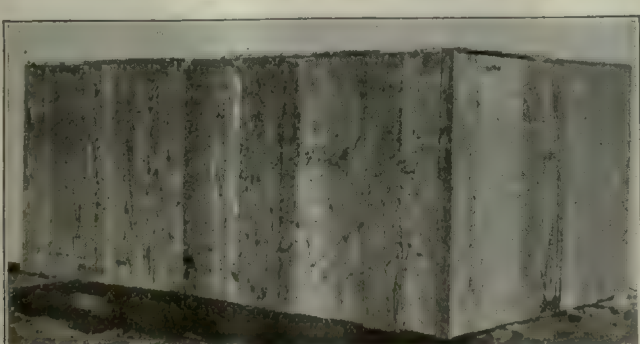


FIG. 2. THE COMPLETED CRATE

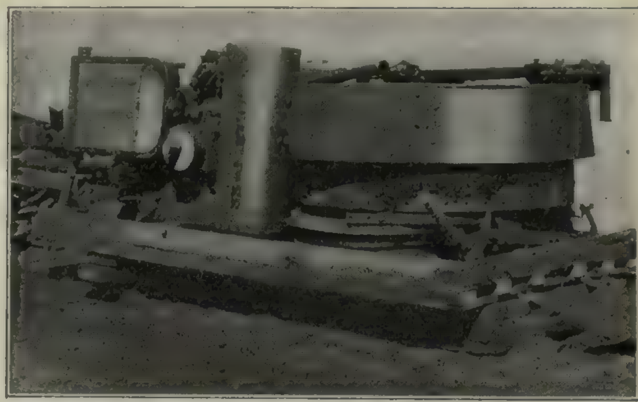


FIG. 3. AFTER THE TOP, SIDES AND ENDS OF THE CRATE HAVE BEEN REMOVED

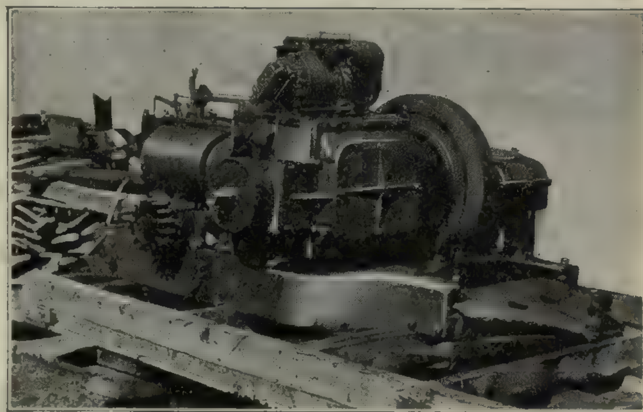


FIG. 4. THE MOTOR AND FRAME
(After removing other parts from the crate)

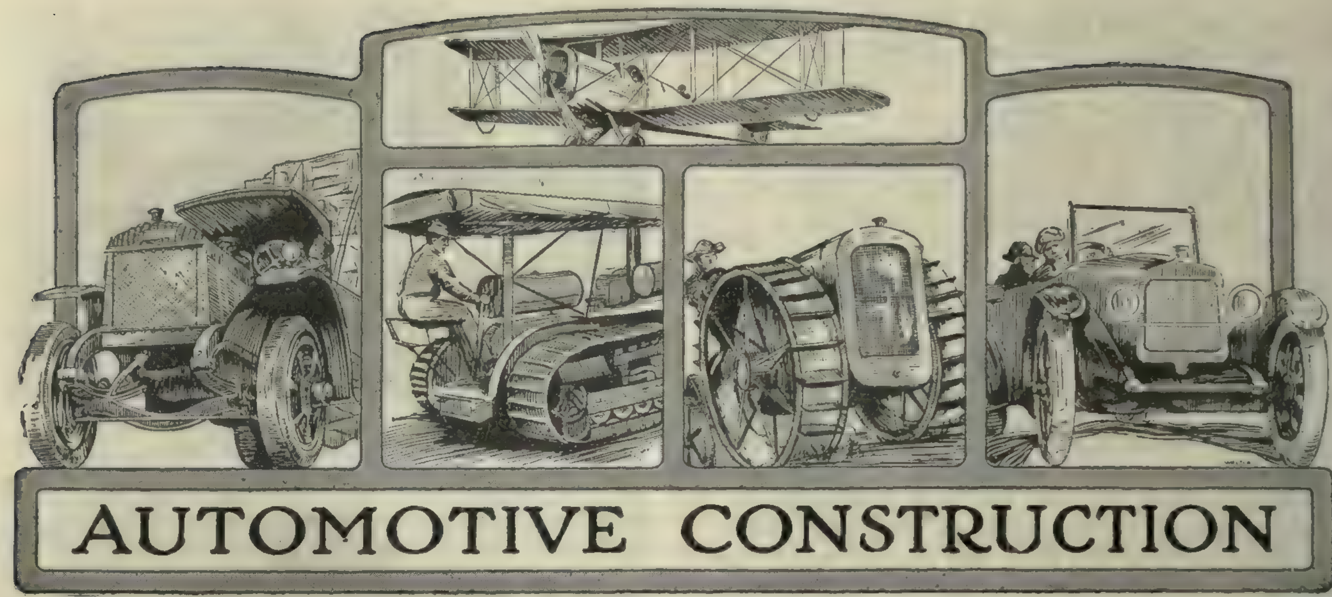
Many articles have been written on how to pack machinery for export properly, some of which have appeared from time to time in the *American Machinist*. It is seldom, however, that we are able to present to our readers better illustrations of good export packing than the ones here shown which represent the method used by the Hart-Parr Company, Charles City, Iowa, in packing its tractors for export. A complete tractor is contained in the crate in the illustration, the crate having a measurement of 278 cubic feet.

The Woes of a Checker

By Henry R. Bowman

A checker has to find other people's mistakes. If he finds any, the one who made them gets peeved; if he doesn't find them and they go through, the man higher up gets peeved and calls the checker up (or down) on the carpet; the men in the shop chuckle with glee and the man who made the mistake asks him why in blazes he didn't catch it, as that's what he's paid for.

He has to know more than a query column editor; carries the responsibilities of the world on his shoulders, and gets about the same pay as the colored "gemmen" that whacks a mule.



Liberty Motor Connecting-Rods

By H. A. CARHART, M. E.,
Lincoln Motor Co., Detroit, Mich.

The machining of Liberty motor parts involves many problems which are similar to those used in other motors and which for this reason are of special interest. In order to give as much data as possible in condensed form, we have adopted the new method of presentation shown herewith.

The connecting-rods for the Liberty motor present numerous production problems, as can be seen from the construction of the rod in Fig. 1. The center or plain rod is comparatively easy, but the various operations on the forked rod require many special fixtures and tools. The variation in the forgings made it necessary to lay out the rods so as to be sure that the proper distances would be secured from the small end or piston-pin boss. This operation was performed in the fixture, shown in Fig. 2, which consisted of a cast-iron plate 16 in. square, on which were mounted one stationary and one movable block. Through the center of the block *A* is an eye-bolt *B* which, when used in conjunction with the pin and thumb nut *C*, clamps the previously milled locating spot on the fork so that the templet *D* can be used for checking the length and location of the bolt bosses, as well as the distance from the bosses to the locating spot on the piston-pin boss. The side of the fork was then covered with blue chalk and a marking tool used to give the proper location from the top of the bolt boss. This marking is used in locating the rod in the fixture on the next operation.

FIG. 1. THE CONNECTING-RODS

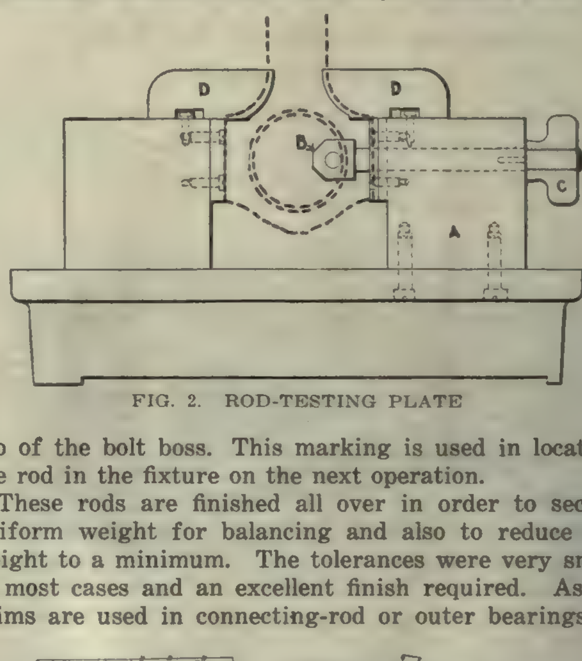


FIG. 2. ROD-TESTING PLATE

These rods are finished all over in order to secure uniform weight for balancing and also to reduce the weight to a minimum. The tolerances were very small in most cases and an excellent finish required. As no shims are used in connecting-rod or outer bearings in

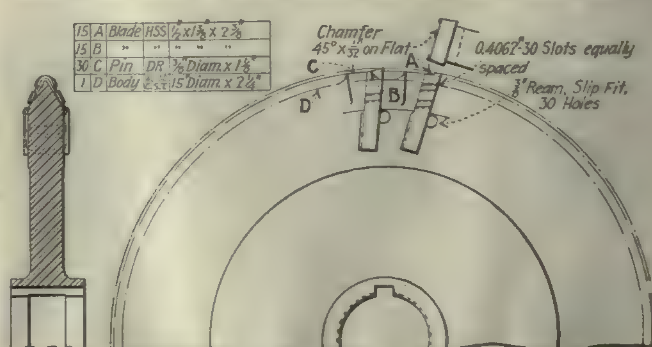


FIG. 4. DETAILS OF MILLING CUTTER

AUTOMOTIVE CONSTRUCTION

airplane practice, the cap which is cut from the end of the rod, is bolted solidly to the rod and is considered as a part of it in future operations. The cap and rod are numbered so that the proper parts may be kept together up to and including the final assembly of the motor.

The fixtures used in the various operations on the connecting-rod are shown for the most part in the half-

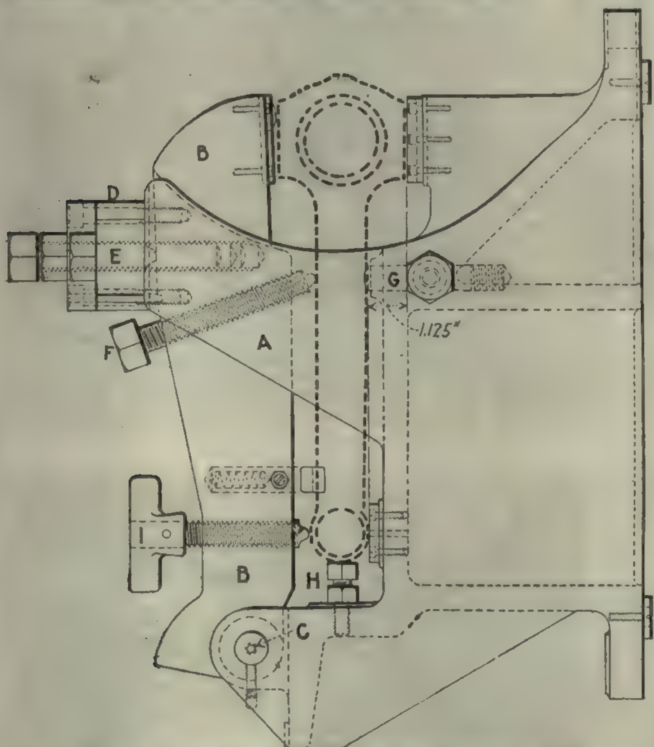


FIG. 3. MILLING FIXTURE FOR FORKED END

tone reproductions. Some of these are, however, shown in detail in order to illustrate how some of the production problems were solved.

Details of the holding fixture are shown in Fig. 3. This must necessarily be a substantial fixture, as it withstands the cutting stress of milling out the forked end. This consists of a heavy casting *A* with horns

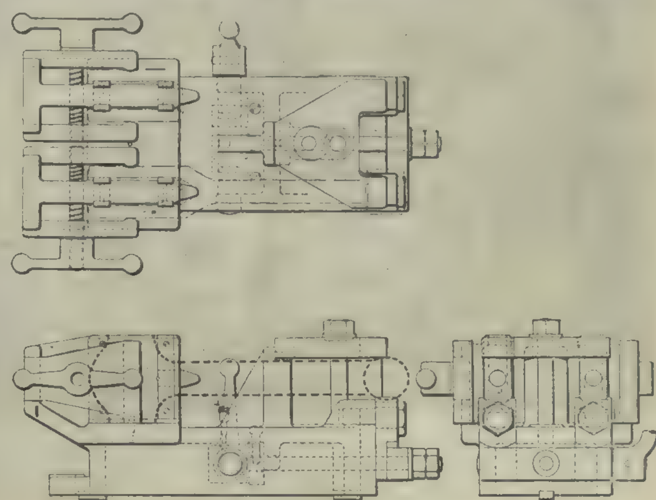


FIG. 5. STRADDLE-MILLING FIXTURE

which project upward to guide the clamping bar *B*, which is hinged at *C*. This carries hardened-steel jaws which clamps the sides of the large end of the rod.

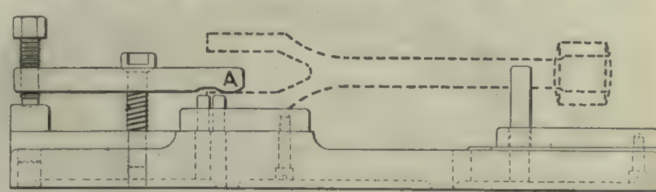
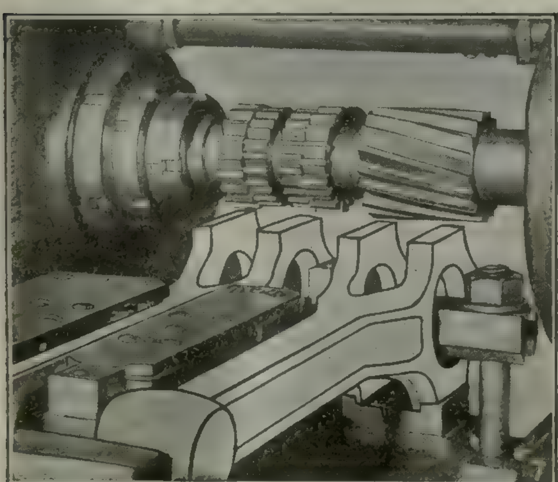


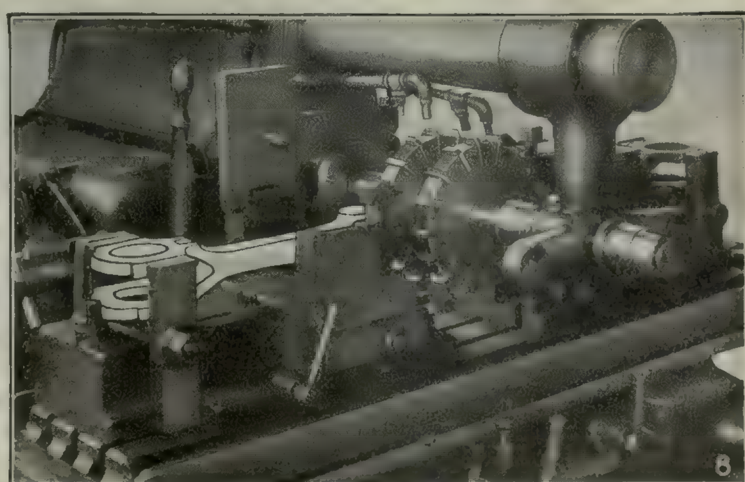
FIG. 6. FIXTURE FOR STRAIGHTENING ROD

Across the top of the fixture is the heavy strap *D*, by means of which the setscrew *E* forces the arm *B* down onto the rod. The screw *F* also helps to steady the rod, the support *G* acting on the opposite side. The small



MILL LOCATING AND CLAMPING SURFACES ON LARGE END OF ROD. BOTH TOP AND BOTTOM OF FORK

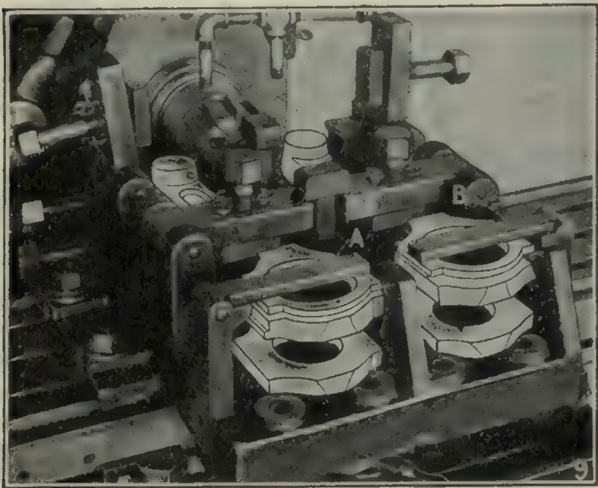
Model A Briggs milling machine; $1\frac{3}{4}$-in. arbor; five cutters; two 3 x $3\frac{1}{2}$-in. side mills; two $2\frac{3}{4}$ x $\frac{1}{2}$-in. plain cutters; one 3 x 3-in. spiral slab mill. Rods are clamped on channel, located lengthwise against pin at piston-pin end. Locating surface milled on one side; rod is then turned and clamping surface milled. Cutter speed, 51 r.p.m. feed, 0.039 in. per revolution. Production, 150 rods per 9 hr. per machine



MILL LOCATING SURFACE ON PISTON-PIN BOSS

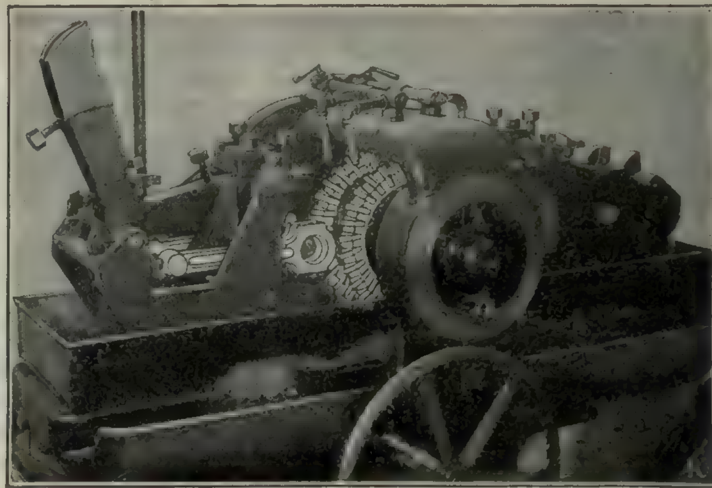
No. 2 Cincinnati milling machine; $1\frac{1}{2}$-in. arbor; two 8-in. inserted-blade cutters. Two fixtures one rod clamped in each. Located by V-block at small end and surface milled on fork Cutter speed, 55 r.p.m.; feed, 0.043 in. per revolution. Capacity, 450 rods in 9 hr. per machine.

AUTOMOTIVE CONSTRUCTION



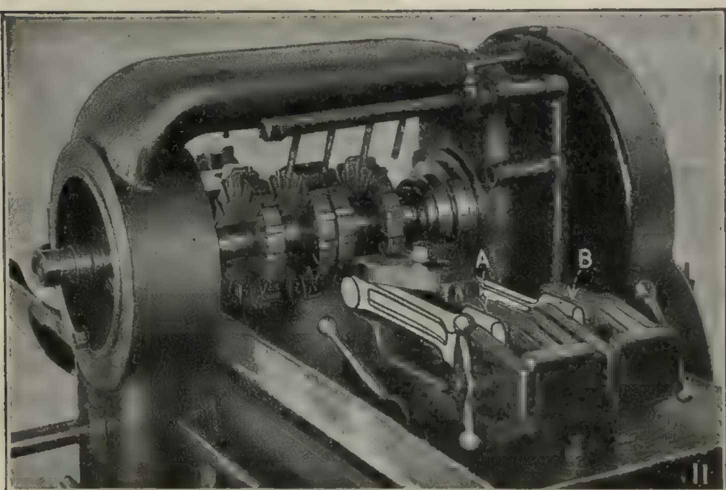
MILL LOCATING SPOT ON TOP OF PISTON-PIN BOSS

No. 2 Cincinnati milling machine with adapter and 4-in. end mill. Two rods in fixture, clamped on channel section. Rods located by templets *A* and *B* and previous markings. Cutter speed, 60 ft. per minute; feed, 0.043 in. per revolution. Production, 650 to 700 rods in 9 hr. per machine.



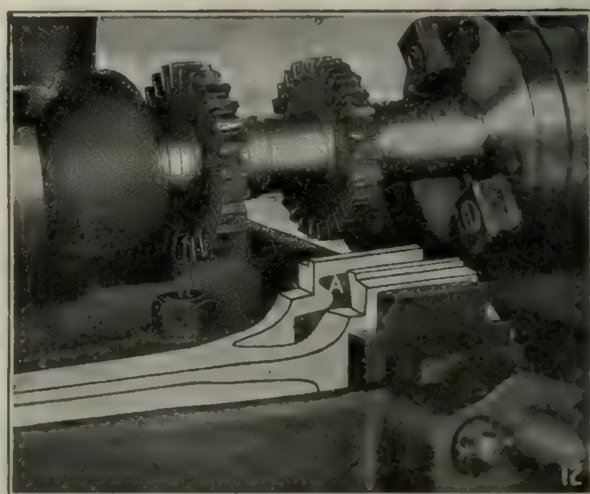
ROUGH-MILL INSIDE OF FORKS AND FINISH-BOTTOM

Model B Briggs milling machine; $2\frac{1}{2}$-in. arbor; two 14-in. inserted-blade cutters, 25-deg. angle blade, $\frac{1}{4}$-in. radius on point. Large, double fixture; two fixtures to machine; rods located by bolt bosses and sides of pin boss and spot on end. Details in Fig. 2. Cutting speed, 60 ft. per minute; feed, 0.054 in. per revolution. Production, 150 rods in 9 hr. per machine.



ROUGH-MILL ENDS OF PISTON-PIN

Model B Briggs milling machine; $1\frac{1}{2}$-in. arbor; four 8-in. cutters. Rod located by tongues *A* and *B*, with hardened inserts inside fork. Hardened pin fits bottom of fork. Small end rests on equalizing blocks. Cutting speed, 80 ft. per minute; feed, 0.023 in. per revolution. Production, 550 rods in 9 hr. per machine. Finish-milled in same way.



STRADDLE-MILL END OF BOLT BOSSES

No. 2 Cincinnati milling machine; 1-in. arbor; two 4 x $\frac{5}{8}$-in. side mills. Two fixtures. Clamp bolt boss with spacing block *A* between forks, drawn against outside of fork. Small end supported by hardened ground pins. Second cut located from first cut. Cutting speed, 60 ft. per minute; feed, 0.090 in. per revolution. Production, 275 rods in 9 hr. per machine.

end comes in contact with the stop screws *H*, while the large thumb screw *I* holds this end in place.

Details of the milling cutter for machining the inside of the fork are shown in Fig. 4. The outside diameter is 15 in. and it is interesting to note how well the cutters are supported, the body being only $\frac{1}{16}$ in. smaller than the cutter itself. An interesting straddle-milling fixture is shown in Fig. 5.

Even with the utmost care, there was a tendency for the rod to twist slightly out of shape after the milling of the inside of the channel which made the H-section. This required a special straightening operation, the rod being clamped on the fixture, Fig. 6, by one fork at *A*, locating against the outside of the fork, and kept in that position.

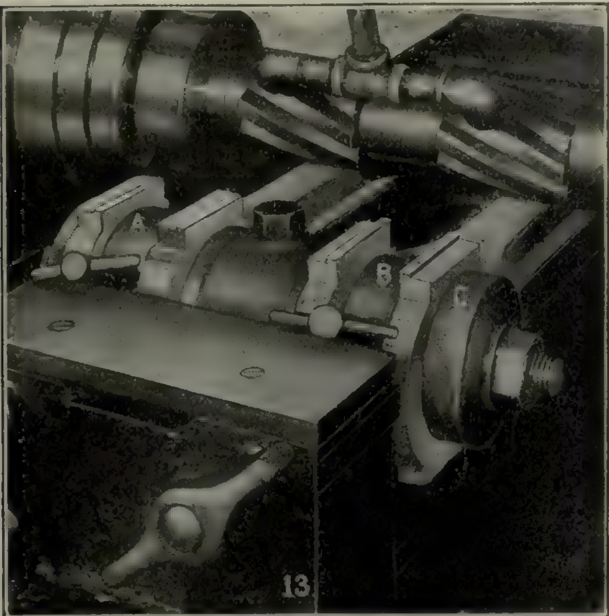
A $\frac{1}{2}$-in. lead hole is drilled in the piston-pin boss to guide the larger drill, a man or woman handling 500 rods in a 9-hr. working day, with a cutting speed of 45 ft. per minute and a feed of 0.005 in. per revolution.

After the milling of the slope of the channel and the channel edges, the rods are burred all over, using a flat mill file, steel scrapers, and rubbing with sandpaper to remove all sharp edges. One man can burr 115 rods in 9 hrs. Careful inspection then follows to see that all dimensions check with the gages, the thickness of the web at the crotch being checked with micrometers.

The rod is next sandblasted to give an even finish, blending all surfaces. A Sly rotary-table sandblast is used with an 8-ft. table holding 150 rods. Each rod is turned four times so as to face the blast, two men requiring 48 min. for this work. White silica sand and a pressure of 190 lb. is used.

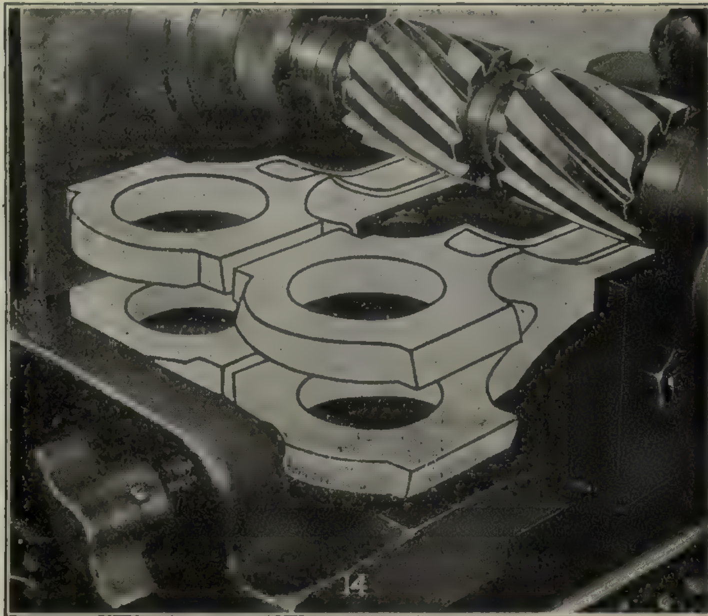
Owing to the light silver-gray color after sandblasting, cracks and other defects are easily detected, so that the rods are again inspected for this purpose.

AUTOMOTIVE CONSTRUCTION



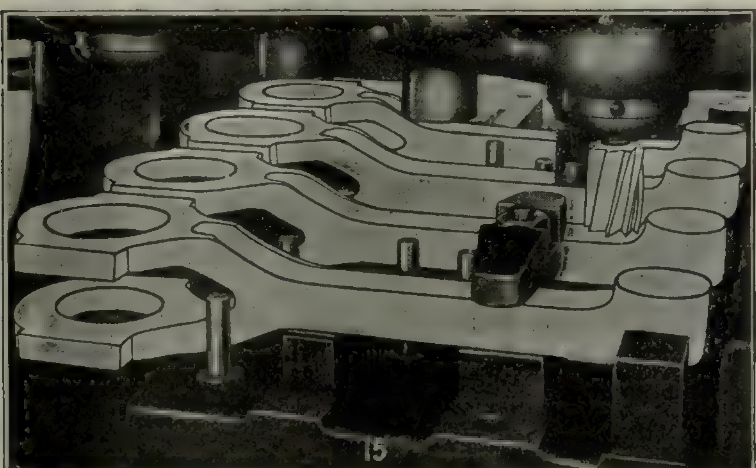
ROUGH-MILL SIDE OF CHANNEL AND RADIUS AT FORK

No. 2 Cincinnati milling machine; $1\frac{1}{4}$-in. arbor; two $2\frac{3}{8}$ x $2\frac{7}{8}$-in. spiral slab mills. Located by top of bolt boss and side of piston-pin boss. Then turn, locating against end of bolt boss and side of channel. Held by bolts through spacers *A* and *B* and clamping washer *C*. Cutting speed, 60 ft. per minute; feed, 0.070 in. per revolution. Production, 120 in 9 hr. per machine, roughing; finishing, 150 rods in 9 hr. per machine.



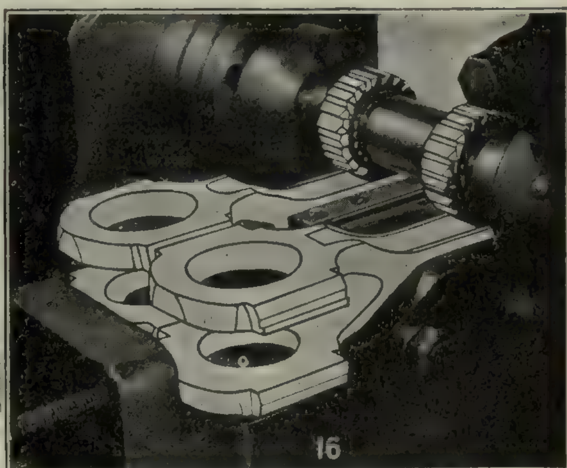
MILL EDGES OF CHANNEL

No. 1 Cincinnati cone milling machine; $1\frac{1}{4}$-in. arbor; two $2\frac{3}{8}$ x $2\frac{7}{8}$-in. spiral slab mills. Located on first cut by side of fork and end of piston-pin boss. Second cut in other side of fixture; located from edges just milled; clamped by channel sides Cutting speeds, 90 ft. per minute; feed, 0.090 in. per revolution. Production, 250 rods in 9 hr. per machine.



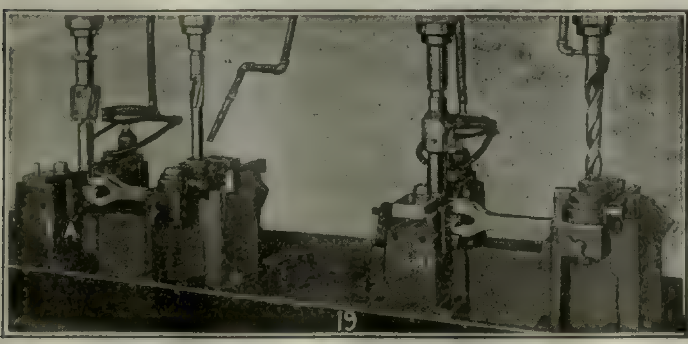
PROFILE EDGES OF CHANNEL NEAR PISTON-PIN BOSS

No. 12 Leland-Gifford profiling machine; $1\frac{1}{4}$-in. end mill. Located on edges of channel. Cutting speed, 125 ft. per minute, hand feed. Production, 600 rods in 9 hr. per machine.



MILL CHANNEL

No. 2 Cincinnati milling machine; $1\frac{1}{4}$-in. arbor; two 3-in. special side-milling cutters on first cut. Locates on edge of channel and end of bolt boss; clamps on sides of channel. Second cut locates on web of channel and end of bolt boss. Cutting speed, 65 ft. per min.; feed, 0.035 in. per rev. Production, 150 rods daily.



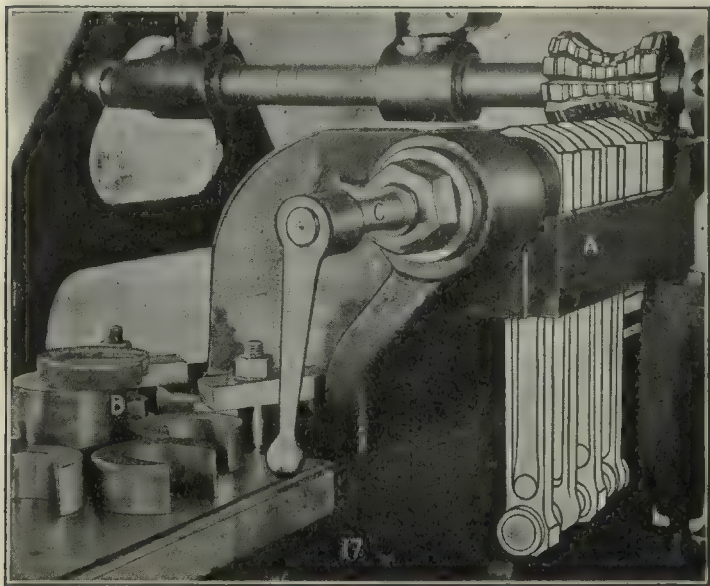
ROUGH-BORE LARGE END; DRILL AND REAM SMALL END

Four-spindle Foote-Burt drilling machine; Wiard chucks. Boring bar, 2.750 in. for large end; drill, $1\frac{11}{32}$-in. bore in small end. Second, reamers, 2.814 in. and 1.40 in., are used; hollow spacers *A* between forks. Cutting speed, 45 ft. ped minute; feed, 0.016 in. per revoluton. Production, 90 rods in 9 hr. per fixture.

HOLLOW-MILL PISTON-PIN BOSS

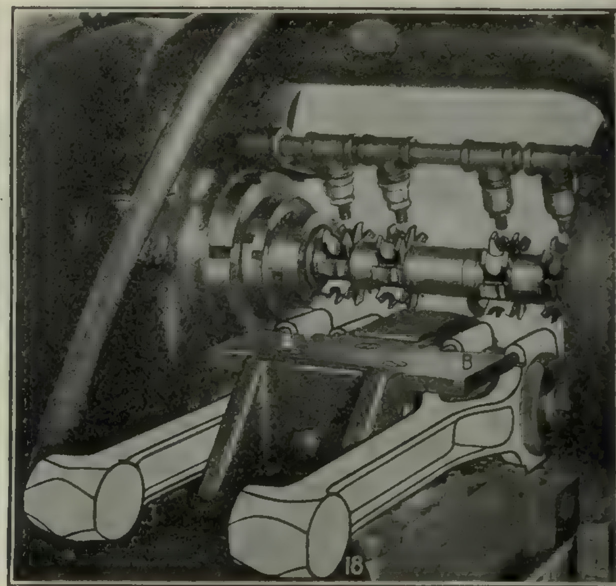
No. 310 Baker drilling machine; hollow-mill with bushing which runs on center guide *A* projecting through connecting-rod. Stop pin prevents rod from turning. Cutting speed, 45 ft. per minute; feed, 0.020 in. per revolution. Production, 500 rods in 9 hr. per machine. Finished in same way.

AUTOMOTIVE CONSTRUCTION



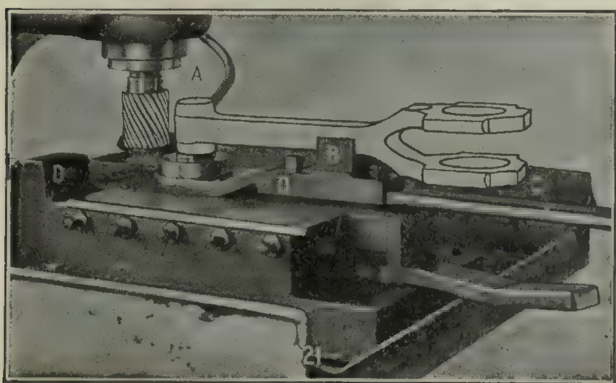
FORM-MILL CAP ENDS

No. 3 Cincinnati milling machine; $1\frac{1}{4}$-in. arbor; interlocking form cutter. Suspended from bolt bosses, locating at sides shown at *A*. Held by spacing washers *B* and drawbar *C* through hole. Cutting speed, 75 ft. per minute; feed, 0.022 in. per revolution. Production, 225 rods in 9 hr. per machine.



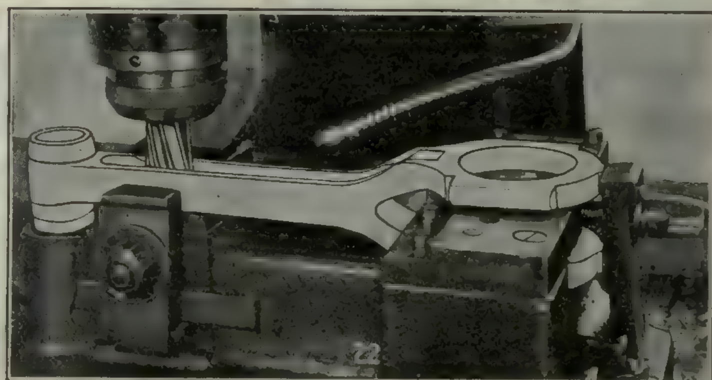
FORM-MILL BOLT BOSSES

No. 3 Model A Briggs milling machine; 1-in. arbor; four form cutters, $2\frac{3}{4}$ in. in diameter. Double fixture locating from side of channel and end of bolt bosses Spacers between forks, rods clamped against spacers and washers. Cutter thrust taken by stops *A* and *B*. Cutting speed, 50 ft. per minute; feed 0.051 in. per revolution. Production, 150 rods in 9 hr. per machine.



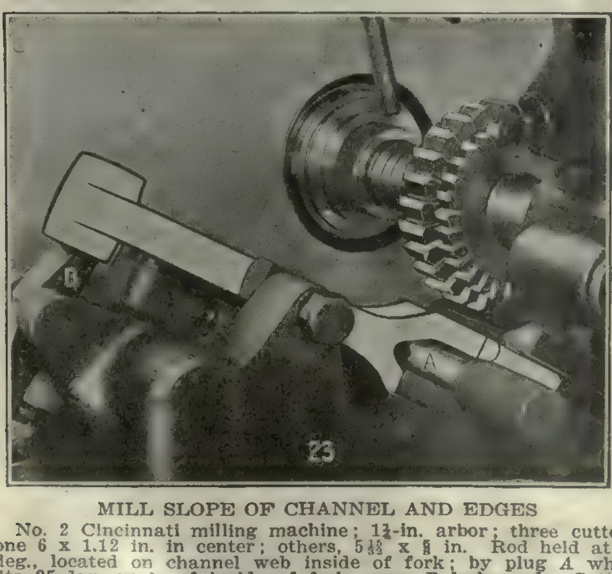
MILL OUTSIDE SMALL BOSS

No. 22 Garvin vertical milling machine; 2-in. left-hand spiral mill. Rod held on pilot pin *A* and fits in block *B*. Fixture swings by hand around mill, using lever *C* to stop *D*. Cutting speed, 135 ft. per minute Production, 250 in 9 hr. per machine.



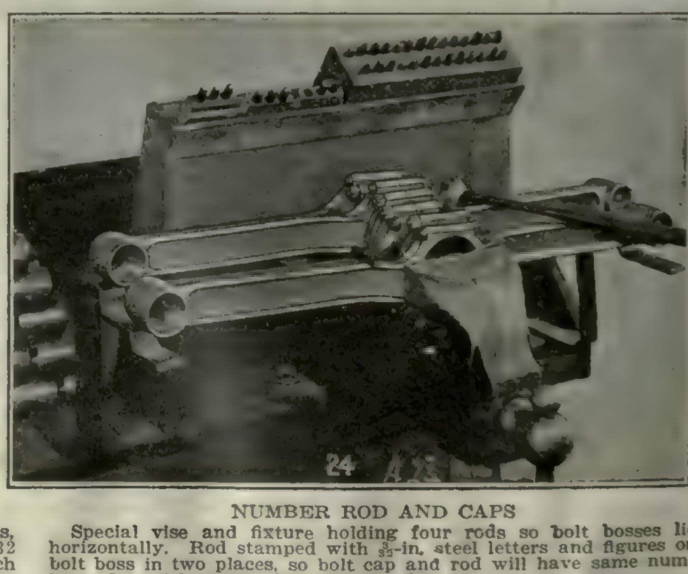
ROUGH- AND FINISH-MILL CHANNEL, PISTON-PIN END

No. 2 back-geared Cincinnati milling machine. End mill, 1.115 in. diameter; No. 10 B & S taper shank. Rod located against edges of channel and pilot in piston-pin hole. One Becker milling machine also used. Cutting speed, 60 ft. per minute, hand feed. Production, 180 rods in 9 hr. per machine.



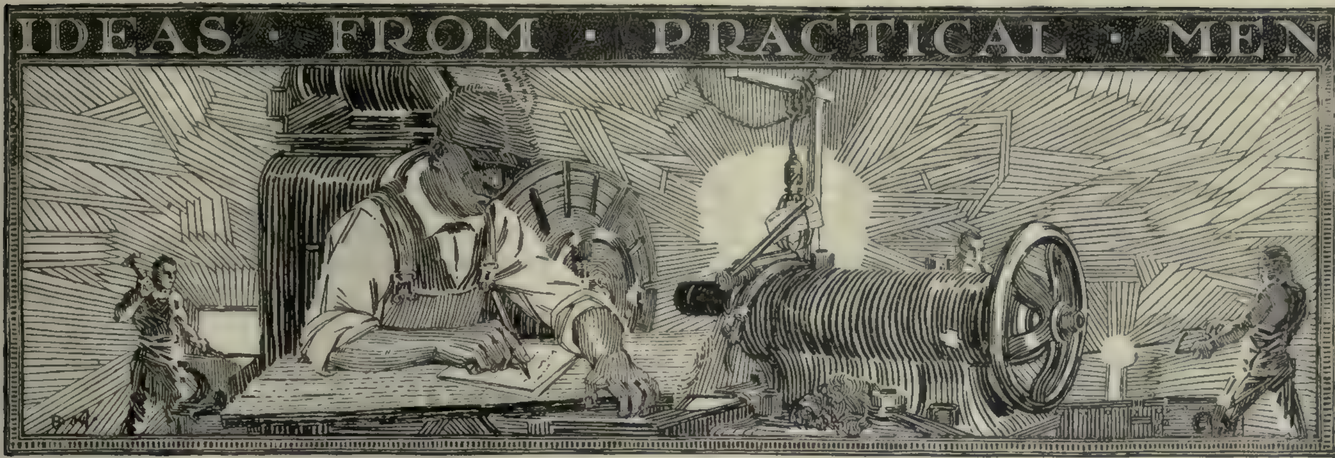
MILL SLOPE OF CHANNEL AND EDGES

No. 2 Cincinnati milling machine; $1\frac{1}{4}$-in. arbor; three cutters, one 6 x 1.12 in. in center; others, $5\frac{13}{32}$ x $\frac{5}{8}$ in. Rod held at 32 deg., located on channel web inside of fork; by plug *A* which fits 25-deg. angle of inside of fork; arm *B* locks rod. Cutting speed, 55 ft. per minute; feed, 0.043 in. per revolution.



NUMBER ROD AND CAPS

Special vise and fixture holding four rods so bolt bosses lie horizontally. Rod stamped with $\frac{3}{32}$-in. steel letters and figures on bolt boss in two places, so bolt cap and rod will have same number. One girl stamps 600 rods per day.



An Extension for a Steel Scale

By E. A. Dixie

The illustrations show an exceedingly handy little attachment for the ordinary steel scale. At first glance one would conclude that it is the product of some Yankee mechanic's brain; however, it belongs to an English lathe-hand who assured me that it was in common use in the shops in the town in England whence he came.

In Fig. 1 the parts are shown. *A* is an ordinary 6-in. scale. Near one end there is a rectangular opening $\frac{3}{4}$ in. long by $\frac{1}{4}$ in. wide. The scale shown is a hardened one and the opening was drilled and then filled in it. A flat drill was made and the extreme tip hardened and drawn very slightly. If such a drill is run at slow speed without any lubricant it will drill anything which is softer than itself.

The member *B*, which is the extension, is made of a piece of $\frac{3}{16}$-in. round drill rod ("silver steel" to our British cousins). It is milled flat on one side so that its section is half a circle. One end is split and spread as shown. The other end is shaped to a point. In total length the extension is the same as the scale. The forked ends are filed or ground so they match up with the one end of the scale while the pointed end matches with the other.

The member *C* is a piece of thin-steel tubing whose outside diameter is $\frac{1}{4}$ in. and whose length is $\frac{3}{4}$ in., corresponding with the width and length of the slot in *A*. The bore of *C* is very slightly larger than the diameter of the drill rod from which *B* was made.

The member *D* is a small flat spring made of steel, 0.021 in. thick and $1\frac{1}{2}$ in. long.

To assemble the device, the member *D* is put in the member *C* and the member *C* is then inserted in the slot in the scale *A*. The extension *B* is then pushed through the hole in *C*, where it projects through the slot in the scale *A*. The tool then appears as shown in Figs. 2 and 3.

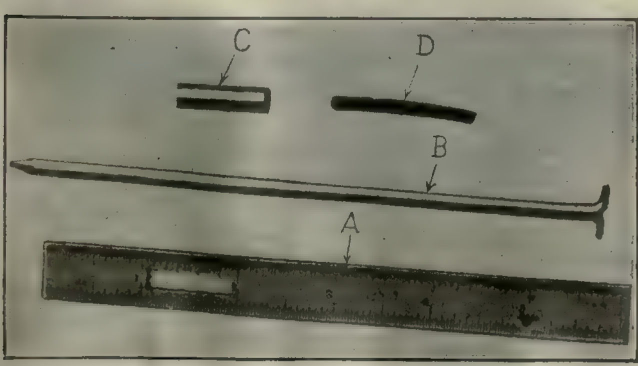
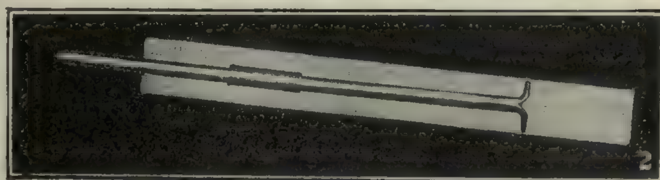


FIG. 1. THE SCALE AND EXTENSION

The ends of the forks indicate the amount that the pointed end projects beyond the end of the scale, the reading being taken from the graduations on the scale.

When using the device as a depth gage the extension is pushed out beyond the amount equivalent to the depth of the hole or recess to be measured. The pointed end is then inserted into the hole or recess and when the pointed end strikes the bottom the extension slides through the member *C* until the end of the scale touches the face of the work. The fork ends then register the depth of the hole or recess. The small spring *D* affords sufficient friction to hold the extension and the scale quite firmly together.



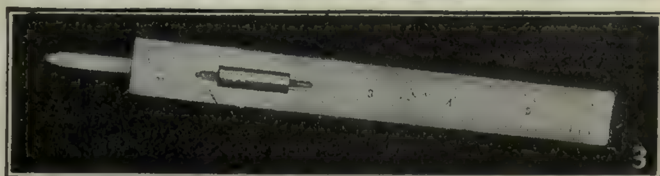


FIG. 2. FRONT OF SCALE AND EXTENSION. FIG. 3. BACK OF SCALE AND EXTENSION

For taking the thickness of internal flanges or the distance from a working face to a radial recess in a bored hole the tool is assembled with the forked end beyond the end of the scale. The part to be measured takes its position between the end of the scale and the inside of one of the fork ends. The pointed end indicates the thickness of this internal flange plus the width of the forked end. It will facilitate matters if the fork ends are made some definite width, say $\frac{1}{8}$ in., which can readily be subtracted from the reading on the scale.

If any of the readers wish to make such a tool they can cut the rectangular hole in a hardened steel scale very easily in the following manner:

Coat the entire scale with asphalt varnish. This is the common black varnish which is often called "stove"

varnish. When the varnish is set, so that it is too hard to be "tacky" but not entirely dry, lay off and scribe the required rectangle on both sides of the scale. Make the scribe marks right down to the steel and be sure to have the two rectangles opposite each other. Another thing to avoid is letting the varnish set so long before scribing the rectangles that it becomes hard and brittle. For when in this state, even with the greatest care in scribing, the varnish will chip and flake off and leave an irregular rectangle. One must also be careful not to scratch the varnish off any other part of the scale so that the bare steel appears.

When the rectangles are properly scribed place the scale in a wide-mouthed bottle containing a solution prepared of 1 oz. of nitric acid to 4 oz. of water. The acid will eat the steel where it is exposed and the rectangle will drop out. The length of time necessary depends on the steel itself, the strength of the acid (strong acid does not always attack steel faster than weak) the thickness of the steel and the temperature at the time when the work is done. Heat accelerates chemical action and cold retards it, but in an attempt to hurry such a job do not overheat the work or the varnish will soften and run and you may spoil the whole job.

When the piece drops out remove the work and wash it very thoroughly in water. A little washing soda in the water will help to "kill" any acid that remains.

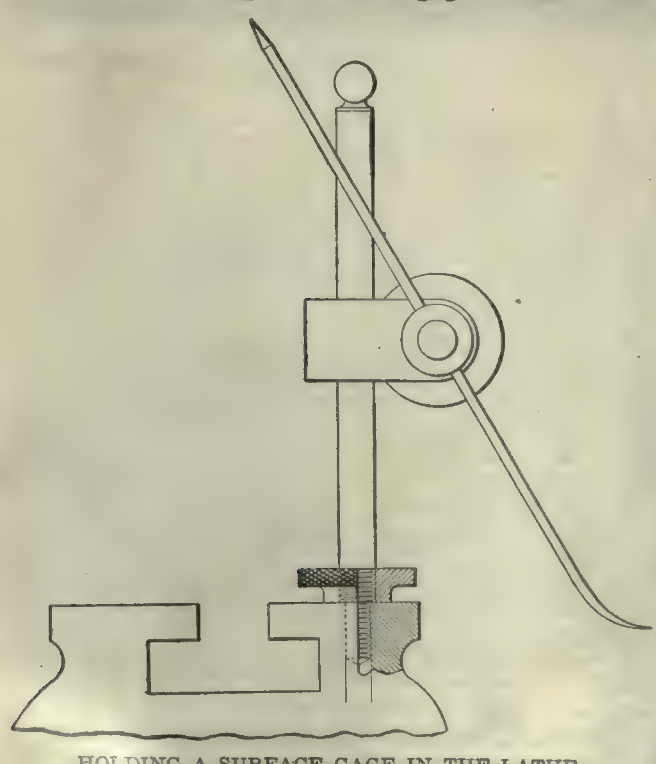
The rough edges of the etched hole can now be finished with a file.

Surface-Gage Adapter for Tool Slide of Lathe

By H. H. Parker

It is sometimes convenient to use a surface gage around a lathe but rather difficult in some cases to clamp its base to the tool slide.

The illustration shows a special upright the same diameter as the regular surface-gage column. The



HOLDING A SURFACE GAGE IN THE LATHE

lower part is turned down for about half an inch of its length to a diameter of ¼ in. and threaded. The upright directly above the reduced portion is also threaded and a knurled nut made to fit. A hole is then drilled and tapped at any convenient part of the tool slide to fit the reduced end of the rod. This hole will be so small that no harm will be done to the slide.

To use the surface gage, the adapter is screwed into the tapped hole and secured by screwing down the locknut. Then the clamp and pointer are removed from the regular gage, slipped over the adapter column and tightened in position.

Using Two Tools at Once

By John C. Wells
Kirkcudbright, Scotland

There are not many instances where the methods of step turning described and illustrated by M. Jacker on page 731, vol. 51, of the *American Machinist* can be

TWO TOOLS IN ONE

used, and where it would prove superior to the regular method of using tools separately for each step—besides, what happens if the required diameters are below that of the tailstock sleeve?

While machining steel liners for aircraft cylinders, I came across an instance where the "two tools at once" idea proved a great time saver, as the nature of the work allowed its use. The point I wish to emphasize is the shape of the tool used, it being a single tool specially forged and not two separate ones.

The sketch requires no explanation. The finisher has the more rounded point so as to leave a smooth surface.

"Old Baldy" Didn't Catch This One

By Gustave Remacle

On page 772 of the *American Machinist* A. R. Durant tells of a fellow who sabotaged his crossfeed so that he could wash up before the whistle blew for lunch. This story brought back to me a noon time many years ago, when I observed a fellow as he maneuvered his crossfeed so as to allow him to wash up before noon. This fellow however, did not get into trouble with "Old Baldy."

As the minute hand moved slowly toward twelve o'clock he looked anxiously at his facing cut which was nearing the center and which promised to arrive there about the time the whistle would blow. Those men who had cuts running, headed for the sink and one of them when passing by chided the anxious fellow about his hard luck. Tired of waiting for the sluggish crossfeed, he threw off the automatic feed, ran the cut rapidly to the center by hand, started a new cut, and joined the crowd at the sink.

Cá Canny Tactics

WHEN a worker does not do his best, but gives half-hearted under-production to his employer, the British say he is using "cá canny" methods. The French call it "gréve perlée." We call it "lying down on the job," "soldiering," "loafing" and other expressive names.

In many cases the loss in individual production is as much as 45 or 50 per cent; or, in other words, it takes in some instances, two men to do approximately what one did before the war.

This means, at a conservative estimate, that an employer is paying about double what he should for his product.

In addition to paying double wages, the employer must carry the overhead and equipment needed to give the extra employee means with which to work.

This means, disregarding the fact that each individual's wages have about doubled, that an employer is paying at least twice the amount he should for his product.

Under-production, of course, means added cost of living because it costs so much more to manufacture.

Workers need not be afraid that if they do as they should, that anyone will be thrown out of a job, for almost every factory in the country is far behind on orders.

We need goods at home. England needs goods. So do France, Belgium, Russia and all the European countries. South America, China, Japan and others are looking to us for raw materials, manufactured goods and machinery of all kinds.

Now let's ALL of us—as REAL Americans—push our peace time and reconstruction work as we did our war work.

Throw off that feeling of "the day after the night before" and get so busy that we won't have time to listen to anything but real American Sentiments.

Let's all stick to the one big union—the Union of the United States—and get into the working spirit that has made this the greatest country on earth.

Ethan Viall

Editor

Combined Meeting of Machinery Dealers and Manufacturers at Atlantic City

One of the largest and probably one of the most representative gatherings of machinery men ever assembled, attended the combined convention of the National and Southern Supply and Dealers' Associations and the American Supply and Machinery Manufacturers' Association held last week at the Hotel Marlborough-Blenheim, Atlantic City, N. J. The convention opened Monday with a joint meeting of the three organizations, following which each took up its individual business at separate meetings. The firms represented, and the men present, constituted one of the most influential and powerful groups of manufacturing interests in the country and their deliberations and conclusions, concerning the condition of the machinery trade today, are of great importance, not only to those in that particular line of business but also to those whose business depends to a great extent on the supply of raw materials—and labor.

General Outlook of Machine Industry

It was the general concensus of opinion, as expressed by most of the speakers, that the future of the machinery trade is bright, though a slump in the supply of raw materials and a decrease in prices is bound to come. Every man whose privilege it was to take the rostrum urged a policy of economy in expenditures, and conservation of the supply of raw materials. The false feeling of relief from war-time production and the "fever" of extravagant spending, which immediately followed the signing of the Armistice, are gradually disappearing and the country is returning to its normal level of production and consumption.

The resumption of inter-ocean steamship service, the opening of European markets after a period of stagnation caused by the war, and a general impetus to all lines of business activities are all important factors in the rejuvenation of American industry.

The Labor Question

Perhaps no subject received more—or even as much—attention as did the great and ever increasing question of labor. The scarcity of unskilled labor, the shortage of apprentices and the continued demands of labor for wage increase, shorter hours and other concessions, were all discussed from various sides. In his address before the National Association, Harold G. North, of the Cap and Set Screw Co., of Cleveland, Ohio, declared that "until labor decides to give a full days work for the highest days wages—conditions of today cannot be expected to improve appreciably." He also said that labor governed the market conditions of today and that the attitude of the worker must change, if the country is to hope for a speedy return to a normal productive basis.

Mr. North lauded the woman as a new element of labor which the necessities of war-time production introduced into the manufacturing field. He said that from his own personal observation, women made less trouble than men, and in certain classes of work were capable of producing more than men. Men will only let a certain amount of work go through the factory per day, but women do not gage their production according to wage scale or the dictates of professional agitators.

Prices—Will They Go Up or Down?

No little time was spent, and no small amount of energy expended in discussing the price situation. One of the most important speeches on this "burning question" was delivered before the American Association by J. C. Howell. "Prices are effects—not causes," said Mr. Howell, "and they are governed by the law of supply and demand. When the supply is short and demand is abnormal, prices rise. But when the demand ceases prices do down. During the past few years the demand for certain products was very urgent and so the prices advanced accordingly. The general underproduction of raw materials during the war period is the basic reason for the high prices of today. Reserve stocks of these materials are almost depleted; machinery, overtaxed by war production, has not returned to a normal basis and a general feeling of uncertainity prevails. Until we all lay aside thoughts of panic and depression and put our shoulders to the wheel and speed up production, we cannot hope for an appreciable decrease in prices."

Mr. Howell also touched on financial conditions as related to manufacturing. He said that the banks of the country were firm; the Federal Reserve bank was the best assurance that a money panic could not exist, but he issued a sound warning to manufacturers to guard against the ebb in the tide of "big business."

Along this same line the Hon. Felix H. Levy, former special assistant to the U. S. Attorney General, gave some interesting facts bearing on the recent decisions of the Supreme Court and their relation to the future of manufacturing.

Transportation

The recent "outlaw" strike of the railroads and the consequent effect in the machine industry was taken as an instance of the importance of rail transportation to the manufacturer. The urgent and immediate need for a speedy reorganization of the railroads under private ownership and the necessary increase in rolling stock to take care of the rush of shipping, were elements which the machine men were asked to consider. Many of the speakers referred to this subject and all were of the opinion that something must be done at once to relieve the congestion of freight traffic and to remove the possibility of labor troubles among rail men. Several representatives of large concerns told how their warehouses were overflowing with finished products— awaiting transportation facilities. This means a large amount of capital tied up, a shortage in the place to which the goods are consigned, and a general disorganization in all manufacturing of which that particular product is a part.

Resolutions

Following the various discussions several resolutions were introduced for the consideration of the delegates. Conspicuous among these were two offered by the American Association. One deals with the heavy burden of taxation which confronts the manufacturer in all lines of business. The resolutions called upon Congress to take some action to relieve this condition.

The other resolution expressed a sentiment in favor of an amendment to the Sherman Anti-Trust Law, whereby co-operative agreements among merchants might be legalized, subject of course to supervisory control by the Federal Trade Commission, to prevent abuse.

Election of Officers

On Wednesday, the last day of the convention, the election of officers for the ensuing year took place. In each case the names proposed by the nominating committees were unanimously chosen for the respective offices.

Colonel Crannell Morgan, of Akron, Ohio, was elected to head the National Association; W. Marshall Turner, of Mobile, Ala., the Southern Association and Charles W. Beaver, of New York City, the American Association.

General Summary

After three days of discussion, deliberation and—at times—fiery debate, the 1920 Convention adjourned, and the delegates returned to their respective fields of endeavor. This brings us to the question, "What has been gained by the convention?" It would take many more reams of paper than it would be prudent to use at this time, to enumerate the benefits which were gained by those fortunate enough to be present. Suffice it to say, that a more general feeling of security prevails among the manufacturers, now that they have aired their difficulties and heard those of others and the means taken to overcome them. There is no doubt but what the next year will be one of the most critical in the whole reconstruction period and the knowledge gained by the delegates will be invaluable in solving the problems which will face the industrial world.

One of the most important and weighty speeches of the convention was made by William H. Barr, of the Lumen Bearing Co. Mr. Barr spoke on "Industry and Labor"; this paper will appear in our next issue.

"The Outlook for Business," was the title of a statement by Robert H. Treman, president of the National Hardware Association. Extracts from his statement follow:

The world today is facing the most difficult financial and economic situation in history. There is constant revolt against high prices, and yet prices continue to rise at the rate of 26 per cent increase in commodity prices from April 1, 1919, to April 1, 1920. This is due fundamentally to there being too much credit and money and too few goods.

It is evident that this country cannot go on boosting wages and prices, curtailing production, attempting to enrich ourselves by non-productive speculation, without fostering further discontent and radicalism, as well as bringing on a crisis sooner or later.

The scarcity of goods in many lines and the difficulty of securing same have led to the continued bidding up of prices and to profiteering, which has been freely indulged in; the insistent demand for articles which in the last analysis are not necessary for immediate needs, and to produce these absorbs too large a proportion of labor and also, generally speaking, relatively higher wages are paid in these lines; the breaking down, at least in part, of our railroad transportation facilities, retarding the free movement of commodities, with the consequent liquidation of credit therefrom, all contribute to make more serious our present situation.

The adverse conditions which now seem to be developing emphasize the necessity for conservatism in the handling of business and in the demands for credit.

Large stocks at the present level of prices are undoubtedly an element of danger. Commitments as to the long future may prove unwise. Conditions as they develop should be carefully watched and studied. There should be co-operation on the part of individuals and corporations in an effort to hold the situation in check.

The time is ripe for everyone to make personal sacrifices for the general economic good. The disinclination to do this so far is one of the disturbing signs, but it behooves every patriotic business man to realize the seriousness of the situation and to co-operate to the fullest extent in an effort to consume less, especially of luxuries, to encourage a greater production of food products, to avoid speculation of all kinds, which ties up credit now needed for the development of our export trade as well as the domestic needs.

While there is much apprehension prevailing at the present time as to the future, it is evident that the necessary deflation of prices and the lessening of the credit tension can be much facilitated by a full realization of existing conditions, coupled with sane and proper efforts to control the situation so that confidence shall be maintained.

To this end the co-operation of each member of our association is urged.

Let us all work along conservative lines at this time.

George T. Bailey, president of the American Supply and Machinery Manufacturers' Association, gave out the following in an interview with our representative:

We all know that there has been a lot spoken and printed about the industrial, economic and social problems, and I believe I voice the opinion of the general public when I say that what we want is more action and less politics.

The passing of the railroads back to private ownership under the direction of the Esch-Cummins bill is one step

GEORGE T. BAILEY
President American Association

toward solving the industrial situation and another step was the decision handed down by the Supreme Court in favor of the U. S. Steel Corporation. This decision only goes to prove that the Sherman law has outlived its usefulness and should be amended or annulled. We are still confronted with a number of problems that will require earnest thought, sound judgment and careful consideration.

I believe the high cost of living can only be brought down by increased production, efficiency, less extravagance and the abolishment of the excess profits tax. This tax is a menace to business and in most cases is added to the selling cost, which helps to keep up the high cost of living. While I do not think we will return to the pre-war prices, I do believe that they will swing back to a more reasonable level. If the manufacturers continue the policy of advancing prices, regardless of cost plus a reasonable profit, they will some day land on a level that will prohibit buying and may lead to disaster. On the other hand, if they exercise good judgment in making prices, the swing back to a substantial level will be accomplished without much injury to anyone.

W. P. SIMPSON
President of Southern Association

What we need most is 100 per cent Americanism and equal legislation for all the people, not class legislation. Any one class should not be permitted to become so powerful that they are in a position to close up our industries at will.

Continued prosperity involves a better understanding between capital and labor, industrial democracy and the earnest co-operation of all.

I have great faith in the common sense, integrity and patriotism of the average American citizen and believe we will emerge from our hysteria and unrest better citizens and better workers.

A digest of the address delivered by J. F. Faulkner follows:

As New York is the heart of American industry, so Washington is the head. Few of you men realize the benefit which can be derived from the information which the Washington office of the American Supply and Machinery Manufacturers' Association possesses and which information it is glad to send you at any time. We are your agent—the agency between the manufacturer and the judicial and legislative elements of your Government.

We can furnish you with all kinds of data on domestic and foreign trade, export and import conditions, Governmental contracts and specifications and the latest decisions of the Supreme Court which directly affect your business. We can also advise you on laws governing foreign patents, trade marks, etc. We are in personal contact with ambassadors, commercial agents, and know what is going on in other countries which might concern the machinery trade in this country.

J. D. NICKLIS
President National Association

There is a great human cry all over the United States today for the resumption of trade with Russia. I believe it will come soon, and the sooner the better for all concerned.

I would also impress on you the value and importance of the Interstate Commerce Commission, which has been, and will continue to be, a great help to the manufacturer and producer.

We offer our services to you men of the machinery field and our motto is "At Your Service."

In an interview with W. P. Simpson, president of the Southern Supply and Machinery Dealers' Association, regarding trade conditions in general he said:

I believe that the peak of prices in all lines of business has been reached. The South will enjoy a longer prosperity than any of the adjoining states, due to the fact that the South is concerned mostly in the products of the soil. There being a shortage of these materials, the South will eventually become a world market for such products.

I predict a larger and more steady demand, even in the face of adverse conditions, for the products of the Southern states. We do not expect any trouble during the present year, despite the tightness of the money market, and I look for a gradual decrease in the prices of all commodities in the very near future.

The Machine Tool Builders' Convention

The Hotel Traymore, Atlantic City, N. J., was the scene last week of the annual convention of the National Machine Tool Builders' Association. The convention opened Thursday morning with about one hundred delegates present, a goodly number of these coming from the Cincinnati district, and up to Thursday evening the total registration had reached the very respectable number of 126 members and 83 guests.

The morning session was devoted to reports of committees and other important business. H. W. Dunbar, speaking for the committee which investigated the bill pending before Congress, for the establishment of a National Public Works Department, rendered a very interesting report on this subject. He urged the builders to work, individually and collectively, for the passage of this bill, and explained how it would benefit their several lines of trade.

R. E. Flanders reported on standardization and also on the machine-tool industry in China and opportunities for American manufacturers to establish a market for their goods in that country.

Mr. Flanders dwelt at some length on the prospect of bringing Chinese students into this country to take up courses of instruction in American universities and technical schools. He touched on the difficulties which this program had encountered in the United States Immigration laws and the objections of labor unions to what they thought was "cheap Chinese labor." He asked that the machine-tool men lend their influence and co-operation to the movement as it may be the means of establishing a future market for their products in the Orient.

On Thursday afternoon the conveners filled the Rose Room of the Traymore and listened to addresses by Roy V. Wright, managing editor of *Railway Age*, and Carl Dietz of the Norton Co. Frank Bruce of

the Bruce Publishing Co., of Milwaukee, was to have spoken on the topic, "Machine Tools in Schools," but was kept from the meeting by illness in his family.

Mr. Wright's subject was "The Relation of Machine Tools to the Transportation Problem," and he brought out very clearly the run-down condition of too many of the railroad repair shops and roundhouses of the country. Some of them are still working with machine tools fifty years old at a loss of time estimated at as much as 75 per cent in some cases. He mentioned the importance of convincing shippers that prompt loading and unloading as well as complete filling of cars were vital to a solution of our difficulties. He asked for co-operation of the machine-tool builders with the railway mechanical men, not only in obtaining the best equipment but in planning its use to the best advantage.

Mr. Dietz discussed "European Conditions and Their Bearing on the Machine Tool Industry." Having just returned from the other side, he was well fitted to give his hearers authoritative information on what might be expected of foreign competition in the next few years. He assured his audience that the German builders would not be in shape to offer dangerous competition for several years because of their shortage of materials and very unsettled labor conditions. He mentioned the rapid recovery of Belgian industry and described briefly the thorough preparations the British and French are making to secure foreign trade and provide credit facilities. Mr. Dietz touched on the disparity in exchange and urged American manufacturers to take full advantage of the provisions of the Edge law. His sane analysis of European conditions was a welcome relief from the conflicting and misleading accounts appearing in the daily press.

Friday, the second day of the convention, was taken up with committee meetings and an executive session at which business of a confidential nature was discussed.

Committees appointed by the chair adjourned to various rooms and discussed the particular machines alloted to them. These included lathes, planers, drilling and grinding machines, boring and screw machines and punching and shearing machines. Plans and ideas for future manufacture of these machines were gone over and many valuable suggestions offered for the approval of the association.

"LOBBYING"

Probably the most important business of the convention was transacted behind closed doors, but there was much talk and discussion in and around the Traymore lobby which, if it could be printed, would make interesting reading. These informal "group" meetings were many and it is safe to say that there was some "deep stuff" passed out by some of the delegates.

National Association of Manufacturers' Convention

These are the Planks of the Platform for Industry which was adopted by the manufacturers. This platform will be submitted to the Republican and Democratic parties at their forthcoming conventions:

PLANKS

1. *Government and Industry.*
2. *Regulation of Combinations.*
3. *Private Employment Relations.*
4. *Taxation and Finance.*
5. *Transportation.*
6. *Immigration.*
7. *Merchant Marine.*
8. *Foreign Trade.*
9. *War Bonus.*

THE National Association of Manufacturers held its Silver Jubilee Convention, the twenty-fifth annual meeting, May 17, 18 and 19, at the Waldorf-Astoria Hotel, New York City. The opening session included the reports of standing committees on Banking and Currency; Bankruptcy; Industrial Betterment, Health and Safety; Industrial Education; Patents; and Taxation.

The committees on Banking and Currency reported that the prosperity of the United States is intimately connected with the situation abroad on account of the credit extended by the Government and exporters, which sums are being carried abroad in terms of foreign money bearing a low rate of exchange, and that the ultimate payment of these credits depends upon the reorganization of European life; also that the rehabilitation of Europe is important to the development of our foreign trade, which itself is necessary for the success of our large scale, standardized production, and that such rehabilitation is possible only in so far as we greatly restrict our own consumption and make available to Europe a large part of our savings.

The report of the committee on Industrial Education covered the field very thoroughly. It decried the system of attempting to educate all the people in civic and occupational understanding in academic, all-day schools. It indorsed the factory training department, or vestibule school, as the proper place to educate the worker for the exact work he will do, adults of the rank and file, as well as apprentices, to be trained, and urged that industry should be fully represented in vocational training and trade schools and on state school boards.

The committee on Taxation recommended the repeal of the excess profits tax and the adoption of a gross sales tax of 1 per cent on all sales of goods; a normal tax of 4 per cent on all incomes over $2,500 for single persons and $5,000 for married; income from customs; excise taxes of established revenue producing power.

Old Home Night was presided over by Col. Thomas P. Egan, of Cincinnati, who had presided at the first convention held by the manufacturers, Jan. 22-24, 1895, at Cincinnati.

During the second day addresses were delivered by H. E. Miles; President Stephen C. Mason; Dr. R. S. MacElwee, Bureau of Foreign and Domestic Commerce, Washington; H. Parker Willis, director Federal Reserve Board for the New York District; Louis Marshall, formerly chairman New York State Commission of

Immigration, New York City; E. J. McCone, general manager *Buffalo Commercial*, and Senator Walter E. Edge, of New Jersey.

Mr. Mason reviewed the work of the association during the past twenty-five years, and enumerated the things for which it has stood, among which he included "increased opportunities for and the dissemination of adequate commercial and technical education; adequate and proper protection for our industries during their stages of infancy and development by scientific tariff legislation; right feeling and better and more cordial relations between employers and employees."

Dr. MacElwee, in his address on "Transportation as an Aid to Production," suggested, as economies to aid our foreign commerce, the rebuilding of railroad terminals in large cities and at seaports, the institution of harbor belt lines unifying all railroads and wharves; the construction of ample and properly located storage warehouses: the development of inland waterways according to a national system; the development of high roads for truck hauls; and the encouragement of aviation.

Mr. Willis, in speaking on "Scientific Distribution of Credit," stated that the Federal Reserve bank system has demonstrated its great usefulness to the country and is the main reason for the United States being in a stronger and better financial position today than any other nation in the world; that the main problem of our banking system today is that of apportioning sound credit to those agencies which are most essential in the upbuilding and restoration of our economic power, to the reintroduction of a normal level of prices and to the promotion of more equitable distribution of wealth; and that the productive business man is, above all others, properly entitled to the use of credit.

Mr. Marshall, in his address "An Immigration Policy," advocated permitting increased immigration, and opposed the literacy test and head tax.

Senator Edge, in talking on "Will Immigration Injure Our Industry or Our Labor?" declared in favor of increased immigration with modification of the literacy test, more exact investigation of the immigrant before he leaves foreign shores and more careful attention after he arrives on our shores to combat the "Red" influence to which he is subjected.

The evening session of the second day was devoted to the consideration of "A Platform for American Industry," which is to be submitted to the Republican and Democratic Conventions for incorporation in their national platforms. The platform adopted follows:

1. Government and Industry—"It is not the function of our Government to own or operate industry, but to protect and encourage its legitimate development under private ownership and management."

2. Regulation of Combinations—"The right to organize and act in combination, whether by employer or employee, corporation or union, is relative and not absolute. It ends where injury to the public interest begins."

3. Private Employment Relations—"Quickened industrial production is essential to national prosperity. To obtain it requires the successful co-operation of management and men through right employment relations. Such relations are not made by legislation. They are a human growth and not a manufacture."

4. Taxation and Finance—"The Excess Profits Tax is a misnomer without foundation in fact. It continually inspires extravagant business expenditures. Its repeal and the substitution for it of a tax on gross final sales of goods, wares and merchandise would serve the public interest. The higher rates of the Surtax operate to the public disadvantage."

5. Transportation—"We favor the development of a definite and constructive plan of national transportation, interrelating railroads, waterways and hard-surfaced roads."

6. Immigration—"Through official foreign agencies of our own we should systematically secure accurate information of the character and qualification of alien applicants for admission and to the fullest extent practicable approve or reject them before embarkation."

7. Merchant Marine—"Successful commerce and national security require an adequate, privately-owned and operated American merchant marine, composed of ships built in American yards, of American material, by American labor, manned, officered and owned by Americans, and sailing without handicap under the national flag."

8. Foreign Trade—"We must by every means facilitate and not discourage foreign trade, but at the same time adequately protect the high standards of our industrial life."

9. War Bonus—"The general and indiscriminate distribution of a cash bonus is not justifiable. The simplest considerations of justice and gratitude require generous provision for the dependents of those who died for their country. Adequate relief should be provided for those disabled."

The third day's program included addresses by Francis H. Sisson, vice president of the Guaranty Trust Co. of New York City on "What are the Dangers if Inflation Continues?" A. Barton Hepburn, chairman advisory board, Chase National Bank, New York City, on "International Exchange"; James A. Emery, general counsel of the National Association of Manufacturers, Washington, on "The Legislative Outlook"; Milo D. Campbell, secretary of the Dairyman's League, Coldwater, Mich., on "The Farmer and the Open Shop"; J. R. Howard, president American Farm Bureau Federation, Iowa, on "The Farmer and the Eight-Hour Day"; O. S. Smith, Nebraska Farm Federation; John E. Edgerton, president of the Tennessee Manufacturers Association, on "Industrial Relations"; and Daniel Willard, president of the Baltimore and Ohio Railroad Co., on "The Future of the Railroads."

Mr. Sisson, in his address, says: "The popular idea of deflation is some process, vaguely conceived, that will reduce prices so that one's income may buy twice as much as it does now. We are all willing and eager to have prices deflated, but, of course, we are decidedly opposed to having our incomes deflated. That is not the way, however, that deflation works. Those who are clamoring for a rapid fall in prices should bear in mind that drastic deflation will mean painful economic readjustment of which widespread unemployment and business distress would be features—such as have occurred in Japan. The average man should remember that there is not much advantage in being able to buy twice as much for a dollar, if he does not have the dollar.

"As yet there is no immediate prospects of a violent readjustment of production and drastic drop in prices. But there is an opportunity for gradual adjustments. The credit structure is sufficiently elastic to make possible an orderly reduction in prices if the means at our disposal are rightly used."

In referring to the high cost of living a great part of the blame was placed on the epidemic of strikes: "An incomplete list of direct losses due to strikes in 1919 places the cost of labor in wages at nearly 725 million dollars, and to industry at more than one and a quarter billion dollars. Yet we wonder why prices remain high! The policy of less work and poorer work with more wages visits its penalties upon capital and labor alike."

The convention closed with the Silver Jubilee Banquet in the Grand Ballroom of the Waldorf-Astoria Hotel.

What Other Editors Think

Let the Optimist Come Forward Now!

FROM THE *Manufacturers' Record.*

LET no one grow pessimistic about the future or about our country because of the turmoil of the hour. Strikes are in evidence everywhere, but these strikes do not mean that the country is going to the dogs or that business is going to be halted. They are the natural outcome of the spirit of uncertainty and turmoil and nerve tension through which the world has been passing for the last six years.

For the last five years or more the seeds of discontent have been sown throughout the land. Germany did its utmost to turn America into hell in order that we might not be a power for good against its evil designs.

Bolshevism, with all of its accursed doctrines, has been preached to almost every workman in the land. Millions of aliens foreign to Americanism in thought as in birth, have fallen an easy prey to radical labor teachings, and American business men, preachers and teachers have fallen short of their duty in working to counteract these evil teachings.

We should not be surprised, therefore, that out of all these conditions there has come a spirit of unrest and of strikes. Men have been made to believe by the Government itself and by many publications, secular and religious, and by some ministers, that all the business interests of the country were engaged in a great profiteering campaign, seeking to rob each other and everybody else. The effect of this campaign of evil has been widespread, but it has not destroyed the genuine Americanism of the genuine working people of the country. Many of them have been misled, and at this we need not be surprised. They have seen the mounting cost of living and have been made to believe that it was due to the work of highway robbers, known as profiteers, instead of being mostly due to a growing scarcity of foodstuffs and of other things which enter into life and to the world inflation which alone would have created a large part of the high prices now prevailing.

Three years ago the editor of the *Manufacturers' Record* begged President Wilson to use his official authority to impress upon the country the danger of a great food shortage, and the consequent high prices, saying to Mr. Wilson that if he did not do so there would certainly come socialistic and anarchistic unrest, by people being misled and made to believe a lie. But President Wilson, while recognizing the facts we gave him as to the food supply, preferred that they should not be made public, believing that they would create a food panic.

The socialistic and anarchistic unrest of the hour is the natural outcome of the suppression of the truth in the past. But this unrest does not spell disaster. Sooner or later men will learn the facts for themselves, and then there will be a return to sanity and to safety.

With all of our boundless resources, with a country more richly endowed than any other land in the world; with a population of more than 100,000,000, we have a sure foundation for safety, sanity and progress.

This is a day for the optimist; for the man who sees the sunrise coming ere the day breaks; for the man who amid the darkness of the night hears the birds singing; for the man who knows that behind the cloud there is a silver lining; for the man who with faith in God, faith in his country, faith in his fellow-men, buckles down to the hardest kind of work, determined that by his example he will do his utmost to carry his part of the burden.

This is the kind of man that should be in evidence today in every office, in every factory, in every home.

The optimist is the man for this hour, and his optimism can be based on a foundation as sure as that of the everlasting truth.

Down, then, with the pessimist! Down with the man who thinks the country is going to the dogs!

Up with the optimist! Let us sing in a spirit of optimism, and soon the mighty chorus will swell from one end of the land to the other.

Metric System Propaganda

FROM *Automotive Industries*

A FEW days ago the American Institute of Weights and Measures learned that a bill had been prepared for submission to Congress to establish, within a limited time, the metric system as the standard of measures in this country and for foreign trade. Representatives of the institute persuaded the Representative who was to sponsor the bill to delay its introduction for a short time. In the meantime, the institute has begun an active campaign against such action.

The metric system campaign is illustrative of the possibility of the influence of one person in this great government of ours. Also, it illustrates how easily this same person may become an international factor, as the campaign is almost as well advanced in Great Britain.

Apparently the campaign is sponsored by the "World Trade Club" of San Francisco. But this club, according to responsible investigators, consists of one man who is personally drafting the leaflets and petitions sent broadcast and who, at last reports, was paying all of the bills. It is said that this man paid $80,000 for one issue of circulars and that he has expended about $500,000 to date in furthering this personal hobby.

But the situation is becoming serious. It is time that manufacturers were taking stock and looking to their own interests before this mysterious individual forces them to junk their machinery and shop practices and forces them to reform all current practices. The testimony of engineers and mechanics who have worked under metric and inch systems is not all in favor of the metric system. Manufacturers should give some serious thought to this situation and act according to their convictions. *Automotive Industries* is quite certain that such action will not aid the propaganda of the San Francisco propagandist. If you want to study the situation, the American Institute of Weights and Measures at 20 Vesey Street, New York, will supply literature.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and · equipment ·

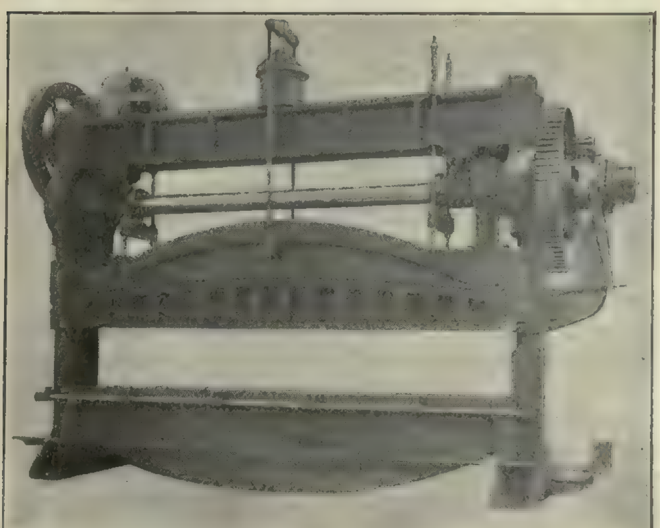
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs · and equipment ·

Williams-White No. 40-A Straight Side Press

Williams, White & Co., Moline, Ill., has recently completed the straight-side press shown in the illustration. The side housings of the press are of cast steel, the other frame members of semi-steel. Adjustable front and rear clamping strippers, also side clamping devices, actuated from the main shaft, are provided. The gears are made of steel and cut from the solid. The eccentric shaft is a high-carbon steel forging. The flywheel is provided with a friction slip in order to protect the machine in case the dies become jammed. In such a case the flywheel may momentarily continue to rotate, thus gradually dissipating in friction the energy which it contains. The flywheel is mounted on an extension of the driving-gear hub, which in turn is keyed to the main driving shaft. Two pitmans are used, these being placed closely against the housings, with the two bridgetree bearings immediately adjacent. The pitmans oscilliate in steel thrust-blocks set into the ram.

The clutch has an automatic throwout, which, when the treadle is released, leaves the ram at the top of its stroke and prevents repetition of action. The treadle can be hooked down for continuous operation, or depressed separately for each successive stroke. Oil cups for all bearings are provided. The maker claims that in the design of this machine special attention has been given to balance, rigidity and to the distribution of metal so as to combine strength and lightness.

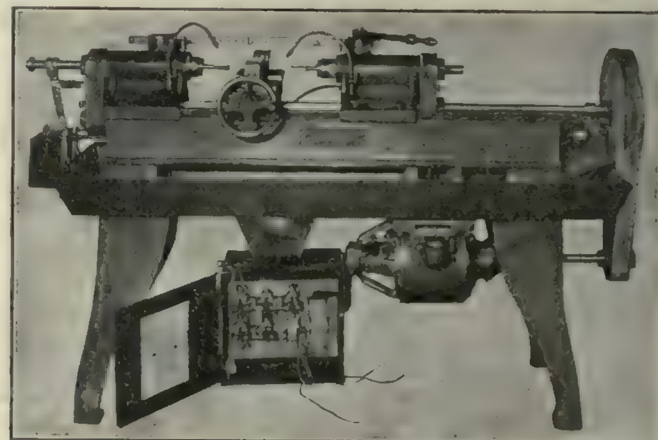


WILLIAMS-WHITE NO. 40-A STRAIGHT-SIDE PRESS

Specifications: Capacity, 600,000 lb. distributed load. Clear distance between housings, 16 ft. Vertical die space with ram down, 24 in. Length of stroke, 5 in. Normal speed, 25 strokes per min. Width of table, 24 in. Width of ram, 16 in. Pneumatic counterbalance operates at 80 to 100 lb. pressure. Motor, 50-hp., d.c., direct connected. Speed 775 r.p.m.

Cadillac Double-End Tapping Machine

The double-end tapping machine shown in the illustration is being built by the Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich., for work requiring tapping on opposite sides. A special instance of the use of this machine is simultaneously tapping both ends of turnbuckles, a right-hand thread in one end and a left-hand thread in the other. The machine is built with beds of different lengths, which gives distances between the ends of the spindles of either 12, 24, 36, 48 or 60 in. The maximum size of tap that can be used is $\frac{5}{8}$ in.



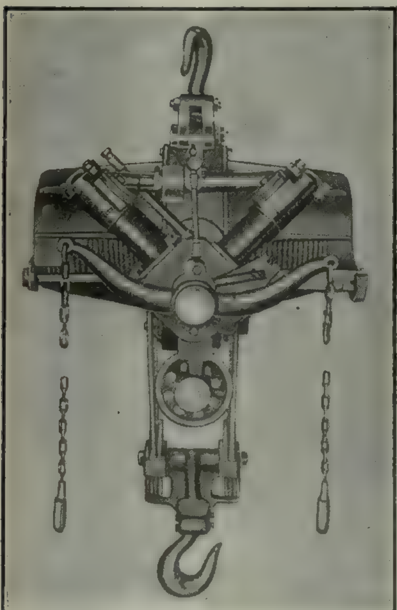
THE CADILLAC DOUBLE-END TAPPING MACHINE

The machine is equipped with a 3-hp. Westinghouse reversing motor, and the proper gear reduction is incorporated in the drive. A reversing switch is connected to the rear end of the stationary head, on the left, and when the taps have entered the work to the proper depth an adjustable stop operates the switch and reverses the motor. When entering the taps into the work they are fed forward by hand, using the lever on the top of the right-hand head, which operates through a double rack, causing both spindles to feed forward equally. A special feed mechanism has been designed for the tapping spindles which gives them considerable length of travel. The machine is furnished with an oil pan, which drains into a coolant-storage reservoir from which a power-driven pump draws the supply of coolant.

The Thor Pneumatic-Motor Hoist

The pneumatic-motor hoist shown in the illustration has been developed by the Independent Pneumatic Tool Co., 600 West Jackson Boulevard, Chicago, Ill. The hoist is equipped with a worm-gear drive and it is claimed that it will not overhaul even should the air supply be cut off. An automatic stop is provided which shuts off the air before the cable is fully wound or unwound, thus preventing injury to the load or hoist. This stop can be adjusted and set for any length of lift within the capacity of the hoist. The hoist is suspended by a swivel hook, and the drum cover contains an eyelet for attaching the cable used for lifting the hoist into position, thus leaving the hook free so that it may be easily attached.

The motor is of the type used on close-quarter pneumatic drills, and is claimed by the maker to be very economical in air consumption. The two cylinders are double acting placed at right angles and use a single-throw balanced crankshaft. The throttle valve has a graduated opening, making possible the control of the speed of the motor for starting or stopping. The motor is equipped with an oil well in which the crank dips, thus furnishing splash lubrication to all parts. About one-half of the worm gear is immersed in the oil. The cable drum, worm shaft, worm gear and sheaves have roller bearings. The cables and drums are placed far apart to prevent twisting or turning of the load. The drums are grooved to accommodate the cable, and each has a guide which leads the cable into the groove and prevents climbing and crossing of the turns when winding. The cable is adequately protected from dirt by the drum covers, which also serve as an additional protection against the climbing of the cable.



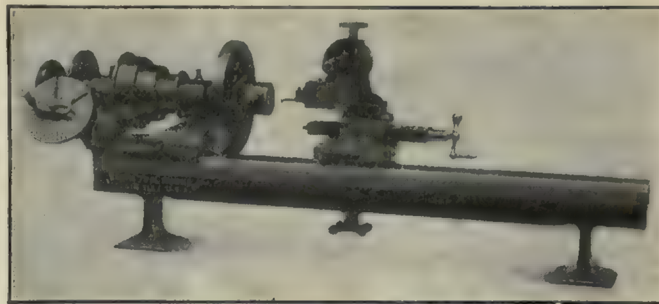
THE THOR PNEUMATIC-MOTOR HOIST

Specification: Built in six sizes, 1, 1-x, 2, 2-x, 3 and 4. Capacity range, ½ to 2 ton. Lift range, height, 10 to 40 ft.; speed, 8 to 32 ft. per min. Shortest distance between hooks, 30 to 36 in. Weight, 225 to 265 lb. Cu.ft. of air per ft. of lift, 1.9 for models 1 and 1-x; 3.8 for models 2 and 2-x; 7.6 for models 3 and 4.

Elgin Planing Attachment

The Elgin Tool Works, Inc., Elgin, Ill., has brought out a planing attachment for its bench lathes as shown in the accompanying illustration.

The attachment is arranged to be mounted on the slide rest and to be used for such work as cutting keyways, small internal gears, slotting, etc. The stroke is adjustable from ½ to 1 in. and the feed is regulated by a large knurled knob. The ram housing is graduated in degrees and may be set to cut clearances inside of dies.



ELGIN PLANING ATTACHMENT

A clapper is provided to clear the tool on the return stroke.

Either round or square tools can be used. Slots in the base, matching the slide-rest slot provide for different settings of the attachment.

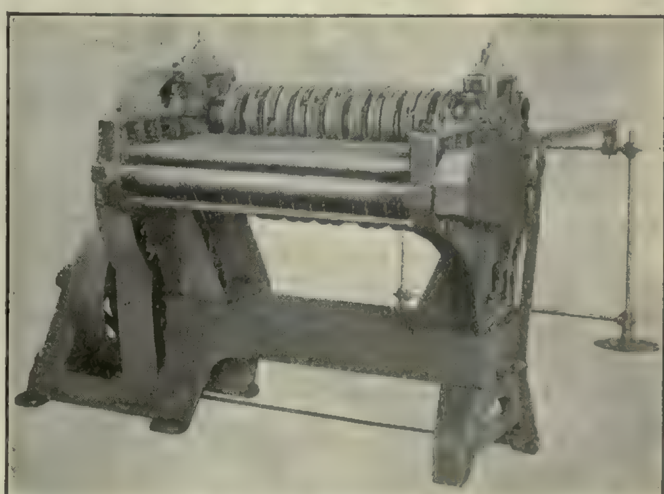
Yoder Gang-Slitting and Leveling Machine

The Yoder Co., Walworth Ave. at West 58th St., Cleveland, Ohio, has recently introduced a gang-slitting and leveling shear, both a heavy-duty and a regular or standard size being built. The accompanying illustration gives a rear view of the regular-duty machine, in which the circular slitting cutters are plainly shown.

The sheet of metal to be slit is held in the proper position for entering and is kept straight while being cut by means of the long guides, one of which can be seen on the right. The sheet enters first a pair of rolls which feed it into the cutters while holding it flat and horizontal. Guides between the feed rolls and the cutters insure that the sheet enters properly.

Each cutter is made in two segments, and is screwed to a slit cast-iron hub, the two parts of which are bolted together. The bore of the hub is threaded to fit the shaft so that its position can be closely adjusted. Tightening the bolts in the hub clamps the cutter in position. The maker claims that this method prevents wabbling of the cutter and insures clean-cut edges on the work.

The strips, upon leaving the cutters, pass between finger guides and then through a pair of rolls, which

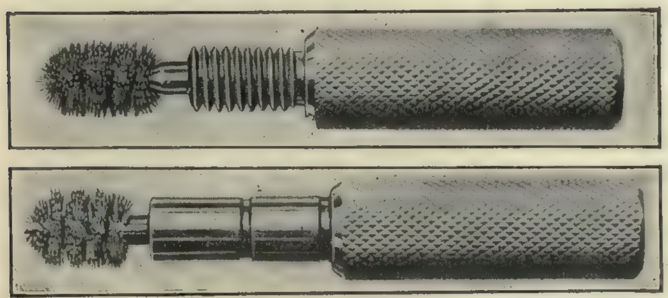


YODER GANG-SLITTING AND LEVELING MACHINE; REAR VIEW OF REGULAR-DUTY MODEL

remove possible burrs. They then go through six more straightening and leveling rolls, seen in the foreground in the illustration. It is claimed that the slitted strips produced are perfectly smooth and straight, without any warping or twisting. When using the adjustable cutters already described, strips as narrow as $2\frac{3}{4}$ in. can be cut in metal up to $\frac{1}{8}$ in. thick. On thicker sheets the minimum width of strip that can be cut is 3 in. When strips narrower than these are required, solid cutters and spreaders are used. The machines are made in various sizes to accommodate a wide range in width and thickness of material.

Brush Pilot Gage

The Brush Pilot Gauge Co., Springfield, Mass., has brought out the gage illustrated herewith. The brush serves to clean the dirt from the hole to be gaged and it is claimed that, thus equipped, the life of the gage is



BRUSH PILOT GAGE

lengthened by not coming in contact with a hole charged with gritty substances.

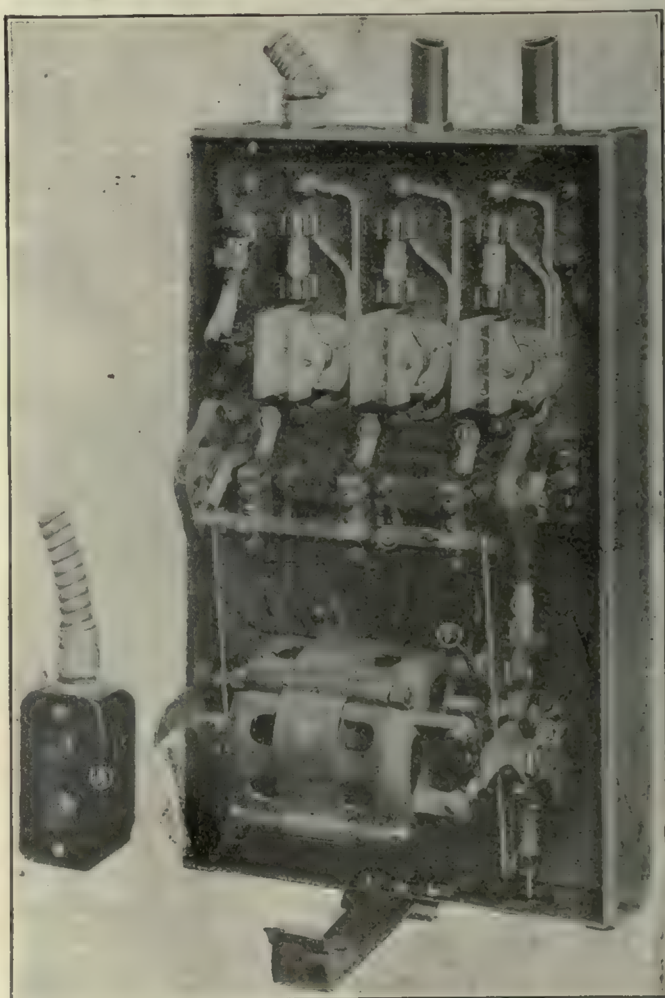
The bristles are slightly varying lengths so that when the brush is used in connection with a thread gage they tend to clean out the thread at both top and bottom.

Harvey "Steadfast" Switch

The electric starting switch illustrated herewith has been developed by the Harvey Machine Co., of Los Angeles, Cal., and is intended for use with a.c. motors of from 1 to $7\frac{1}{2}$ hp., and 110, 220, 440 and 500 volts. Among other improvements are included push-button control, separate starting and running contacts, long wiping action of contacts and simplicity of construction and operation. The switch is fully enclosed in a sheet-metal case and removal of the cover breaks all connections, leaving no live surfaces exposed.

The switch is actuated by an oscillating magnet, having eccentrically formed pole-faces mounted within a laminated keeper which has similarly formed faces. The oscillating magnet exerts a uniform pull around a central shaft through an arc of 75 deg. and provides movement and power to operate the mechanical elements of the switch.

Push-button stations may be arranged in convenient positions, while the switch is installed on a wall out of the way of machinery. Pressure of the starting button *A* closes the circuit to the oscillating magnet *B*, which throws the swinging frame *C* to bring the fingers *D* into sliding impact with the first set of contacts *E* on the panel. This closes the line circuit to the motor. Further movement is temporarily suspended by a stop *F* connected to the plunger *G* of a solenoid *H*. The solenoid, energized by the first rush of current, raises the plunger against gravity. The starting position of the switch is thus maintained on the line until the motor is accelerated to normal velocity, when the energy of the solenoid is decreased and the plunger falls. This permits the actuating magnet to move the swinging frame still further, and the fingers slide off of the first set of contacts onto the second *I*, the current passing from these latter to the motor through the protective fuses on the panel. The switch is maintained in operative position by the magnet so long as normal current is flowing. Should the current be interrupted, either by failure of the voltage or by pressure of the "stop" button, the swinging frame carrying the fingers will be instantly thrust away and then drop by gravity to the



HARVEY "STEADFAST" SWITCH

"off" position without passing back over the starting contacts. This movement is determined by the track guides *J*.

The switch will then remain inoperative upon renewal of the current, requiring another pressure of the starting button.

Contacts are enclosed within heavy insulators, any slight tendency to arcing is confined to the tips of the fingers, and arcing is minimized by the strong magnetic field induced by the coils *K*. The long sliding action of contact surfaces makes them self-cleaning, preventing corrosion, pitting and roughening.

The switch provides full protection both for starting and running loads by the use of simple cartridge fuses, which any novice is competent to replace, if renewal should become necessary.

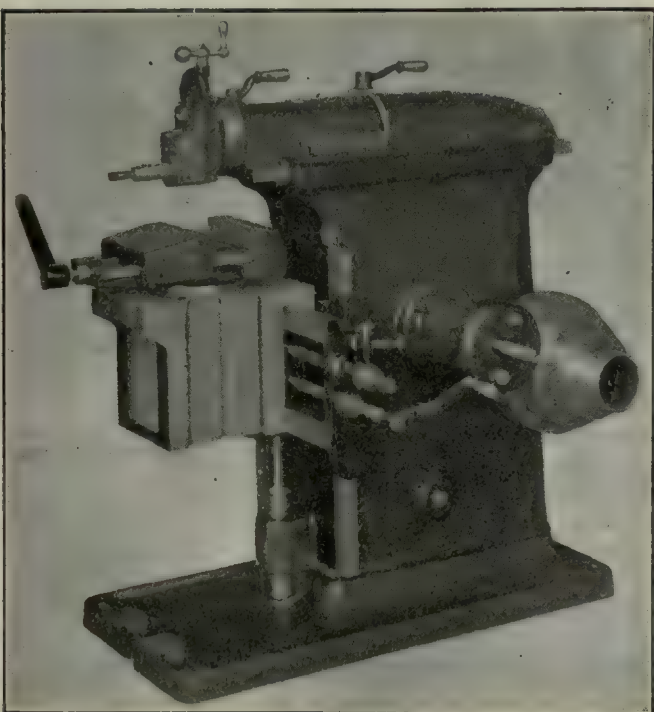
Whipp 16-In. Crank Shaper

The shaper illustrated herewith is a product of the Whipp Machine Tool Co., Sidney, Ohio.

The column is strongly ribbed to take the strains developed when taking heavy cuts. The ram guides are extended both at the front and back to give a long bearing for the ram. The nut for the telescopic elevating screw is carried in the main column casting, thus insuring alignment. The base is of the pan type to keep dripping oil from the floor and is ribbed underneath to form a substantial foundation. It extends in front to the full length of the table, forming a base for the table support.

The ram is of box type, heavily ribbed and its design is such as to give maximum stiffness.

The swivel head is provided with an eccentric lock, insuring ample power for holding, and also affording



WHIPP 16-IN. CRANK SHAPER

a quick means of adjustment. The head is graduated for accurate angular setting and the down-feed screw is provided with a micrometer collar graduated to 0.001 in. The automatic cross feed is simple and can be adjusted for different feeds while the machine is running. The stroke can also be adjusted without stopping the machine. The vise is equipped with tool-steel jaws. An outboard table support can be furnished as an extra. Specifications: Stroke, 16½ in. Table travel, horizontal, 20 in., vertical, 13 in. Maximum distance table to ram, 16½ in. Down feed, 6 in. Table; width, 10 in.; length, 16 in.; depth, 12 in. Ratio of gearing, 6 to 1. Shipping weights; domestic, 1,850 lb. boxed; for export, 2,000 lb.

Andrews Rust Proofing Process

A process for rust proofing ferrous metals has been developed by the Andrews Rust Proofing Laboratories, 821 Book Building, Detroit, Mich.

The pieces to be rust proofed are placed in a furnace which burns a mixture of gas and air. It is claimed that after the work has reached the uniform heat of the furnace, an atmosphere is created that forms an oxide which penetrates the most minute pores of the metal. The work is then removed from the furnace and immersed in a bath of oil, heated to a temperature of 100 deg. F. The oil carbonizes and, mixing with the oxide, forms a paste which sinks into the pores. At the same time, quenching in the oil contracts the pores and seals up the deposit therein. While the temperature of the furnace is not given, it is stated that it is not high enough to distort or in any way injure the work.

Among the claims made for the process are: That parts treated by it have a fine ebony finish and that they have withstood a test by being sprayed with salt water in a closed vessel for 83 hr. and remaining suspended over the salt solution for an additional 157 hr. without being rusted.

Taylor Society Meeting

The Taylor Society, whose object is the promotion of scientific management, met in Rochester, N. Y., May 6, 7 and 8, under the auspices of the Industrial Management Council and the Manufacturers' Council of the Chamber of Commerce. Henry S. Dennison, of the Dennison Manufacturing Co., Framingham, Mass., president of the Taylor Society, presided at the first regular session, and urged that as fast as solutions of industrial problems are approached, Taylor principles be applied to other problems. Carl G. Barth was elected an honorary member of the society.

The following are extracts from several addresses of great interest and value delivered during the three days of the meeting.

In a paper on "The Necessity of Planning in Administration," J. William Schulze, of the J. William Schulze Co., New York, described the methods of planning production for from three to twelve months ahead, based on analysis of all factors entering into its control, and contrasted the benefits of such methods with the system of carrying on production on the basis of orders coming in day by day.

William D. Hemmerly, resident engineer the Thompson & Lichtner Co., Boston and New York, in his address on "Balance of Work," explained how the management is enabled to ascertain accurately, constantly and instantly the condition of the plant insofar as work ahead is concerned.

Although turning out a diversified line of products, the manufacturers of Rochester have organized to work out basic principles of all industry which would be of practical help to each of them. They are cutting down the costs of labor turnover, and are gettting increased production through co-operation. This was explained by Henry T. Noyes, general manager, Art in Buttons, Inc., in an address on "Administration in Rochester."

William O. Lichtner, of Thompson & Lichtner Co., in a paper on "The Promulgation of Standards by the Taylor Society," advocated a systematic pooling of the knowledge and experience of the members of the society; urged the standardization of organization plans, and formulated basic policies for bonus payments and base wage rates.

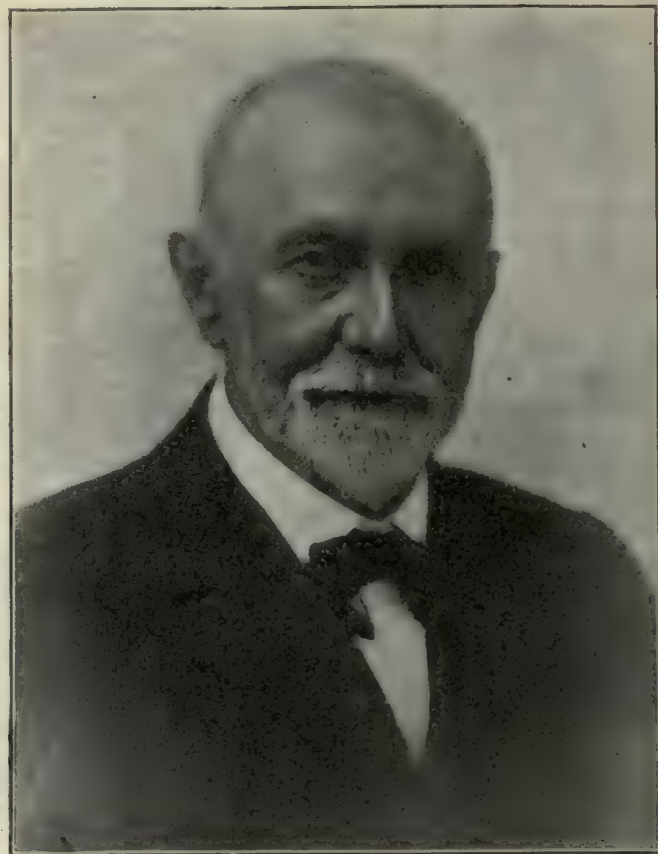
"The Necessity for Standards of the Relation Between Illumination and Output," was advocated by Ward Harrison, illuminating engineer, of Cleveland, who stated that production increases of from 10 to 20 per cent have followed lighting betterments.

Dr. Meyer Jacobstein, labor manager of Stein-Bloch Co., Rochester, in his address "Can Industrial Democracy Be Efficient?" states that after a year of operation the "Rochester Plan" shows higher standards of production, decreased labor turnover, operation uninterrupted by strikes, and more satisfied workers. The plan consists of the representation of the employers by "labor managers" assisted by employment managers, production men and time-study men, and the representation of the workers by shop chairmen and a union manager. Disputes are settled by an impartial chairman whose salary is paid by both sides and whose decision is final.

"The Worker's Reaction to Scientific Management," was the subject of an address by Dr. William R. Leiserson, chairman of the Labor Adjustment Board of the Rochester Clothing Industry. He declared that labor as such was not opposed to scientific management or to improved production, but that it is afraid of change, that before scientific management can be installed, it is necessary to educate the workers and explain to them the whole truth, and that if the workers have a share in responsibility of distributing the total wage bill of the industry, they see that the wages are fair.

The final session was in the form of a banquet at which Ernest Martin Hopkins, president of Dartmouth College, spoke on "The Industrial Problem," stating that the main problem of industry is the human one and urging that the workers be educated in the principles of industry and given a definite knowledge of just what part they are playing.

William Oesterlein



WILLIAM OESTERLEIN

William Oesterlein, president of the Oesterlein Machine Co., Cincinnati, Ohio, died at his residence in that city on May 10, aged 72 years. With the passing of Mr. Oesterlein, Cincinnati loses an enterprising citizen and a pioneer machine-tool builder.

Fifty years ago Mr. Oesterlein was a mechanic in the shops of Hilles & Jones, Wilmington, Del. Leaving there he traveled, working at his trade in various cities and finally located in Cincinnati where he found employment with John Steptoe, working alongside of such men as Ford Holz, William Lodge and William E. Gang, all of whom became prominent in the machine-tool industry.

Later Mr. Oesterlein was appointed superintendent of the Cincinnati Workhouse where many machines were used in the shops. While there he invented a clutch to take the place of the tight and loose pulleys on countershafts. In 1886 he started in business with a borrowed capital of $325 and for the first four months worked entirely alone, but by 1892 his business had grown so that he had to seek larger quarters. In addition to his clutches he was then building machine tools on contract for Davis & Egan.

In 1897 he brought out his first milling machine which had taken him a year to build. Again he sought larger quarters and in 1899 moved into a building that is now a part of plant No. 2 of the Lodge & Shipley Machine Tool Co.

In 1904 Mr. Oesterlein built a four-story shop, occupying two, then three, and finally all four of the floors, remaining there until 1918 (during which time he incorporated the Oesterlein Machine Co.) when the business was removed to its present location on Colerain Ave., opposite the workhouse where the original product was conceived.

His unusual mechanical ability, his constant attention to detail and continually striving for better workmanship are fundamental reasons for his success.

Mr. Oesterlein's friendliness and hospitality earned him many friends, especially among the travelling men who solicited his trade. He was one of the founders of the Casino Club. Of music he was passionately fond, and for many years sang in the Cincinnati May Festival.

State Accident Insurance Extremely Successful

Miles M. Dawson, consulting actuary, New York City, in *The American Labor Legislation Review*, Vol. X, No. 1, in writing of his official investigation during 1919 of the state insurance funds for workmen's compensation in the three states Ohio, Pennsylvania and New York, concludes that such funds are extraordinarily successful, financially sound, operated on the strictest actuarial principles, reduce management expenses to a minimum, have made steady progress even under competitive conditions, etc.

A comparison of the "ratio of management expense to premiums" demonstrates the economy of the state funds, and particularly that of the *exclusive* state funds. (The premiums are taken at stock insurance company rates, which are much higher than the actual rates of the state funds.)

RATIO OF MANAGEMENT EXPENSE TO PREMIUMS. PER CENT

Commercial stock insurance companies	35 to 40
Pennsylvania state fund (competitive)	9.000
New York state fund (competitive)	6.200
Ohio state fund (exclusive)	1.625

It is stated that these state funds save, on the net cost to policy holders, in New York 29 per cent; in Pennsylvania 19 per cent for coal mines and 23½ per cent for other employers; and in Ohio 35 per cent.

WHAT *to* READ
—for the man in a hurry

Suggested by the Managing Editor

> *Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.*

SOME people can't see the use of studying or even reading history. Most of them have had very little to do with making history for it is an old truism that learning by the mistakes of others is a far simpler and less expensive process than making them all yourself. All of this is introductory to the fact that the leading article, by H. H. Manchester, contains a lot of history that is worth looking into. How would you like to work for 42 cents a month in summer when the days are long and for 35 cents a month in winter when they are short? It sounds impossible, yet those were the rates 4,000 years ago. Apparently, there was no eight-hour day then.

But there is another side to the story, for wheat cost only a very small fraction of what it does now, and other things were in proportion. Otherwise the human race would have starved to death.

Much food for thought can be secured by reading Mr. Manchester's story of the fluctuations in wages and price levels throughout the centuries, although everyone may not agree with his conclusions. The price-cutting wars which fill the newspapers as this is written seem to bear witness to the accuracy of his deductions, however, and they are most welcome, particularly to the workers who strive to exist on an inelastic salary.

Part XII of Professor Furman's series on cam design and construction commences on page 1129 and concludes a group of articles which we cannot help but feel is a valuable contribution to the science of machine design. These articles are to appear in book form very shortly; in fact they would have done so before this, except for certain manufacturing difficulties from which the printing business is no more immune than any other industry.

"There are so few men who work for any other reason than because they have to, that it is safe to say that necessity alone will stop our present orgy of spending. . . . When the money is spent, when the last Liberty bond has been sold at a discount and all the bonds are in the hands of those who will ultimately cash them at maturity, then we may safely look for men to go to work with a will." Very much to the point although not very palatable, is our old friend Entropy's little dissertation on "Sweeping Back the Tide" on page 1135. There are bonuses and bonuses and many of them are bones of contention. The American Legion has gone on record as favoring a bonus for ex-service men and it is hard to blame the members if we stop to consider what some of the stay-at-homes did and what they got while the Army worked for a dollar a day. The big associations of business men have passed resolutions condemning an indiscriminate bonus in diplomatic terms. The verdict rests with Congress. This bonus is a very big bonus, two billion dollars according to some estimates, but there are many smaller bonuses which have made just as much trouble in their own way. The one we are describing in this issue is in bold contrast to these for it works. Read about it on pages **1137, 1138** and 1139

We earnestly urge all machine-shop men to keep up with A. J. Langhammers' article on the testing of high-speed steels. Part II begins on page 1140 and takes up the variables which must be dealt with before any such comparative test can be successful. This is a very live subject and there may be points on which you disagree with the author. **If so, let us know** about it.

Another article dealing with a purely shop subject is H. A. Carhart's "Liberty Motor Connecting Rods," page 1148. There is so much detailed information in this article that we have adopted a somewhat unusual style of treatment. We hope it will appeal to you.

One of our newer contributors, Elmer W. Leach, has an article which starts on page 1145. He says frankly that he has only a very tiny shop of his own but apparently that little shop would make a very good model for some large ones we all know of. It will pay you to get acquainted with Mr. Leach. He has a style all his own that is very easy to read and we expect to get more of his stuff soon.

SPARKS FROM THE WOR

Valentine Francis

American Chambers of Commerce Abroad

Removal of war restrictions, and a general resumption of foreign trade have brought about a revival of activities of American Consular Officers in the formation of American Chambers of Commerce at various posts in foreign countries. These organizations have proved exceedingly helpful to our foreign representatives of the United States in establishing and maintaining friendly commercial relations with the business men of their localities. The membership is usually composed of both American and foreign firms, particularly those having branch houses.

The Department of State is encouraging its officers to organize chambers of commerce wherever practicable, since such organizations have been found to be a most valuable aid to the consular corps in providing a direct means of communication and discussion of commercial opportunities and problems.

Permanent organizations have been operating at Buenos Aires; Rio de Janeiro and Sao Paulo, Brazil; Barranquilla, Colombia; Shanghai, Tientsin and Peking, China; Havana; Valparaiso; London; Paris; Milan, Naples, Italy; Mexico City, Tampico and Monterey, Mexico; Barcelona; Constantinople; Brussels; La Paz, Bolivia.

Chambers are now being organized at Antofagasta, Chile; Guatemala City; Harbin, Manchuria; Kobe, Japan; Havre (branch of the Paris body); Gothenburg and Stockholm, Sweden; and in Copenhagen and Hongkong.

Patent Office Salaries

The Technical staff of the U. S. Patent Office is protesting through the Patent Office Society the recommendations made to Congress regarding the salaries for patent examiners because the Commission on Reclassification recommended a lower salary scale for this service than for other technical branches of the Government. The probable reason for this recommendation was that Congressional action had already been taken in part with reference to the Patent Office salaries and the Commission apparently desired to recommend to Congress without changes in these matters which had already received Congressional attention.

Hart & Cooley Increase Stock

At a meeting last week the stockholders of the Hart & Cooley Manufacturing Co., acting on the advice of the board of directors, voted to increase the capital stock from $550,000 to $1,000,000.

Machinists' Annual Convention

The sixteenth annual convention of the International Association of Machinists will be held in Rochester, N. Y., from Sept. 20 to Oct. 9, 1920. This is the first annual convention to be held since the war. The International Association of Machinists has a membership of nearly 400,000 in the United States, Canada, Alaska, Panama, Porto Rico, Canal Zone and Hawaiian Islands. There are about 300 members in Rochester.

Result of the Zone Law

Webster Groves, Mo.,
May 12, 1920.

McGraw-Hill Co.
Gentlemen:

You will please discontinue sending *Power* and *American Machinist* to me after June 1 and render bills for both magazines covering the months for which I owe.

The zone postal law cuts in so much that I am compelled to discontinue some publications and try getting along as best I can.

Yours truly,
I. N. West.

Charles W. Johnson

Charles W. Johnson, assistant director of engineering for the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., died from double pneumonia on April 21, 1920, following an illness of only a few days.

Mr. Johnson was born June 30, 1874, and was graduated from the Ohio State University in 1896. He then entered the employ of the Steel Motor Co., Johnstown, Pa. Later he became superintendent of the Allis-Chalmers Bullock Co., of Cincinnati, Ohio. He entered the employ of the Westinghouse Electric and Manufacturing Co. in 1907 and was soon appointed chief inspector. In 1912 he became general superintendent of the East Pittsburgh works and in the early part of 1919 was made assistant manager of works. On Jan. 1, 1920, he was appointed assistant director of engineering.

Mr. Johnson was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the Engineering Society of Western Pennsylvania.

Strikes Said To Be "A Relic of the Dark Ages"

Frederick W. Mansfield, thrice Democratic gubernatorial candidate in Massachusetts, and for many years counsel, state branch, A. F. of L., at a recent organized labor meeting in Milford, Mass., in plain language took to task those employees who break contracts made with employers. He said in part:

"In former days the employer was able to dictate whatever terms of employment suited him, and the worker was forced to accept them. Now, when the worker finds himself in a position of power because of combination, the worker in turn is endeavoring to get all he can from the employer. Labor unions, to be successful, must be honest, honorable in intention, their objects lawful and praiseworthy, and above all they must regain public respect and confidence. One can't deny that unions in the last few years have lost caste."

Strikes, he said, are "a relic of the Dark Ages, cause untold suffering to the strikers and tremendous loss to employers. The remedy for unrest is not to strike, but to get together and work. While I do not say that strikes ought to be forbidden by law, I do say that the unions themselves ought to make such a law unnecessary by voluntarily agreeing to arbitrate all disputes, in all cases where the public would be seriously inconvenienced if service were stopped." Mr. Mansfield called on his hearers to produce more as the quickest cure for high prices.—*Iron Age.*

A New Grinding Company

The Precision Grinding Wheel Co., Inc., Philadelphia, Pa., a new corporation manufacturing grinding wheels, has just started the building of one unit of a very complete plant. The first unit of the plant will have a six-kiln capacity and floor space of 38,000 sq.ft. It is planned to go into the complete wheel line, making wheels of aluminous and silicon carbide abrasive by four processes—vitrified, silicate, elastic and rubber. A. S. Vane is president and H. A. Plusch is secretary and plant manager. The temporary office is at 1215 Filbert St.

Removal and Consolidation

The Page Steel and Wire Co., New York, has announced the removal of its offices on May 15 to the offices of the American Chain Co., Grand Central Terminal, N. Y.. with which it has consolidated.

E. W. McCullough Manager of New Industrial Department

E. W. McCullough, for nine years executive secretary of the National Implement and Vehicle Association, with headquarters at Chicago, has been named manager of the new Industrial Production Department of the United States Chamber of Commerce. In the departmentalization plan of the National Chamber, the Industrial Production Department occupies an important place because of the scope of the terms embraced in its name.

Mr. McCullough undertakes the work of organizing this department with an experience gained as the result of having spent his entire business life in manufacturing institutions or with organizations representing them.

In 1904 Mr. McCullough was called on to reorganize the National Wagon Manufacturers' Association, comprising most of the farm wagon manufacturers of the country. The work was accomplished under his direction by turning the trend of the organization's activities into more practical channels—namely, a study of production costs, standardizations, elimination of variety of production, and establishment of uniform grading and inspection rules for wood materials.

Later, in 1910, it was determined to consolidate for greater efficiency the several national associations representing manufacturers of the farm operating equipment lines such as plows and tillage implements, wagons and seeding machinery. Mr. McCullough was chosen secretary and general manager of this new organization. For the past nine years the affairs of that organization were under his direction. During the war period the organization rendered efficient service to the Government, and it was recognized as one of the best industrial associations in the country.

The new department will be divided into two sections, one to deal with natural resources, the other with fabricated production. This new department will study many of the problems of manufacturing and will deal with selection and education of employees along efficiency and safety lines, wage or compensation plans, housing, insurance, benefits and pensions, alien labor, Americanization, standardization of products, etc.

Mr. McCullough points out that there is a great need of more definite and accurate information as to our resources of basic materials, natural and developed, and also as to the resources of the country.

In production, according to Mr. McCullough, much benefit of good equipment is lost unless production schedules and accurate cost reckoning is made part of the system. Too much of our industrial output is figured on a gambling basis. The day of estimating and cost-plus methods went with the war, and has been supplanted by competition which measures profits based on cost facts.

The new manager holds there is as great need in most lines for reliable production figures as there is in information concerning markets. An unnecessary surplus in production is an injury to producer and consumer alike and is in fact economic waste. Underproduction produces starvation and suffering. Both may be avoided as far as manufactured products are concerned, except in times of stress, through the availability of accurate production data.

E. W. McCULLOUGH

The majority of industries make no gathering nor statements of correct production, while that furnished annually, or to the Federal Census Bureau, is valuable only for comparison. Up to this time defective records or total absence of records, together with reluctance because of competitive reasons, have prevented the gathering of figures which would be the most valuable guide to intelligent production.

The National Chamber offers to business the service of this department together with that of other new departments recently created.

Trade Currents from New York and Chicago

New York Letter

More inquiries resulting in orders were received this week by the machine-tool manufacturers of this district and caused the market to be fairly active.

The General Electric Co. is asking for grinding machines, lathes and milling machines for its Baltimore plant. The Chesapeake & Ohio R.R. Co. has a small list out and it is reported that the Baltimore & Ohio will shortly be in the market.

The electric motor business has recently shown great development and a great many inquiries indicate the increasing popularity of the motor drive.

The Navy Department issued a list this week for which bids will be opened May 28 at Washington. The Cutler-Hammer Manufacturing Co. will soon be in the market for equipment for its new plant at 137th St. and Southern Boulevard. The Savage Arms Corporation, of Utica, N. Y., has started to manufacture rear axles and will shortly need more machine-tool equipment.

Due to the congestion at the Port of New York, caused by the freight embargo and railroad tie-up, most of the machine tools are now sent to Philadelphia for export.

Chicago Letter

Conditions from a purely trade standpoint are, in the main, unchanged in the Chicago district. The previously reported slackening in the volume of business transacted has become confirmed, and a new normal seems to have been established, amounting to about 60 per cent of what was done the first three months of the year. One or two dealers report current business better than the above-stated average.

Labor, with its usual facility for picking up points of attack which will cause the utmost demoralization in industry, has started a strike among the foundry men of Chicago. Machinery manufacturers here and in the Rockford district, which to a great extent depends on Chicago for castings, are being seriously inconvenienced. Indications are that the strike will last just so long as the men stick to their demands, for the employers show no disposition to treat. The situation in Cincinnati is reported as unchanged. All manufacturers but one are tied up and although it is not thought the strike can last long, no one will yet say the end is in sight. Detroit automobile factories are making sharp labor reductions.

Dealers here are congratulating themselves on the amount of freight the railroads are able to move. While conditions are by no means normal, every concern reports considerable movement of goods, and the number of producing points closed by embargoes is constantly growing less so that direct shipments are moving more freely. Collections are reported as slow.

Then and Now

By Khaymar Ojam

When I was but a husky lad
  And worked out by the day,
I used to work like "all possessed"
  To try and earn my pay.

From morning's light to evening's dusk
  I strove to do my bit.
Few holidays e'er came my way,
  I never dared to quit.

My conscience ever spurred me on
  That more I might achieve,
And thus return equivalent
  For all I might receive.

I always tried to please the boss
  By faithful, patient work.
It ne'er occurred to pass the buck,
  To soldier or to shirk.

But now my head is bending low
  It pains me to observe
The antics of the lusty youth
  That get by on their nerve.

They come to work at half past nine,
  They dodder 'round all day;
Their one concern to note the boss
  Is looking—not their way.

They care not that their time is spent
  To all intent in vain;
Their only goal is five o'clock,
  Next payday, and a Jane.

There is no lasting benefit
  In this old world attained,
Without somebody pays the price
  In labor unrestrained.

I think these bluffers, boobs, and duds,
  A decade hence or so,
Will find the clime, to their surprise,
  Much hotter down below.

Advice from the Belgian Commission

Unless the Belgian Commission can find firms which will extend a five-year credit no further purchases of machine tools from private manufacturers will be made.

Lieutenant Jean Jean recently returned to Washington from Belgium with the advice that all future purchases will be made from the War Department stocks unless the long-time credits should be arranged. Some additions have been made to the list of Belgian requirements.

Machinery Goes In with Roof Incomplete

The Witney-Hanson Co., Hartford, Conn., is proceeding very satisfactorily toward the completion of its new building and expects to be occupying it in full operation by July 1. The machinery is being installed while the roof is not yet completed.

Business Conditions in England

From Our London Correspondent

London, April 30, 1920.

In addition to other handicaps, uncertainties regarding budget proposals have regarded business in Great Britain during the last fortnight or so, and some special concern has been felt in regard to overseas trade owing to the exchange difficulties. The government financing scheme, referred to in our last letter, is thought somewhat complicated, and interests have joined together in a proposal which has been laid before the Board of Trade and which has been described as in the nature more of insurance than of credit. The scheme will be accepted as additional to that put forward by the government.

Returning to budget matters, it cannot be said that the trading interests concerned have managed to shine in their opposition to the government proposal of retention and increase of this duty. The Chancellor of the Exchequer stands firm, but is willing to make concessions to new firms and to firms which can show a poor basis of pre-war profits. If these concessions are reasonable the ground for the opposition of trading firms will crumble. The money has to be found and no satisfactory alternative was suggested by those who opposed the tax.

Great Britain's National Debt

Great Britain is burdened with a national debt of about £8,000,000,000. While this dead weight is hanging round the neck of the nation nothing in the nature of ordinary taxation can be expected. The weight must be removed as quickly as possible, and one way or another it is certain that a definite effort will be made to lift the major part and to lift it quickly. While the currency is inflated it is obviously advantageous to pay off as rapidly as possible; for the £8,000,000,000 will have to be paid, presuming the debt is to be removed, whether the pound is at its present value or nearer its pre-war value. Incidentally this suggests that there will be no sudden drop in prices even from the present high rates, that is, if they rise to any marked extent from currency inflation. But suggestions of falling values are again being put about from several directions, lower demands for commodities are being reported and the imminence of decline in freight rates is persistently rumored.

Reports from the iron and steel markets show unaltered conditions, though quietness on the export side has been specially noted for the reason given. In the London market this week, it was stated that foundries are receiving only about half their usual requirements in the way of pig iron, and any immediate help as regards iron and steel supplies from the United States was thought unlikely owing to the railway troubles on that side. In Manchester it was reported that £35 a ton was paid for steel bars.

A recent official estimate gives an average increase in weekly wages up to the end of February last, as compared with the pre-war rates, of between 120 and 130 per cent. This is regarded as approximate only, for it is pointed out that in certain instances among skilled workmen in some industries, the increase was but 100 per cent while the increase for lower grade workers in the same industry has reached 170 per cent or even 180 per cent. These figures refer to weekly rates. Simultaneously the length of the working week has been reduced, generally to 47 or 48 and in some instances to 44 hours; this means a corresponding further increase in hourly rates. Overtime is quite the exception; the trade unions have set their faces steadily against it.

Decline of Hourly Production

A rough idea has been given in these columns of the decline in hourly output, more particularly in the engineering trades. The writer visited a well-known motor tire factory recently and found that the hourly output had certainly declined, though not in so marked a degree as in many engineering plants. Figures, too, have been given in the House of Commons regarding the getting of coal, the outputs of 1913 and 1919 being compared. For the former, the figures given are 259 tons per person above and below ground, against 197½ tons for 1919, the cost of wages per ton raised at the pit's head being given at 76.01d. in 1913 and 223.68d. in 1919; the ratio is therefore about 1 to 3. Employed in the industry were 1,110,884 persons in 1913 and 1,163,000 persons in 1919.

The Ministry of Labor here is setting out to advise firms who wish to start new works, as to suitable areas from the labor-supply point of view. It has been mentioned that details relating to the numbers and qualifications of people who are unemployed in various areas are in the possession of the Ministry and would-be employers are invited to apply for such information, applications being treated as confidential.

The statement has been published that, through its department of overseas trade, the British Board of Trade had under organization a series of trade tours, including one to South America leaving later in the coming summer, and another to the United States leaving in the winter. We learn that they have been postponed for the present.

To the Imperial War Museum at the Crystal Palace, Sydenham, S. W., a victory exhibition will be added in June next. From particulars issued it appears that engineering, electricity and gas are to be represented, a special section being devoted to oil, with working models, etc.

Machine-Tool Situation

Turning to machine-tool affairs, special arrangements for the export of Scandinavian tools have, it is under-

stood, been made by the combination of a number of firms in Sweden. In Great Britain the agency for these tools has been accepted by J. Holroyd & Co., Ltd., which at the Milnrow works may be running rather counter to the prevailing general policy in that, according to present suggestions, it will confine itself to the production of special tools, only those that can be described as of standard character being manufactured. Though it might not be quite impossible, yet it would be very difficult to find German machine tools being imported into Great Britain at present. On the other hand, arrangements have certainly been made for producing one or two British copies of German machine tools. Dean, Smith & Grace, Ltd., Keighley, which specializes in the production of center lathes, is the latest firm to join the British Machine Tool Makers, Ltd., which, therefore, now consists of 12 firms. The nature of its output will be regulated by agreement with other lathe makers in the association. Some slackening in demand, possibly only temporary, is reported from Johnstone, the Scottish machine-tool center. Shortage of castings is still noted everywhere and it seems clear that the foundry facilities of Great Britain are insufficient.

British engineers visiting America seem to have come back with appreciative views regarding steam-driven stamps of arch form. In consequence B. & S. Massey, Ltd., Manchester, has taken up the manufacture of this type again, having introduced it a considerable number of years ago both in arch and pillar form. It is again now making double-acting steam stamps of arch form and in larger sizes than previously. This firm, by the way, has also applied to certain of its pneumatic power hammers the electrical device of the relay, but in mechanical form. The flywheel bears the internal portion of a small cone clutch. The external portion of the clutch, being engaged, is carried round and a projection on it is forced against a cam lever which puts into action the main clutch, this being of the band brake type operating with drum cast with the flywheel. The relay clutch is, of course, controlled by the workman. The device is thought to be specially suitable where frequent starting and stopping is desirable and in confined circumstances.

New Industrial Institute

A new body has come into being in the form of the Institute of Industrial Administration, which held its first general meeting in London on April 27, 150 members attending. The object of the institute is to establish the status of management as a definite force in industry with capital and labor, for, in the words of the prospectus, "on management or administration the burden falls of becoming qualified to direct the activities of labor with the means provided by capital." Membership will be in three classes, namely: corporate subscribers, to include firms and associations; senior members, such as managers, heads of departments, principals and directors; and juniors, including technical and clerical staff. On the lines of most of the British institutes, meetings will be held monthly in London and elsewhere, when prepared papers will be read and discussed. In addition, after the fashion of some of the London technical institutions, informal meetings will be held, a short paper being followed by a general conversation rather than a set discussion. Lecture courses are to be delivered, the first being on the organization of payment by results. Help will be given in arranging works lectures and correspondence courses. Through a journal and correspondence administrative practice will be collated, and it is further proposed to form a panel of consultants who will do work of efficiency engineering character; that is, report on existing methods, technical and administrative, and on their possible improvement. The institute has offices at 110 Victoria St., London, S. W., with E. T. Elbourne as honorary secretary. It is to be self-supporting and self-governing and has no commercial aim behind it.

Personals

W. F. McLaughlin, who has been general superintendent of the Hyatt Bearing Division, General Motors Corporation, has left the Hyatt Co. to take the position of works manager for the Ace Motor Corporation in Philadelphia.

George A. Shoemaker has been appointed works manager of the Bound Brook Roller Bearing Co., Bound Brook, N. J. Mr. Shoemaker was formerly connected with Messrs. David Lupton Sons Co., Philadelphia, Pa.

Paul Swenson, who has for many years been general superintendent of the Minneapolis Threshing Machine Co., Hopkins, Minn., has retired from active service and will shortly sail for a vacation trip to European cities.

Frederick Curtin, of Hamilton, Ontario, Can., has returned to Welland, Ontario, to take his old position as purchasing agent for the Canadian Steel Foundries Co.

Arva Stroud announces his removal to 327 Broadway, New York City.

Clarence B. Atkins has been appointed superintendent of the new forge and machine shop division of the New Departure Manufacturing Co., at Bristol, Conn. The new buildings are being erected on Terryville Ave., Bristol. Mr. Atkins has been with the New Departure Co. for the past fourteen years.

Wesley R. Johnson has been appointed as mechanical maintenance superintendent of the forge and die machine shop of the New Departure Manufacturing Co., in Bristol, Conn. Mr. Johnson was formerly connected with the New England Westinghouse Co., at Meriden, Conn.; also with the General Electric Co.; and was for eight years with the New Haven Railroad, in a mechanical engineering capacity.

Edward Granger has been made assistant superintendent of the forge and machine shop division of the New Departure Manufacturing Co., at Bristol, Conn. Mr. Granger has been with the company since 1915. He will take up his new duties when the new plant buildings are completed.

G. A. Ricker has been elected treasurer of the Walworth Manufacturing Co., of Boston, to succeed G. H. Graves, who has been treasurer since 1886. Mr. Graves will remain with the company as secretary. Mr. Ricker has been associated with the Walworth Co. since 1890, and has been assistant to Mr. Graves for a number of years.

P. J. Darlington has been appointed works manager of the machine-tool division of the Greenfield Tap and Die Corporation, of Greenfield, Mass. Mr. Darlington is a graduate of Cornell, class of 1891. Mr. Darlington, previous to his connection with the "GTD," was with the Roto Co., of Hartford, Conn., Sprague Electric Co., of Bloomfield, N. J., and the Royal Electric Co., of Montreal, Canada. He has also been with the William Sellers & Co., and William Cramp & Sons Co., of Philadelphia.

E. D. Gordon of the weights and measures division of the Bureau of Standards has resigned to take up a position as sales-engineer with the General Automatic Scale Co. of St. Louis. Mr. Gordon will be engaged in both development and special problem work for this company which contemplates a still further extension of its line of scales.

George A. Brewster, chief metallurgist of the American Radiator Co., Buffalo, N. Y., was seriously injured May 15, when a ladle of molten metal overturned in the steel mill at the Pierce plant in Elmwood Ave. Mr. Brewster was struck on the forehead by the ladle shank. His skull was fractured and he suffered concussion of the brain. Physicians at the Homeopathic Hospital, where he was removed following the accident, report that Mr. Brewster's injuries, while serious, will not prove fatal.

H. B. Wilson has been selected as office manager of the new Forge and Machine Shop buildings of the New Departure Manufacturing Co., on Terryville Ave., Bristol, Conn. He has been with the New Departure Co. for about four years, and previously was connected with the L. V. Estes Co., industrial production engineers, of Chicago. He has also been with the American Locomotive Co., and with the Pratt and Cady Co., of Hartford, Conn.

Clyde A. Phillips, formerly connected with the machinery department of the W. M. Pattison Supply Co.,

Cleveland, Ohio, has severed his connections with that concern and is now on the sales force of Cyril J. Bath & Co., Cleveland, Ohio.

W. K. TEWKSBURY, who for the last ten years has been superintendent of the Automatic Electric Co., Chicago, Ill., has resigned to accept a position with the Steel Products Manufacturing Co., Chicago, Ill. He has been elected a director of the company, and as secretary and treasurer will have complete charge.

Business Items

Barnes Drill Co., Rockford, Ill., has let contract for the construction of an addition to its plant, 80 x 150 ft.

The Lincoln Products Corporation, Newark, N. J., has been formed recently to market transmission equipment. It will represent the Hyatt Roller Bearing Co., Standard Pressed Steel Co., and Steel Treating Equipment Co., in Newark, N. J.

The Schaffer Engineering and Equipment Co., to provide for the expansion of its business and to obtain ample plant facilities, has sold a large block of its capital stock to the Fawcus Machine Co.

The Williams Tool Corporation has merged its interests with the John Hall & Sons, of Brantford, Ont. It is reported here that the concern will retain its original name and that the Canadian plant will be known as the Hall plant of the Williams Tool Corporation. Leslie S. Hall, president and general manager of the Canadian plant, will become vice president of the amalgamated concern. A. R. Hall will be the manager of the Canadian plant and E. L. Williams will be in charge of the office.

The Airway Engineering Co., of New York, is negotiating with the owners of the plant and equipment of the Ley-are Boat Works, Ogdensburg, N. Y., for the purchase of the plant at about $100,000 to establish a manufacturing plant for both air and water craft.

Since the purchase of the Skillin & Richards Manufacturing Co., in June, 1918, by the Webster Manufacturing Co., Tiffin, Ohio, a new building has been erected, which will increase the capacity of that plant about 50 per cent. The receiving and shipping facilities have been improved, a sprinkler system installed and the plant made thoroughly uptodate in all respects. The sales office in the McCormick Building, and the general offices and engineering staff at Tiffin, Ohio, now occupy the new office building, which is at 4500 to 4560 Cortlandt St., Chicago, Ill.

The entire assets and good-will of the Sears-Cross Co., Bush Terminal, Brooklyn, N. Y., manufacturer of the Sears-Cross lock for automobile doors, have been acquired by the National Seal Co., Inc., manufacturer of metal seals and automobile hardware.

The Marf Machine and Die Casting Co., Inc., New York, has succeeded the Marf Machine Co., Inc. The new company announces that the same organization which has conducted the business in the past will continue in the management. With the increased capital and facilities now at its command the company expects to broaden the scope and volume of its business.

Clark Brothers Company, Olean, N. Y., manufacturer of saw-mill equipment, has been awarded a certificate of merit by Secretary of War Newton D. Baker for war production. The company furnished the American Expeditionary forces with eighty-seven saw-mills.

Catalogs Wanted

The Conradson Machine Tool Co., Green Bay, Wis., requests catalogs of all kinds pertaining to the manufacture of machine tools and general factory supplies. Send all catalogs to the works manager's office.

New Publications

American Machinists' Handbook and Dictionary of Shop Terms. By Fred. H. Colvin, Editor of the "American Machinist," and Frank A Stanley, formerly associate editor of the "American Machinist." Third Edition, revised and enlarged. 758 pp. with numerous illustrations. Published by McGraw-Hill Book Co., 239 West 39th St., New York, N. Y. Price $4.

The first printing of the third edition of this invaluable handbook of machine-shop data brings the total issue to 175,000. It contains only seventy-seven more pages than the second edition but many pages from the older editions have been dropped to make room for newer and more convenient data covering the same ground, and the small errors bound to creep into a work of this sort have been corrected. The dictionary of shop terms for the benefit of the apprentices and younger machinists has been retained and amplified.

It would be impossible in the space available here to enumerate the changes that have been made as there is not a section in the book that does not show some improvement and refinement. More data are included on the subjects of grinding and milling and also on the newer alloys such as stellite. Practically the same arrangement has been used as in previous editions.

Dyke's Automobile and Gas Engine Encyclopedia. By A. L. Dyke, E. E. Twelfth Edition. 960 pp., 3,362 illustrations. Published by A. L. Dyke. Publisher, St. Louis, Mo. Price $6.

This remarkable book has once more been revised and enlarged to keep it in step with the advances of the automotive industry. Used extensively during the war as a reference book by various branches of the service which handled motorized equipment it now resumes its peace-time place as a guide for the repairman and amateur, and textbook in many automobile schools.

In addition to the standard material in the body of the book there are complete supplements on the Ford and Packard automobiles and the Liberty aviation engine.

Most of the new material added to this edition deals with electrical equipment, sections being devoted to voltmeter and ammeter tests; how to test and repair magnetoes; how to construct an electric testing outfit; how to make "cadmium tests" for storage batteries and how to disassemble and repair them; Ford electric starting, generating and lighting systems. There are also new sections on how to repair tires, including suggestions as to the proper equipment for starting in the business; how to measure piston and ring clearances and other hints on engine repair; specifications of 1920 cars.

Separate sections are devoted to trucks, tractors, motorcycles, airplanes and airplane engines.

The Czecho-Slovak Trade Journal. Published monthly at Purkynovo nam. 6, Prague-Vinohrady, Czecho-Slovakia. Subscription price $3, 25 cents a copy.

The first issue of this trade paper has just reached us. A letter from the editor states that it is the only commercial paper published in the English language in the new country of Czechoslovakia. The aim of the paper is to acquaint the business men of English speaking countries with the economic position of Czechoslovakia. The first number contains short sketches of the various industries of the country, advice to foreign travelers, a word about import and export regulations and something on the money situation.

Trade Catalogs

Electric Fixtures. Benjamin Electric Manufacturing Co., Chicago, Ill. Catalog No. 22. 8½ x 11 in. An illustrated and descriptive catalog covering electrical lighting apparatus, plugs, clusters, reflectors, show-case, fixtures, industrial signals and panels.

Reamers, etc. H. H. Arnold Co., Rockland, Mass. Circular, 3½ x 6 in.; gives the size and prices of its shell reamers, chucking reamers, counterbores and side milling cutters.

Precision Machinery and Special Tools. Sloan & Chace Co., Ltd., Newark, N. J. Catalog, pp. 36, 4½ x 7 in. This catalog contains descriptive matter of its milling attachments, drill pads, faceplates, tail-stock, step, chucks, spring collets, tapping machines, pinion cutters, etc.

Leather. Edward R. Ladew Co., Inc., Glen Cove, N. Y. Catalog, pp. 56, 6 x 9 in. This catalog describes and contains illustrations of its various products such as leather shafting rings, pump leather, mill strappings, cup packings, flat fan belting, etc. Prices are also included.

Belts. I. B. Williams & Sons, Dover, N. H. Catalog, pp. 55, 6½ x 9½ in. The first three pages of this catalog contains illustrations of its different branches; the remaining pages present a line of flat and round belting, rawhide and tanned lace leather, Goodyear welting, etc.

Forthcoming Meetings

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The Railway Supply Manufacturers Association will hold an exhibit on Young's Pier at Atlantic City, June 9 to 16, in conjunction with the annual mechanical conventions of the American Railway Association. Many of the leading machine-tool builders of the country will be among the 330 or more exhibitors.

The American Drop Forge Asssociation will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials wil hold its next annual meeting durring the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25, inclusive.

The American Steel Treaters' Society will hold a convention in Philadelphia, Sept. 14 to 18. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is the secretary.

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The Manufacture of Household Appliances

By J. V. HUNTER
Western Editor, *American Machinist*

The necessity for the reduction of the labor required to keep up the modern home has lately caused an increased demand for the numerous labor-saving machines that have been developed. One of the large manufacturers in this line has built a modern plant for the production of such machines, and the methods there employed are described in the following article.

AMONG the arduous duties in the modern household are washing, ironing, and the necessary sweeping away of the daily accumulations of dust. The reduction of this work to a minimum has lately attracted so much attention that large manufacturing plants have sprung up throughout the country for the production of household labor-saving machines. The Hurley Machine Co., Chicago, Ill., has built up a large factory devoted to supplying the demands for household appliances. This factory is an almost complete manufacturing unit, as its activities extend from the gray-iron foundry through all departments of machine, woodworking and assembling shops to the final inspection and shipping.

FIG. 1. ONE BAY OF THE MODERN FOUNDRY

The Foundry

A portion of the foundry floor is shown in Fig. 1, and illustrates its modern character and the excellent lighting and ventilating facilities. Note the absence of objectionable smoke or fog, although the picture was taken while the afternoon heat was being poured off.

The cupola is tapped directly into truck ladles and by these the iron may be transported to all portions of the foundry over light steel rails laid almost flush with the floor. At the present, daily heats of about 20 tons are taken off. Most of the pouring off is done by hand ladles, as the majority of the work is light, and requires quick pouring and a very fluid iron.

The molding of much of the work is done on air squeezers. These are supplemented in some cases by the use of the jolt-squeezer type of molding machine on which match-plate patterns are usually employed. The heavier parts, such as legs for washing and ironing machines, require larger molds and roll-over molding machines have been provided for this work. Stripping-plate molding machines have also been provided for some of the castings.

Considerable bench molding is still done in the shop and the type of bench used is shown in Fig. 2. This bench is provided with shelves and extension arms so that everything used by the molder will be in the most convenient position to reach. The shelf at the left is usually occupied with the riddles (now resting on the working portion) and the shelf at the right gives the molder a space where he can place the cope when it is lifted off the drag. The strike-off bar is lying on a little shelf *A* on the front of the upright portion, and the top shelf of this same portion carries the rammers and small tools. It will be noted that the bench is made of ample width to straddle the pile of molding sand, so that it may be pushed back as the sand pile is used up.

FIG. 2. A MOLDING BENCH PLANNED FOR EFFICIENCY

Most of the cores are light, and a partial view of the core room, Fig. 3, shows the type of benches and ovens provided for this work, and gives a general idea of the character of cores made. Split coreboxes of the gang type, producing from four to six cores at a single ramming, are in general use. Most of the cores are baked standing on end, and are placed on the plates in staggered rows for mutual support.

The cleaning room is equal in efficiency, lighting, and

FIG. 3. PORTION OF CORE ROOM AND OVENS

cleanliness with the remainder of the foundry. Rattlers are used almost exclusively for removing the sand from the castings, and are provided with exhaust equipment which keeps the dust from the cleaning room. A large bank of grinding wheels is provided and from these the operators pass the castings directly into sorting bins, each of which is mounted on truck wheels, and as fast as these are filled they can be pushed into the casting-storage room.

No very large stock of castings is carried on hand, as the whole factory is run on an efficient production-scheduling system, which permits the foundry to know, a few days in advance, the castings that will be required by the machine shop, so that they can get their production started as required.

Attention has been given in all the shops to the best possible working conditions, and this is noticeable throughout the machine shop where many provisions have been made for the welfare of the workers. These shops are at present employing quite a number of women workers, and for these ample rest rooms with noon-hour recreation facilities have been provided, also a hospital and first-aid nurse. A cafeteria was installed during the past year, and in connection with this is a large dining room with clean neat tables where all workers, including those who bring their own lunch, may go during the noon hour. There is also a laundry with several attendants who daily wash and iron all of the table linen and all the towels which are in use throughout the plant.

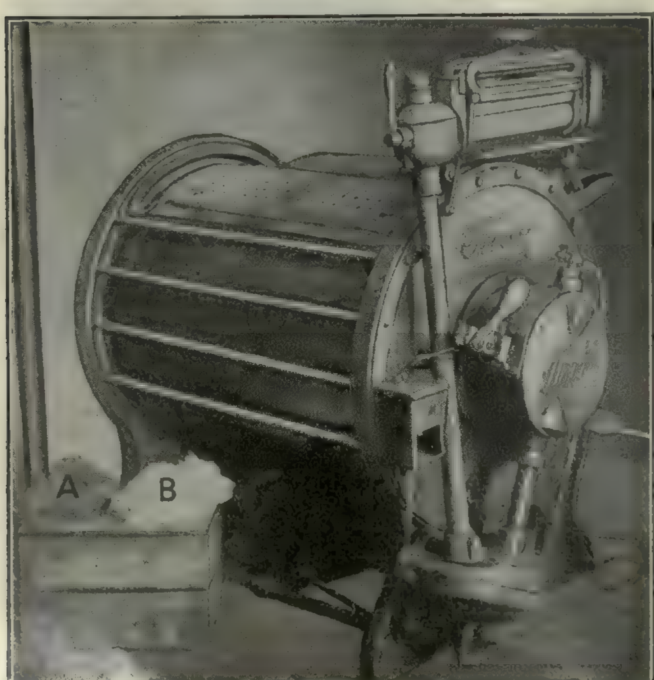


FIG. 4. MACHINE USED FOR WASHING COTTON WASTE

An institutional type of Hurley washing machine has been installed in the boiler room, and to this all cotton waste from the shop is taken and so thoroughly washed that it comes back satisfactory for re-use. Fig. 4 shows this machine together with samples of dirty waste *A* and cleaned waste *B* after it has been subjected to the washing process in this machine. A special soap solution in hot water is used for this washing, and, after rinsing, the waste is passed through the wringer and hung in a special drying room. All paint, dirt, and even chips of metal are removed by the washing.

The scheduling of the work through the machine shop has been done in a thoroughly progressive manner by modern production methods, and all is planned to insure that even where the machine capacity may be somewhat limited, no hold-up in production will be occasioned by a shortage of material. For routing work, production-schedule boards are employed which are located right in the shop so that they will be constantly convenient for observation by the foreman.

FIG. 5. PRODUCTION SCHEDULE BOARD IN MACHINE SHOP

The Schedule Board

One of the schedule boards is shown, Fig. 5, and on this, each machine is listed in the column at the left of the ruled space where each square represents a day's production. These boards carry the production outline for each machine for a period extending over approximately one month in advance of the present day's work. At the top of these squares small brads have been driven, upon which are hung the square white tags shown in the illustration. On these is written the part-name, job number, and the quantity of parts to be produced by that machine. Where the machine will be engaged on any particular job for a number of days, it is unnecessary to write cards for each one of these days, and instead small brass washers (which might be called ditto marks) are hung in each one of the following squares, representing the necessary number of days' production to complete the job. To prevent the tags from being blown from the brads, rubber bands are stretched over four to five brads at a time.

Machining Aluminum Pistons

By P. T. Lennon
Master Mechanic, Lynite Laboratories, Cleveland, Ohio

In machining aluminum where both accuracy and good finish are required it is necessary that the machine used should have no lost motion, the work must be held tightly and yet not be sprung, and the tools must be properly ground. The most approved methods of machining aluminum pistons are given herein by a man who has had a large experience in this class of work.

IT IS interesting to note the attitude sometimes taken, not only by the men, but even by the foremen in many machine shops and service stations, toward the machining of aluminum parts and particularly of lynite pistons. Despite the fact that the machining of aluminum is steadily becoming a larger feature in the daily grind, it does not seem to have received as much attention as regards a common knowledge of cutting speeds, feeds, shape of tools and lubrication, as has been devoted to the machining of other metals.

This impression has been recently strengthened by hearing a foreman, when handing a lynite casting to the machinist, warn him to "be very careful, the stuff tears easy, and there are no extra castings. So go slow and take no chances."

Accordingly, the machinist takes the job knowing that he can afford to cut and try and experiment a little and when finally, he does get down to where the cuts should leave a good smooth, clean and true finish, he gets scared of that "digging in" that occurred in his earlier trials, and allows, as on cast iron, for generous application of a file and abrasive cloth. The result is not always what is should be, particularly if there is a depression cast around the wrist-pin hole where the file will rise and fall on the surface, and will not only pick up particles that will scratch, but will produce irregularities which will show up in the wear of the piston.

It is because the foregoing practice is peculiarly pernicious in the production of lynite pistons, and because pistons generally present some very interesting problems in tooling, that I venture to present the methods that have been found by extended experience to be fairly satisfactory in our own shops. I sincerely hope that this experience may elicit an exchange of ideas and suggestions from wide-awake contributors.

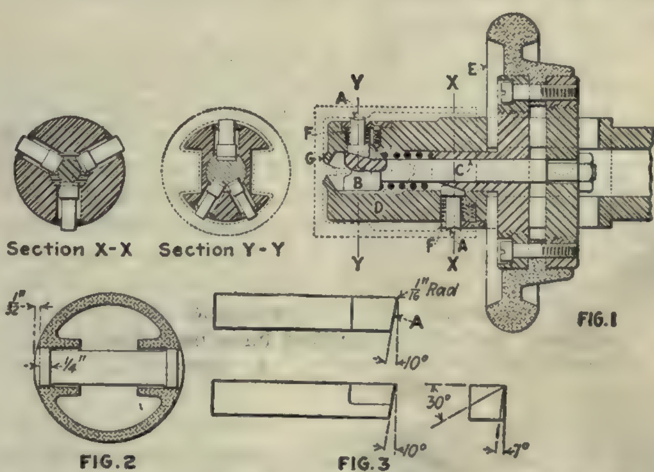
Inside of Piston Should Be True and Concentric With Outside

It is, of course, of prime importance that a piston be machined so that the entire inside is quite true and concentric with the outside. This can hardly be over emphasized. This condition is usually established in the first operation, namely that of squaring the end of the skirt and boring the register seat. To perform this operation, some makers merely grasp the head in an ordinary 3- or 4-jaw chuck (which seldom runs within $\frac{1}{64}$ in. of true), and true the end of the skirt by the introduction of a cone center. The result frequently is, that while the skirt looks all right, the head is badly out of balance. One section under the ring grooves is dangerously thin and its opposite diameter proportionately heavy.

This unsatisfactory condition may be avoided by using a somewhat familiar type of arbor with adjusting pins, as shown in Fig. 1. The six adjusting pins *A* are actuated by tapered seats on the sliding spindle *B* and sleeve *C* each of which has projections passing through slots in the body *D*. These projections are threaded right and left hand respectively to engage with nuts shown inserted in handwheel *E*, thus conveying a telescopic action to spindle *B* and sleeve *C*. The adjusting pins are kept in contact with and returned to their lowest position by springs *F*.

The Operation Is Usually Performed in a Turret Lathe

As the operation is usually performed in a turret lathe, this arbor is held in the turret and projects as little as possible. The piston is slipped on this arbor until the underside of the head comes against the stop



FIGS. 1 TO 3. TRUING ARBOR AND TOOLS USED IN MACHINING ALUMINUM PISTONS

Fig. 1—Arbor for truing pistons. Fig. 2—Pin for holding pistons against register plate. Fig. 3—Tool for turning pistons.

G. The stop should be slotted to clear in the case of a cross rib in piston head. The pins are then expanded to hold the piston rigidly by means of handwheel *E*, and the work is carried forward to a floating chuck which grasps it by the head and which in turn is secured to the back plate before the expanding pins are released.

After the arbor is withdrawn, the inside edge of the skirt should be chamfered deep enough to allow about $\frac{1}{32}$ in. to remain after finishing the end of the skirt and register seat. Next, a cone center is brought forward as a support while a roughing cut is taken almost to the chuck jaws. This allows from 0.01 to 0.015 in. for a finish cut. Then the cone center is withdrawn and the end of the skirt squared to length with rough and finishing cross slide tools. Finally the register seat is bored very carefully to size with rough and finishing turret tools.

One of our sales engineers once asked why a rough cut is taken off the diameter at this early stage in the proceedings. He protested that most of his customers

did this later on when the piston was mounted on its register ring. The principal reason for taking the roughing cut at this stage of the work is that the throwing of a bad burr to the edge of the register seat which might affect later operations is avoided.

Although some shops, and especially those which hold pistons with pins in the wrist-pin hole cores, do not bore these holes until the pistons are nearer completion, it is preferred to make this the second operation for the following reasons: Boring the wrist-pin hole at this time permits the use of the largest cross pin possible to draw the piston against the register plate, and it lessens the danger of the cross pin bearing on the inside ends of the bosses, as the cored hole usually has considerable taper. It is found that when this happens, and especially if the register seat is a sloppy fit on the plate, the piston will be pulled considerably out of round.

As a further precaution, the cross pin should be relieved to within $\frac{1}{4}$ in. of each end and its length be made to within $\frac{1}{16}$ in. of the finished diameter of the piston or to within $\frac{1}{32}$ in. of projecting through each end of the hole. See Fig. 2.

If the wrist-pin hole is machined in a jig, the boring tools should be piloted at both ends, and they should be boring tools, not a drill and machine reamer, as there is apt to be enough freedom in the bushings and wear on the drill to allow it to run off and the reamer will follow the drill to some extent.

If the operation is done on a turret lathe, as is quite common, at least two roughing cuts and one finishing cut should be taken, bringing the hole to from within 0.003 to 0.006 in. of final reaming size. In no case should it be finish-reamed until after all other operations.

Some people are inconsistent in their handling of this operation inasmuch as they bore the hole while resting the rough turned piston in a V-block, and ignore the accurate register seat which presents the only true base from which the hole may be bored with any certainty of its being true and square with the finished surface.

A Good Finishing Reamer

A good finishing reamer has wide flutes cut about 12 deg. left-hand spiral, has long enough taper to enter both holes before cutting full, and should pass entirely through, and not back again.

All further operations may be divided up according to expediency, but all should be performed while on the register ring. On a turret lathe it is possible to drill for center in head (if called for). The diameter of the head may be rough turned with offset turret tools, and the ring grooves may be rough turned to within $\frac{1}{64}$ in. in width and 0.005 in. in depth, and the head rough-squared with cross-slide tools.

After that, it has been found preferable to do all finishing operations in an engine lathe.

When finishing ring grooves, care should be exercised to see that all end play in the spindle is taken up either by bringing up the tailstock center to the center in the piston head, or in its absence, against a plate bearing on the head. The tool carriage should be locked in position to prevent any possible floating. "Go-in" and "not-go-in" gages are necessary for the grooves with limits of from standard for the "go in" to 0.0005 in. over standard for the "not go in." For instance for a $\frac{3}{16}$-in. ring, the gages should be 0.1875 in. for the "go in" and 0.1880 in. for the "not go in." It is essential that the tool bits should be gripped close in the tool holders, and that the holders do not project more than is necessary from the toolpost. All tools should be properly ground and carefully oil-stoned.

In discussing tool grinding, one is tempted to utter a wail over the passing of the old fashioned forged tools. In looking over the old-time tool board, we could see all the then approved shapes from the diamond point to the parting tool and goose neck, all of which were more or less religiously adhered to. The machinist prided himself on his ability to demonstrate wherein he excelled over the other fellows' grinding. Now the tool board is usually a small tobacco box containing a few stubby characterless bits, over which it is difficult to work up any enthusiasm.

Although all manufacturers use high-speed steels for roughing cuts, a great many advise using carbon-steel tools for finishing aluminum. It is quite possible to get a very satisfactory finish from a good, selected high-speed-steel tool when properly ground and carefully oil-stoned; it will usually hold a keen edge that will not break down under a light, well-lubricated cut.

A Proper Tool for Use on Aluminum

Generally speaking, it may be said that a tool properly ground and set so that it will cut an easy flowing, loosely curling chip from machine steel will be about right for aluminum; that is, its top rake should be a 25- to 30-deg. angle to the right, and about 15 deg. back. The forward or cutting corner should be well rounded, say to about $\frac{1}{16}$-in. radius. The face of the tool to the right of this corner need not be ground so as to recede very much from the work, as it is well to have the face just to smooth the ridges after the round corner removes the bulk of the stock. (See Fig. 3.) For finish turning only the middle portion of the face of the tool is used at *A*. This provides sufficient flat against the work to cover the feed comfortably despite the angularity of the face, and gives an easy shearing cut.

The same practice applies to parting tools for cutting ring grooves as for any other work. The tool should have sufficient clearance downward on both sides to make sure the prevention of rubbing. The top should have the least possible clearance back to prevent chips from wedging and they must be perfectly square with the work. It is very essential that the face of the tool be well oil-stoned, as the tendency for the material to stick and pile up on this tool is greater than on others.

As to cutting speeds, from 400 to 500 ft. per min. is a fair roughing speed (some manufacturers run 700 ft. or better), and from 125 to 175 ft. for finishing. (We usually run about 140 ft.)

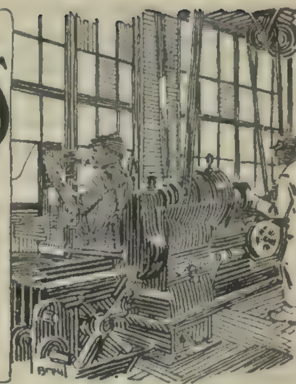
A fair roughing feed is from 0.03 in. to 0.04 in. per rev. and a finishing feed should not exceed 0.02 in. per rev.; 0.01 in. will give better results.

The majority of shops do all their rough turning dry, but usually use some lubricant for finishing. Very satisfactory results may be obtained from a mixture consisting of about 70 parts kerosene and 30 parts lard oil. This should be used freely on all finish cuts. Wherever it can be arranged it is well to pump it directly on the cutting tool with enough force to wash the chips off.

Shops that are equipped with grinding machines can finish their pistons more satisfactorily than in the lathe. A Crystolen wheel of about a No. 40 grain and a J or K grade, when used with a lubricant even as lean as 10 parts lard oil and 90 parts water, will give a very beautiful and true finish to lynite pistons.

MODERN PRODUCTION METHODS

By
W. R. Basset
of
Miller, Franklin, Basset & Co.



V. Tool Issue

The amount of time wasted at the grinding stand in the average shop is proverbial, but it doesn't seem to be shrinking to any appreciable extent. It is typical of the wastage all along the line where efficient methods of handling tools have not been introduced. Here the author describes a few flagrant cases, gives general remedies and points out the improvement resulting from the changes made.

(Part IV appeared in our May 20 issue.)

HERE is a conversation I once overheard which is typical of what occurs daily in too many machine shops:

Machinist (at toolroom window)—"Give me a 1⁄16-in. reamer and socket."

Storekeeper—"Here's the socket. Get the reamer from John Jones. I think he had it last."

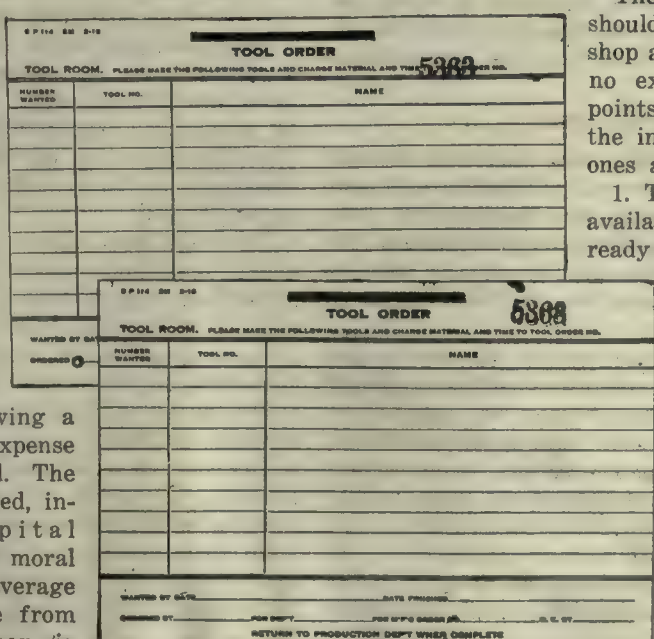
Fifteen minutes later:

Machinist—"He hasn't got it and I can't find it."

Foreman (who overheard him)—"Well, keep lookin'. Ain't Jim told you he ain't got it?"

The conversation grew acrimonious, leading to impolite reminders by the workman that he was on piece work and wouldn't give his time to the search and to vituperative comments by the allied storekeeper and foreman. Too frequently the time lost in changing jobs and obtaining new tools is not sufficiently considered. The management may be conscious of the loss, but even in the most efficient plant the sum total of cost is seldom known. A study in this machine shop showed that the improper racking and follow-up of tools and the consequent loss of time amounted to 13 per cent of the productive labor payroll. If, under such conditions, the man's time were the only loss, it would be bad enough. But it isn't. First, an expensive machine is thrown into the non-productive list, piling up its many items of overhead expense. The production of the shop as a whole is decreased, throwing a heavier burden of general expense on every article manufactured. The rate of turnover is diminished, increasing the working capital needed. Then there is the moral effect on the men. The average working man takes his cue from his leaders. If the foreman is efficient and dispatches his work to the best advantage, the men will generally do their share; but if the foreman is careless and does not attend to detail the men will become imbued with the same spirit and do their work in a listless "I'll-do-what-I-must" manner. Delays do not bother them and they lose the ambition to turn out their work quickly and efficiently. When this condition exists the quality of their work is also very apt to suffer. After considering the many phases of this question it will be realized that the initial labor loss is small in comparison with the ultimate.

If a machine shop has the crudest vestiges of a cost system, its executives must realize the losses that such a waste of productive time causes. And yet the fear of system, which to many means "red tape," makes them prefer the loss to the cure. There is some cause for this feeling; but in the toolroom, as elsewhere, it is quite easy to have well-ordered handling and records without red tape. I would be the last one to advocate routine for the sake of the routine.



[redacted]
TOOL ORDER 5368
TOOL ROOM. PLEASE MAKE THE FOLLOWING TOOLS AND CHARGE MATERIAL AND TIME TO TOOL ORDER NO.

NUMBER WANTED	TOOL NO.	NAME

RETURN TO PRODUCTION DEPT WHEN COMPLETE

FIG. 16. TOOL ORDER FORM

There are certain rules which should be followed by a well-run shop and which allow of practically no exceptions. There are other points which must be settled by the individual shop. The absolute ones are:

1. The proper tools should be available when the workman is ready to start an operation.
2. The exact location of every tool should be known.
3. It should be possible to tell at once just which tools any man has.
4. No workman should be allowed to sharpen, repair or make tools.

The questions which must be settled in the light of the peculiar needs of each shop are:

1. Shall workmen own any tools?
2. Shall tools be deliv-

ered to men or called for by them at the toolroom?

3. Shall men specify the tools needed?

4. Shall any tools remain permanently at the machine?

We saw in a preceding article how, when a part is to be made for the first time, the engineering department notifies the tool designers what is needed. This is done early so that the tools, jigs and fixtures may be ready before the part is released to the shop. This can be done whether a single part is to be made or a hundred thousand. Fig. 16 shows a form on which new tools may be ordered. A simple and obvious routine can be relied upon to follow the making of the tools through all the operations until they are delivered to the tool crib. The form shown in Fig. 17 may serve as a follow-up reminder whether the tool is made in the plant or ordered from the outside.

The Double-Check System

It is, of course, simple enough to know where tools are, if the customary single-check system is used. But it is also desirable to know what tools are in the possession of any man. This can be accomplished by the double-check system, under which not only is a brass check with the workman's number hung in place of the tool, but a check bearing the tool number is hung on a board under the workman's number. Thus, if a workman leaves the company, the exact tools in his possession are known. This method can be improved upon as will be indicated later.

The favorite gossiping place in any shop is the grinder. Here men may congregate and have a perfect alibi, for they "are waiting to get at the wheel." It's amusing, in shops which subdivide operations to the last hair, to see men who are little more than machine tenders, sharpening their own tools. The management does not consider them all-round mechanics, but apparently feels they are toolmakers.

Tools should invariably be kept in condition by men who do nothing else. This saves the time of productive men and assures that the tools will be ground to give the best cutting results. I can conceive of no shop employing fifty or more men where it would not pay to have at least one man to keep tools in condition.

When tools are turned in to the crib, they should be examined and repaired, if they need it, before being issued again.

Ownership of Tools

Personally, I believe that the shop may well furnish all tools used. This, however, will depend to a degree upon the nature of the work and the kind of men employed. If a shop is fortunate enough to have a few temperamental, all-round mechanics it may be wise to "compromise" and let the men use their own tools if they want to.

The big objection to a man owning his own gages is that he will not usually provide a sufficient range, nor are the gages he possesses always well adapted to the work he is doing. He may have a micrometer, a pair of calipers, a depth gage and so on. In up-to-date shops on repetitive work, snap gages are used, which, of course, the men cannot be expected to furnish for every job they may be put on.

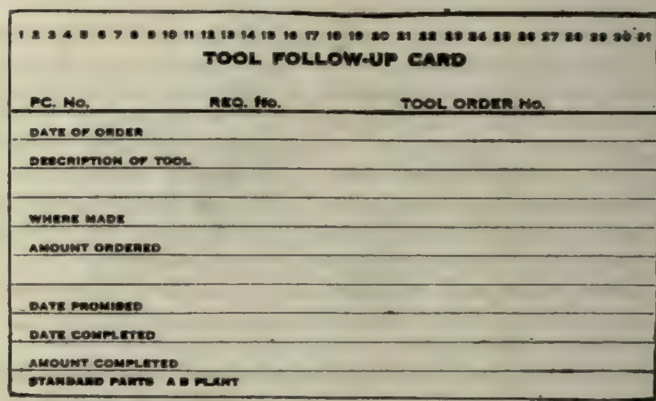
If a man furnishes some of his own tools, it is, of course, out of the question for whoever inspects his kit when he leaves the plant to tell which tools belong to him and which to the company, unless, as seldom is done, the company's tools are stamped with the company name.

In the planned shop, it is, as a rule, best to have tools delivered to the men a short time before a new job is started. This is handled by the planning department which knows not only what tools are needed, but just *when* they will be needed. In job shops where it is not feasible to forecast the approximate time when a new job will start, it is best for the workman, or perhaps the foreman, to get the tools.

It is always possible to determine what tools will be needed for a job. This should be done by the engineering department. Of course if no engineering department exists, the judgment of the workman or his foreman will have to govern.

As a rule it is best to have the tool turned in to the crib when an operation is finished. There is no great objection, however, to having certain standard cutting tools for lathes, planers, etc., remain permanently at the machine.

However these questions are answered, I want to impress the importance of having a close control of tools exercised by the tool crib. If this is not done, great wastes can go on.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

TOOL FOLLOW-UP CARD

PC. No. REQ. No. TOOL ORDER No.

DATE OF ORDER

DESCRIPTION OF TOOL

WHERE MADE

AMOUNT ORDERED

DATE PROMISED

DATE COMPLETED

AMOUNT COMPLETED

STANDARD PARTS A B PLANT

FIG. 17. FOLLOW-UP CARD ON NEW TOOLS

Take, for instance, the case where it was possible to cut, at pre-war prices, the investment in tool steel $13,000. It was evident, on casual observation, that the investment in tool steel was too high.

We found that there was no real system in use for handling tools, nor were there any standard prints from which they could be made. Each foreman, as he needed, or thought he needed, tools, or even at times the operator on the machine, would go to the stockroom and get sufficient steel to make such tools as he wanted.

He would then take this stock to the blacksmith who would forge them up for him in the way he described. If he had a preference for a tool with a large clearance or rake angle, the tool was made up that way. Frequently we found another foreman requesting a tool for identically the same work, but with a different angle.

Not at all infrequently a foreman from one of the outlying buildings would send in a written order for a quantity of a certain tool which he would describe roughly. If he did not receive them he might send in another order, not mentioning the first at all. In due time he would receive just twice as many tools as he ordered and that would probably be about three times as many as he needed.

We first investigated where the tools were kept. There did not seem to be a very great congestion in

the tool cribs, although there were seemingly a few more tools there than necessary, but on going out into the shop to the machines we found even more trouble.

A night and day turn was employed, and as the tools were ground by hand by the operator himself, no man was ever satisfied with any other man's grinding; consequently, the night man on a job always tried to hold his tools away from the day man and vice versa. There was always a duplicate set at a machine and frequently sets for several jobs which the operators had collected and never turned in.

At ten machines we found an average of thirty tools weighing on an average, 5 lb. apiece. These were all of high-grade tool steel, costing at that time about $6 a pound. One can easily see that here was a lot of money tied up in tools that only a few operators could use.

30 tools @ 5 lb. each = 150 lb. per machine.
150 lb. @ $6 per pound = $900 per machine.
$900 × 10 machines = $9,000.

Then at forty-two other machines we found the following conditions:

5 tools @ 4 lb. each = 20 lb. per machine.
20 lb. tools @ $5 = $100 per machine.
$100 × 42 machines = $4,200

A lower-price steel was used on these machines. **These figures do not include tools in use at the machine at that time.**

Here is a total of $13,200 tied up in tool steel which was being used only a small portion of the time, as only a maximum of eight tools was ever used at one time on one job, and many jobs used considerably less. While one job was running on the machine, the tools for all the other jobs were idle in the workman's tool box. Had they been handled from a central crib they might have been in use on some other machine.

Several of the men's tool boxes were so heavy that it was impossible to move them when we tried to take them into the crib, and the tools had to be taken out and piled on a hand truck. These tools were all

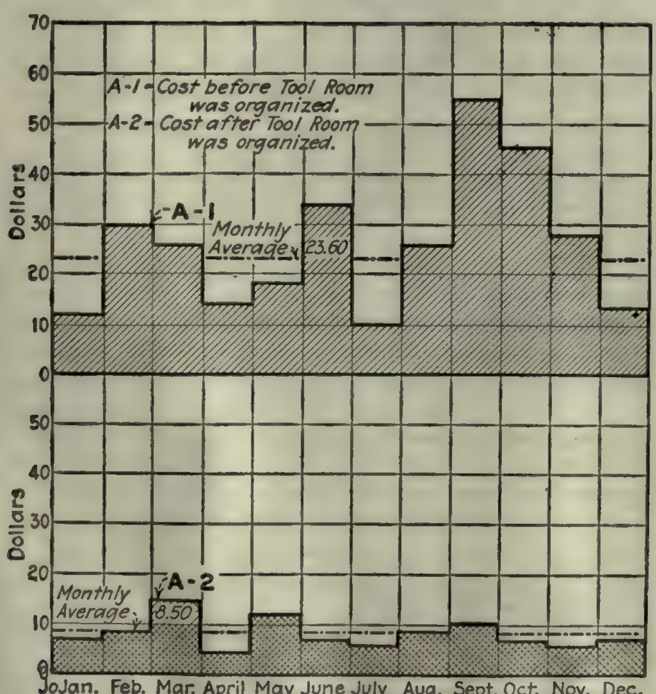


FIG. 18. CHART SHOWING SAVING IN TAPS AND DRILLS

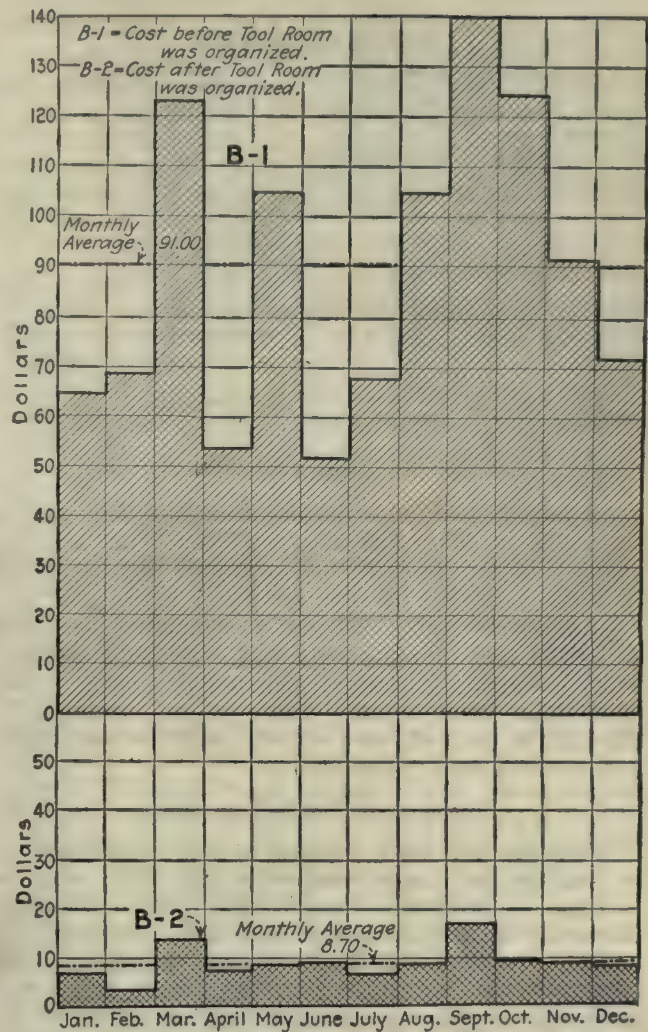


FIG. 19. CHART SHOWING SAVING IN FILES AND HANDLES

taken into the central tool crib, and all similar tools were placed in the same bin so that the complete stock of any tool could be immediately ascertained. After sufficient data had been obtained as to the usage of the different types, a minimum limit and desirable amount to order was placed on the bin tag and the stock was kept within these limits by requisition on the tool stock.

The System Devised

A brass-check system was in use at this time for keeping track of the tools that were out; but as there were two turns it necessitated turning tools out and in both night and morning. If this was done, there was constant trouble between the two turns; consequently a system of written slips was installed.

This operated as follows: A tool list was written in triplicate for all tools ordered out, one list remaining in the crib, while the other list would be given out—one to the day man and one to the night man. Then if the tools were given out to the day man, the night man, when he came in, checked over the tools with the list given him. If any were missing, he reported the fact to his foreman for adjustment. If he did not report it, and turned in the tools later with one missing, a charge was made against him.

At the same time it was found desirable to start a central tool-grinding department where all similar tools might be ground the same. The tools in the crib

SHOP SUPPLIES.

Charge Acct. 20-Ma. Date 7-7-19

Stock Delivered Only on this Order.

Store Keeper:
Please deliver the following Supplies:—

Amount	Size	Material	Rate	Amount
1	T-2977	Form Tool		18 68

To be used for the following purpose:—

New Work	Repairs	Operating	Name of Department	Symbol
		X	Ma	5919

NOTE.—Make a cross in Block showing for purpose material is to be used.

[illegible] *Foreman.*

FIG. 20. TOOL REQUISITION

were kept ground, and when a man had a dull tool, he turned it in and received a new one. This not only saved time but assured that each tool was so ground as to give the best possible service.

This central tool department also maintained a stock of forged tools on a minimum and desirable amount-to-order basis, so when requisitions for tools came in they were filled from stock. This tended, naturally, to standardize the tools used and tool numbers were placed on all which were necessary.

Reforging Worn-Out Tools

Worn-out tools were returned to this department and it was decided there whether or not they could be reforged into another shape. This alone effected a saving of about $152 a month in scrap tool steel.

The chart, Fig. 18, shows the saving made in taps and drills in one plant by making only elementary betterments. The management was so afraid of red tape that it would not countenance a really modern method of handling tools. But even with the rudimentary changes made, the saving in the one item of taps and drills amounted to $180, and in files and handles $987, in one year. The latter item is shown graphically in Fig. 19.

Formerly nearly all of the shop tools were allowed to remain in the care of the operatives at their benches or machines. Many workmen accentuated this semi-ownership by keeping the tools under personal lock and key. As no record existed showing what tools belonged to the company, it was a very common occurrence to find that tools had vanished—where to, no one knew.

In an effort to determine where these tools were or how they had been disposed of, an examination of every operative's tool stand or bench drawer was made.

Productive Service Card Form 128

Date Moved	Operation: Drill, ream, & form & cut off.	Man No. 349	
Pieces Wanted		Order No. 1718	Lot 1
Completed		Part No. 5919	
Rejected			
Credit	Tool No. M-A-77 / Oper. No. 1	Mach. No. 493	Dept. Ma
Move To Dept. M	Date / Total	P. Price .0152	
To Mach. 382	Elapsed Hours	Change Mach.	
	7-31-19 M. / Hourly Rate	Total Credit	

FIG. 22. JOB TICKET GIVING TOOL SET-UP

Tool Release Order

Please Release Check No. 379 on the following:—

No.	Size	Article	Broken	Damaged	Cost
1	T-2977	Form Tool	X		18 68
		Part-5919			

NOTE:—Mark X in column denoting condition.

Date 7-7-19
Dept. No. Ma
Foreman J. Kester

FIG. 21. TOOL RELEASE ORDER

The result was that drills and taps, in quantities ranging from 50 to 150 per size, were found at the benches. The majority were usable, only a small expenditure being required to put them in shape. The men in the shop, when questioned, admitted that if a drill or tap became damaged, they went at once to the shop office for another. The assistant foreman would give the tools out; even suggesting—"better take two or three and you won't have to bother me again so soon."

Summed up, the unnecessary investment and subsequent loss in stolen, mislaid, idle or needlessly discarded tools was due to the common carelessness of the foreman and his assistant.

The first step was to centralize tool storage in a crib. As tools are taken from this and given to the workman they are listed on a standard card, and filed by the man's number (in a 3 x 5-in. card file) in the toolroom.

Drills and taps were given out only upon the return of the shank end of the tool originally supplied. Files and handles could be secured only by returning the old ones. Bolts and machine screws were not given out by the box as before; but according to the quantities specified on the bill-of-material. Additional tools were issued only upon presentation of a tool check.

All locks were removed from bench drawers and a standard lock used throughout the shop. Each workman was given his key, a master key fitting all locks being placed on the key board in the toolroom.

Another Simple System

The following simple tool system—one we recently installed in a well-planned shop—indicates the routine

Mach. Name ____ List No. ____
Mach. No. ____ Drawing No. ____

Pieces	Name	Size	Symbol	Location

(over)

WHEN THE TOOL LIST IS NOT CORRECT THE FOREMAN MUST REPORT THE ERROR AT ONCE TO THE PRODUCTION OFFICE. DATE ____ SIGNED ____

TOOLS CALLED FOR ON THIS LIST MUST BE ISSUED TOGETHER

Form O-109 **TOOL LIST**

FIG. 23. TOOL LIST

FIG. 24. ISSUING TOOLS IN BOXES

that can easily be adapted to nearly any needs. It assumes economical handling of tools.

Briefly, these are the points we took up:

1. We gave all tools a number.
2. We classified all tools as jigs, fixtures, gages, tools, dies, etc.
3. We listed tools needed on operations for every part manufactured, showing the tool number, name and size.
4. We rearranged the tool cage and divided it up into sections; each section divided into bins and drawers for all tools and gages.
5. We installed an "in-and-out" tool cage record and used this for each tool. It is a card which shows the tool number, name, location in the tool cage, what part it was used for, what operation, the maximum and minimum stock required and the operator who has the tools out, with his name and number. Whenever a tool is used or broken, it is entered on this card, thus showing at all times the balance on hand.
6. We designed a tool requisition for the issuing of all tools, showing the operator's name, number, department in which he works, the tool name, number, size and number of each kind needed.
7. Tools to be repaired are entered on a repair order in triplicate by the man in charge of the cage. The original remains in the cage, the duplicate goes with the work to the toolroom, and the third copy is sent to the layout man in the planning department for his planning. Each copy shows the tool name, number, size, nature of repair and when wanted.

On all productive operations the tool requisitions are handled entirely by the control board operator, in the central planning department. On all other work the tool requisitions are handled by the foreman.

The tool requisition is made out in duplicate, signed by the foreman and then sent to the tool cage. The tool cage man first sees if the tools are in by looking on the "in" file of the tool cage record. If they are in the tool cage, he enters all tools called for on the requisition on the "in" cards and places the cards in the "out" file. The requisition is then filled, and the original is filed against the operator's number and the duplicate sent with the tools to the operator so that he can check the tools.

Filing the tool requisition, Fig. 20, against the operator insures that he will return all tools before being paid off if he is discharged or quits, as the tool cage man must sign his "tool release order" (shown in Fig. 21) before he is paid.

When the tools are returned by the operator, they are checked against the tool requisition to see that all the tools called for on the requisition are returned. They are then sent to the tool inspector to determine their condition.

After the tool inspector approves their condition, he signs the tool requisition and turns it over to the clerk in the tool cage who enters the tools returned on the "out" card of the tool cage record. This card is then placed in the "in" file.

In any shop where the tools to be used for an operation are specified by the engineering department, it is well to have a copy of the parts list or of the shop order, Fig. 22, sent to the toolroom. This may show simply the tool number, as does the one illustrated. Or from the list of tools needed for any operation, which is on file in the toolroom, the proper tools, gages, fixtures, and instructions are collected in a tray and sent to the machine, ready for the set-up man. Such a form listing the tools needed with a full description of them and showing their location is shown in Fig. 23.

To prevent the shut-down of machines due to breakage, all tools that are subject to easy breakage or that are unusually delicate are furnished in duplicate.

The requisitions for tools, etc., received from the planning department are filed in the tool crib against the man, machine or unit to which they were sent. When the tools come back they are checked and breakage immediately replaced and reported.

Often where an operation repeats quite frequently it is well to have permanent sets of tools, gages and so on kept in boxes, as shown in Fig. 24. Sometimes duplicate boxes are advisable. This does away with the trouble and time taken in gathering sets together. The set-up or other instructions may be pasted to the inside of the set-up box cover, or as in this instance a list of tools like that shown in Fig. 25 may be shellacked to the bottom of the box.

A performance record of various tools is not hard to keep and frequently will point the way to considerable economies. It may for instance indicate a saving

FORM 143

Box No MA-77

MODEL L-Adj. Nut. OP. Drill, ream, form & cut off

TOOLS REQ'D

QUAN.		SHORTEST LENGTH
1	T-2977 - Form Tool	
2	T-581 - Turning Tool	2½"
1	T-2496 - Reamer Shank	–
2	1 5/32" St. Shank H.S. Oil Drill	6"
2	1.182 H.S. Shell Reamers	
1	1.180 go 1.184 Not go Plug Gauge	

FIG. 25. TOOLS REQUIRED LIST

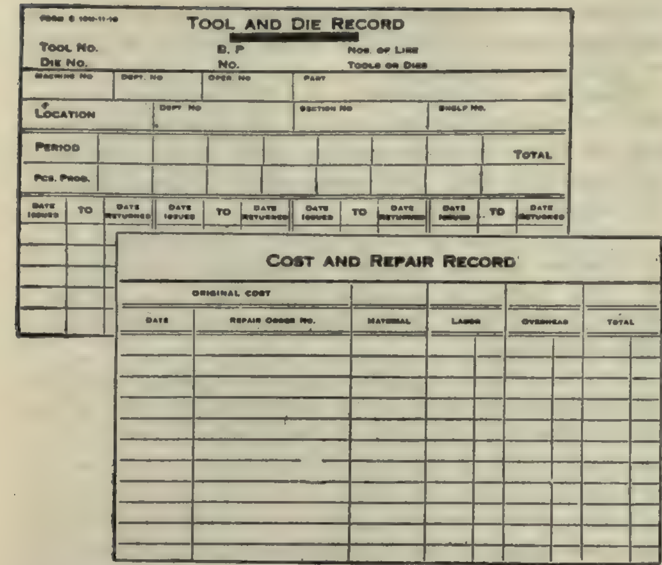


FIG. 26. PERFORMANCE RECORD FORM

through purchasing tool steel of just the right quality.

Fig. 26 shows both sides of such a card record. It combines a record of the location of the tool or die with a record of the production obtained from it, the cost of making the tool and of repairs that become necessary.

While such a record is of particular value for a tool which is in use for long periods at a time it may well be used for any tool which is expected to stand up under quantity production.

Welding Malleable Iron

By Fred B. Corey

From the standpoint of the autogenous welder, a malleable-iron casting presents more peculiarities and is a more prolific source of trouble than any other metal with which he has to deal. The reasons for this condition do not seem to be generally understood, although those who have made a study of it know that the trouble is due to the unstable condition of the carbon in the metal.

In order to gain an understanding of this matter, we will briefly review the process of producing malleable-iron castings. As originally cast in the foundry, the iron is white in color and almost as brittle as glass. These hard, white castings are packed in annealing pots and subjected to a temperature of 1,600 deg. F.

After holding the pots at this temperature for a considerable time, in some instances 80 hours, they are very slowly cooled. During this heating and cooling, the structure of the iron undergoes a radical change. The carbon, which in the original castings was in chemical combination, becomes dissociated from the iron, segregating in the form of graphite and imparting a black color to the resulting material.

Metallurgists do not seem to be in agreement as to whether this change takes place at the time of subjection to the high temperature or during the subsequent cooling. It seems probable that it occurs largely during the cooling process, as a too rapid cooling causes excessive hardness in the finished product. For the best results, the rate of cooling should be not more than 20 deg. F. per hour.

In order to make this change clear, two photomicrographs are shown herewith. Fig. 1 is from a sample of the white, hard iron before annealing, showing the fine crystalline structure of this material. These minute hard crystals lie in more or less irregular rows throughout the mass. Fig. 2 is from a piece of the same casting after annealing, showing the black masses of graphite separated from the iron, while the purified iron is left in a soft, ductile state.

If the iron shown in Fig. 2 was again heated and very slowly cooled, the structure would not be greatly changed, or if it was heated to a comparatively low temperature and cooled quite rapidly, the iron would still be soft. If, however, it was highly heated and cooled rapidly, the structure would again change and become similar to that shown in Fig. 1.

We are now in position to understand what happens when we try to produce an autogenous weld in a malleable casting. If the casting is merely brazed, using a filler rod of tobin bronze or similar material, the cast-

FIG. 1. STRUCTURE OF MALLEABLE IRON AS CAST

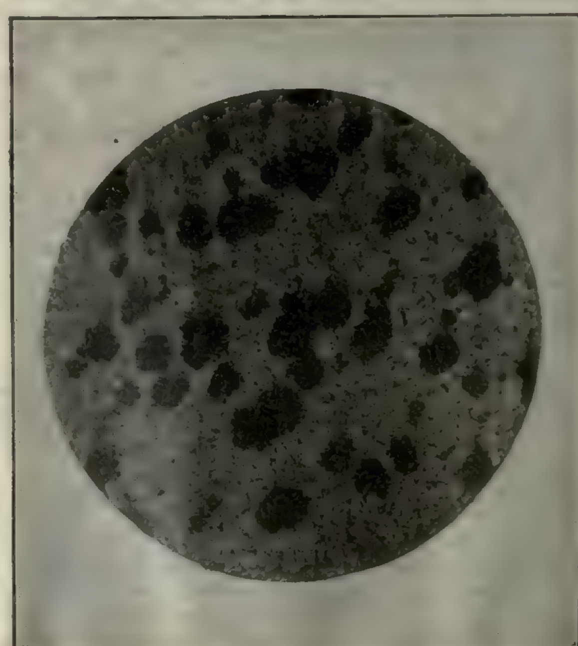


FIG. 2. SHOWING CHANGE DUE TO ANNEALING

ing need not be heated to a sufficiently high temperature to recombine the carbon and a fairly good job may result. If an iron filler rod is used to make a weld, a much higher temperature is required. The weld itself may then be soft, but this weld will be surrounded by a zone of hard iron where the heat has been high enough to cause the carbon to recombine with the iron. The resulting structure, throughout this surrounding zone, will be somewhat similar to Fig. 1. It is this tendency of the carbon to recombine with the iron when heated that causes the lack of success of the autogenous welding processes when applied to malleable-iron castings.

The writer has salvaged many defective malleable-iron castings from the foundry by having them welded. In all cases these castings have been welded before they were annealed, using filler rods of white iron of the same composition as the castings. The welded castings were then subjected to the regular annealing process which, of course, produced a perfectly homogeneous structure as a final result. When a real weld is desired, this method seems to be the only one that will give entire satisfaction with this peculiar metal.

The Trade Trained Boy

By Clarence MacNiven
Instructor, Connecticut State Trade School at New Britain

Until recent years, the belief has generally prevailed among parents that any boy, even though not up to the mark in his studies at the grammar school, could enter, and graduate from, a trade school; for, they considered the trade school taught only manual dexterity and called into play but little brain activity.

This condition no longer exists. It has been made plain to parents that a boy, to be acceptable as a student in the State trade school, must show a creditable degree of proficiency in his school work, and a degree of mentality quite on a par with the average youth of his age.

We have in this city a school, known as the Pre-vocational Grammar School, which has the following departments: Machine, drafting, printing, wood-workng and job and repair. These departments are in operation every school day, and each grammar-school pupil who elects to take the "Arts and Crafts" course is required to devote nine hours per week to these studies in their consecutive order. This training not only broadens the pupil's mental vision and gives him a more comprehensive view of his future relations in the business world, but it enables the vocational adviser to judge to better advantage the pupil's natural inclination or aptitude for one or the other of these trades.

The boy's future course of training is governed to some extent by this means, thereby eliminating to a considerable degree the misfits that formerly came to us determined to learn this, that, or the other trade for no other reason than that the trade selected "paid more money" or was the trade followed by their fathers.

The prospective student is entered at the training school according to the card made out at the pre-vocational school and is closely watched for the first few days, until we are assured by his manner of taking hold that he is upon the right track. Sometimes, after a week or so, the boy under observation develops sluggishness and lack of interest in his work, and at such time we try, by earnest talks with him, to bring out his true leaning. We try him in other departments, keeping up the same watchful oversight of his actions for a period of several weeks, or until we have located him in the trade for which he is naturally adapted or satisfied ourselves that he will not be successful in any trade within our field.

Once his course of training is determined upon we start him upon those problems involving the least mental effort, seeking rather to concentrate his efforts upon purely manual movements, until he has become accustomed to his new surroundings and feels himself "at home" among them.

This precludes the possibility of starting all boys in the same way. A cut and dried routine must never be followed. The boy's size and age must be taken into consideration, and his characteristics carefully studied before deciding upon what is best for him.

Many boys come to us without the pre-vocational training; some who have finished the grammar school course intending to supplement it by high school or technical training, but who through misfortune or from other causes have decided to take up a trade. In such cases we have no other guide than our personal observations as to the best way to handle them. Because of this it is necessary to include in all courses the most elementary problems and practices of the chosen trade in order to make sure that no essential part of the foundation of the boy's education has been neglected to develop embarrassing results at a later period.

We teach drafting, pattern making, machine work, electrical construction and printing. The period of instruction covers 4,800 hours; the working time being eight hours per day, five days per week, and four hours on Saturday. At least one-quarter but not more than one-third of the 4,800 hours must be devoted to academic studies.

Under our State laws, a boy may leave school at the age of fourteen, provided he gets a working certificate from the State Board of Education, but most of the larger employing concerns do not care to bother with boys at this age because of the trouble involved in keeping the certificates on file and complying with the requirements of the law. Therefore, the average boy who is not taking a high-school course has two years that can most profitably be employed in learnng a trade.

The object of the trade schools is to teach the boy the fundamental principles of the trades within their scope; carrying out the manual instruction contemporaneously with the mental training so necessary if manual skill is to be developed to its highest degree.

We do not instruct from a platform. Our work is conducted in much the same manner that it would be carried on by a competent and conscientious foreman of a factory department personally instructing an apprentice. If we are teaching a boy to operate a lathe, we take him to the machine, show him its various movements and give him certain pieces of work to do with which he can demonstrate its capabilities and which, when he has finished represents a component part of a tool or machine possessing real value. This is a factor of inestimable importance in awakening and holding a boy's interest in his work.

We endeavor to grade our course so that a boy may get the greatest possible variety of work consistent with a thorough understanding of the principles involved, for a boy does not have the stamina to stick to routine work that an older person possesses and is therefore likely to lose interest if kept too long on one job.

Heat-Treating of Brazed Fittings for Aircraft

BY ARCHIBALD BLACK

Heat treating and brazing have not generally been looked upon as processes that could be easily applied to the same piece. The automobile has left its mark upon shop practice and here we come upon an evidence that the airplane is likely to have as great an effect.

A TENDENCY exists in most shops to assume that brazed joints cannot be successfully heat-treated. As a consequence, many fittings used in aircraft work and assembled by brazing smaller parts together are finished and installed without being heat-treated after the brazing operation. This practice causes parts to be used that not only do not develop the available strength of the material, but which are even, in some cases, under internal stress due to the heating in the brazing operation. It has been shown by some recent experiments, made at the Naval Aircraft Factory, that this assumption is entirely erroneous. It is therefore advantageous to consider this matter with a view toward specifying the use of steels and brazing spelters which will permit the subsequent or perhaps the simultaneous heat-treatment of the parts.

MATERIALS

Considering the spelters required for such work, it is necessary to know not only their melting but also their approximate softening points, to avoid the destruction of the brazed joint during heat-treatment. Fig. 1 gives the approximate melting points and tensile strengths of several different compositions which provide a wide range for selection. These values are, however, subject to slight modification, due to the presence of some 1 to 1.25 per cent of impurities in commercial spelters, yet for the purpose of this work they may be considered correct, and it is recommended that the curve of tensile strength be assumed correct for the strength of the spelter in a brazed joint.

More detailed information of the properties of spelters is given by Hofman. Information about softening points is not so definite. Something can be learned from the equilibrium diagram for brasses given by Hofman, and also from a test made by the Naval Aircraft Factory which showed that a brazing wire of 80-20 brass mixture appreciably softened at about 50 deg. F. below its melting point.

Considering the steels likely to be required for the construction of aircraft parts, by consulting specifications issued by the Air Service and by the Bureau of Construction and Repair of the Navy Department, it is

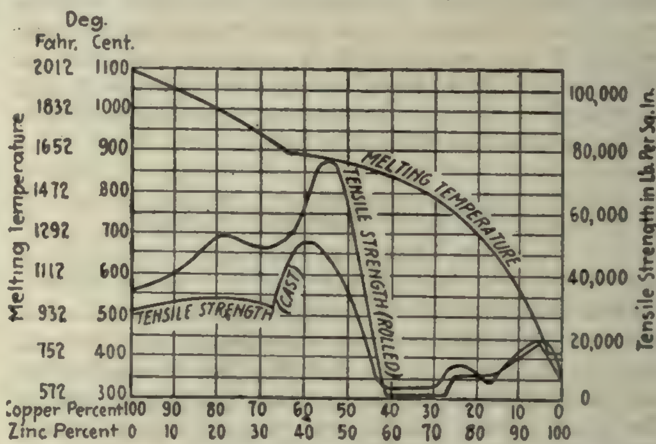


FIG. 1. APPROXIMATE MELTING POINTS AND TENSILE STRENGTHS OF SPELTERS

found that a typical list such as that given in the accompanying table can be compiled. This table is reproduced from aëronautical specification No. 89a of the Bureau of Construction and Repair, Navy Department, for the heat-treatment of brazed joints and is based upon work done by the division of metallurgy of the Bureau of Standards.

As is well known, when steels are heated or cooled, irregularities in the rise or fall of temperature take

TYPICAL LIST OF STEELS USED IN AIRCRAFT WORK, WITH THEIR APPROXIMATE PROPERTIES

		Heat Treatment			After Heat Treatment					
		Hardness After Oil Quench			Hardness		Tensile Test			
Steel	End of Upper Critical Range on Heating, Deg. Fahr.	Brinell	Shore Scleroscope	Drawing Temperature, Deg. Fahr.	Brinell	Shore Scleroscope	Ultimate Strength Lb. per Sq.In.	Yield Point Lb. per Sq.In.	Elongation in 2 In., per Cent
Mild carbon (0.15 to 0.35 per cent carbon)	....	150 to 225	30 to 40	800 to 1,300	180 to 130	30 to 20	90,000 to 60,000	60,000 to 40,000	18 to 26
Medium carbon (0.35 to 0.55 per cent carbon)	....	225 to 325	40 to 55	700 to 1,200	250 to 180	40 to 30	110,000 to 90,000	80,000 to 60,000	16 to 20
High carbon (0.55 to 0.75 per cent carbon)	....	325 to 380	55 to 70	250 to 1,000	325 to 250	65 to 40	160,000 to 125,000	125,000 to 90,000	2 to 10
High carbon (0.75 to 1.05 per cent carbon)	....	380 to 420	70 to 90	250 to 1,000	400 to 325	90 to 65	250,000 to 160,000	200,000 to 125,000	2 to 10
Nickel (0.20 per cent carbon, 0.50 to 0.80 per cent manganese, 3.25 to 3.75 per cent nickel)	1,390 to 1,330	350 to 550	50 to 80	900 to 1,100	275 to 200	44 to 34	140,000 to 108,000	110,000 to 78,000	20 to 25
Nickel (0.40 per cent carbon, 0.50 to 0.80 per cent manganese, 3.25 to 3.75 per cent nickel)				600 to 900	400 to 295	60 to 44	215,000 to 155,000	190,000 to 130,000	12 to 16
Low nickel chromium (0.35 to 0.45 per cent carbon, 0.50 to 0.80 per cent manganese, 1.00 to 1.50 per cent nickel, 0.45 to 0.75 per cent chromium)	1,385	400 to 600	60 to 100	700 to 1,100	360 to 245	60 to 42	204,000 to 112,000	168,000 to 94,000	10 to 17
Chromium-vanadium (0.35 to 0.45 per cent carbon, 0.50 to 0.80 per cent manganese, 0.80 to 1.10 per cent chromium. over 0.15 per cent vanadium)	1,425	400 to 600	60 to 100	800 to 1,400	440 to 210	60 to 25	220,000 to 105,000	190,000 to 65,000	10 to 20

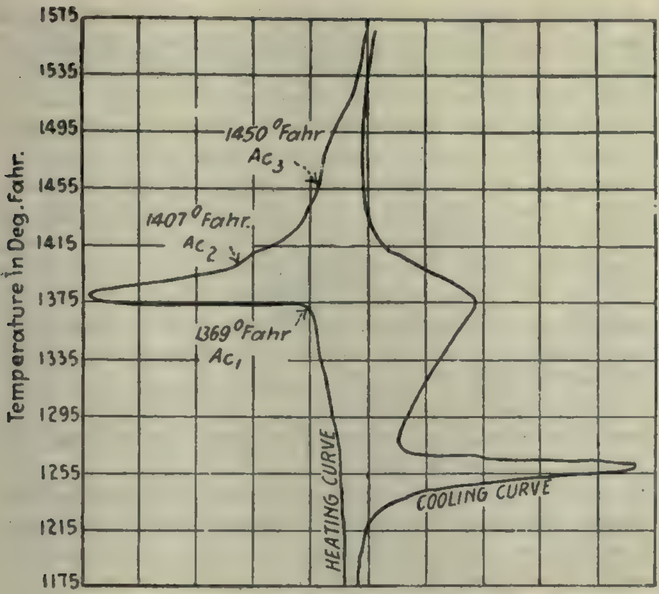


FIG. 2. HEATING AND COOLING CURVE FOR STEEL

place at certain periods, indicating internal changes in the material. These so-called critical points are actually short ranges but are known in steel technology as the Ac_1, Ac_2 and Ac_3 points where they occur during heating and the Ar_3, Ar_2 and Ar_1 points where they occur during cooling. Fig. 2 is a typical heating and cooling curve, showing the transformations for a steel of 0.3 per cent carbon and 0.7 per cent manganese, and Fig. 3 is the "equilibrium diagram" for straight carbon steels and is correct for 0.05 to 0.80 per cent carbon, at temperatures of 700 to 950 deg. C., the critical points being clearly shown. Such diagrams are usually only approximate, however, as they are affected by the impurities always found in commercial steels. An extended discussion of the heat-treatment and metallography of steel will be found in Sauveur, Bullens and other standard works.

In the heat-treatment of a steel it is necessary to quench it from a temperature slightly above the upper end of its higher critical range, the actual temperature depending largely upon the size of the part being treated. As a general rule this temperature should be at least 50 deg. F. above, and if information is not at hand concerning quenching temperature. it is advisable to consult the steel manufacturer for advice on the entire heat-treatment, rather than to attempt any experiments. The Midvale Steel & Ordnance Corporation issued a booklet containing much information about its series of alloy and tool steels, which is of general value. If the parts are to be brazed and heat-treated, a

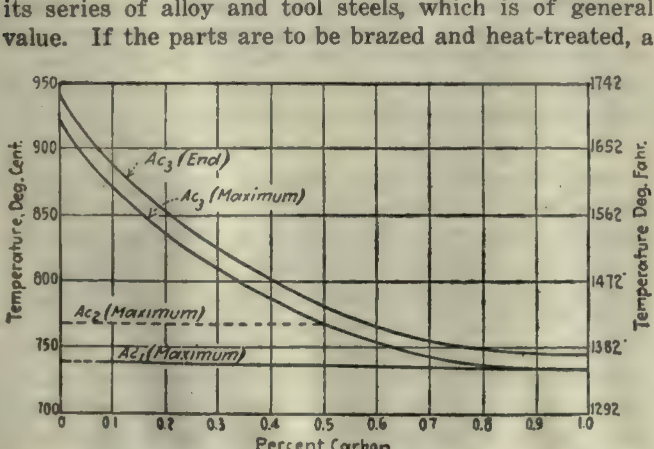


FIG. 3. EQUILIBRIUM DIAGRAM FOR CARBON STEEL

spelter should be selected such that the quenching temperature of the steel employed will be at least 125 deg. F. below that at which the brazing spelter melts, and, if possible, this difference should be greater to avoid danger of destroying the brazed joint during heat-treatment.

HEAT-TREATMENT

If the parts are to be brazed first and heat-treated in a separate and subsequent operation, the two operations can be handled in the usual manner, except that it may be found necessary to take special precautions to avoid warping during heat-treatment. It would seem advisable, however, to rivet, spot-weld or otherwise fasten the parts together before brazing, so as to prevent trouble from slippage of the joints during the subsequent heating. This practice of fastening parts together before brazing is in use in many shops at present and has been found to facilitate rather than to hold up production in most cases. Boulton gives a detailed discussion of brazing.

The operations of dip brazing and heat-treating can be combined by selecting steels and brazing spelters

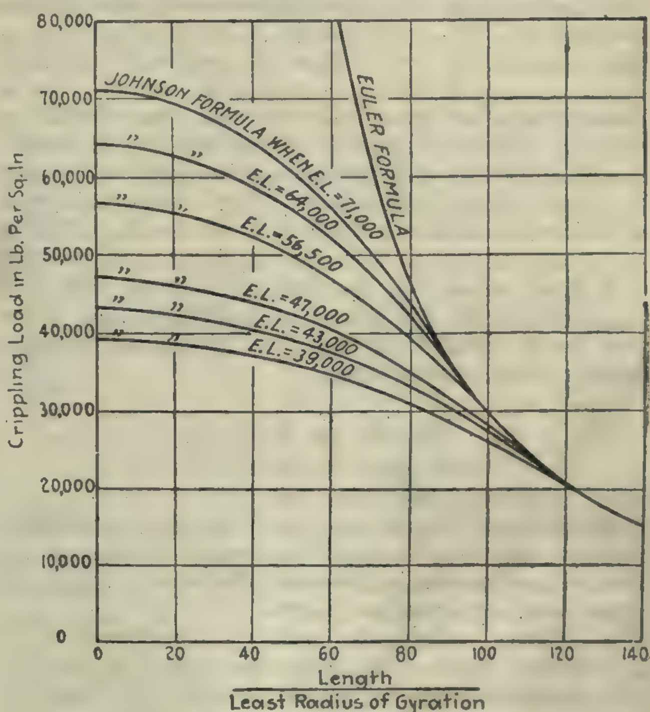


FIG. 4. GRAPHS OF COLUMN FORMULAS

which have the necessary quenching and melting temperatures respectively. In this method the brazing spelter should be maintained sufficiently above the specified quenching temperature of the steel to insure quenching at the proper point. If possible, a brazing spelter should be selected which has a melting point sufficiently above the specified quenching temperature of the steel to permit the practice of allowing the brazing to set slightly before quenching. If, however, the temperature of the brazing pot is allowed to approach 1,750 deg. F., the composition of the spelter will be subject to a gradual change, due to the rapid volatilization of the zinc, with a resultant rise in its melting point. The parts should be allowed to remain in the pot sufficiently long to raise the temperature of all of the material to that of the spelter, and should then be withdrawn and immediately quenched in accordance with the instruc-

tions of the heat-treatment being used. The re-heating and drawing operations can then be followed in the usual manner.

As the combinations of processes described are new to the workmen, it is very advisable to proceed with caution in attempting to introduce them into the shop. Once the workmen become familiar with the methods and the proper materials have been determined and obtained, they possess considerable advantage in permitting the designer to make use of the important gain in strength due to heat-treatment, with the consequent lightening of the larger parts.

It is well to mention, however, that no material advantage will be gained by heat-treating many of the tube struts or frames used in aircraft work, inasmuch as these are loaded as columns when in service. An examination of Euler's formula for crippling loads of long columns will show that the strength of such columns is determined by the form of the column and the modulus of elasticity of the material used, the strength of the material not entering into the equation. Many tests have shown that the modulus of elasticity of steel is practically unaffected by heat-treatment, in addition to varying but little with great differences in the chemical composition. Thus, for example, a strut of heat-treated alloy-steel tubing will cripple at practically the same load as a strut of the same dimensions but of annealed low-carbon steel, providing (*a*) that the slenderness ratio is sufficiently high to justify the use of Euler's formula, and (*b*) that the ends are designed to transmit the loads without local failure. Fig. 4 shows the graph of Euler's formula, together with the graphs of Johnson's formula for various elastic limits, corresponding to different steels, and illustrates very plainly that nothing is gained by the use of high-strength steel where the length divided by the least radius of gyration exceeds about one hundred.

Brain vs. Brawn

By John A. Honegger
President, Production Engineering Co., N. Y.

In glancing through a New York daily newspaper recently, the writer noticed the several help-wanted ads for designers and engineering draftsmen which are given here. One read as follows:

> Wanted: Technical graduate experienced in factory construction, plant lay-out and general machine design to act as assistant to Plant Engineer.
>
> Salary to start $28 per week, with advancement. Give full particulars in first letter. Box ABC-123.

and another:

> Wanted: An engineer experienced in general mechanical drawing and shop practice, as instructor in a technical school.
>
> Salary to start $2,000 per annum. State full particulars when applying for position.

and still another:

> Wanted: Draftsman, preferably married, who can design special equipment for increased production in a manufacturing plant.
>
> Must have some knowledge of automatic design. Will act as assistant to superintendent. Salary to begin $35 per week.

Immediately preceding these ads were others for chauffeurs at $40 per week, bricklayers at $1.25 per hour and carpenters $1.25 per hour and following them were those for plasterers at $1.25 per hour, presshands $40 per week and ship-yard men $50 to $60 per week.

Is it any wonder that numerous technical men are leaving the field of engineering for more lucrative positions in other fields of endeavor? The writer personally knows of several cases where technical men, who have been in the engineering field for the last ten or fifteen years, have left this field, taken jobs as riveters' helpers, chauffeurs, etc., and received considerably more financial benefit than in the engineering field. The writer employs, on an average, ten draftsmen and the lowest pay to the youngest detailer is considerably more than that offered to the assistant plant engineer.

For the amount of time and energy spent by the average draftsman in becoming a proficient worker the financial return is nowhere near sufficient. In order for a draftsman to become a successful designer he must have a working knowledge of pattern making, foundry practice, mechanical drawing, mechanics, algebra, geometry, trigonometry, machine design, tool design, production methods, and numerous other subjects. In addition to this, he must keep up to date in his work.

Furthermore, a designer works more than the specified number of hours set by the company. He does not lay down his ideas when the whistle blows and forget about them until the next morning. The writer has known of a number of incidents where a designer has been stumped on a certain mechanism or tool and, taking it home with him, has sat up half the night and a good part of the morning doping a way out. He neither asks nor receives any extra or overtime pay for this extra work. His pay is the satisfaction of having created an idea and having planned it in concrete form for the use of those who may benefit by it.

There are numerous draftsmen today seriously considering the advisability of changing their vocation for one which will reward them financially in proportion to the energy expended. No doubt there are numerous concerns who are seeing to it that their engineering staffs are receiving just compensation, but there are also numerous concerns who have not considered this phase of their organization when dividing profits.

The machine-tool industry is considered the basic industry and the writer believes that the engineering department is the basic department of the machine-tool industry, for in this department the idea is put into concrete form before it is built into a product.

Obtaining the right class of men for the designing of a certain product is becoming a hard task in some sections of the country. It is, therefore, to the interest of the engineering profession in general to keep as many of its technical men in the field as possible, and, in addition, to provide an incentive to prospective candidates to enter the field of engineering.

Prof. Henry B. Dirks, head of the Department of Mechanical Engineering at Michigan Agricultural College, Lansing, Mich., has asked us to correct an error in our issue of April 29. On page 961 of that issue we published an account of the new courses in Metallurgy at M. A. C. and credited it to Professor Dirks. He writes us that the author was W. H. Hildorf and that his name should have appeared at the head of the article. We take this opportunity to make the correction and to apologize to the two gentlemen in question.—Editor.

The Evolution of the Workshop—IX

BY H. H. MANCHESTER

The beginning of the development of machine tools can be seen in the industrial happenings which followed the initiation of the use of water power. This time is characterized chiefly by a raising of the standard of accuracy in machine work.

(Part VIII was published in our April 22 issue.)

AT THE end of the Eighteenth and the first of the Nineteenth Century we enter upon what might be distinguished as the beginning of the machine-tool era. Before this period, while some of the slow heavy work had been done by water power, the fine work had been done almost entirely by hand, and there had been no methods combining speed and accuracy.

The rapid development of machine tools at that time was probably due, more than to anything else, to the influence of the steam engine. While this held up before the imagination vast possibilities for the application of power, it demanded far more accurate workmanship than had hitherto been customary.

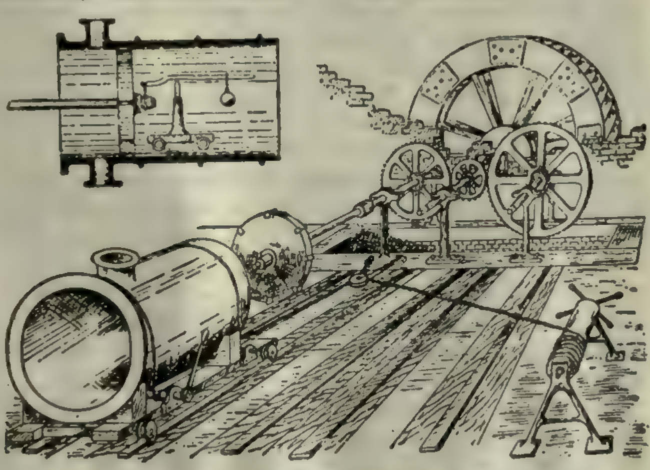


FIG. 54. SMEATON'S BORING MACHINE

Watt had the greatest difficulty in getting his cylinders bored with sufficient accuracy to permit of the use of pistons in them. A variation in diameter of half an inch throughout the length of the bore was not at all unusual. He tried all sorts of packing without much

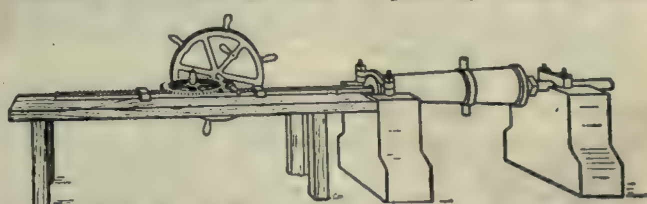


FIG. 55. WILKINSON'S BORING MACHINE

success, and it was not until he could get better boring that the triumph of his engine was assured. The first of those whose work was true enough to be dependable was John Smeaton, one of whose boring machines is reproduced, Fig. 54. It was soon improved upon by John Wilkinson, who greatly increased its accuracy by running the shank of the borer entirely through the cylinder and fixing it at the other end, as is shown by Fig. 55. This kept the borer in line instead of leaving it in the air, and made it possible to produce a cylinder whose diameter did not differ throughout its length more than the thickness of a shilling, which in these days was considered a notable feat.

Development of the Slide Rest

Probably the next highly important invention making toward accuracy was the slide rest for lathes. As has been suggested in previous articles, this was not entirely new, but it was greatly improved and applied in a far more important way.

A predecessor of the slide rest may be seen in a support for the tools used in mirror cutting mentioned by Maignan of Rome in 1648. Another is the guide for the tools used for cutting clock wheels, which was designed by Dr. Hooke in 1655. As if to emphasize the influence of clock making on the development of accurate tools, the thread cutting device for clock screws

which was invented by Hindley in 1741 had a similar rest or guide for the tools. We have likewise seen that the French Encyclopedia of Methods depicted tool rests employed in turning iron and working silver plate in 1785. None of these, however, were as yet automatic nor slid the length of the work.

Such a support for the tools is also indicated in the long patent on the methods of working wood and metals taken out by Samuel Bentham in 1793. He wrote on this subject, "When the motion is of the rotative kind, though advancement may be performed by hand, yet regularity may be more effectively insured by the aid of mechanism. For this purpose, one expedient is the connecting, for instance, by cogged wheels the advancing motion of the 'piece' with the rotative motion of the tool." Bentham included no drawings, but apparently we have here an automatic advancement without a sliding movement.

The sliding support for tools was probably added to the lathe by Henry Maudslay in 1794, while he was still working for Joseph Bramah. In his original invention, which is shown in Fig. 56, the rest was advanced to the work by a handscrew and slid along the bed by another screw, which was also turned by hand. After Maudslay left Bramah's employ to set up for himself in 1797, he improved on the supports; and by 1800 he had connected the screw that slid the support for the tools with the rotating work by means of worm-geared wheels, so that the rest slid along automatically. This device was employed particularly for the cutting of threads on bolts and screws. A machine of this type is shown in Fig. 57, while Fig. 58 is a reproduction of an old print showing the advantages of the new type of machine over the old.

The lathe, thus improved by the slide rest, was soon applied to various types of work and made possible an accuracy never before approached. For a number of years, however, it continued to be operated by hand, during which period it added little if anything to the speed and cheapness of the work.

Development of the Planing Machine

Another epoch-making advance in machine tools for working metals was the planing machine. As in the

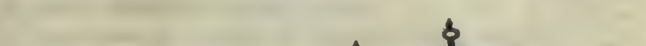


FIG. 56. SLIDE REST ON MAUDSLAY'S LATHE

case of the slide rest, this was not entirely new. In 1694 Noxon in his Mechanical Exercises mentioned a device of this sort for making brass moldings. It had a revolving cutter and a table and might be considered the first milling machine. In France a machine was invented in 1751 for planing the wrought iron barrels which were

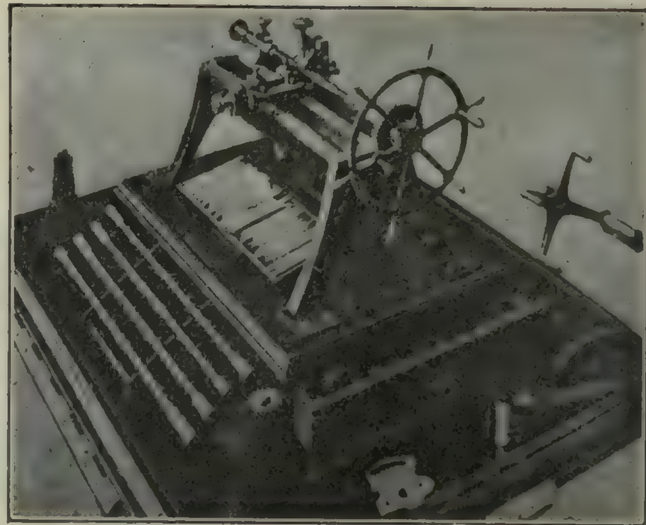


FIG. 57. A BOLT CUTTER OF 1800-1810

used at Marly. Plumier also in 1749 pictured a small crude device for the purpose.

In many respects, however, the era of the planing machine began with the patent for one taken out by Samuel Bentham in 1791. This had a reciprocating action, and was to be applied to wood, but in his patent of 1793 Bentham extends its use to metals. In 1802 a planing machine with a transverse action was patented by Joseph Bramah. This had a horizontal roughing wheel armed with gouges, followed by planing irons for finishing. It was intended for wood, but in 1811 Bramah improved on the revolving cutters and applied it to metals, thus producing practically a milling machine.

Other Planing Machines

Various other planing machines are said to have been invented or used by different machinists for working iron as early as 1814. One of these was credited to James Fox, another to Matthew Murray, a third to Joseph Clements in Bramah's shop, and still a fourth to Roberts and Rennie of Manchester. Bramah used his machine to trim the surfaces of his famous locks. In 1820 Clements was employing it to plane the sides of looms while Fox was making use of it on the bars of lace machines.

The same year Rennie supplied it with an improved movable bed, an endless screw and rack, and with a revolving tool.

One important point about the planing machine was that from the first the effort had been made in England to have it driven by power, and very early by steam power. In connection with power, it must be borne in mind that, although Watt invented his steam engine in 1767, it was at first used only for raising water from mines, and it was applied to other industries only very gradually. It was 1781 before Watt took out his patent to change the reciprocating motion which it developed into a circular one. It was 1789 before it was first introduced into cotton spinning. In 1792 John Wilkinson took out a patent to apply steam power to the rolling of iron, but it was well into the Nineteenth Century before steam power was applied generally in even the greatest machine shops.

Another great advance of this period lay in the invention of various types of wood-working machinery, which were naturally adapted, after a few changes, to the working of metal.

Bentham's patent in 1793 covers, besides planing, sawing by reciprocate motion, working by a reciprocate lathe, giving curvature by bending, working by a rotative motion of the tool, boring, mortise making, turning in a lathe, adjustment and steadiment, advancement, and clearance. The claims of this patent extended to metal as well as to wood.

Another highly important series of woodworking machines, developed by M. I. Brunel, were involved in the inventions and operations for manufacturing ships' blocks or pulleys. His block-making ideas were evolved in association with Sir Samuel Bentham. In 1801 his designs were inspected and approved, and Henry Maudslay was given the job of constructing the machinery to make the blocks. There were forty-four machines in all, and it was 1808 before Maudslay completed them, which is only one more illustration of the time required to build an industry from the ground up.

In this series were machines for mortising, a sketch of one being shown in Fig. 59, shaping, scoring, coaking and broaching, besides the more common straight and circular saws, facing lathes, drills, riveting hammers, and iron polishers. The machines were in three sets and produced seven types and 214 sizes of blocks.

Nail Making Improved

One industry that was greatly improved during this period of invention was nail making. In 1790 Thomas

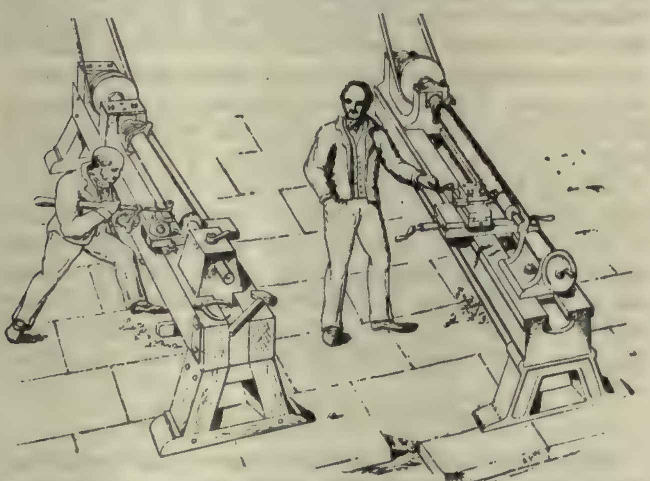


FIG. 58. A CONTRAST BETWEEN THE SLIDE REST AND THE PREVIOUS METHOD OF HOLDING TOOLS BY HAND

Clifford received a patent on a machine for pressing out nails and soon afterwards on another for rolling and cutting them out. The field was evidently a fertile one, for Clifford's machines were used in French's factory in 1792, and patents on nail making averaged one a year for the next half century.

Introduction of Metal-Working Machines

There were a number of other patents taken out at that period which give a bird's-eye view of the ideas that were developing. A good many of them were never put into actual practice, although they are interesting.

In 1783 William Playfair patented a machine for cutting and shaping metals, but it seems to have been intended for the softer types. Joseph Hately in 1790 received a patent for a pneumatic engine for rolling, slitting and stamping metals, but we do not hear of any further development in the way of an air engine for many years. A patent for rolling metal plates was taken out by John Bennoch in 1801, and one for rolling out the shanks of nails by Booth Hodgetts in 1803. A new file-cutting machine was made by William Nicholson in 1802, and a still more important one by Reichenbach in 1804. An improved vertical boring machine was developed by Billingsley in 1803, and a horizontal one by John Dixon in 1807. Circular saws seem to have been invented by someone unknown, but probably in Holland in the Sixteenth Century. The first band saw that was successful, however, appears to be that of William Newberry, which dates from 1808, and which is shown in Fig. 60. Circular shears were invented by James White in 1811. All of these machines were of course at first applied to materials other than metal. In 1808 Benjamin Cook forged iron pipe from flat bars, but only partly by machine. An important use of rollers for the purpose was begun by Henry James and John Jones in 1811.

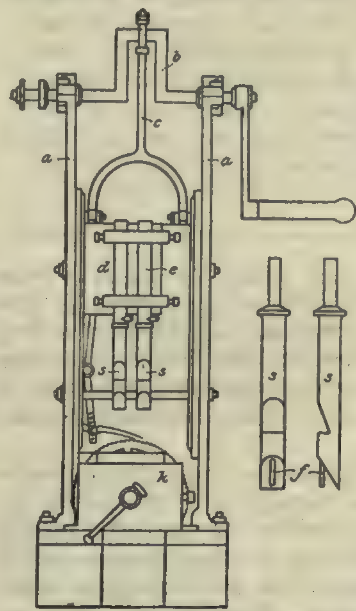


FIG. 59. MORTISING MACHINE OF BRUNEL 1801

This new method was particularly valuable in connection with the use of gas for lighting, which was just being made a success. In the same year James and Jones also patented an improved lathe for gun barrels, while another advancement in the turning of iron was claimed by Henry Osborn in 1812.

A new subject was opened up in 1815 by the invention of William Vance Palmer of a machine for twisting metal.

A Sign of Accuracy

One sign that machining had reached a far higher degree of accuracy was the fact that engines for steamboats could be built successfully, and that steam power was in 1815 just being applied with advantage to weaving. But the era of handwork had by no means passed. Most iron work was still done by hand, many of the so-called machines were as yet run by hand, and it was only for the heaviest operations that power was employed.

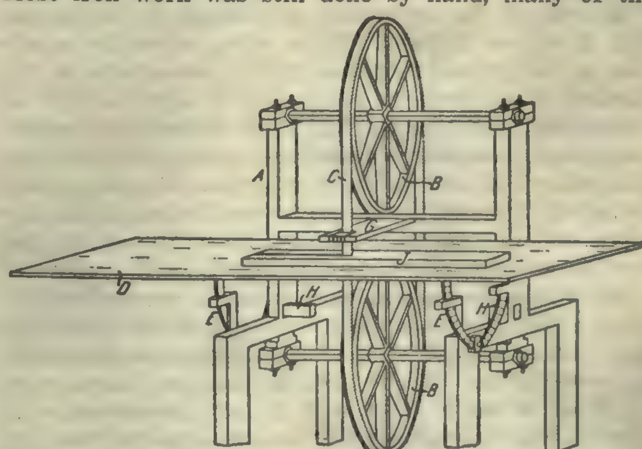


FIG. 60. NEWBERRY'S BANDSAW, 1808

Load Characteristics of Radio-Thrust Bearings

BY F. C. GOLDSMITH
Chief Engineer, New Departure Manufacturing Company

This article is a reply to that of F. W. Gurney under the above title and which appeared in vol. 50, page 1233 of the American Machinist. The author suggests that Mr. Gurney give the mathematical derivation of the formulas used in the article to which he is replying and also takes the opportunity to advance some of his own ideas on the subject.

THIS subject is one with which the writer is more or less familiar, as evidenced by a paper by him on the same subject, entitled "Load Carrying Possibilities of Angular Contact Ball Bearings," which was presented at the semi-annual meeting of the Society of Automotive Engineers held at Ottawa Beach, Michigan, June 23 to 27, 1919.

Without doubt, Mr. Gurney has given considerable time and thought to this subject as evidenced by his curve sheet, Fig. 4; but the writer for one, after having very carefully read the article, is not willing to accept Mr. Gurney's curves without first knowing more about their mathematical derivation. Undoubtedly, other engineers have the same feeling toward formulas and curves that the writer has; namely, that all steps in their derivation must be thoroughly proved before they are finally accepted. Knowing Mr. Gurney personally and realizing his ability to handle this kind of subject, I take the liberty of suggesting that he take us into his confidence and explain his reasoning and mathematical proof.

There are several points in the use of the curve, Fig. 4, which are not quite clear to me and I should like to ask about these, and at the same time, advance some of my own ideas, hoping that other engineers will advance theirs. In this manner we will learn more of this very interesting subject.

First, does Mr. Gurney believe in the original Hertz and Stribeck theory of the loading of annular or radial ball bearings, which proof considers both balls and races as elastic bodies?

Second, in the explanation of the use of the curves, Fig. 4, we are told that "These curves show the capacities of the radio-thrust bearings in percentages of the regular rated loads to carry various combinations of radial and thrust loads." If I am correct, the regular rated load means the catalog radial rated load for the particular kind of bearing in question. Therefore, why do not all three of the curves have a 100 per cent value when there is no thrust load and 100, 150 and 200 per cent values when there is only a thrust load?

In trying to analyze this point, I am inclined to believe that the pure radial values of these curves are based on an annular or radial bearing as having a 100 per cent value. But an annular bearing cannot carry much of a thrust load and if my interpretation is correct, is it right to compare an angular contact bearing under a combined load to a pure radial bearing under only a radial load?

In order to further this subject, I am requesting the *American Machinist* to insert at this point that portion of the writer's article, "Load Carrying Possibilities of Angular Contact Ball Bearings," dealing with the mathematical proof.

* * *

While the use of balls as load-carrying devices dates far into antiquity, the use of hardened-steel balls with raceways as journal bearings is of comparatively recent origin. It was only in the last quarter of the Nineteenth Century that an American invented ready means of producing steel balls in quantities at anything approaching reasonable costs and, even then, many years of experiment and research were required to devise means for producing balls of sufficiently accurate spherical form to enable them to be used in journal boxes.

Coincident with the production of spherical balls, various forms of race member were devised which, in combination, produced journal bearings of a more or less satisfactory nature, and beginning with the development of the bicycle industry, ball bearings began to be used to a large extent in various industries. Of all the early race forms that survive, the cup and cone type found widest application in the bicycle. In these bearings the race members were lightly casehardened, the balls were either casehardened or made of nature-hard steel; and while the balls themselves were highly polished the surface of the race member was but lightly polished and very seldom ground. These early applications of the ball bearing to widely distributed commercial use were subjected to very little load and, in consequence, small balls served faithfully to perform the functions required and markedly reduced journal friction as compared to any form of plain or roller bearing then extant. The success attained with ball bearings in the bicycle rapidly brought the attention of the mechanical world to their friction-saving qualities, and many attempts were made to apply the then very crude existing types to other mechanical uses.

EARLY USE OF BALL BEARINGS

Very little accurate knowledge was at hand concerning the load-carrying capacities of balls or races, and mary mistakes were made in the employment of too-small balls and too-thinly carburized race sections, until it became the belief among many mechanical men that the ball bearing was suited only to carrying the lightest of loads; but in the endeavor to attain the very low friction values present when balls were used in journals, early means having been discovered of testing the load-carrying values of balls themselves, larger and still larger balls were used as load-carrying members. The raceways, however, suffered very little improvement, merely being increased in size, without change in material or its treatment.

Even up to the present day, many applications exist wherein relatively light pressed steel members are employed, using large balls and subjected to heavy loads. These types of bearing are still called the cup and cone bearing. These bearings are practically always of angular-contact form, in that the load line of the ball is at an angle to the axis of the shaft, and either one or both of the race members are casehardened and in general are of inferior steels to begin with, though the balls in gen-

eral are made from most excellent steels. The race members in most of these bearings are not ground and very little attention has been paid to the proper study of race curvature and accuracy. Needless to say, the service performed by these bearings is as good as the design, materials and structure will allow. Friction is reduced by their use but not to an extent possible by the use of greater care in design, fabrication and choice of metal.

It is possible that the relatively unsatisfactory service given by the pressed-steel cup and cone bearing has caused considerably more interest in the more highly developed and technically studied annular type of ball bearing of more or less foreign origin than in the possibilities of perfection of the angular type of bearing for the performance of certain specific and well-adapted service. The angular contact, more commonly known as the cup and cone bearing, is particularly an American invention.

The annular bearing in which the journal load is applied through the balls in a line directly perpendicular to the axis of rotation and in which the balls are confined between curved raceways in accurately generated and ground race rings of the most highly perfected of alloy steels hardened throughout is properly of German origin. The technical structure of the annular bearing has received, at the hands of the German scientists, very careful analysis. Its load capacities have been subjected to most careful research, and the features of its design most accurately determined.

Analysis of Possibilities of Bearings

It is the purpose of this article to analyze the possibilities of the angular-contact (cup and cone) type of bearing when it is made as accurately as must needs be to utilize to the fullest extent the friction-reducing properties of absolutely accurate steel spheres confined between accurately generated and ground curved raceways made of steels as highly perfected and as scientifically treated as are the balls themselves, and to determine, in so far as possible, the load-carrying powers of such bearings, both for axial (thrust) loads as well as for radial loads, and to determine the law of variation of load-carrying capacity in such a bearing as the direction of the bearing load may vary from the perpendicular to the axis of rotation (pure radial load) to the axis of rotation (pure end thrust).

My development of the loading of angular-contact ball bearings considers both the balls and races as elastic bodies and develops the load-carrying possibilities in terms of the carrying power of a single ball. When we think that the balls, as well as the races, are elastic bodies, we realize at once that if we consider the actual load as divided into two component loads, one a pure radial load and the other a pure thrust load, we are working under a false premise, for the races can approach each other only in the line of action of the single load.

In the proof to follow, the load on the bearing is considered as acting in one direction at a time, and the load-carrying possibilities of the bearing are studied as the load changes its direction from a pure radial to a pure thrust load.

According to Hertz and Stribeck, for balls between raceways which have curved cross-sections closely fitting the contour of the ball, as in our present-day high-grade ball bearings:

$$\delta_0 = K\sqrt[3]{P_0^2} \qquad (1)$$

δ_0 = increment of approach of the raceways when ball is under maximum load and line of load application coincides with line of ball contact

K = a constant

P_0 = maximum load ball is subjected to

Stribeck's equation for the theoretical loading of annular or radial type ball bearings (which neglects speed factors) is:

$$P = P_0(1 + 2\cos^{\frac{5}{2}}\alpha + 2\cos^{\frac{5}{2}}2\alpha + 2\cos^{\frac{5}{2}}3\alpha \; . \; . \; . + 2\cos^{\frac{5}{2}}n\alpha) \qquad (2)$$

P = total journal load

α = angle in degrees between two consecutive balls

$n\alpha \leqq 90°$

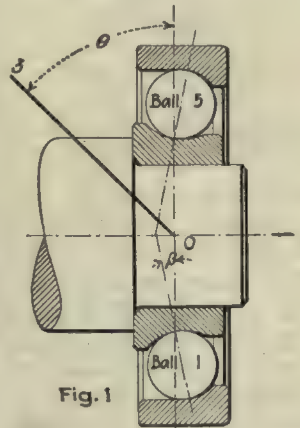


Fig. 1


Fig. 2

FIG. 1. ANGULAR CONTACT TYPE OF BEARING
FIG. 2. LOAD POSITIONS FROM 0 TO 90 DEGREES

For a bearing containing ten balls—

$$P = \frac{nP_0}{4.38} \qquad (3)$$

For a bearing containing fifteen balls—

$$P = \frac{nP_0}{4.36} \qquad (4)$$

For a bearing containing twenty balls—

$$P = \frac{nP_0}{4.37} \qquad (5)$$

where n is the number of balls in the bearing.

For practical consideration and considering looseness of balls and spring of races—

$$P = \frac{nP_0}{5} \text{ or } P = 0.2nP_0 \qquad (6)$$

From the result of tests and experiments it has been pretty generally accepted that the load-carrying possibilities of a present-day high-grade steel ball vary directly as the square of the ball diameter; therefore P_0 bears a direct relationship to the square of the ball diameter.

Fig. 1 shows a cross-section of an angular-contact type ball bearing, β being the angle of contact. The arrow shows the direction of the load as applied to the inner race. The load is neither radial nor thrust.

Fig. 2 represents seven different positions of the load as it shifts through 90 deg., the vertical arrow marked 0 being a pure radial load and the horizontal arrow marked 6 being a pure thrust load.

Fig. 3 is a side elevation and end view of a bearing containing eight balls, but the mathematical proof to

follow considers any number of balls. The lettered arrows show the direction of the applied load as well as the direction of approach of the races with respect to the individual balls, the angle between consecutive balls being shown as α.

The heavy black arrow marked 3 in Figs. 1 and 2

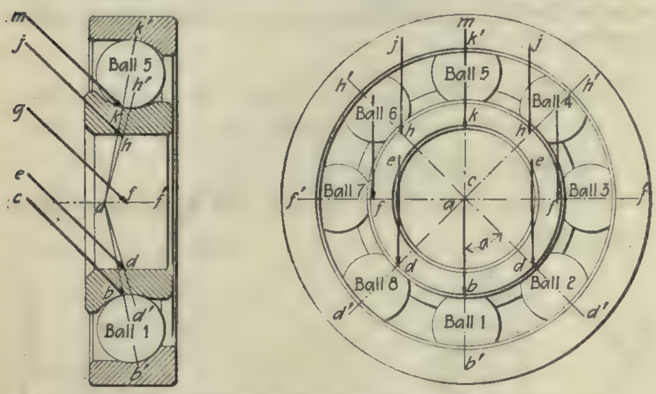


FIG. 3. BEARING HAVING EIGHT BALLS

represents any load to which the bearing may be subjected. In Fig. 3 the small arrows show how this same load acts with respect to each individual ball. When the line of action of the load $\overline{cb}$ makes an angle cbb' greater than 90 deg. with the line of contact $\overline{bb'}$ between ball and races, then the ball will carry a portion of the load. In Fig. 4 is shown the true angles between the line of ball contact and the line of load application for each of the eight balls. The angles ω_1, ω_2 *and* $_8$, ω_3 *and* $_7$, ω_4 *and* $_6$ and ω_5 represent the supplementary angles in each case, these being used in the proof, the real angles being cbb', edd', gff', jhh' and mkk'. From an inspection of these angles one can readily see that for this particular load balls 4, 5 and 6 do not carry any of the load.

Starting with a pure radial load and considering an infinite number of loads through an angle of 90 deg. to a pure thrust load, we would have one-half the number of balls under load in the radial position, and as the angle of load increased we would anticipate the maximum loading-carrying capacity of the bearing shortly after the angle of load has become greater than the contact angle. When the line of load application makes an angle of β, the angle of ball contact with the arrow 6 in Fig. 2, we can understand that the last ball in the bearing is coming under load and would expect a rapid increase in the bearing carrying capacity beyond this point.

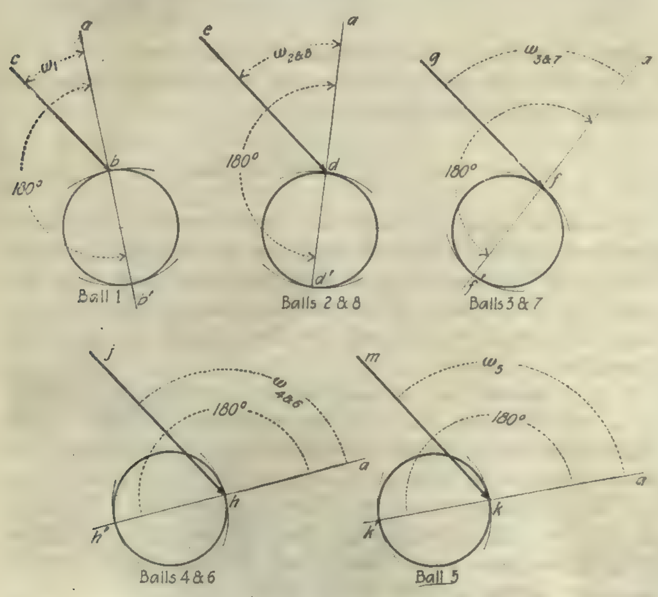


FIG. 4. ANGLES BETWEEN LINE OF BALL CONTACT AND THE LINE OF LOAD APPLICATION IN BEARING HAVING EIGHT BALLS

Let us consider the mathematical proof as divided into two problems, the first problem being to establish a mathematical relationship between known angles and assumed directions of load application and determine in degrees of the ball circle just when a ball will begin and leave off carrying any part of the applied load for each different direction of load application; the second problem being to establish an equation in terms of bearing load, known relationships and the maximum load a ball can safely carry.

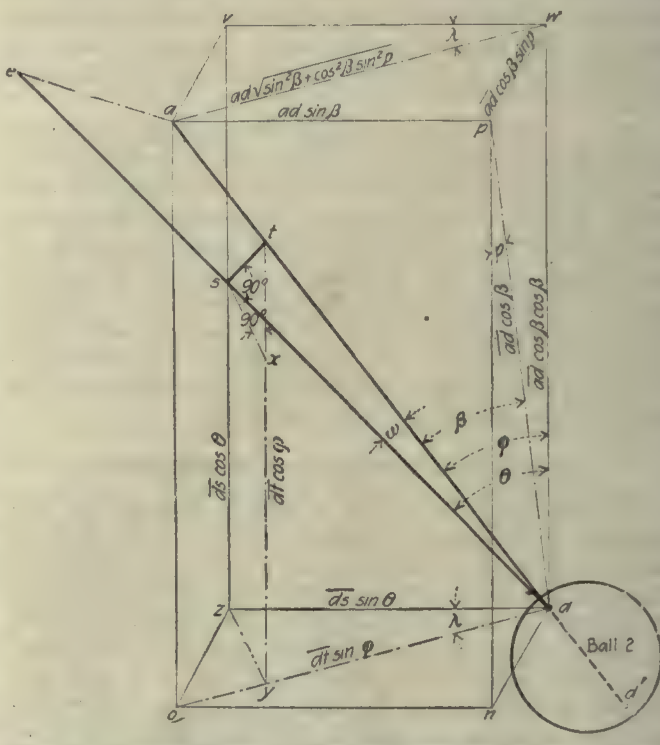


FIG. 5. CONSTRUCTION LINES TO DEVELOP MATHEMATICAL RELATIONSHIP BETWEEN DIRECTION OF LOAD APPLICATION AND ANGLE OF BALL CIRCLE THROUGH WHICH BALLS ARE LOADED

Fig. 5 shows the necessary construction lines to develop the mathematical relationships between the direction of load application and the angle of ball circle through which the balls are loaded. In the diagram the ball 2 is shown as representing any ball position other than when the line of ball contact lies in a vertical plane. Plane *pwdn* is plane of contact of all balls with the inner race or cone. Line $\overline{ap}$ is the axis of rotation of either the cup or cone (axis of shaft). Line $\overline{add'}$ is the line of ball contact extended to intersect the axis of rotation $\overline{ap}$. Line $\overline{esd}$ is the line of load application as applied to any ball. Plane *vwdz* is perpendicular to the plane of ball contact *pwdn* and contains the line of load application $\overline{esd}$.

Angle β is the angle of ball contact. Angle θ is the angle of load application (angle between load application line and plane of balls and cone contact *pwdn*). Angle ρ is one-half of that portion of the ball center circle through which any ball carries a part of the load and varies with the angle θ.

Angle ω is the supplement of the angle between the line of load application and the line of ball contact. It can vary between 90 and 0 deg., the ball carrying no load when ω equals 90 deg. and a maximum load when ω equals 0 deg.

To establish relationship of angle ω, let

$$\overline{ty} = \overline{td} \cos \phi$$

$$\overline{sz} = \overline{sd} \cos \theta$$

$$\overline{tx} = \overline{ty} - \overline{sz} = \overline{td} \cos \phi - \overline{sd} \cos \theta$$

$$\overline{zd} = \overline{sd} \sin \theta$$

$$\overline{yd} = \overline{td} \sin \phi$$

$$\overline{sx} = \overline{zy} = \sqrt{\overline{zd}^2 + \overline{yd}^2 - \overline{zd}\ \overline{yd} \cos \lambda} \text{ by trigonometry}$$

$$\overline{sx} = \sqrt{\overline{sd}^2 \sin^2 \theta + \overline{td}^2 \sin^2 \phi - 2\,\overline{sd}\ \overline{td} \sin \theta \sin \phi \cos \lambda}$$

$$\overline{st} = \sqrt{\overline{tx}^2 + \overline{sx}^2}$$

$$\overline{st} = \sqrt{\overline{td}^2 \cos^2 \phi - 2\,\overline{td}\ \overline{sd} \cos \phi \cos \theta + \overline{sd}^2 \cos^2 \theta + \overline{sd}^2 \sin^2 \theta + \overline{td}^2 \sin^2 \phi - 2\,\overline{sd}\ \overline{td} \sin \theta \sin \phi \cos \lambda}$$

$$\overline{st} = \sqrt{\overline{sd}^2 (\sin^2 \theta + \cos^2 \theta) + \overline{td}^2 (\sin^2 \phi + \cos^2 \phi) - 2\,\overline{sd}\ \overline{td} (\sin \theta \sin \phi \cos \lambda + \cos \phi \cos \theta)}$$

$$\overline{st} = \sqrt{\overline{sd}^2 + \overline{td}^2 - 2\,\overline{sd}\ \overline{td} (\sin \theta \sin \phi \cos \lambda + \cos^2 \phi \cos \theta)}$$

$$\overline{wd} = \overline{pn} = \overline{pd} \cos \rho = \overline{ad} \cos \beta \cos \rho$$

$$\cos \phi = \frac{\overline{wd}}{\overline{ad}} = \frac{\overline{ad} \cos \beta \cos \rho}{\overline{ad}} = \cos \beta \cos \rho \qquad (8)$$

$$\overline{vw} = \overline{ap} = \overline{ad} \sin \beta$$

$$\overline{aw} = \overline{ad} \sin \phi$$

$$\cos \lambda = \frac{\overline{vw}}{\overline{aw}} = \frac{\overline{ad} \sin \beta}{\overline{ad} \sin \phi} = \frac{\sin \beta}{\sin \phi} \qquad (9)$$

$$\overline{st} = \sqrt{\overline{sd}^2 + \overline{td}^2 - 2\,\overline{sd}\ \overline{td} (\sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta)} \qquad (10)$$

$$\overline{st} = \sqrt{\overline{sd}^2 + \overline{td}^2 - 2\,\overline{sd}\ \overline{td} \cos \omega} \qquad (11)$$

$$\cos \omega = \sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta \qquad (12)$$

$$\therefore \omega = \text{arc} \cos (\sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta) \qquad (13)$$

Angle ρ can be considered as being made up of multiples of the angle α.

Equations (12) and (13) show the relationship existing between ω, θ, β and ρ. For any angular-contact ball bearing having a given number of balls and a fixed angle of contact, the angle β is known. If we consider angle θ as varying from 0 to 90 deg. or from a pure radial to a pure thrust load, it would be entirely possible to establish for each value of θ the corresponding value of 2ρ in degrees of the ball center circle, through which a ball would carry a portion of the load; for when ω becomes 90 deg. the ball ceases to carry any of the total load. Knowing the number of balls in the bearing, angle α is known and we can at once find how many balls are under load for each corresponding value of the angle θ.

Using the above established relationships, we have the final problem to establish an equation for the load-carrying possibilities of an angular-contact type ball bearing in terms of known quantities. In this case, let

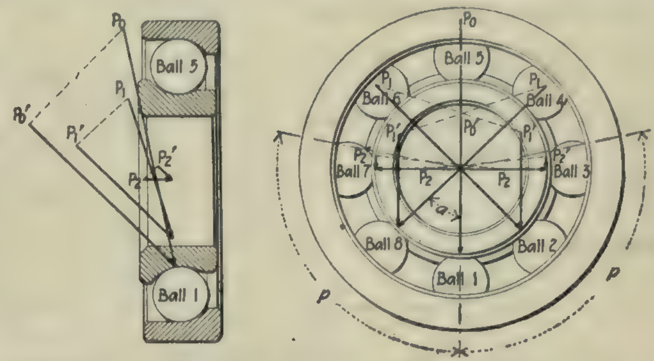


FIG. 6. DIRECTION OF INDIVIDUAL BALL LOADS

P = Total resultant load on one ball row
P_0' = Load on bottom ball in direction of load
P_0 = Load on bottom ball in direction of contact
P_1' = Load on next ball in direction of load
P_1 = Load on next ball in direction of contact.
δ_0' = Approach of races at bottom ball in direction of load
δ_0 = Approach of races at bottom ball in direction of contact
δ_1' = Approach of races at next ball in direction of load
δ_1 = Approach of races at next ball in direction of contact
α = Angle between balls in vertical plane
β = Angle of contact
θ = Angle between line of load application and plane of balls
ω = Angle between line of load application and contact lines

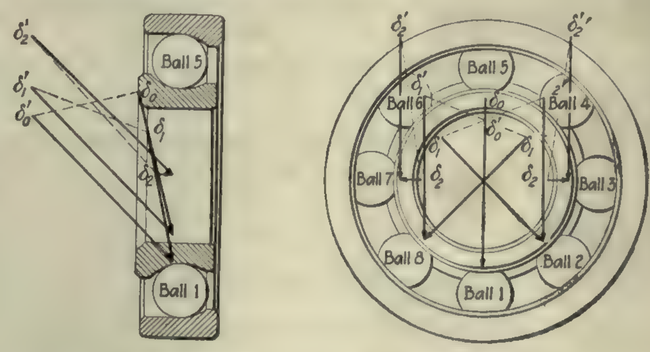


FIG. 7. APPROACH OF BALL RACES

From equation (12).

$$\cos \omega = \sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta$$

Referring to Fig. 6, which shows direction of individual ball loads

$$P = P_0' + 2P_1' + 2P_2' + \dots 2\,P\eta' \qquad (14)$$

$$P_0' = P_0 \cos \omega_0 = P_0 (\sin \theta \sin \beta + \cos \theta \cos \beta) = P_0 \cos (\theta - \beta) \qquad (15)$$

$$P_1' = P_1 \cos \omega_1 = P_1 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha) \qquad (16)$$

$$P_2' = P_2 \cos \omega_2 = P_2 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2 \alpha) \quad (17)$$

Referring to Fig. 7, which shows approach of races:

$$\delta_0 = \delta_0' \cos \omega_0 = \delta_0 \cos (\theta - \beta) \quad (18)$$

$$\delta_1 = \delta_1' \cos \omega_1' = \delta_1' (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha) \quad (19)$$

$$\delta_2 = \delta_2' \cos \omega_2 = \delta_2' (\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2 \alpha) \quad (20)$$

Also,

$$\delta_0' = \delta_1' = \delta_2' = \ldots \delta\eta' \quad (21)$$

From Hertz:

$$\frac{P_0^2}{\delta_0^3} = \frac{P_1^2}{\delta_1^3} = \frac{P_2^2}{\delta_2^3} = \ldots \frac{P\eta^2}{\delta\eta^3} \quad (22)$$

$$\frac{\delta_0}{\cos \omega_0} = \frac{\delta_1}{\cos \omega_1} = \frac{\delta_2}{\cos \omega_2} = \ldots \frac{\delta\eta}{\cos \omega_\eta} \quad (23)$$

$$\delta_1 = \frac{\cos \omega_1 \delta_0}{\cos \omega_0}$$

$$P_1^2 = \frac{\delta_1^3 P_0^2}{\delta_0^3} = \frac{\cos^3 \omega_1 \delta_0^3 P_0^2}{\cos^3 \omega_0 \delta^3_0} = \frac{\cos^3 \omega P_0^2}{\cos^3 \omega_0} \quad (24)$$

$$\therefore P_1 = \frac{\cos^{\frac{3}{2}} \omega_1 P_0}{\cos^{\frac{3}{2}} \omega_0} \text{ and} \quad (25)$$

$$P_2 = \frac{\cos^{\frac{3}{2}} \omega_2 P_0}{\cos^{\frac{3}{2}} \omega_0} \quad (26)$$

By substitution equation 14 becomes

$$P = P_0 \cos \omega_0 + 2P_1 \cos \omega_1 + 2P_2 \cos \omega_2 + \ldots 2P\eta \cos \omega_\eta \quad (27)$$

$$P = P_0 \cos \omega_0 + \frac{2 P_0 \cos^{\frac{5}{2}} \omega_1}{\cos^{\frac{3}{2}} \omega_0} + \frac{2 P \cos^{\frac{5}{2}} \omega_2}{\cos^{\frac{3}{2}} \omega_0} + \ldots \frac{2 P_0 \cos^{\frac{5}{2}} \omega_\eta}{\cos^{\frac{3}{2}} \omega_0}$$

Where η is such that $\cos \omega_\eta = 0$

$$P = P^0 \left(\cos \omega_0 + \frac{2 \cos^{\frac{5}{2}} \omega_1}{\cos^{\frac{3}{2}} \omega_0} + \frac{2 \cos^{\frac{5}{2}} \omega_2}{\cos^{\frac{3}{2}} \omega_0} + \ldots \frac{2 \cos^{\frac{5}{2}} \omega_\eta}{\cos^{\frac{3}{2}} \omega_0} \right)$$

$$P = P_0 \left[\cos (\theta - \beta) + \frac{2 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha)^{\frac{5}{2}}}{\cos^{\frac{3}{2}} (\theta - \beta)} + \frac{2(\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2\alpha)^{\frac{5}{2}}}{\cos^{\frac{3}{2}} (\theta - \beta)} + \ldots \frac{2 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \eta\alpha)^{\frac{5}{2}}}{\cos^{\frac{3}{2}} (\theta - \beta)} \right]$$

$$P = P_0 \left\{ \cos (\theta - \beta) + \frac{2}{\cos^{\frac{3}{2}} (\theta - \beta)} \left[(\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha)^{\frac{5}{2}} + (\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2 \alpha)^{\frac{5}{2}} + \ldots (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \eta\alpha)^{\frac{5}{2}} \right] \right\} \quad (28)$$

As a check let θ and β become 0 as in a radial bearing, then

$$P = P_0 \left[1 + 2 (\cos^{\frac{5}{2}} \alpha + \cos^{\frac{5}{2}} 2 \alpha + \ldots \cos^{\frac{5}{2}} \eta\alpha)\right]$$

$$P = P_0 (1 + 2 \cos^{\frac{5}{2}} \alpha + 2 \cos^{\frac{5}{2}} 2 \alpha + \ldots 2 \cos^{\frac{5}{2}} \eta\alpha)$$

which is the same as Stribeck.

Referring to equation (28) we can readily see that for any one value of the load angle θ all other quantities are known and by solving this equation for bearings containing ten, fifteen and twenty balls, and letting θ vary through 90 deg., we shall arrive at a variable factor which has a fixed value for each corresponding value of θ. Plotting these values of the variable factor against degrees of the angle of load application θ through 90 deg., we have a curve from which, when we know the angle of load application, we can pick the proper value of one of the principal bearing load factors.

In Fig. 8 we have a curve showing the variable factor K as ordinates against values of the load angle θ as abscissa for a very popular line of 100 per cent thrust angular-contact type of ball bearing. The values of K are the average of bearings having 10, 15 and 20 balls. Referring to equation (5) we have the reciprocal of the number 0.229, which is the average value of the constant from the Stribeck equation for radial or annular ball bearings having ten, fifteen and twenty balls. The

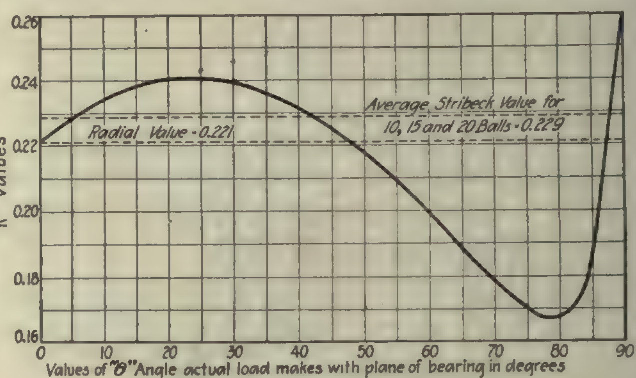


FIG. 8. CURVE SHOWING VARIABLE FACTOR AGAINST VALUES OF LOAD ANGLE

value 0.229 represents in the Stribeck equation for annular bearings, the same factor as the variable factor K represents for this particular make of annular-contact type ball bearing.

As a matter of passing interest, we have shown in Fig. 8 this value of 0.229 as a dotted line to bring out the fact that for some load angles this bearing will carry a greater load than the same size of annular bearing can carry even as a pure radial load.

Just a few words describing the use of the curve, Fig. 8. All speed load catalog ratings are given as pure radial loads, and the corresponding value of K would be 0.221. Now, supposing the angle of load application happens to be 25 deg., the corresponding value of K would be 0.24, and in selecting the proper size bearing from the catalog rating we would multiply the resultant load by 0.221 over 0.240 or

$$\text{Catalog Load} = \frac{0.221}{0.240} \times \text{Resultant}$$

$$\text{Load} = 0.92 \times \text{Resultant Load}$$

In case the load angle proved to be 85 deg.

$$\text{Catalog Load} = \frac{0.2210}{0.1675}$$

$$\times \text{Resultant Load} = 1.32 \times \text{Resultant Load}$$

After a careful study of this curve we can see that when the load angle is less than 48 deg. we really have in this angular-contact type ball bearing a very excellent load-carrying device.

* * *

Fig. 9 shows three different curves plotted in accordance with Mr. Gurney's curve for a 100 per cent radio-thrust bearing with the one exception that the radial

values start at 100 per cent or the radial value for a 17½-deg. contact angle, angular contact bearing (which contact angle we assume to be correct for the Gurney 100 per cent radio-thrust bearing). Curve *A* is Mr. Gurney's curve corrected to 100 per cent for both pure radial and pure thrust loads. Curve *B* is a curve derived from formula 27 of the writer's article, which formula does not consider the effect of elasticity. Curve *C* is a curve derived from formula 28 of the writer's article using a 17½-deg. contact angle.

Fig. 10 is really a very interesting curve sheet, in that after the radial and thrust loads are once determined, one can readily arrive at the proper bearing size. Under curves *A*, *B* and *C*, which correspond to the same lettered curves in Fig. 9, we have percentage curves which show at a glance what the percentage factor is for any particular combination of radial and thrust loads and

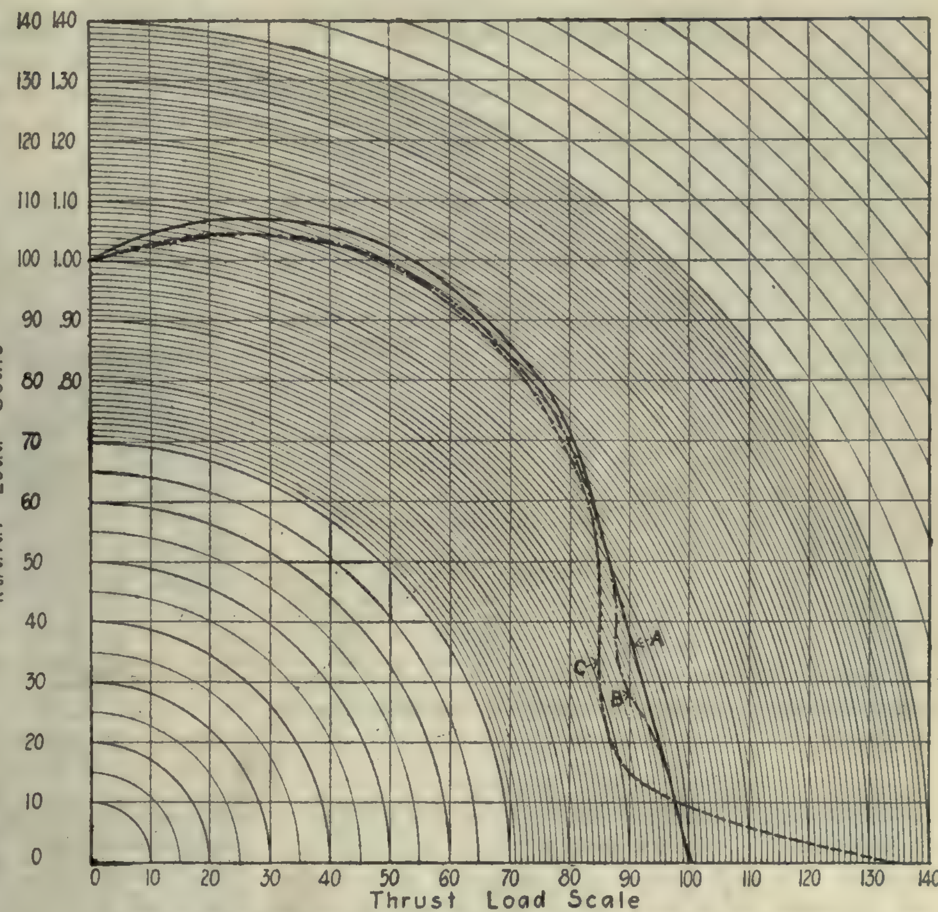


FIG. 9. CURVES FOR 100 PER CENT RADIO-THRUST BEARING

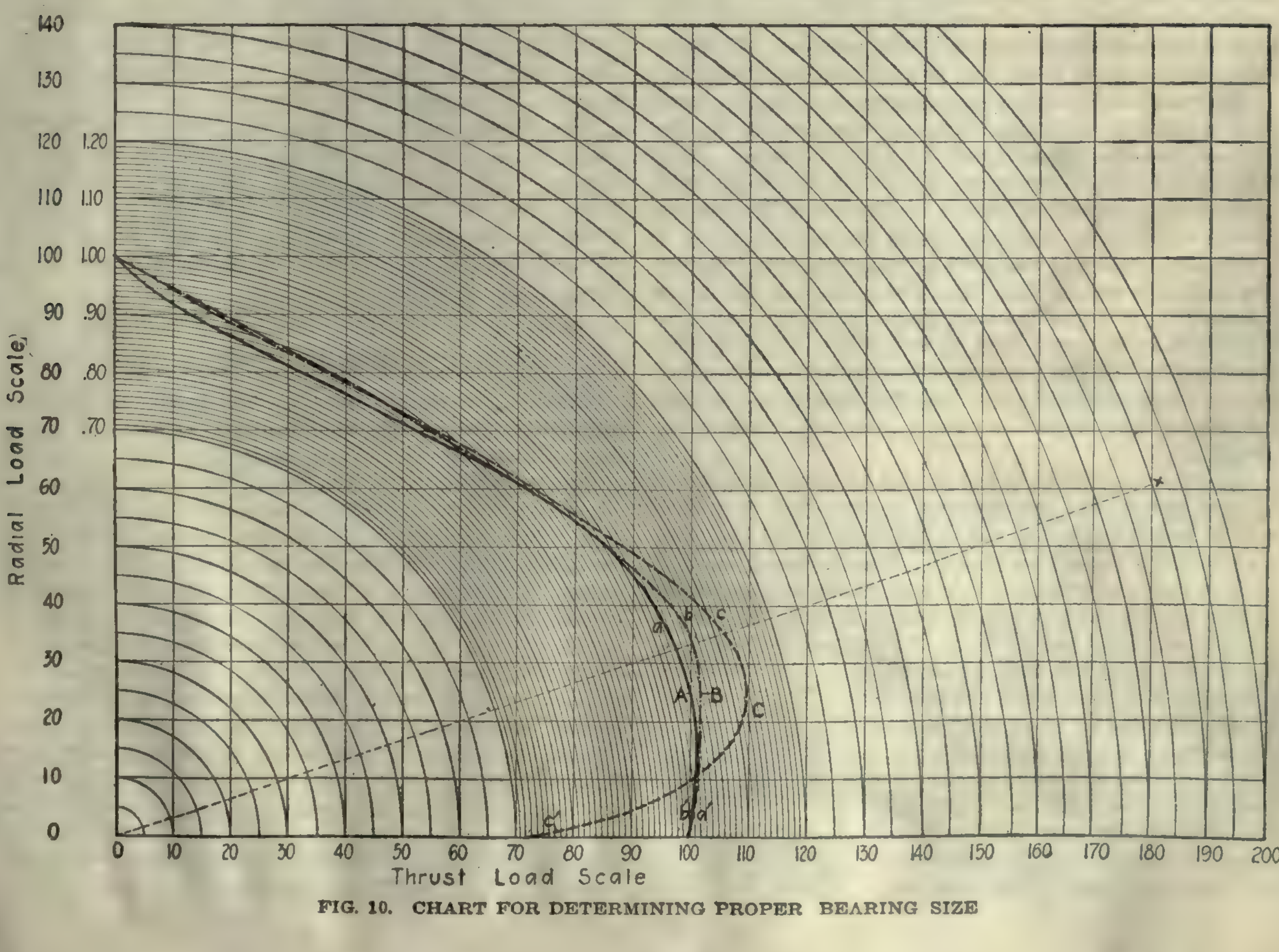


FIG. 10. CHART FOR DETERMINING PROPER BEARING SIZE

by which the resultant load should be multiplied to pick the proper bearing from the catalog radial rated load.

To use these curves with a radial load of 600 lb. and a thrust load of 1,800 lb. find the point x in a similar manner as described by Mr. Gurney; the nearest polar curve passing this point has a value of 190, which at once tells us we have a combined load of 1,900 lb. Connect points o and x with a straight line which cuts curves A, B and C at a, b and c respectively. The nearest polar curve passing through points a, b and c are 1.03, 1.06 and 1.116 respectively. Now, to select the proper size bearing, multiply the resultant load by the factor in the accompanying table.

Curve	Point on Curve	Factor	Resultant Load	Catalog Bearing Rating, lb.
A	a	1.03	1,900	1,957
B	b	1.06	1,900	2,014
C	c	1.116	1,900	2,120

For Pure Thrust Load of 1,800 Lb.

Curve	Point on Curve	Factor	Thrust Load	Catalog Bearing Rating, lb.
A	a1	1.00	1,800	1,800
B	b1	0.996	1,800	1,793
C	c1	0.725	1,800	1,305

The question still remains—which of the three curves is correct?

Dies for Producing a Valve-Spring Washer

By W. A. Flumerfelt

Through experiments to overcome difficulties in the manufacture of a valve-spring washer, such as is used on the valve stems of automobile motors, the press tools here described were evolved. The number of operations were reduced from four to two, and the appearance of the resulting article was improved to a point where it is described as being "snappy" because of its flat surfaces, sharp corners and burnished edges. Dead soft, cold-rolled, sheet steel, 0.125 in. thick, is used. Annealing between operations is eliminated by the use of the dies. The piece is shown in Fig. 1.

Blanking, piercing and first forming are performed in the tools shown in Fig. 2. The blanking die A is mounted on the machine-steel holder B which serves as a guide for the draw ring C and holds the removable piercing die D. The parts mentioned form a unit which can be taken out of the die shoe for repairs or renewal by removing three screws, one of which is shown at E.

Spring pressure for drawing and ejecting is obtained by the use of the conventional rubber pad or helical spring beneath the die, and is transmitted to the draw ring through the spring pins F. The blanking punch G is also the drawing die. A hole through the center guides the piercing punch H, which is mounted on the positive knockout rod I. Thus, H and I combine to make the piercing punch and knockout. Stripping the piece from the punch is accomplished by so proportioning the parts of the die that the center hole is pierced before the shell has been drawn to its full depth. As the drawing of the shell is continued after the center has been pierced, the metal is drawn or stretched away from the punch, thus being cleared. The ejection from the upper die is made by contact of the shoulder of the punch with the shell, which is forced out of the upper die on the upward stroke of the press. The necessity for a spring stripper on the punch is eliminated by the use of three stripping fingers, one of which is shown at J. The final operation is performed by the swaging tool, Fig. 3. The two hardened-tool-steel rings K and L form the swaging die. These are retained by the machine-steel ring M. This sectional construction permits the use of ground surfaces with sharp internal corners on the die, and the machine-steel retaining ring M, which receives the retaining screws, does away with the necessity of weakening the rings K and L by tapping holes in them.

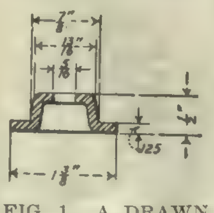


FIG. 1. A DRAWN STEEL WASHER

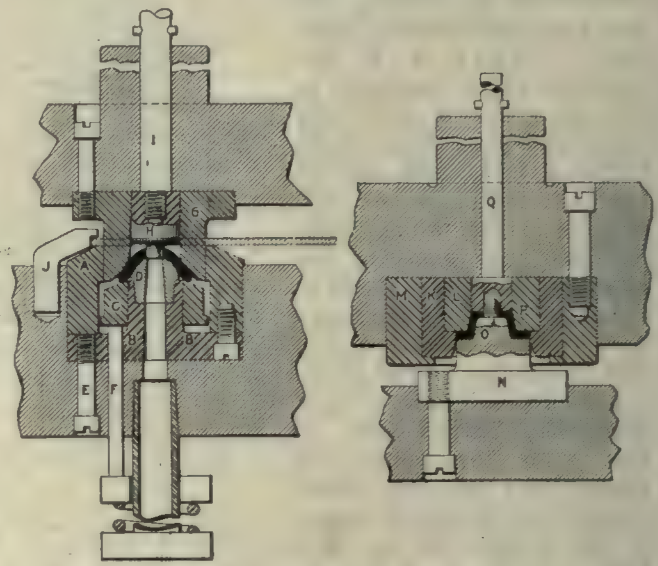


FIG. 2. BLANKING, FORMING, AND PIERCING DIES
FIG. 3. THE SWAGING TOOLS

The swaging punch N is ground concave on the face indicated at O to insure the flat surface on the finished washer. The concavity of this face is determined by trial. The edge P on the die ring K produces a mirror finish on the edge of the work. The work sticks to the die and ejection is made on the upward stroke of the press by the positive knockout Q.

Brittleness in Sheet Lead

Cases of brittleness in sheet lead have recently been studied by the Bureau of Standards. Effects of corrosion sometimes transform sheet lead into a brittle, granular condition, which has often been supposed to be chargeable to allotropic transformation resulting in something analogous to the well-known "gray tin." Metallographic examination of such brittle lead by Henry S. Rawdon now has shown that the individual grains of the brittle lead are the same as those of ordinary lead, but the intercrystalline cohesion of the grains is abnormally low. Corroding agents attack the impurities in the metal, which lodge chiefly between the grains, and possibly also attack the presumptive "intercrystalline cement." Specimens of exceptionally pure lead (99.993 per cent) immersed for 24 days in a neutral solution of lead acetate became appreciably embrittled by minute intercrystalline fissures. No evidence was found that there is an allotropic form of lead or anything similar to "gray tin."—*Engineering News-Record.*

The Cost of Labor in Germany

SPECIAL CORRESPONDENCE

Some information of more than passing interest is contained in this article, which discusses wages in Germany at present. Since the author collected the facts at first hand, the article gives a very accurate idea of industrial conditions in Germany today.

DURING the war, labor was so scarce and continuous working at high pressure of such importance that the remuneration of the workmen went up on a steep line. Wages for a fully trained man, like a skilled lathe hand, were, before the war, on the average six marks for a day of 10 workng hours. Men of this class earned during the war easily 20 to 30 marks and even more by piece-rate payment. Employers did not dispute the ever-increasing demands, as they found easy recompensation in the higher prices which they got without difficulty, if only the work was done.

Such were the conditions when the war came to an end abruptly and the revolution set in. It was, of course, impossible for the manufacturers to pay wages as lavishly as had become the habit during the war. On the other hand, the workmen were not willing to climb down, but demanded an adjustment of wages on the basis of the piece-rate earnings which they were then making. They endeavored to establish the principle that they should be paid for an eight-hour day, and at a fixed payment per hour, as much as they received in a day then. As they were backed by the government and were practically in control of the country, they were able to make good their claims. Payment of piece-rates was abolished almost throughout the country. Only a few shops with an old, faithful staff of workmen were able to continue piece-rate payment in secrecy.

The Formation of Wage Agreements

From that time originated the great labor dispute which held the country in its spell during the best part of last year. It seemed impossible for quite a while to bring about a settlement. Factory owners were inclined to go out of business and sell out. Many of them would have done it, if they had found anyone ready to buy their property. The workmen had no ear for the arguments of the factory owners, not believing their protestations that they were on the point of ruin.

During the second part of the last year, however, a marked change took place. Several unsuccessful strikes, especially the noteworthy strike of the Berlin metal-working industry, which was really a test of the strength of the opposing forces, made the workmen realize the situation of industry and their own position. They became amenable to terms with the employers. In all parts of the country negotiations for the establishment of a regular schedule of wages were taken in hand and brought to a successful conclusion, both with and without outside pressure from the government.

The arrangements made between workmen and employers are local and vary greatly in the different parts of the country, since the cost of living was taken into consideration. They are made in the shape of agreements, compulsory for both parties for a certain pre-arranged time, during which they are not permitted to be disturbed by new demands or strikes. If a party desires to revise these arrangements, notice has to be given in due time.

Present Wage Schedules

The wage schedules have been made on the basis of payment per hour, the workmen having been strongly opposed to piece-rate payment until quite recently. Only during the last months they have been won over to it step by step. The accompanying table shows the schedule of wages of the principal classes of workmen in the engineering industry in a number of German towns and districts. The figures represent the minimum wages per hour in marks and fractions of marks. The actual wages are higher by about 10 or 15 per cent. Great differences exist between the wages in large towns and rural districts, as is apparent in the case of the Sieg district in comparison with Cologne or Düsseldorf.

It is noteworthy that, although Berlin is the town of highest living cost, the wages paid there are below those of Cologne and some other towns. Workmen in Berlin, however, receive extra payment in the shape of a premium, which is 6 marks a week for the unmarried and 9 marks for the married. If there are children the premium is increased by 6 marks for each child. Females receive 6 marks per week and juveniles 4 marks.

As the average earnings per hour in pre-war times

TABLE SHOWING THE MINIMUM WAGES PAID TO MECHANICS IN DIFFERENT PARTS OF GERMANY, ACCORDING TO RECENT WAGE AGREEMENTS

Minimum Wages per Hour in Marks

	Berlin	South Germany			Westphalia		Saxony		Rhineland		
		Manheim	Munich	Nuremberg	Hagen District	Sieg District	Leipsic	Dresden	Cologne	Düsseldorf	Saarbrücken
Trained machinist	2.90—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	3.80	2.50—2.80	1.90—2.50
Machinist's helper	2.90—3.10	3.00	2.90	2.85	3.30	2.15	2.95	2.00	3.58	2.50—2.70	1.60—2.05
Lathe hand	2.90—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	3.80	2.50—2.80	1.90—2.50
Tool makers	3.40—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	3.90	2.70—2.80	1.90—2.50
Fitters	3.10—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	....	....	1.90—2.50
Planer, miller and drill hands	2.70—3.10	3.00	2.90	2.85	3.30	2.15	2.95	2.00	3.80	2.50—2.80	1.60—2.05
Turret lathe and automatic operator	3.20—3.60	3.00	2.90	2.85	3.30	2.15	2.95	2.00	3.57	2.50—2.80	1.60—2.05
Females	1.70—1.90	1.70	1.65	1.40	2.05	1.30	1.70	1.20	2.00	2.05—2.25	0.85—1.00
Apprentices and Juveniles:											
First year	0.35—0.40	0.50	0.40	0.45	0.40	0.30	....	....	0.40	....	....
Second year	0.50—0.60	0.75	0.50	0.60	0.60	0.45	....	....	0.60	....	....
Third year	0.70—0.80	1.00	0.60	0.85	0.90	0.75	....	....	0.90	....	....
Fourth year	0.90—1.00	....	0.80	0.95	1.20	1.00	....	....	1.50	....	....

had been 50 to 60 pfennigs, the increase since then amounts to from 500 to 700 per cent, which is considerably more than in other countries. The position of the German manufacturers would be very difficult indeed, if the increase in cost of labor was not counterbalanced twice or three times by the depreciation of the German money. Fully trained machinists earn in a week of 45 working hours in rural districts about 125 marks and in large towns about 195 marks. While these are high figures to those accustomed to the wages paid in Germany before the war, they will appear ridicuously low if expressed in dollars. At the rate of exchange existing at the time of writing, machinists earn about \$1.40 to \$2.20 a week. Lathe hands get from 100 to 200 marks a week, or about \$1.20 to \$2.40. Planer, miller, and drill hands and turret lathe and automatic operators earn from 85 to 195 marks per week, corresponding to \$1 to \$2.20, while females are paid 65 to 115 marks or 75c. to \$1.30 weekly.

These figures reveal the strong position that German industry holds now in the markets of the world. The advantage of the low cost of labor did not become so very marked during the first half of last year, as the efficiency of the workmen was much lower. It was commonly estimated that the efficiency of the workman was only one-third to one-fourth part of that before the war. The actual wages paid in relation to the work done were consequently higher than appeared on paper. The workmen were idling a good deal in the shops, and most of their energy was absorbed by political discussions. A change in these conditions set in last summer. The efficiency of the workmen increased and their opposition against piece-rate payment vanished. At present, payment according to results is re-established in the large majority of all German factories. While the circumstances did not bring the workmen's efficiency up to the old standard, it has risen steadily and can be said now to be about half of what it used to be. The labor question may now be considered to be settled. The evolution of the cost of labor has, of course, not come to a standstill, but it has been steadied.

It is an open secret that the German manufacturers are now making large profits, much more so than during the war. Those profits are, however, not as large as they would appear on the face of it, and the manufacturers do not have it all their own way. There is considerable discontinuity in the flow of materials coming into the factories, and the coal supply is sorely lacking. The shops have to pause quite frequently, sometimes for weeks, waiting for coal or raw material, while the expenses are running on. All efforts of the country are concentrated to bring about an improvement in this respect; but, as a large part of the German coal output and of the production of raw material has to be exported, the scarcity is very likely to be perpetuated unless help comes from outside.

I told Harry in the assembly department to make me up a sketch of a proposed change in the department and to mark up the position of the benches, machines and aisles.

In due time his sketch came to my desk and he had very carefully made it up but had spelled AISLE without the first letter; making it ISLE. I called the attention of one of the clerks in the office to it who looked it over carefully and remarked, "I don't see what the H——l he put the S in for." E. F. CREAGER.

Excess of Imports Over Exports Now Inevitable

That war loans to belligerent nations, the repurchase of American securities, and the development of our merchant marine have revolutionized our ordinary ideas of what constitutes a "favorable" foreign trade, was the assertion of George E. Roberts, vice president of the National City Bank of New York, in an address delivered May 12 before the National Foreign Trade Convention at San Francisco.

"During the ten years preceding the outbreak of the war," said Mr. Roberts, "the average annual balance of trade in favor of the United States on merchandise account was approximately \$500,000,000, and it was practically offset by the balance in what has been called the invisible account.

"It is evident that the war has disturbed this old state of equilibrium. We have bought back most of the American securities which were held abroad and the interest and dividends upon them hereafter will remain at home. We are building a great fleet of merchant ships with the intention of carrying a larger portion of the overseas trade, and we have become creditors to Europe in a very large amount. Including the loans of the United States Government to the governments associated with it in the war, the balance in our favor upon interest account is doubtless considerably above \$500,000,000 per annum.

"What effect will this shift of the balance of payments in the 'invisible' account have upon our foreign trade? How many people have realized that there is a relationship between the two classes of payments, or that they have influence upon each other? And yet a moment's reflection will show that the payments and receipts of a country in international relations must balance in the aggregate.

"In the past it was necessary for the United States to have a trade balance of approximately \$500,000,000 per year in order to pay the charges accruing against it abroad: but in the future it will be necessary for the United States to receive a balance of perhaps an equal amount in order to collect the interest running in its favor and against other countries.

"This may sound to some people like a startling and even alarming change. Our own history has accustomed us to thinking that we must have a trade balance in our favor in order to be in a sound and prosperous condition, but that was true because we were in a debtor position. We had to have an excess of exports over imports sufficient to meet the other charges in the account against us.

"We must now consider that our position is reversed, that our own requirements are reversed, and that the countries which are now debtor to us need to have the favorable trade balance for the same reason that we formerly required it. It is in the interest of both sides that the debtor country shall have the favorable trade balance, because that is the only condition under which it can meet its obligations.

"The plain truth is that if in our relations with the rest of the world the balance of payments runs continually in our favor, both on trade account and on interest account, exchange rates will rise against us as the balances increase, discouraging exports and encouraging imports, until the trade is brought substantially into balance."

Producing 17,000 Connecting Rods a Day—I

BY FRED H. COLVIN
Editor, *American Machinist*

The methods used by the Ford Motor Co. which are here described differ from the usual practice in two particulars. The first is that instead of machining the ends of the bosses as working points, the work is located from the piston-pin hole, the ends being faced square with the holes and the length of the boss gaged in a very simple manner. The second departure is in forging and machining the rod and cap separately up to the final boring, facing and broaching operation. Both the methods and the results are extremely interesting.

ONE of the striking features of the connecting-rod department of the Ford Motor Co. is the conveying system which brings the forgings from the straightening stand shown in Fig. 3 to the drilling machines across the main aisle, as shown in the headpiece. The arch over the aisle is for clearance in any kind of trucking which may be necessary, and not for the purpose of making an imposing display. This conveyor carries hangers at short intervals, each hanger accommodating three connecting rods as shown. The conveyor moves continuously and is loaded at the straightening bench so that the men at the drilling machine shown are always supplied with work. It is only necessary to reach up and pick a rod out of the rack which happens to be most convenient, the operators rarely looking up but depending almost entirely upon the sense of location and feeling to pick out a rod forging whenever it is needed.

An outline of the various operations is shown in the transformation sheet, Fig. 1. Of the 17,000 rods required per day, about one-third come from the Ford forge shop. After trimming and snagging inside and out, the rods are heat-treated before going to the machine department. This consists of a heating, quenching and an annealing, after which they are again struck in the dies to straighten them and condense the metal. Then comes the tumbling in the large tumbler shown in Fig. 2, cleaning with a sandblast, and then the straightening, as shown in Fig. 3. The simple pedestal shown, placed at the height of a man's eyes, enables him to inspect the straightness of the rods very rapidly, and any straightening which may be necessary is done on the block shown at *A*. These blocks give the same sort of a flat surface as an anvil, and also have an opening at the end which will hold the end of the rod in case any twisting is necessary. The inspectors keep the racks of the conveyor practically full and the rods go on their way to the various machining operations.

It will be noted that the small end of the rod has a very decided center punched in by the forging die. This is used for centering the roughing drill, no bushing being used in this operation, as can be seen in Fig. 4. The rods are very quickly handled by means of the clamping wheel *A*, the main requirement being to hold the rod square on its face and prevent it turning under the action of the drill.

The sides of the piston-pin boss are then spot-faced by a facing tool with a pilot, the length of the pilot in connection with the stop pin which locates the piston-pin hole determining the length of the piston-pin boss. The way in which this operates will be shown in a later illustration. Next comes the rough-reaming, which is

AUTOMOTIVE CONSTRUCTION

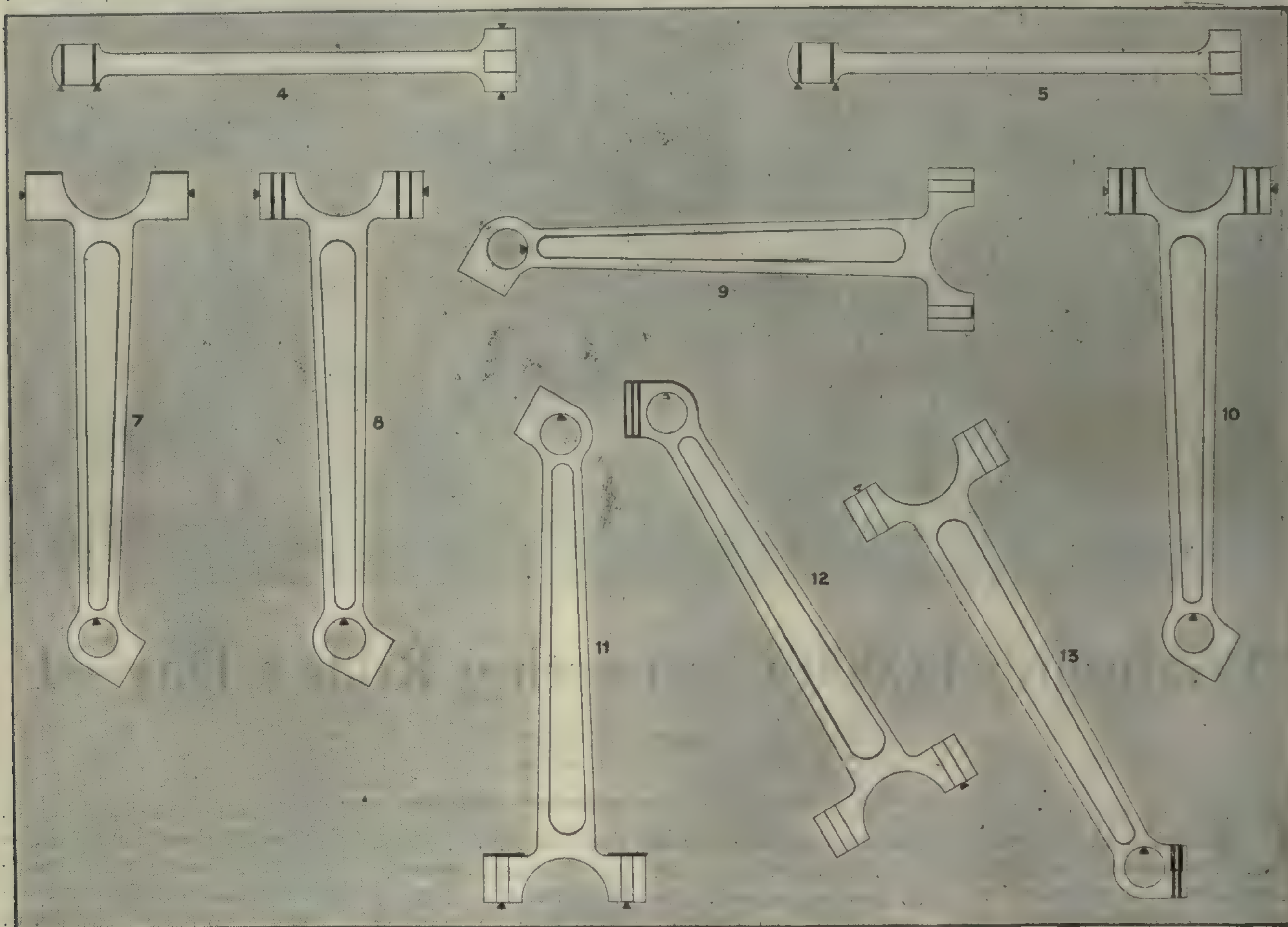


FIG. 1. TRANSFORMATION OF OPERATIONS ON FORD PISTONS

a simple operation, as in Fig. 5. The fixture is of the simplest kind, the rod being located under the plate *A* and against the pin *B*. The pin *C* is simply a stop which prevents the rod from turning under the action of the reamer. Flooded lubrication is used throughout.

The rods are now rough-straightened from the reamed piston-pin hole, as shown in Fig. 6; an easily handled pin *A* goes through the piston-pin hole, the small end

FIG. 2. TUMBLING BARREL FOR FORGINGS

FIG. 3. FIRST INSPECTION AND STRAIGHTENING

AUTOMOTIVE CONSTRUCTION

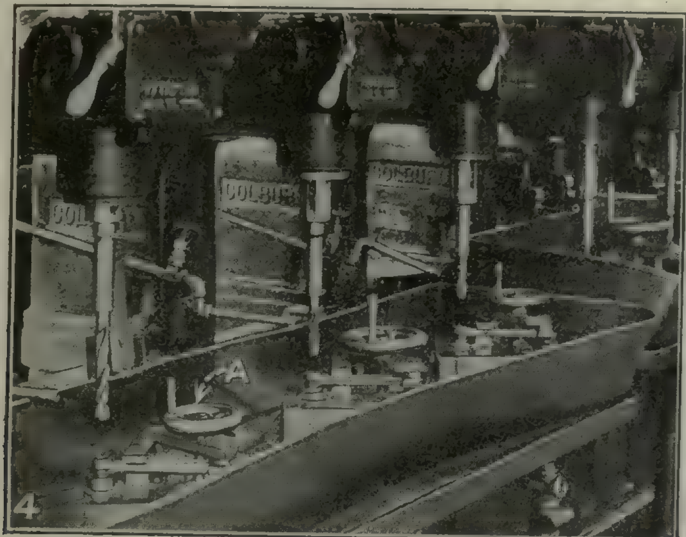


FIG. 4. ROUGH-DRILLING PISTON-PIN HOLE

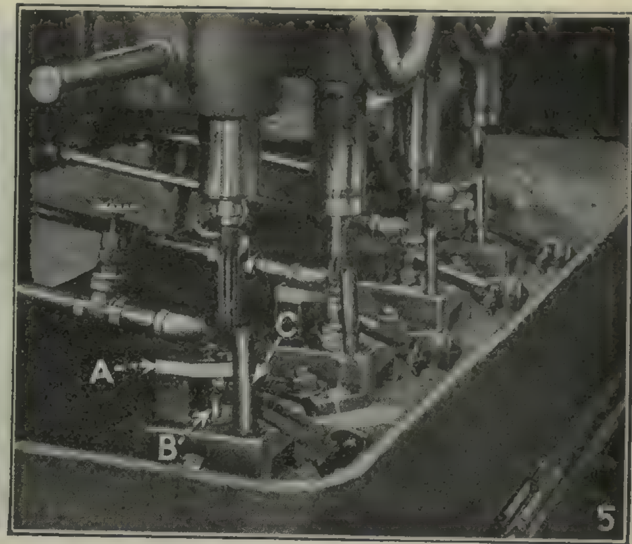


FIG. 5. ROUGH-REAMING PISTON-PIN HOLE

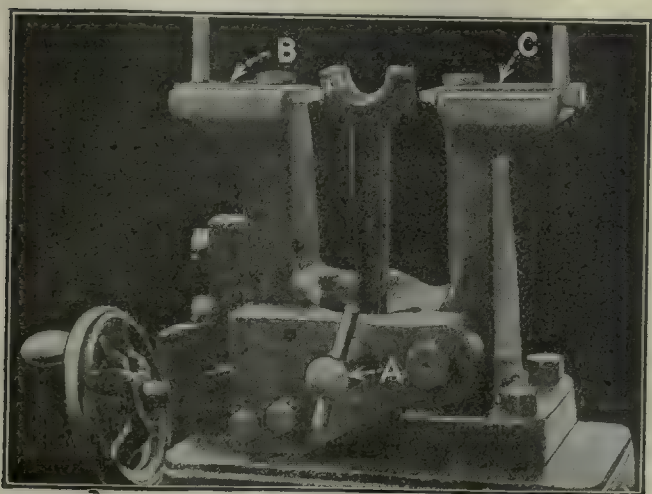


FIG. 6. THE SECOND INSPECTION

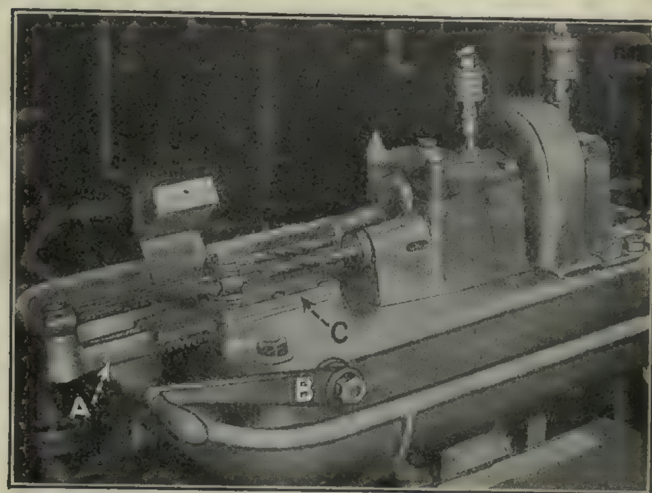


FIG. 9. BURRING BOLT HOLES

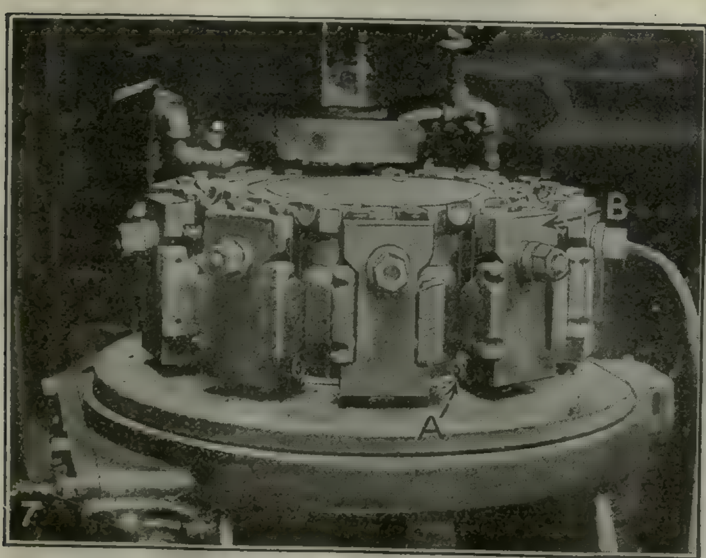


FIG. 7. MILLING LARGE END OF ROD

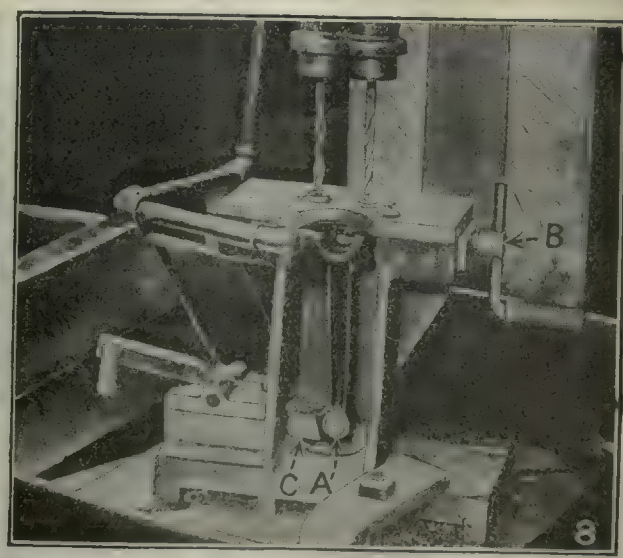


FIG. 8. DRILLING BOLT HOLES

then being clamped by means of the handwheel shown. The sliding gages *B* and *C* show whether the rod is twisted or not, and how much. Gage *B* has a forked end, while *C* is a single point. These gages test the rods by the bolt bosses and can be handled very rapidly.

Using the piston-pin hole as the locating point, as at

AUTOMOTIVE CONSTRUCTION

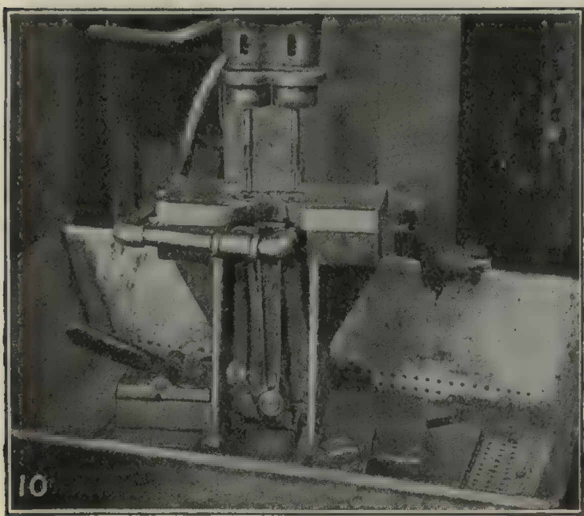


FIG. 10. REAMING BOLT HOLES

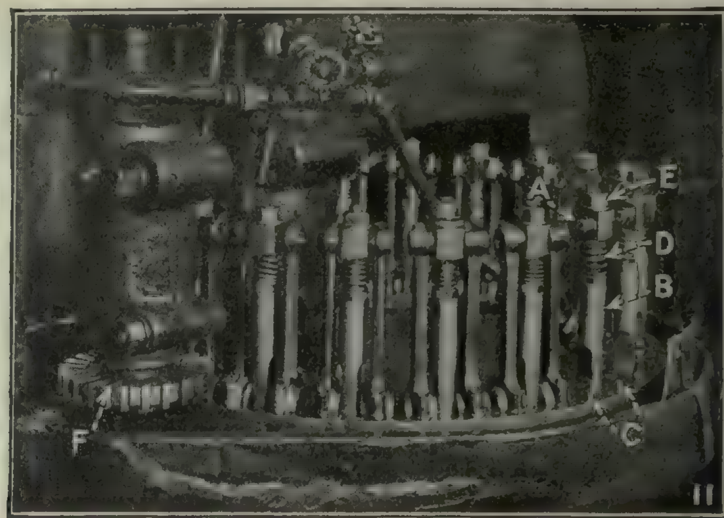


FIG. 11. MILLING END OF BOLT BOSSES

A, the rods are placed in the double fixtures shown in Fig. 7, and the faces of the large ends surfaced in the continuous milling machine shown. The single clamping plate *B* enables the rod to be very easily handled. The fixture holds 20 rods and handles 250 per hour. Cutters are changed two or three times per 8-hour shift, the change averaging 15 minutes.

Drilling the Bolt Holes

Next comes the drilling and burring of the two bolt holes, the fixtures being shown in Figs. 8 and 9. The rod is located on the pin *A*, the screw clamp *B* holding the upper end, while the clamp *O* holds the lower end firmly against the pin. The drilling time is about 40 sec. The burring is done on a special motor-driven two-spindle machine shown in Fig. 9. The rack *A* carries a pin on the outer end which fits the piston-pin hole, and the crank *B* operates the pinion which forces the rod over the burring drill shown. The large end of the rod simply slides on the steel plate *C*. These machines handle 1,200 rods per hour.

The reaming of the bolt holes, Fig. 10, is identical with the drilling in Fig. 8. Lubrication is freely used, as can be seen from the large splash pan which has been provided. The seat for the bolt head is another continuous-operation job and is shown in Fig. 11. This is a somewhat different type of fixture, the pins *A* which fit the piston-pin hole being carried in a crosshead on the upper end of the pillars *B*. The lower end of the rod is located by the dowels *C*, which fit the bolt holes.

The crossheads carrying the upper pins are normally raised by the springs *D*, so that when the connecting rod is slipped over the pin *A* the lower end clears the dowel pin beneath. The nut *E* is then tightened and forces down the crosshead, carrying the two rods, and holds them firmly in place while the upper ends of the bolt bosses are being milled by two cutters, the outer one being shown at *F*, while the inner cutter is hidden by the fixtures.

Another simple but interesting fixture is shown in Fig. 12, this being for drilling the clamping-screw hole through the piston-pin boss. The rods are located by

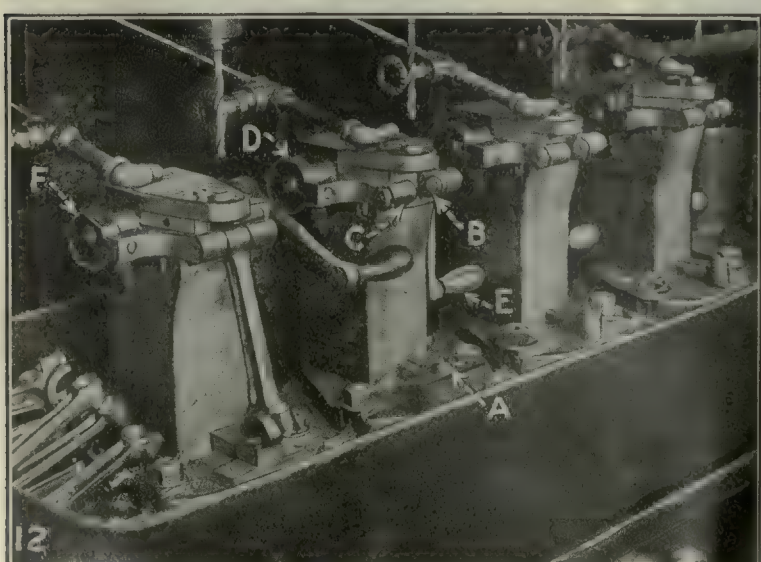


FIG. 12. DRILLING FOR CLAMPING BOLT

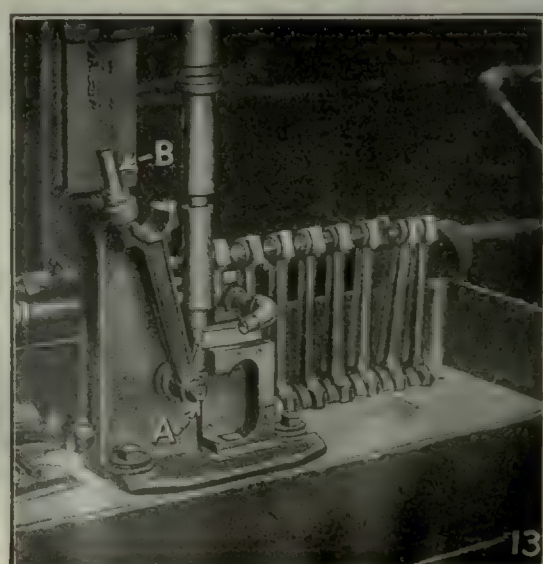


FIG. 13. DRILLING BODY HOLE

the dowel pin *A* in one of the lower bolt holes, while the piston-pin hole fits over the fixed stud *B*. Then the movable stud *C*, which is controlled by the cam *D*, is swung into contact with the other side of the rod by the handle *E*, holding the rod firmly during the drilling operation. The position of the cam when the arm is closed can be seen at *F*, and this picture also shows the handle in its raised position. Some idea of the ease with which the fixtures can be handled may be had from the fact that the four spindles drill about 200 holes per hour.

The larger or clearance hole for the binding bolt is drilled in the fixture shown in Fig. 13. Here, of course, it is necessary to reverse the position of the connecting-rod, but the same locating points are still retained. The rod is simply slipped over the pin *A* and the locating pin *B* slid into the left-hand bolt hole, making this a very easily handled operation.

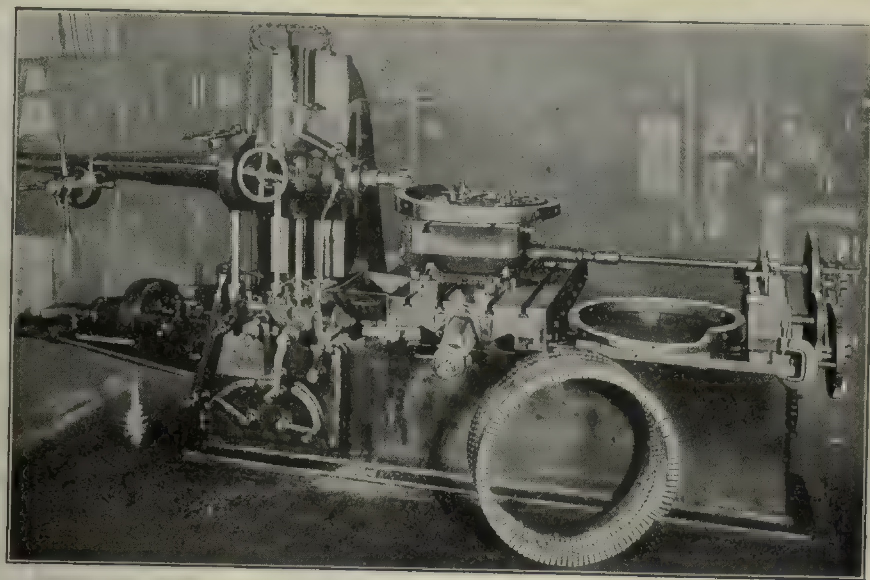


FIG. 1. BORING MACHINE CUTTING LARGE CAMS

Cutting Cams on a Boring Machine

By Frank C. Hudson

The adaptability of an accurate horizontal boring machine when in the hands of skilled mechanics is illustrated in Figs. 1 and 2, which come from the toolroom of the Ford Motor Co., Detroit, Mich. A general view of the machine, which is a Lucas, is shown in Fig. 1.

The outer support has been removed from the end of the bed, and in its place is a housing, *A*, Fig. 2, held in position by two C-clamps. This support carries the gearing shown, which is driven from the head of the machine in the same way that the outer bearing is moved in the support which has been removed from the bed.

This gearing drives the rotary table *B* by means of shaft *C* and the gearing is so proportioned as to turn the cam being cut in the correct relation to the milling cutter which is raised at the proper rate by the elevating screw of the regular spindle head.

The method of cutting the blanks for the cams can be seen from the cylinder standing in front of the boring machine. This is turned and bored to the proper dimensions and is then cut up by drilling a series of holes so that one line makes a straight cut, while the next row of holes gives a very close approximation to the contour of the finished cam. The screw holes for fastening the cam in position on the machine are also drilled at the same time, so that the cam is completed, except for a few finishing touches, when it comes off the rotary table of the machine.

While this is an unusual method of cutting cams for automatic machines, it has been found satisfactory, and reflects credit on the ingenuity of those who devised it.

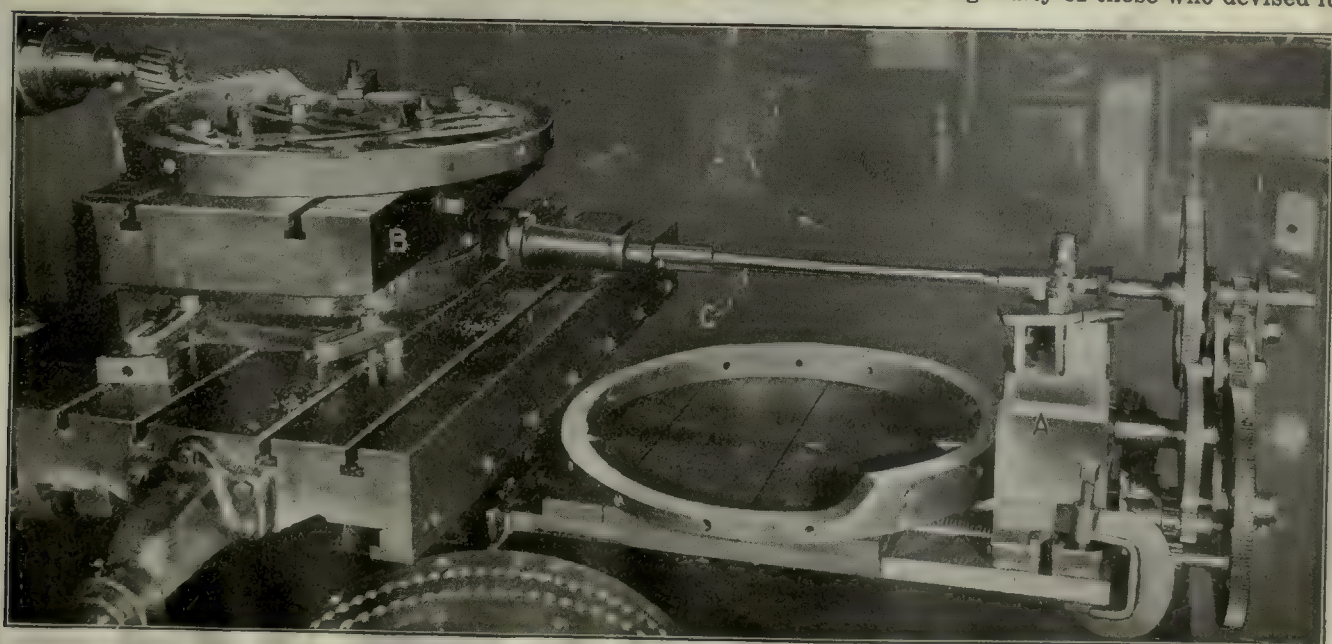


FIG. 2. DETAILS OF THE SET-UP AND GEARING

Not Politics—but Common Sense

EVERY time some unusually foolish piece of legislation is threatened, it is jarringly bumped into the business men that they have practically no real representation in legislative bodies.

Politicians of the professional type as a rule, pick the candidates and select mediocre lawyers, business failures, second-rate newspaper men and others of this class, mainly with an eye to their amenability to suggestion and their "stand-in" with certain organizations.

The real business man and manufacturer is too busy—or thinks he is—to bother with politics and votes mechanically for what he thinks to be the least of the evils put on the slate.

He has no standing or influence with the politicians, such as an organized body has, and consequently seldom sways a nomination.

Generally speaking, the average business man does not understand the issues. If he gives to the campaign fund, and votes—if the weather is nice,—he feels that he has done his share.

If a business man of ability is, by any chance, asked to run for office, he almost invariably says he cannot afford the time or the financial sacrifices.

All this is wrong. He CAN afford it, and in the final analysis he DOES.

Every year he has to spend time and money lavishly to head off injurious laws and regulations. Sometimes—often—he fails to head them off and pays heavily, through his business, for worse than foolish legislation put over by the schemers and the ignorant.

Things will never go right in this country until we put men into office who are **successful business men in a large way**—be they manufacturers, engineers or merchants.

The first question asked regarding a candidate for **ANY** office, should be: "Is he a **success** in his line and does he understand the needs of industry **FROM THE INSIDE?"**

We need a new order of "minute men" who will drop everything at the call, and go to the primaries and the polls for the good of industry which is also the country's good.

We need industrial giants in office to take the place of the meddling pygmies that are now so common.

We need *successful* engineers in office. Those who are used to gathering facts and coolly analyzing them in their relation to industry before deciding on a course of action.

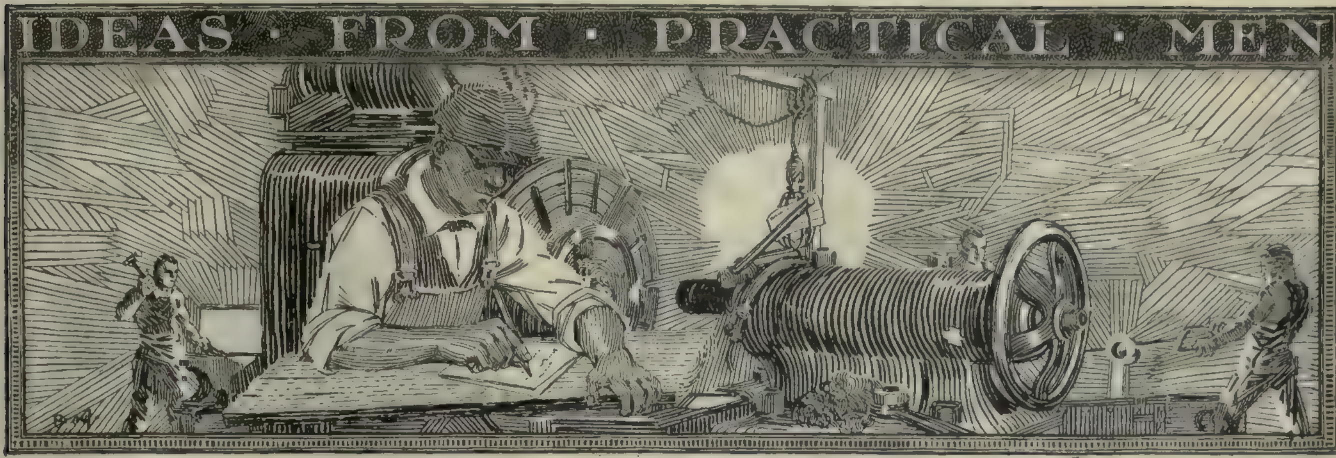
If men of this type are sent to legislatures, to Congress, and are put into high office, we won't have to be continually on the alert for the appearance of foolish, dangerous, industry-crushing legislation.

We need another Paul Revere, **BUT DON'T WAIT FOR HIM.**

THIS ISN'T POLITICS—IT IS COMMON SENSE.

Ethan Viall

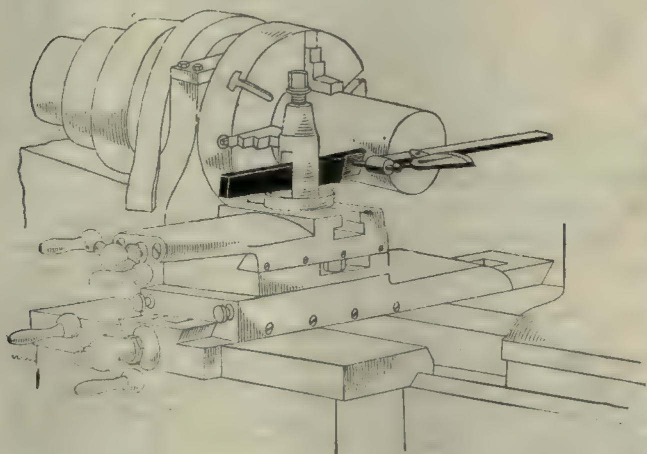
Editor



Gages for Setting Tool for Cutting Off Piston Rings

BY ROY F. LEIGHTON

In the illustration may be seen a gage for setting the parting tool for cutting off piston rings from a pot casting. The sliding pin that bears against the gaging point of the indicator is easily removable and pins of different lengths should be made to accommodate different thicknesses of rings.



DEVICE FOR SETTING PARTING TOOL

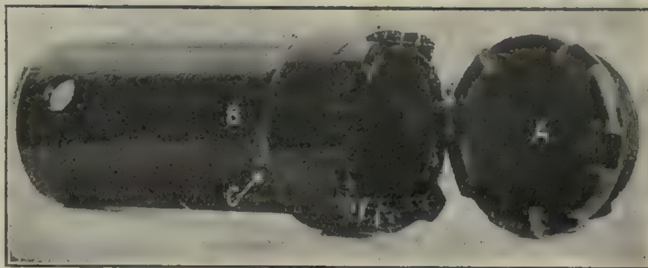
Using this device for setting the parting tool I have cut off twelve rings with an accumulated error of but 0.004 in.

A Home-Made Valve-Cap Wrench

BY BILL HUGHES

In repairing or overhauling automobile engines it is necessary to remove several caps having castellated tops as shown at *A* in the illustration. A spanner wrench for this purpose is generally supplied by the maker of the engine, and works well while the engine is new, but after considerable carbon has formed the strain necessary to remove the caps will soon batter up the castellations and sometimes break them off.

To overcome this difficulty, I made the wrench *B*, of steel pipe. A coupling was screwed on the pipe to increase the thickness and welded at *C*. The end of the coupling was then faced off and castellated to match the plugs. Holes for a bar drilled in the upper end of the pipe completed the job.



A HOME-MADE VALVE-CAP WRENCH

Pipe was used for the wrench both for lightness and to go over spark plugs, pet cocks, etc., that protrude from the plugs.

A Good Layout for a Yard Crane

BY C. W. GEIGER

At the Baker Iron Works in Los Angeles, Cal., the tracks of the traveling electric yard crane have been extended over the street that passes the plant, thus enabling heavy pieces of machinery to be loaded or unloaded from trucks without the necessity of driving into the yard. As shown by the illustration, steel poles, riveted to the tops of the columns supporting the tracks, carry the telephone wires. This eliminates the danger of these wires coming in contact with the feed wire that supplies the crane motors.

TRACKS OF A YARD CRANE EXTENDING OVER THE STREET TO FACILITATE LOADING

WHAT *to* READ
—for the man in a hurry

Suggested by the Managing Editor

WE lead off this week with another manufacturing story. It comes from our Western Editor, J. V. Hunter, and deals with the production of Household Appliances in one of the modern plants in the Middle West. There is good evidence given that industry is doing its share to counteract the effects of labor shortage in the home.

For those engaged in work which requires machining aluminum, P. T. Lennon's contribution, "Machining Aluminum Pistons," beginning on page 1175, will touch the spot. The author gives freely of his knowledge gained by experience, and hopes, as we do, that his treatise may elicit an exchange of ideas and suggestions from you.

> *Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.*

As a machinist, many a time you have watched your chance of making "premium" go by while you chased up a drill, or a reamer, or a tap, haven't you? And you've cussed the system, or lack of system, which forced you to be a pretty fair detective to find the tool you needed. And when you finally found it, how was it ground, or what condition was it in? You growled and let it go at that, because you felt that you weren't in a position to do anything about it—that was when you were a machinist. But did you, as a foreman, superintendent or manager, go further and dope out what this same situation meant in the way of plant expense—in direct production time lost, increased overhead, etc., and did you figure out the effect on the selling price of the product? The fifth of W. R. Basset's series on "Modern Production Methods," dealing with "Tool Issue," on page 1177, shows the evils of a lack of good system in handling tools from a centralized station, and details a system devised for economy and efficiency.

We don't hesitate to step into an automobile and "step on it" for from thirty to sixty miles an hour; at the same time we realize that we are relying upon a rather complicated mechanism not to fail. We are waiting for the day when we can feel just as secure in an airplane, only we'll not want to stop at a mere sixty miles per hour. Designers, engineers and scientists are at work to bring this condition about, just at they worked for years on the automobile. Not the least important factor in such development is the art of heat-treating metals. "Heat-treating of Brazed Fittings for Aircraft," by Archibald Black, page 1184, is a compilation of data which has been issued by the Government and steel concerns from time to time, and a summarizing of its facts. "Brain vs. Brawn" by John A. Honegger, page 1186, is an article which will interest the designer and engineer. It treats of something with which they are very familiar and in the author they have a champion of their cause.

We see both humor and pathos in a condition which offered Watt cylinders for his steam engine, bored with a variation in diameter of as much as one-half inch. Suppose Watt had not been able to get a cylinder bored with sufficient accuracy to prove his theory! Increased accuracy in machine tools is the subject of this week's installment of H. H. Manchester's series on "The Evolution of the Workshop"—page 1187.

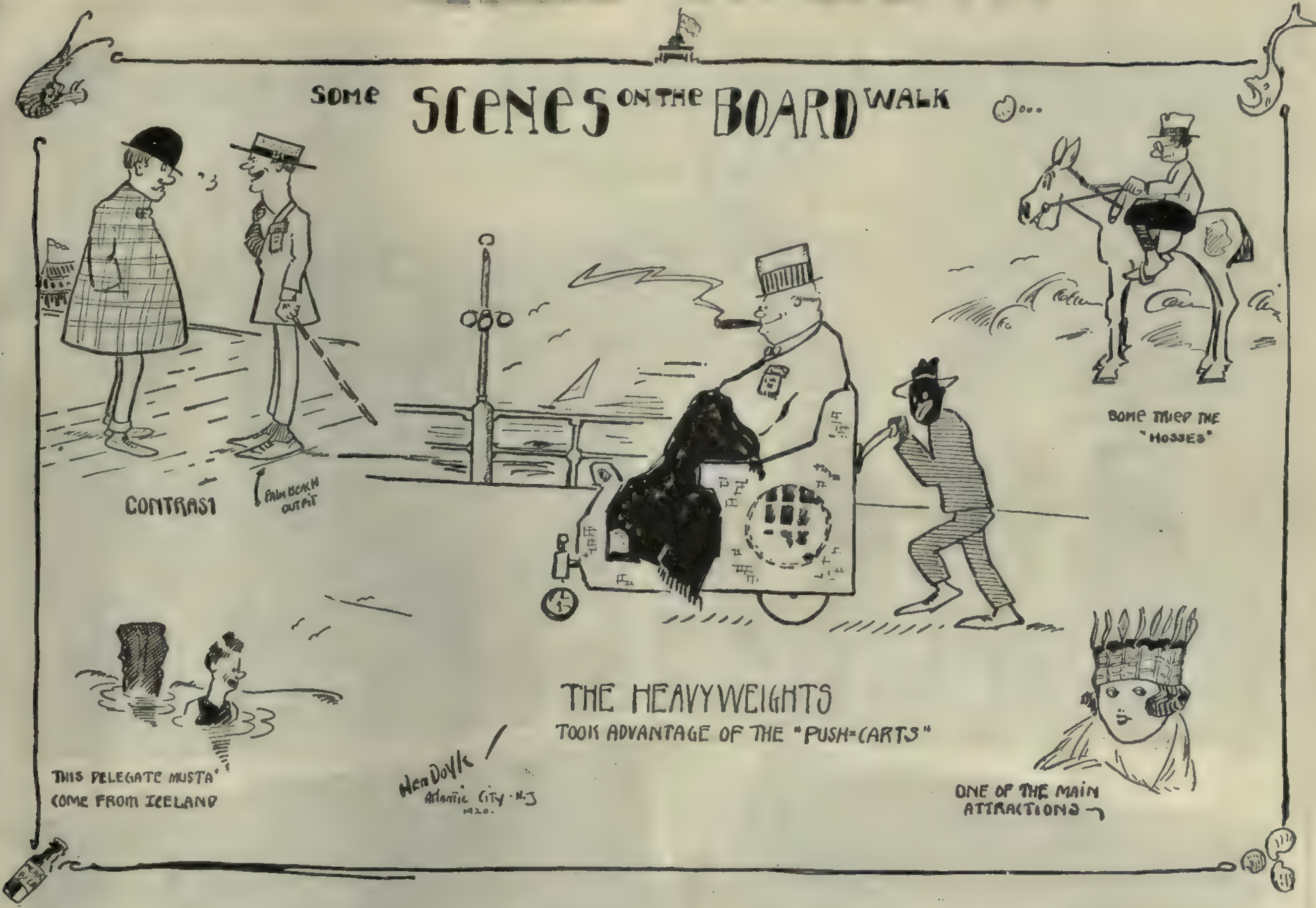
"Load Characteristics of Radio-Thrust Bearings," page 1190, by F. C. Goldsmith is directed particularly at F. W. Gurney, whose treatise on the same subject we published in Volume 50. There is no reason why you shouldn't get in on it, if you want to. It offers a very nice little task, if you follow through the "math" and "trig." Answer the closing question if you can.

You will find Fred Colvin's article, page 1199, up to the very high standard of his Automotive Series. This week it is on "Producing 17,000 Connecting Rods a Day." Yes, it's Ford's plant. Part II will appear in the issue of June 17.

Doyle's cartoons on the "Machinery" conventions at Atlantic City speak for themselves—page 1207.

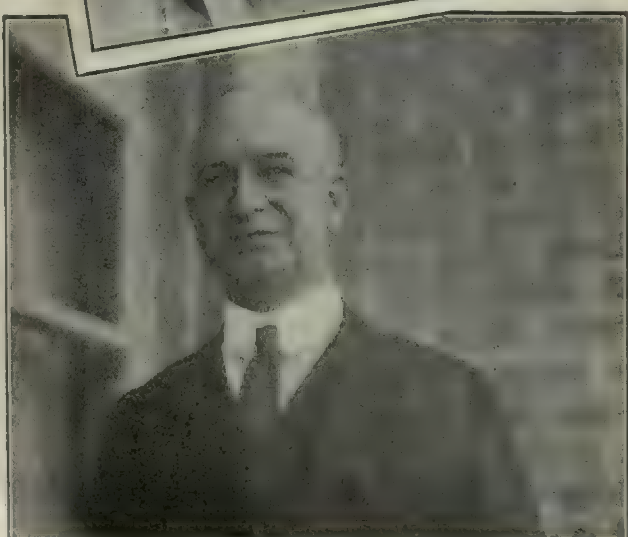
Beginning on page 1210 we give a resumé which touches the high spots of the National Foreign Trade Convention at San Francisco. There is a digest of the addresses to come next week. Foreign trade is becoming a larger and larger factor in American business; it will pay to learn all you can about it.

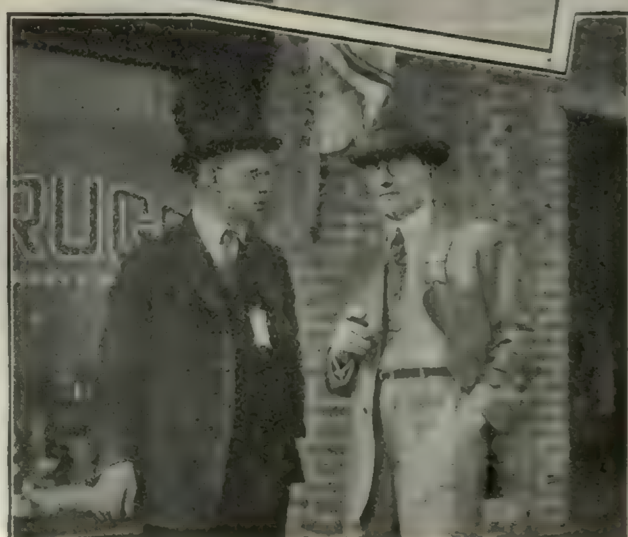
The first part of William H. Barr's address on "Labor and Industry" appears on page 1212; the second part will appear in our next issue.



Sidelights of the convention as seen by the "American Machinist" staff artist at the Combined Meeting of Machinery Dealers and Manufacturers at Atlantic City.

Recess Periods at Machine Tool Builders' Convention





W. MARSHALL TURNER
President, Southern Supply and Dealers Association

COL. CRANNELL MORGAN
President, National Supply and Dealers Association

CHARLES D. BEAVER
President, American Supply and Machinery Association

Here we have the pictures of the newly elected presidents of the three associations. Each is a "captain of industry"—a leader in his particular field. Crannel Morgan is president of the Hardware and Supply Co., of Akron, Ohio, and is well-known to the machinery trade. Marshall Turner, president of the Turner Supply Co., of Mobile, Ala., is one of the most prominent machinery dealers in the South. Charles D. Beaver, foreign sales manager of the Yale & Towne Manufacturing Co., New York, by reason of his long business experience and intimate acquaintance with foreign and domestic trade, is one of the best informed men on present world industrial conditions.

With leaders of this type, the Dealers and Manufacturers associations should enjoy a prosperous and progressive year.

Predicts Renewed Business Activities

The following is an extract from the address delivered by J. D. Nicklis, president of the National Supply and Machinery Dealers' Association, at the opening of the annual convention of that body at Atlantic City, N. J., May 17, 1920. Mr. Nicklis is prominent in the machinery trade and his opinions on commercial conditions of today are worthy of note. Mr. Nicklis is manager of the supplies department of the Manning, Maxwell & Moore Co., New York.

"When we assembled a year ago in Pittsburgh the opinion prevailed that we had reached the peak of high prices and that the industrial life of the country was facing one of the most critical periods in its history. Events have proved that we were at that time entering a period of great business activity, which for the most part has continued and is in force at the present time. Most of us can recall listing our overstock, whereas today we are worrying a great deal about our shortage. The floors and shelves of our factories and warehouses have been swept clean and there is evidence on every side of a large accumulation of unfilled orders many months in arrears. Even with the price of labor and material at its present height, and with the end apparently not yet in sight, it is difficult to believe that the wheels of commerce are going to slow down in the near future.

Refuse to Consider Lower Prices

"The Mill and Factory representatives with whom you come in contact, refuse to consider the idea of lower prices this year and are urging your buyers to get goods wherever obtainable to keep up stocks. The leading industries report great activity and are well booked with orders. Manufacturing as a rule shows undiminished activity. Production in certain lines has been speeded up to meet the demand but in most cases there is a great under-supply of special productions and this applies to many items handled by the members of this association.

"The greatest obstacle to trade during the past month, outside of the serious shortage in many lines, was the inadequacy of transportation facilities and the almost complete tie-up brought about by the "outlaw" railroad strike. The effects of this strike will in all probability be felt for months to come and let us hope that the strike will be settled before factories for want of fuel and other raw material are crippled any further. It is certainly to the interest of the country at large that the normal routine of production of business keep on with as little interruption as possible.

Country Prosperous for Past Five Years

"It is not difficult to look back and find that the country has been very prosperous for the past five years. Everyone has been making money, employers and workers alike. Wages have gone up and at their present level are way beyond the wildest dream of labor leaders in 1914. Yet the irritating fact remains that for most of us, the extra wages and profits are balanced by the ever-increasing expenses.

"The future of this association is very bright and to say that we have earned an enviable place among organizations of this character and are firmly entrenched in the esteem of the trade would be putting it very mildly indeed. Having earned that position it would be dangerous for us to rest on our laurels. With this growth in membership and influences, I hope this convention will suggest new fields of endeavor in order that the organization may maintain the present strong position and continue to grow."

Seventh National Foreign Trade Convention

THE Seventh National Foreign Trade Convention was held in San Francisco, May 12-15, 1920, most of the sessions being in the new Auditorium which is a part of the new Civic Center, a monument to the foresight of some of those who are responsible for the re-building of the city. All previous records of attendance were smashed to smithereens, about 2,500 delegates registering. The weather was fickle to the extent of being disappointingly cool to both natives and visitors, the latter naturally expecting balmy days to match the wonderful flowers and shrubbery. The sun was kind however and the hospitality displayed to both delegates and ladies had sufficient warmth to make up for any deficiencies in the outside temperature.

The delegates came from all over the world, the far east being especially well represented. All were apparently anxious to do business with the United States. Ocean transportation is a huge factor in this trade, the Philippinos pointing out the great hardship of irregular and inadequate steamer accommodation to their ports. This was also touched on by Robert Dollar in his address of welcome, in which, quite incidentally, he gave voice to his opinion that the center of the world's trade must inevitably line on the Pacific Ocean.

Imports as Well as Exports

Mr. Dollar pointed out the problems of ocean transport, showing the necessity of full cargoes both ways in order to secure minimum freight rates, and that at the present time we are shipping long, straight, staple cotton to China and bringing back short fiber, curly, Chinese cotton, which afterward becomes "wool" through some of the modern methods of transmutation. However, a side light on the question of ballast comes out in connection with the manufacture of glass and glassware on the Pacific Coast, for much of the sand used comes from Belgium in ballast, and being ballast, the glass companies can secure it at a low rate. Just how full cargoes each way would affect them it is not difficult to figure out.

Machine Opportunities in China

An urgent need of the country, as brought out by conversations with those fresh from the great land of China, is the repeal of the laws which make it impossible for for the young men of that country to come to the United States to learn our methods and our machines by actually working in our shops. China naturally turns to her best friend of the days of the Boxer Rebellion, to learn modern methods and to buy modern machinery. But she is confronted with the law which compels, or at least allows, consuls to refuse passports to young Chinese men who want to come here and work in our shops to learn our machinery and the methods of handling it. Passports may be granted if the man agrees to work without compensation all the time he is here, and can be, and are being, refused if the consul professes to believe that the young man may accept wages after he arrives.

This is resulting in many young Chinese men going to France, which is welcoming them without any such foolish restrictions and naturally means that they will become familiar with French machines and will buy French machines when it comes to equipping their own, or other Chinese shops. All of which may result in diverting a large amount of business from this country to France and England, business which the Chinese would for various reasons, prefer to place in this country.

Double Taxation

Another difficulty in the way of foreign trade is the present law by which American organizations for such trade are taxed both at home and abroad and so placed at a disadvantage, as traders from other countries have no such handicap. A large representation of American business men from China are making strenuous efforts to have this handicap removed, but with a Congress more interested in mending and strengthening fences than in matters of national welfare, it is doubtful if anything can be done at present. And the longer this is delayed the greater hold will other countries secure on the business in foreign countries.

One need only glance at the list of papers presented to the convention to see that practically every phase of the situation was considered and discussed. Many of these deal with the financial problems involved, the questions of exchange, the methods of determining which fields to enter, and direct selling, being parts of that feature of the program.

The general feeling, as James A. Farrell expressed it, was that "The United States must become a foreign trading nation—its industrial development has reached just that stage," or as R. M. Calkins said, "As the growth of our commerce exceeds the demands of the domestic market, the surplus can be only disposed of in the markets of the world."

Beginning in Our High Schools

One of the striking papers presented was by E. L. Bogart, of the University of Illinois, on "How and Why Economics Should Be Taught in the High Schools." The "why" is because comparatively few go beyond high school and if they are to be groomed in the fundamentals of economics it is necessary to do this while they are available. The necessity for it is pointed out in the author's endeavor to clear away misconception as to how economics affect the every-day life—and death. Mr. Bogart rather shatters some of our ideals, but economic law seems to recognize no sentiment. The paper starts off with:

"The most important questions which confront our civilization today are economic in character, and even those which have to do with other activities or interests are affected by economic considerations. An excellent illustration of this fact is found in the issues which are being discussed in the present presidential campaign —immigration, foreign trade, federal taxation industrial relations, high cost of living, etc.

"Without taking the extreme view of economic determinism, it may safely be asserted that our leading problems are economic and that their correct determination calls for a knowledge of economic science and the application of correct economic principles. The Great War and its effects provide the world with its great outstanding problems today. Not only are these primarily economic and financial, but the war itself in large measure grew out of economic considerations.

"The economic pressure of a rapidly growing popula-

tion in Germany, which doubled in sixty years, combined with an incorrect analysis of the nature and value of foreign trade, together with overweening political and military ambitions, led to the greatest war in history. Our own participation in this struggle was made necessary by the disregard and defiance of our rights as neutral traders. In fact it can be shown that the determining factor in all wars in which this nation has engaged, has in the last analysis been economic in its nature. The colonists went to war with England in defence of their right to carry on profitable lines of trade which the mother country tried to suppress, and also of the right to issue their own paper money. "Taxation without representation" made a convenient slogan at the time, but it is now recognized that more fundamental economic issues lay behind the political demands. The war of 1812 was fought to secure our commercial rights on the high seas; the war with Mexico resulted from the need of the slave-owners of the Southwest for more land in which to push their extensive exploitative system of cotton growing; the Civil War was at bottom the inevitable struggle between two opposing systems of labor, that of the free labor working for a competitive wage and that of compulsory slave labor. Even the Spanish War, in which idealistic motives probably played as large a part as is possible in any such struggle, may be traced to the investments in Cuban sugar plantations of American capital. And if we should go to war with Mexico in the future, does any one doubt that our investments in oil lands would be a leading factor in bringing about such a conflict? The justification of a resort to arms to decide the various issues involved in these wars need not be raised; the simple fact remains that the issues themselves were fundamentally economic.

Economic Questions Most Important Now

"There never was an age in which economic questions were so important or so predominant. Human interests differ from time to time and so too the problems vary which are presented to society for solution. In the Middle Ages men's minds were absorbed by religious considerations, and from the theological controversies there resulted the Reformation. In the seventeenth and eighteenth centuries the great issue presented was that of constitutional government and to its solution the greatest intellects of the day gave their best. But the nineteenth century was primarily industrial; in that period industry was completely revolutionized and greater progress was made than in all preceding history.

"The rapid, almost dizzy, progress of this period has left to the twentieth century some serious economic problems, whose solution calls for the application of our best talents. We are often reproached for the sordidness of our interests and all called material-minded; but the truth is that no greater challenge was ever given to the human intellect and soul than is presented by the social and economic problems of today. The present industrial unrest has moreover rendered these problems much more significant and their correct solution more imperative than has even been the case before."

Must Exchange Products

All through the convention one could not escape the trend of thought and argument that foreign trade must mean buying as well as selling. The old notion that we must make all that we need and then sell the surplus to foreign countries, has no foundation in economic theory or practice. For after all, trade is only bartering or exchanging products as it has always been and must be. The only difference is that modern business methods with credits and easy methods of exchange, make it unnecessary for the producer to barter direct with the consumer. The emphasis laid on imports as well as exports should help to assure other countries that the advantages of trading with the United States are not all one sided.

The Foreign Trade and the Press

One session was devoted to the part the trade and technical press has played and will play in stimulating foreign trade. The three papers were: "The Service of the Business Press," by James H. McGraw;* "The Agricultural Press," by G. Howard Davidson, and "The Export Press," by Franklin Johnston. Each brought out salient points in the matter of securing and holding foreign trade and the way in which proper publicity, through thoroughly established mediums, can be of great assistance.

It was pointed out that as the conditions in any country reflected and reacted on all the rest, it was essential that we appreciate the necessity of aiding prosperity in all other countries as well as our own; that fair and comfortable living conditions for all people were the best and only answer to ultra-radical ideas and agitators. Expression and not repression, lower living costs and not policemen's clubs, would smooth out the discontent in industrial centers.

Trade with Russia was discussed from three angles by ex-secretary of Commerce Redfield, David P. Barrows and Jerome Landfield. A full session was devoted to the merchant marine, the papers including an American maritime policy, marine insurance and the effect of fuel oil on foreign trade.

Exporting in general, from the problems of the export manager to the training of export salesmen and the surveying of new markets, received careful attention. The effect of the Webb law was carefully discussed as was parcel post extension in general and Pacific problems in particular.

The last session reviewed the whole national program for foreign trade, heard the report of the group sessions and of the general convention committee and adjourned, well satisfied with the great amount of interest shown and feeling that considerable progress had been made.

Some of the Papers Read

Some of the papers that were read are: "The Relation of Our Industrial Capacity to Our Foreign Trade," by James A. Farrell, chairman National Foreign Trade Council and president U. S. Steel Corporation; "Why Direct Selling," by William L. Launders, president American Manufacturers Export Association; "Methods of Surveying New Markets," by E. Wilhelm Drooster, of the Rubleins & Myers Co.; "The Work and Service of American Chambers of Commerce Abroad," by Charles W. Wittemore; "Reorganization of the Foreign Service of Our Government," by W. W. Nichols, Allis-Chalmers Manufacturing Co.; "How to Use the Federal Information Services," by E. A. Brand, secretary Tanners' Council of the U. S. A. and formerly assistant director, Bureau of Foreign and Domestic Commerce. Extracts from these papers will appear in our next issue.

*To be published in an early issue.

Labor and Industry*

By WILLIAM H. BARR
President of the Lumen Bearing Co., Buffalo, N. Y.

"Capital has its rights, which are as worthy of protection as any other rights. Nor is it denied that there is and probably always will be a relation between labor and capital producing mutual benefits.

"The strongest bond of human sympathy outside of the family relation should be the one uniting all working people of all nations, and tongues and kindreds. Nor should this lead to a war upon property or the owners of property. Property is the fruit of labor; property is desirable; is a positive good in the world. That some should be rich shows that others may become rich, and hence is just encouragement to industry and enterprise.

"Let not him who is houseless pull down the house of another, but let him work diligently and build one for himself, thus by example assuring that his own shall be safe from violence when built."

—The Author's quotation from Abraham Lincoln.

IN THE presentation of my subject "Labor and Industry" I have chosen a phrase which seems to be timely, although much of it must perforce be a restatement of existing facts. Industrially speaking, we are suffering from many things, not the least of which is a lack of constructive co-operative leadership. But worse indeed, we suffer from the fact that labor is under singularly short-sighted leadership; one that has no knowledge of economics; no knowledge of the political world, and having but one thing in mind, higher wages, regardless of all else. The corollary to that, is the dictum of John Mitchell, who eleven years ago said: "Not more than 200,000 men a year shall come into this country from overseas." For the American Federation of Labor leaves no stone unturned to hold the labor supply down to the most illimitable bottom, and they apparently have no conception today that they are cutting from under their feet the ground on which they wish to stand. Today, union labor is definitely aligned against industry. Obviously, of course, its position is antagonistic to its own interests, but when any set of men is filled with arrogance resulting from the feeling which success inspires, it is difficult for them to understand that their action is reflex and directed against themselves more than against those whom they single out for their antagonism. The present policy of trade unionism is one of reckless misunderstanding. If it cannot rule industry, it is willing to ruin it, forgetting that in the ruin of industry is involved the ruin of the worker.

WILLIAM H. BARR

Those who may doubt that this is a correct interpretation of the position of organized labor can verify it by studying the record of the unionists during the past few years, and particularly since the beginning of the European War. When this country recovered from the slough of industrial depression, in the spring of 1915, the unionists saw their opportunity and began a campaign to convert the necessities of the country to their own uses. Demands for higher wages began, and were continued until our entrance into the war, which precipitated a situation entirely to their liking, because they held the fate of the nation largely in their hands. During eighteen months of war, there were 5,300 union labor strikes, clearly defining their brand of patriotism. They were responsible for the epidemic of wage raising, which was a prelude to price raising. They exercised every power which they possessed to compel Government officials to bow to their will, and they almost succeeded in imposing their power upon the country. They would have accomplished this purpose if the war had lasted another year. As it is, we see the effect of their efforts, and we see the influence on themselves of the power which they had and which should now be subordinated and controlled.

But let us not misunderstand the situation, and condemn the honest workers who are members of the unions. They are merely puppets in the hands of unscrupulous leaders, and are either unwilling to or are incapable of, voicing their own views, or making affective their own silent protests against the dictatorial policy of their leaders. During the war, in order to increase membership, the ranks of the unions were thrown open to radicals and Reds, and when

*Address delivered at the convention of the American Supply and Machinery Manufacturers' Association, Atlantic City, N. J., May 17, 1920.

peace came, and the radicals had supervened in the unions, the old leaders appealed to the public to be sustained as against the outlaws which had practically captured the various organizations. But the appeal was not to co-operate in promoting justice and equity in industry, but to grant the un-American demands of the unions, in order to check the radicals. But industrial men realized that by strengthening these leaders they would strengthen those who in the heyday of their own power had attempted to strangle industry.

Every great strike in recent months has been called an outlaw strike. The coal miner's strike was disavowed by certain leaders. So was the steel strike, and so is the railroad strike. There is an object in these disavowals which is unmistakable. The unpopularity of the strikes, and the resentment of the public, was quickly apparent. Certain union leaders tried to avoid criticism by publicly proclaiming their antagonism, forgetting it was known that they were trying to carry water on both shoulders. The position of union labor today is that they have created public antagonism, but, unfortunately, they still retain their political associations, through the threat of reprisal at the polls.

Now, gentlemen, that is the point which I wish to emphasize. If you have followed developments in legislation and in industry for the past few years, you will know that whatever power labor has possessed through the unions has come from political alliances. The power of the labor union vote is negligible, but it is advertised with drums and threats, and, accordingly it has assumed a real entity for the average politician, whose business in life is counting votes before and after election. I do not ascribe venality to any of our public men, but I do ascribe weaknesses to many, which is almost as sinister, because the pliable legislator is difficult to locate and to handle. But before we condemn a public man for this weakness, we should look for the causes, of which there are at least two. One is the definite propaganda of the unionists along political lines. They are always active in the campaign for the promotion of their own interests. On the other hand, the business man pays no attention to politics. Apparently, he does not understand the issues. He may vote and he may not. If he contributes to a campaign fund he feels that he is doing all that is necessary. He is often unaware of the character of the candidates for whom he votes. He accepts a party tag without knowing whether or not the candidate is named, after consultation with a union leader. He is careless and indifferent in the exercise of his citizenship prerogatives. He is neither helpful nor hurtful to the public man. Therefore, he is ignored. He is a nonentity and does not figure as a factor in the situation.

When legislation antagonistic to commerce is enacted, the business man is indignant, forgetting that his indignation should be directed against himself and not against legislators with whom he is unacquainted.

The present political campaign is one of serious importance. We shall elect a President, who, for the sake of the country, must stand squarely on the Constitution; who must be against privilege and must be an exponent of the square deal. Unless we get back to the Constitution and a proper understanding of its principles, there are dark days ahead for industry. Legislation of the greatest importance will be considered by the next, or Sixty-seventh Congress, and the real reconstruction period will begin on March 4, 1921. To what extent are you interested in this campaign, in the selection of candidates for Congress, for the State Legislature and for the Presidency? Are you allowing someone else to name the men and tell you when and how to vote? Or, are you taking an active interest in the campaign and seeing to it that your efforts are directed towards the election of men who are sound Americans, who are against privilege and who will give special concessions to no one?

Are you aware that the labor unionists are conducting a campaign to elect a Congress in sympathy with their uneconomic demands? Are you aware that they have a campaign chest of millions of dollars, and a campaign committee of approximately 140,000 men? Do you realize what will happen to industry and business if the unionist class should dominate Congress? Pointedly, gentlemen, I ask you, what are you going to do about this vital issue?

The unionists are frank in their statements as to their objective. They would control Congress and compel the enactment of the so-called principles which they have enunciated, including the limited workday, the complete unionization of the country, the abolition of injunctions to protect property in strikes, the dilution of the power of the Courts, and the control of the judiciary and legislative machinery of the nation. If you are Americans you are against these principles, even aside from your selfish interest in them. What are you doing to prevent the success of this movement? Let me say that you have no greater duty than to take an active and direct interest in politics, to give your time, your energy and your money, not to the success of a party, but to the success of individual candidates who stand squarely on an American platform. You can all, irrespective of party affiliation, take part in this campaign. If you fail to do so, the consequences will be serious to yourself and to the international prosperity of your country.

This attempt to fasten class domination on the United States is in part due to well thought out plans which have been made effective through the weakness of Congress. The literacy test has brought about a shortage in the immigration of unskilled labor, and there is a shortage in skilled labor also. In these circumstances, the power of the unions increased, but Congress will not repeal the literacy test because it fears the menacing attitude of union labor. There seems to be no generally well understood idea concerning the labor situation and the effect which restrictions on immigration have on it. Let me read to you a statement which I prepared recently, showing the shortage of workers as a result of the dwindling of immigration during the war and because of the unnecessary and restrictive literacy test:

"Official immigration and emigration statistics for the five-year period immediately preceding the war is as follows:

"Year	Immigration	Emigration
1910	1,041,570	380,418
1911	1,030,300	518,215
1912	1,017,155	615,292
1913	1,427,227	611,924
1914	1,403,081	633,805
Totals	5,929,333	2,759,654

(To Be Concluded in Next Week's Issue.)

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

The Ryerson-Conradson Multi-Speed Planers

Joseph T. Ryerson & Son, Chicago, Ill., has added to its line the Ryerson-Conradson multi-speed planers which are being built by the Conradson Machine Tool Co. These machines are primarily designed to be motor driven as shown in Fig. 1, but they are equally efficient when arranged for constant-speed, single-pulley drive.

For motor drive a constant-speed non-reversing motor is used and is connected to the main-drive shaft by a Clark flexible coupling, and through this shaft to the reversing mechanism which is operated through pneumatic clutches. It is claimed that the type of clutch used is self-compensating for wear and requires practically no attention. Dogs on the platen trip a distributing valve alternately admitting compressed air to one or the other of the clutches. A spacing rod connects the two, and one clutch is automatically disengaged when the air is admitted to the other, thus making it impossible to lock the drive gearing. The machines are equipped for cutting speeds of 25, 30, 37½ and 45 ft. per minute and have a return speed of 100 to 120 ft. per minute. All speeds may be varied to suit special requirements.

The primary shaft carries two gears and has at its extreme end the reverse pinion which engages directly with the return clutch gear. The gears for varying the cutting speed are mounted on a square shaft and are shifted by a lever mounted in a gridiron.

The driving train, bull wheel, and rack are of herringbone design. All pinions and gears are of chrome-nickel steel heat-treated with the exception of the herringbone gears which are cast steel. All gears and bearings are automatically oiled by the splash system and the overflow of lubricant is returned to a central tank by gravity.

The bed is of the box-section type and the ways consist of V's of unequal angles, one side of each V being inclined 15 deg. to the horizontal while the other is inclined 15 deg. to the perpendicular.

Oil is carried by the bull wheel to the pockets in the V's for lubricating the ways, and each end of the bed carries a large apron extending beyond the maximum travel of the table for catching all surplus oil. The table has a central longitudinal rib for supporting the rack and cross-ribs are placed at frequent intervals.

The driving mechanism of the rack-feed, Fig. 2, consists of a piston operated pneumatically, which turns the feed-regulating disk through 180 deg.; its crank being connected by levers to a gear segment which raises or lowers the feed-rack as required. When the table trips the air-distributing valve to the clutches the air is at the same time admitted to the corresponding end of the feed-rack piston.

The elevating screws are driven by an individual

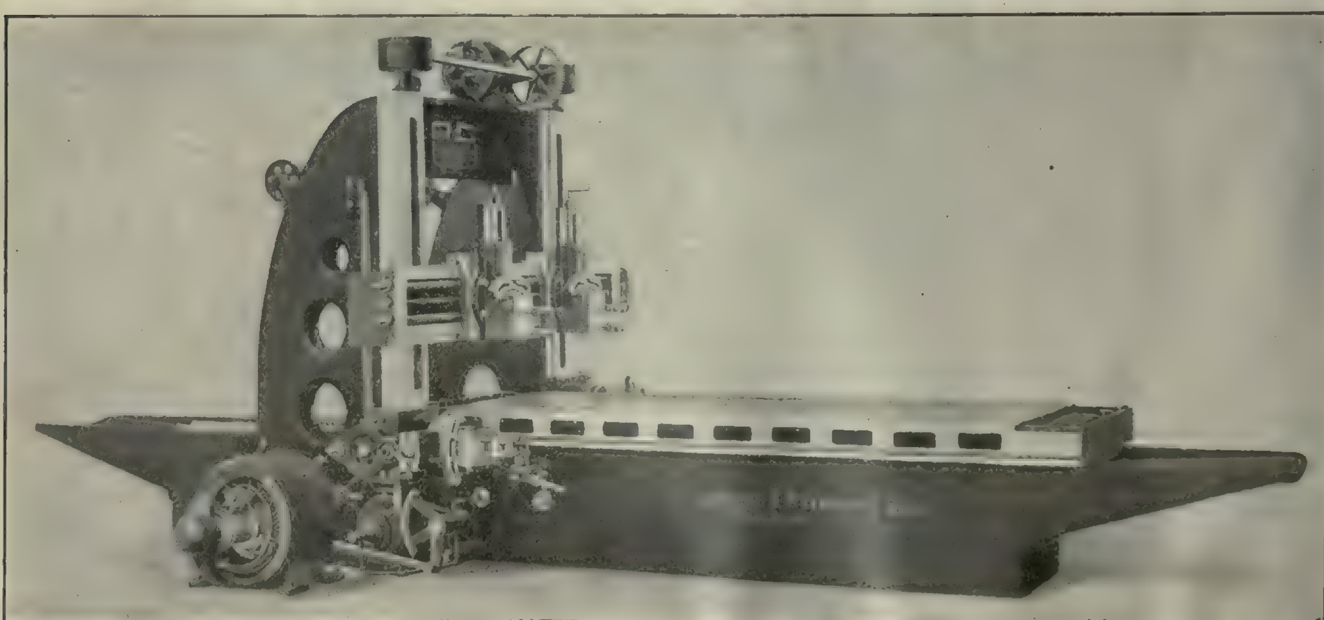


FIG. 1. RYERSON-CONRADSON MOTOR-DRIVEN PLANER

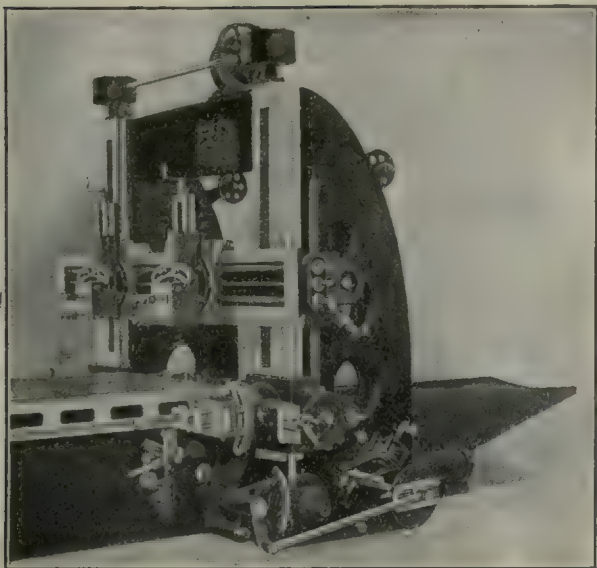


FIG. 2. CONTROL SIDE OF RYERSON-CONRADSON PLANER

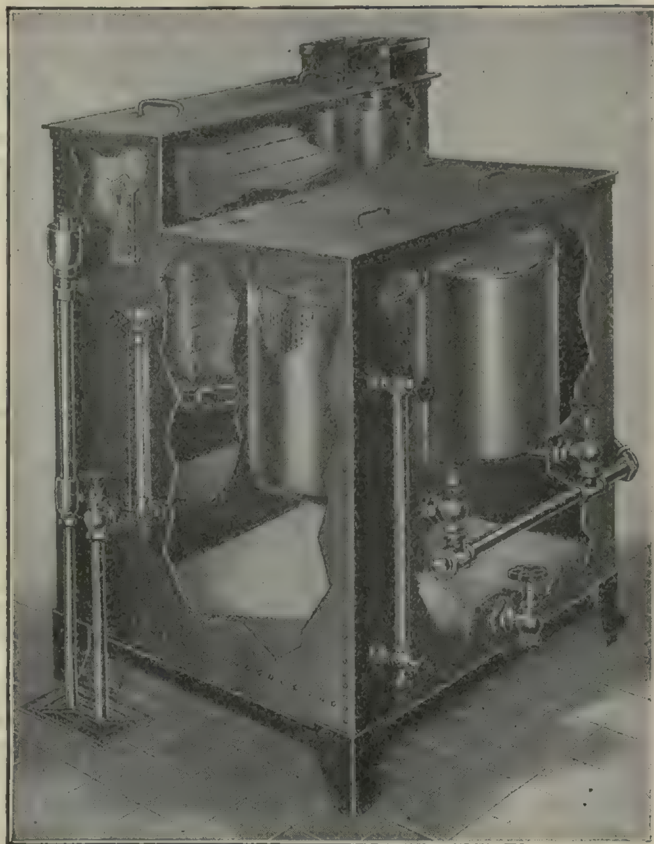
Specifications: Built in 24 x 24, 30 x 30, 36 x 36, 42 x 42, and 48 x 48 in. sizes. Respective widths between housing, 25, 31, 37, 43, and 49 in. Maximum distance from table to cross rail, 25, 31, 37, 43 and 49 in. Length of working surface of table for standard machine 6, 6, 8, 8, and 10 ft. Length of table overall 7 ft. 6 in., 7 ft. 6 in., 10 ft. 10 ft., and 12 ft. Cutting speed, 25, 30, 37½, and 45 ft. per minute. Return speed 120, 120, 100, 100, and 100 ft. per min. Speed of main-drive shaft 1,200, 1,200, 720, 720, and 720 r.p.m. Horsepower required, 3 to 5, 5 to 10, 7½ to 15, 10 to 20, and 15 to 25. Horsepower required for elevating motor, 1, 2, 3, 3, and 5. Total width without motor 5 ft. 9 in., 6 ft. 7 in., 7 ft. 9 in., 8 ft. 3 in., and 8 ft. 9 in. Total height including motor 6 ft. 8 in., 7 ft. 3 in., 8 ft. 3½ in., 8 ft. 9½ in., and 9 ft. 3½ in. Air pressure required 80 to 100 lb. Net weight, 8,000, 11,000, 18,000, 23,000, and 32,000 lb. Weight boxed for export 9,200, 12,500, 20,500, 26,500, and 36,500 lb. Boxed for export 220, 250, 500, 750, and 1,000 cu.ft. Net weight additional for each 2 ft. length of table 1,200, 1,600, 2,000, 2,500, and 3,000 pounds.

motor mounted on the top of the tie-piece. The cross rail is of standard construction permitting individual traverse and feed of each head in either direction. Both the heads on the cross rail, and the side heads on the uprights have power angular feed and are of heavy design. The side heads have power vertical traverse. To operate the reversing clutches and rack-feed pistons, compressed air is required at a recommended pressure of from 80 to 100 lb. per square in. The air consumption will range from 3 to 10 cu.ft. of free air per minute. For shops not having a compressed-air system, a small standard compressor may be provided which is connected directly to the main-drive shaft.

Wayne Oil Filtering Cabinet

The Wayne Oil Tank and Pump Co., Fort Wayne, Ind., has added to its line the Type C oil filtering cabinet illustrated herewith. The cabinet is intended to be placed below the machines from which the oil is to be filtered so that surplus oil from the bearings will flow to it by gravity.

In entering the cabinet the oil passes through a fine brass-wire screen into a compartment where it is heated to 180 deg. F. and then into a precipitating chamber where all grit and sediment is deposited. From the precipitating chamber the oil passes through cloth filters, which remove the slime and remaining impurities, and finally into a storage tank. The object of heating the oil is to thin it so that the settling of heavy impurities will be hastened. The filter is built in four sizes for which capacities are claimed for filtering from 100 to 600 gal. of oil per hour. In addition to the cabinet shown, a tank for either fresh or filtered oil is furnished and is intended to be placed above the bearings to be lubricated so that the oil will flow to them by gravity.

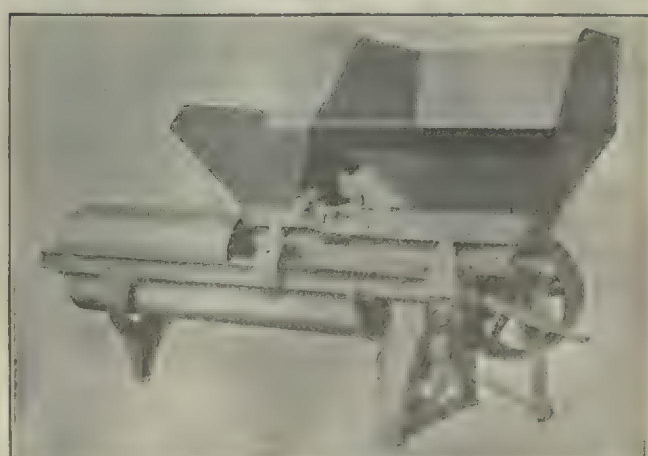


WAYNE TYPE C OIL FILTERING CABINET

Kent Carburizing-Compound Mixer

The machine illustrated herewith is made by the Kent Machine Co., Kent, Ohio, and is intended for mixing carburizing compound.

After each carburizing heat it is customary to replenish the used compound with a certain proportion of new material which, to insure uniform results, should be thoroughly mixed with the old. The large hopper holds the used compound and the small one the new material. On the throat of the small hopper there is a gate which can be adjusted to restrict the opening through which the material is carried by a reciprocating



KENT CARBURIZING-COMPOUND MIXER

feed plate. As the feed plate also carries the used compound from the large hopper it is only necessary to adjust the gate of the small hopper so that the new material passed will be in the desired proportion to that of old material and for this purposes a scale and pointer are provided. During the backward stroke of the feed plate the material on it is wiped off and falls into the mixing trough. A series of paddles attached to a horizontal shaft thoroughly mix and convey the material to the discharge-end of the trough.

Kelly 20-In. Crank Shapers

The R. A. Kelly Co., Xenia, Ohio, has recently re-designed its 20-in. crank shaper, Fig. 1 showing the machine equipped with a countershaft for belt drive and Fig. 2 showing the machine motor-driven through a gear box.

The base is of heavy construction and has a rib around the edge for catching oil and chips. The rocker arm is a semi-steel casting and is connected to the ram by means of a link, which has a tendency to pull the ram down on its bearings and thus neutralize the upward thrust of the tool.

The cross-rail elevating screw is equipped with ball bearings which take the thrust of the bevel gears. The apron is fitted to the cross rail with a taper gib and the table is so mounted on a central stud in the apron that it can be turned through a complete revolution. A hardened taper plug is used for locating the table in place.

The vise has a graduated base, and is held to the table by four bolts. A boss cast underneath the vise takes part of the downward thrust of the cut. The thrust of the screw is taken in the head of the vise, thus lessening the danger of breakage.

The feed box, located on the end of the cross rail, fully incloses the moving parts of the feed mechanism. A knurled lever on the top of the box controls the direction of feed, the table traveling in the direction the lever is thrown. The amount of the feed is controlled by the knob on the side of the box, thus no moving parts need be touched to control the amount or direction of the feed. The feed automatically disengages when the table reaches the end of its travel. All shafts are heat treated and ground, and all bearings have automatic lubrication. All gears are of semi-steel and all pinions of steel, and have helical teeth.

The machine can be furnished as shown in the illustration, or equipped with a single pulley for belt drive, either from a variable speed motor or through a gear box. It can be provided with power feed to the head and a tilting top for the table.

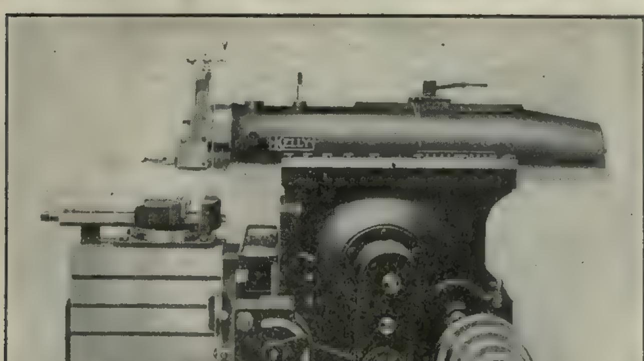


FIG. 1. KELLY 20-IN. BACK-GEARED CRANK SHAPER WITH CONE PULLEY

Specifications: Stroke, 20⅝ in. Travel of table, horizontal, 26½ in.; vertical, 12½ in. Ram to top of table, 4½ to 16¾ in. Down feed, 7½ in. Table: top. 14 x 20 in.; side, 15¾ x 30 in. Horizontal feed, 0.007 to 0.125 in. with 18 changes. Keyseating capacity, 3½ in. dia. Ratio of gearing: single gear, 6.2 to 1; back gear, 24.6 to 1. Number of speeds, 8. Strokes per min., 6.5 to 92. Weight; net, 3,900 lb.; crated, 4,250 lb.; boxed 4,400 lb. Size of box for export, 67 x 46 x 60 in.; 104 cu.ft.

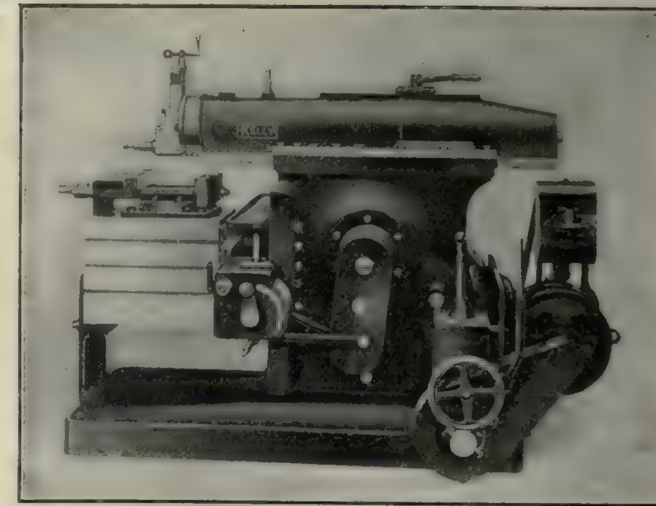
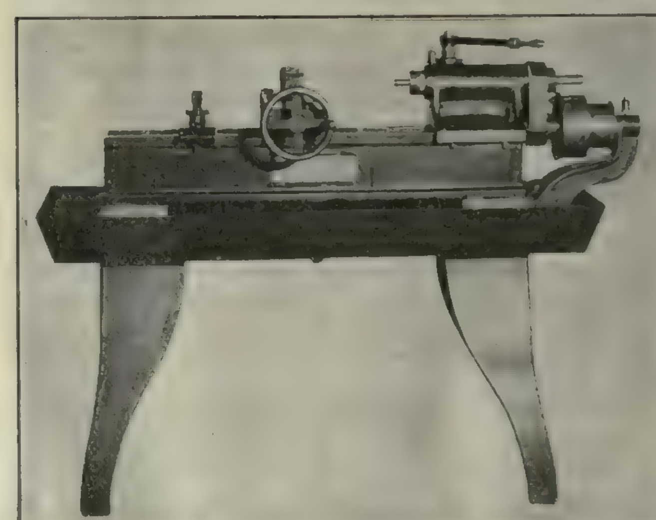


FIG. 2. KELLY 20-IN. BACK-GEARED CRANK SHAPER WITH GEARED MOTOR DRIVE

Specifications (same as for Fig. 1, except for drive). Motor: 5 hp., a.c.; speed, 1,800 r.p.m.

Cadillac Single-End Drilling and Centering Machine

The single-end drilling and centering machine shown in the illustration is built by the Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich. The spindle feed is operated by the lever on the top of the head. A sliding vise for holding the work is mounted on the



CADILLAC SINGLE-END CENTERING AND DRILLING MACHINE

Specifications: Length of bed, 44 in. Distance from ways to center of spindle, 5½ in. Capacity of standard vise, 4-in. round or hexagon stock. Spindle; speed, 750 to 1,740 r.p.m.; axial movement, 4 in.; nose fits No. 3 Jacobs chuck. Countershaft: pulley, 6 x 2¾ in.; speed, 1,050 r.p.m. Motor required, ½-hp., 1,150 r.p.m., constant speed; or ½-hp., 900 to 1,800 r.p.m., variable speed.

ways, and a support or stock-rest is furnished for sustaining the outer end of the work.

The machine may be furnished either belt-driven, as illustrated, or with a motor drive. When furnished with belt drive a two-speed countershaft is part of the regular equipment. The countershaft and loose pulley are provided with Hyatt roller bearings. All other bearings of the machine are bronze-bushed, with suitable provisions for oiling. The drilling capacity of the machine is 11/16 in. when drilling steel. An oil pump with tank and piping, drill chuck, special jaws and fixtures can be furnished as extra equipment.

Ingersoll Reciprocating Type Milling Machines

The Ingersoll Milling Machine Co., Rockford, Ill., has developed milling machines of a reciprocating type which are shown in the illustrations. Since each

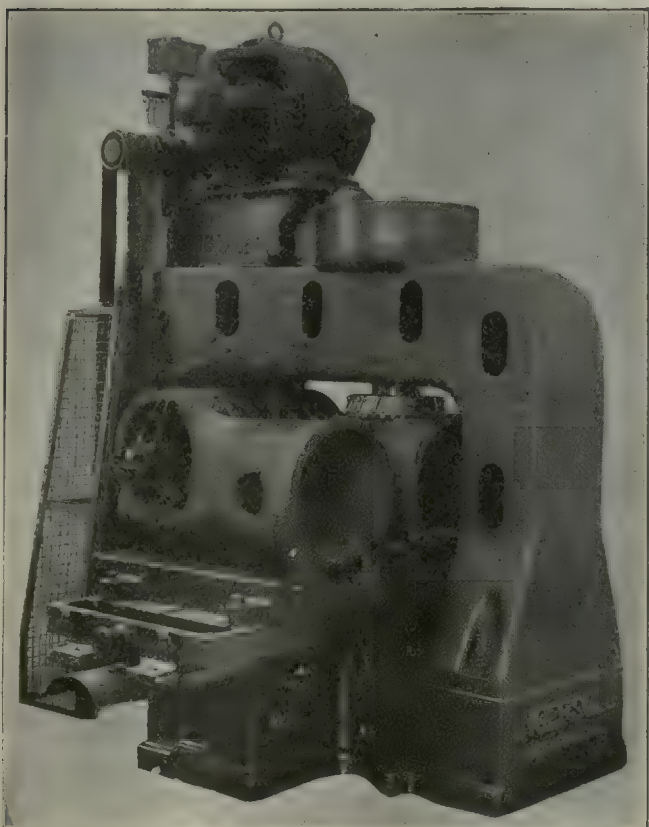


FIG. 1. INGERSOLL RECIPROCATING-TABLE MILLING MACHINE FOR TRACTOR TRANSMISSION HOUSINGS

Specifications: Casting finished, 20 x 21 x 38 in. Table, 30 x 60 in. Feed, 8 in. per min. Rapid traverse, 10 ft. per min. Cutter sizes, horizontal, 8 in.; vertical, 10 in. Floor space 7 ft. 6 in. x 9 ft. Weight 15,000 lb.

machine is built to suit the particular piece of work upon which it is to be used, there is no attempt at standardization of design beyond employing as many standard parts as the design warrants.

In the use of reciprocating types of milling machines, duplicate pieces of work are mounted on opposite ends of the table and alternately fed to the cutters. While a cut is being made on the work on one end the operator places work on the other end. When one cut is finished the table is returned by a rapid traverse motion and, as it approaches the fresh piece of work, automatically resumes its normal rate of feed. This reversal of feed and rapid traverse continues indefinitely while

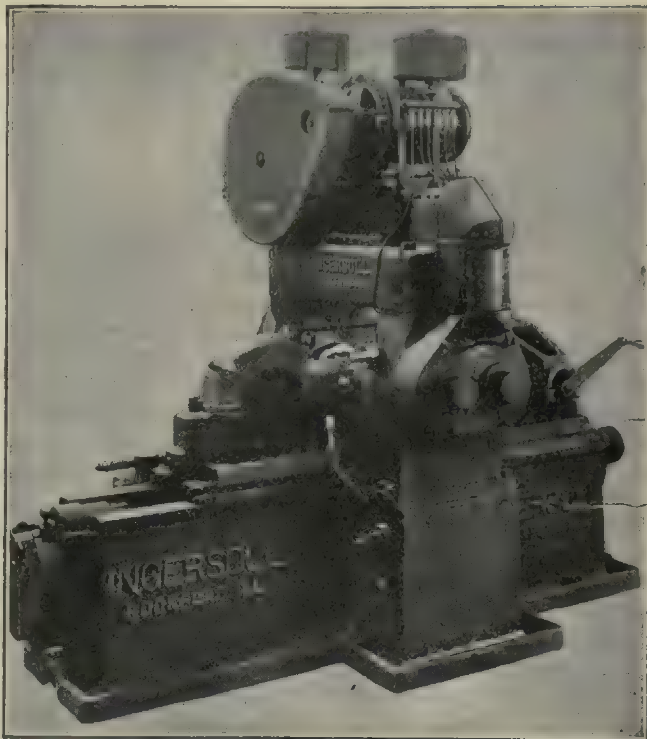


FIG. 2. FOUR-SPINDLE RECIPROCATING-TABLE MILLING MACHINE

Specifications: Four spindles. Tables, 14 in. x 4 ft. Floor space, 23 sq.ft. Height, 78 in. Weight 12,000 lb.

the operator alternately loads work on the opposite ends of the table.

The machine, Fig. 1, was designed for milling tractor transmission-housings, using one vertical spindle with a 14-in. cutter and one horizontal spindle with an 8-in.

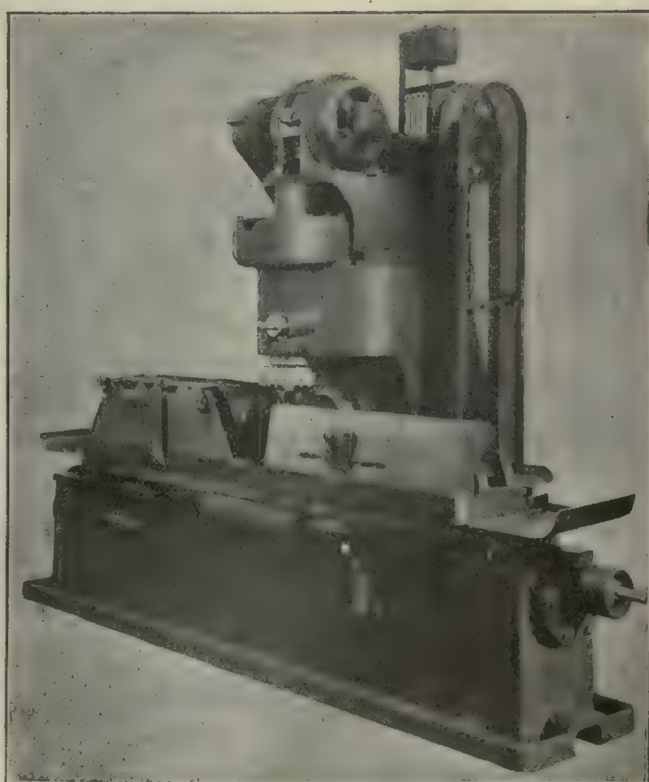


FIG. 3. OPEN-FRAME RECIPROCATING-TABLE MILLING MACHINE

Specifications: Two spindles. Twelve-inch cutters. Table, 14 in. x 6 ft. Feed, 6½ in. per min. Rapid traverse, 10 ft. 6 in. per min. Floor space, 36 sq.ft. Height 8 ft. Weight 10,000 lb.

cutter. The latter finishes a flanged surface on the side opposite the observer. Special fixtures are provided which aid in quickly mounting and firmly supporting the work.

The spindles are controlled directly by starting or stopping the motor, but the table motion can be controlled separately by feed levers, one of which is mounted on each end of the bed so that either may be available to the operator while loading. The table feeds can be varied to suit the character of the work.

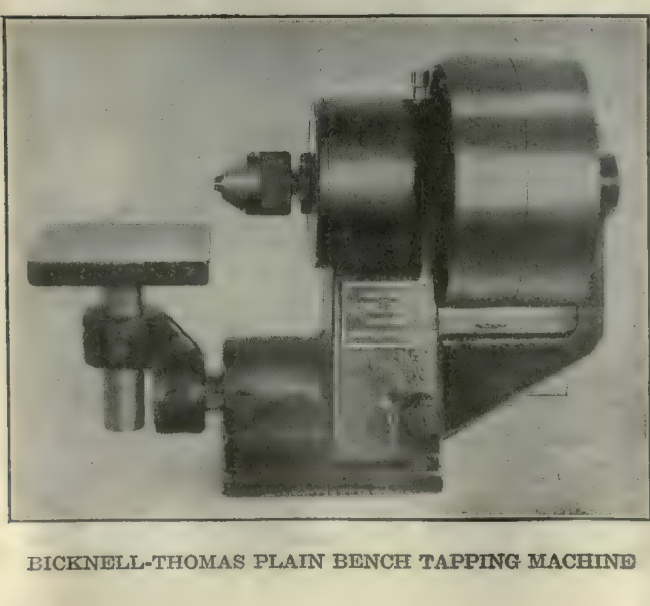
Another reciprocating type of machine, Fig. 2, was built for milling opposite ends of a transmission-case cover. This casting has shoulders which prevent the work passing clear through the housing. Four cutter spindles are provided and arranged in pairs so that one pair takes care of the work on one end of the table, the other pair running idle while work is being loaded on the opposite end.

The machines are also built in the openside type, Fig. 3, and while similar to the other types in general construction, they have an advantage in accessibility for loading work of certain character. The machine shown is used for milling four surfaces on a gas engine cylinder-block. The first two surfaces are milled by placing the casting in the left-hand fixture. After this operation the casting is transferred to the right-hand fixture and its other sides are milled, while a fresh casting is being loaded on the opposite end of the table, so that after the first one has been finished, two castings are always in process, one being loaded while the other is being milled.

The machine has both vertical and horizontal spindles. All cutter spindles on the machines are adjustable and the feed control is centralized in a single lever on the front of the bed.

Bicknell-Thomas Tapping Machine

The Bicknell - Thomas Co., Greenfield, Mass., has recently added to its line of tapping machines, the small plain bench machine shown in the accompanying illustration. The machine is furnished with either a friction drive or a positive drive, the mechanism being inclosed in the head. The friction-drive machine has a capacity up to $\frac{3}{16}$-in. taps, while the positively driven machine can accommodate taps up to $\frac{3}{8}$ in. in size. The machine is driven by means of a 6-in. pulley and a $1\frac{1}{2}$-in. belt.

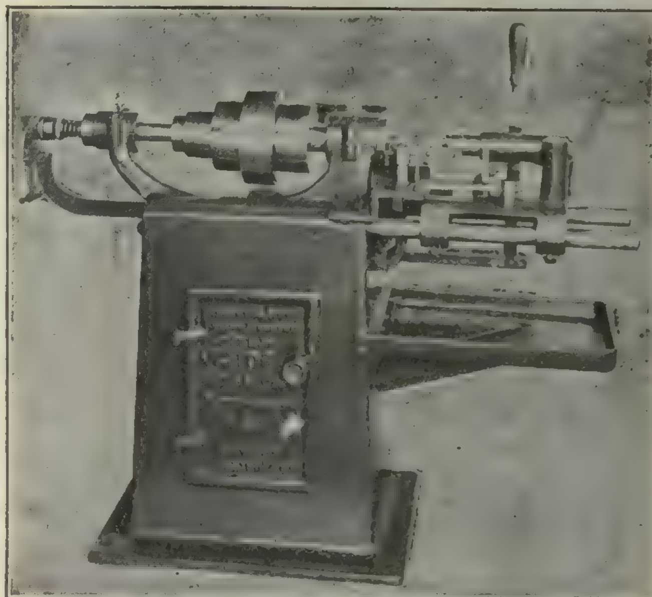


BICKNELL-THOMAS PLAIN BENCH TAPPING MACHINE

The work table slides horizontally on a splined steel shaft, which is held in position by a pilot screw. An adjustable stop is provided, so that holes may be tapped to a uniform depth. The work table can be adjusted for height, and also removed so that any special work-holding fixture required may be mounted in its place.

Victor No. 0 Nut-Facing Machine

The Victor Tool Co., Inc., Waynesboro, Pa., has recently added to its line of nut-facing machines, a No. 0 machine for facing small-sized nuts. This machine, shown in the accompanying illustration, holds the nut



VICTOR NUT-FACING MACHINE NO. 0

Specifications: Size of nuts handled, $\frac{3}{8}$ to $\frac{1}{2}$ in. Spindle: speed, 990 r.p.m.; taper hole, No. 3 Morse; bearings, dia., front $2\frac{1}{4}$ in., rear $1\frac{3}{8}$ in. Floor space, 47 x 16 in. Weight with countershaft: net, 475 lb.; for domestic shipment, 525 lb.; for export, 700 lb. Measurements, boxed for export, 60 x 30 x 40 in.

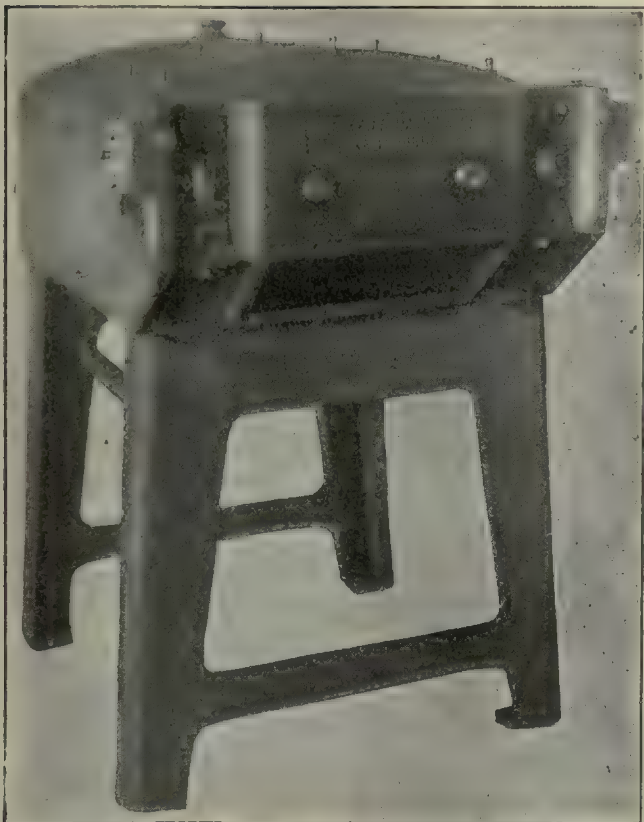
on a hardened threaded mandrel and against an equalizing collar. The carriage holding the cutters is moved forward by means of the lever shown at the right. After the nut is faced, the facing head is withdrawn by means of the lever, which also operates a friction clutch that reverses the spindle. Fingers attached to a yoke hold the nut while the mandrel unscrews from it. Instead of feeding the nuts directly on the mandrel by hand, they are inserted one by one into a magazine, from which they are automatically fed on the mandrel, eliminating the danger of injury to the operator's hands. It is claimed that an average production of twenty $\frac{3}{8}$-in. nuts per minute can be obtained.

Kent Semi-Automatic Pointing Machine

The Kent Machine Co., Kent, Ohio, has brought out the two-spindle pointing machine illustrated herewith.

The machine will point bolts or rods up to $\frac{3}{4}$ in. diameter and of any length over $1\frac{1}{2}$ in. Only one operator is required as all he has to do is to enter the work in the gripping chucks, all other operations being entirely automatic. The spindles are cam actuated and one is moving forward while the other is moving backward, allowing the operator to place work alternately in the chucks.

After the work has been placed in one of the chucks



KENT TWO-SPINDLE SEMI-AUTOMATIC POINTING MACHINE

it is gripped by the jaws; the spindle moves forward bringing the cutter to the work, then recedes; the chuck jaws then open, allowing the work to drop out. The pointing heads are made of steel and are provided with slots in which the cutters are inserted and securely held by self-adjusting clamps. Guide bushings for various sizes of work are furnished.

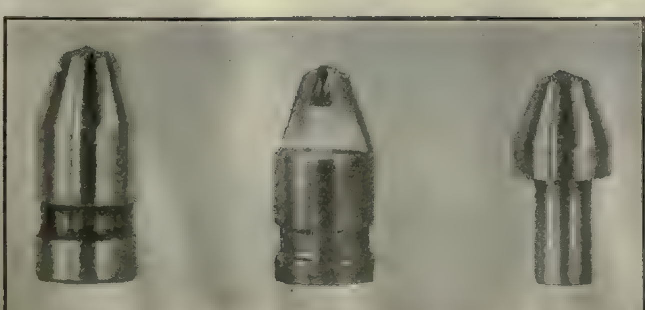
It is claimed that the machine will point bolts or rods at the rate of 50 per minute. The machine occupies a floor space of 31 x 41 in. and weighs 1,100 lb.

Diamond Tools for Truing Abrasive Wheels

The Tungsten Tool Co., Inc., 110-114 West 42nd St., New York City, is putting on the market diamonds mounted in nibs as shown in the illustration herewith.

The diamonds are mounted in drill-rod nibs by a patented process in which no hot metal is used, thus avoiding danger to the stones from excessive heat.

The nib in the center has been partly cut away and shows the diamond closely held by its matrix.



TUNGSTEN TOOL CO.'S DIAMOND-POINTED TOOLS

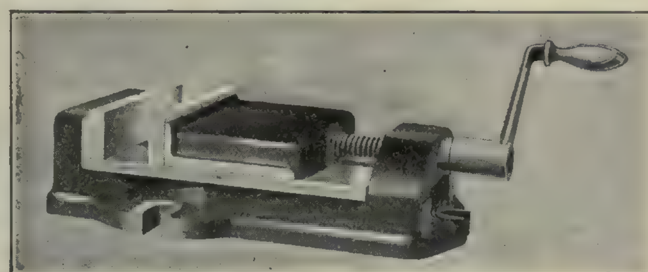
It is claimed that a diamond set by this process can be of almost any size or shape and that it will be so firmly held as not to be loosened by any work it may be called upon to do, also that there is no need to reset the stone when worn down to the steel setting, the intention being to have the wheel cut away both the stone and the metal setting until the stone has been two thirds used.

Diamonds can be furnished in various grades and sizes mounted in nibs to fit the holders used in all standard makes of grinding machines.

Hoosier Drilling- and Milling-Machine Vises

The Hoosier Drilling Machine Co., Goshen, Ind., has brought out a line of machine vises, one of which is illustrated herewith.

The jaws are faced with hardened steel, unless otherwise specified. On the bottom of the vise body a milled slot, running the entire length, has been provided for alignment when attaching the vise to the machine table. The body is also provided with slotted bolt-flanges for use in securing the vise to the table of the machine tool.



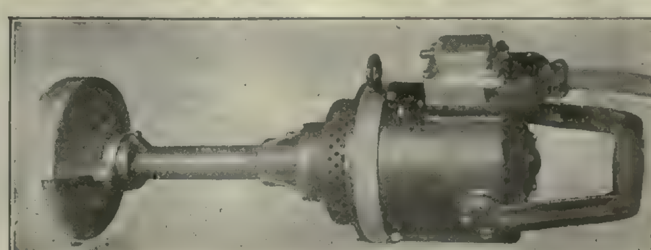
HOOSIER DRILLING- AND MILLING-MACHINE VISES

Specifications: Built in three sizes, Nos. 1, 2 and 3. Widths of of jaws, 5$\frac{3}{4}$, 7$\frac{1}{8}$, 8$\frac{3}{8}$ in. Depths of jaws, 1$\frac{1}{2}$, 2 and 2$\frac{1}{2}$ in. Maximum opening of jaws, 3$\frac{1}{4}$, 4$\frac{1}{2}$ and 7 in. Weights. 45, 90 and 175 lb.

Van Dorn Aerial Grinder

The Van Dorn Electric Tool Co., Cleveland, Ohio, has added to its line the aerial grinder illustrated herewith.

The grinder has a 12-in. extension carrying the abrasive wheel well out from the frame. Power is transmitted from the armature shaft to the wheel arbor through an equalizing coupling, allowing smooth running. Ball bearings are used throughout and lubrication is by grease applied at three accessible points. The end bearings are protected by felt grease-washers. The device is made with either of the following motors: d.c. $\frac{1}{2}$ hp. 110-220 volts, 4,000 r.p.m.; a.c. polyphase, $\frac{1}{2}$ hp. 110-220 volts, 3,600 r.p.m.; a.c. single phase, $\frac{1}{2}$ hp. 110-220 volts, 3,600 r.p.m. Equipment comprises one 6 x 1 x $\frac{1}{2}$-in. wheel, wheel guard, 10-ft. electric cable, attachment plug and suspension spring. Weight, 26$\frac{1}{2}$ to 31 lb.



VAN DORN AERIAL GRINDER

SPARKS FROM THE WOR

Valentine Francis

Delegates to International Chamber of Commerce Sail

The American members of the organization committee for the International Chamber of Commerce sailed for Paris on May 9. They are:

A. C. Bedford, chairman of the Board of the Standard Oil Co., and member of the National Foreign Trade Council, New York, chairman; S. C. Mead, secretary of the Merchants' Association of New York, vice chairman and secretary; Thomas W. Lamont of J. P. Morgan & Co.; Edward A. Filene, president of William Filene's Sons Co., Boston; Richard S. Hawes, president of the American Bankers' Association, St. Louis, and John H. Fahey of Boston, formerly president of the Chamber of Commerce of the United States.

This delegation will meet similar delegations appointed by Great Britain, France, Belgium and Italy, to agree upon a Constitution for the proposed Chamber. The new chamber will hold its first meeting early in June. President William Fellowes Morgan will go to Paris for the purpose of attending that meeting with Mr. Mead on behalf of the Merchants' Association. The creation of the International Chamber was agreed upon at the International Trade Conference in Atlantic City last October, under the auspices of the Chamber of Commerce of the United States. It is proposed that the members of the International Chamber shall meet every two years, and that the Chamber shall take the place of the International Congress of Chambers of Commerce and Commercial Organizations, which held two meetings before the outbreak of the war.

A permanent bureau will be established to maintain contracts between sessions and to gather authoritative statistics. In discussing this bureau, Mr. Fahey, just before sailing, said:

"The permanent bureau will provide means of following up the results secured from biennial sessions of the chamber, the decisions business men arrive at as to legislation needed in their various countries to provide necessary progress. There will be, out of this development, machinery constantly at work the year around. As a result of the disturbed conditions following the war, there is hardly a country whose statistical information is worth the paper it is written on—our own, as well as the rest.

"All their government bureaus and institutions have been affected by the war, thousands and thousands of new employees are still months and months behind in their work, and necessary information on which business men must do their reckoning is not available. It is not brought up to date and, as a matter of fact, as conditions exist between one nation and another, is co-ordinated in no intelligent fashion."

While the committee is meeting in Paris, delegates from Great Britain, Belgium, China, Japan, Italy, Greece, Portugal, Brazil, Finland, Poland, Rumania, Czechoslovakia and Jugoslovakia will meet in Paris for the International Parliamentary Conference of Commerce, which was created upon the initiative of Great Britain before the outbreak of the war. It held its first meeting in Brussels in 1914, and it has met since then in Paris, London or Brussels each year, excepting in 1915. This conference will discuss a large number of important international questions.

The United States was invited to send representatives to the conference, but it has not replied to the invitation.

Russian Militarization of Labor

The State Department has issued the report of Leon Trotzky, made at Ninth Congress of Russian Communist Party, as published in Moscow Izvestia, of March 21. It says in part: "At the present time the militarization of labor is all the more needed in that we have now come to the mobilization of peasants as the means of solving the problems requiring mass action. **We are mobilizing the peasants and forming them into labor detachments which very closely resemble military detachments."**

Material Handling Machinery at the New York Electrical Show

Practically every type of machine used in handling freight shipments at the steamship piers and railroad terminals, will be exhibited at the Electrical Exposition to be held at the Grand Central Palace in October.

These exhibits which are to be a special feature of the show will be presented and demonstrated under the auspices of the Material Handling Machinery Manufacturers' Association, which has spared no pains or trouble in making this big industrial exhibit comprehensive to the last detail.

This will be the first time that the Electrical Show has specialized to any degree in one particular branch of electrical machinery.

Machine-Tool Situation in Denmark

The demands of the Danish industries for machine tools are being taken care of by American, German, British and Swedish manufacturers who, besides Danish manufacturers, supply the bulk of the required machinery.

There is, however, a decided recovery of the Danish machine-tool industry noticeable of late which is mainly due to two reasons. First, import of American machines has somewhat decreased lately on account of the high rate of exchange of the dollar, rendering further purchases from American manufacturers rather costly. Second, German competition, against which the home industry had a rather hard stand during the last year, is fast losing ground, inasmuch as prices for German machinery are almost 100 per cent in excess of those quoted by British manufacturers, a fact which is largely accounted for by the steadily increasing wage demands of the German workmen, rendering many products unexportable.

While German welding machines still dominate the Danish market, Danish manufacturers have not been slow in turning the opportunity caused by the aforementioned facts into practical advantage. There is a marked tendency on the part of Danish manufacturers to prevent foreign makes from further penetrating Danish industries, though it is rather doubtful whether or not the home manufacturers will be able to satisfy the demands of the Danish industries.

Construction of lathes and milling machines, for instance, is being resumed on a large scale and further extended, as is occasionally revealed by the business reports of the larger companies. Cost prices of Danish machinery are largely a matter of raw materials, coal and wages. Raw materials and coal having to be imported from abroad, they naturally loom large, considering the present high rate of exchange.

The price for coal ranges within 160-200 Kr. per ton f.o.b. factory, depending upon whether being shipped at the reduced rates of the so-called freight board or at the higher rates charged by companies not under the administration of that board. Altogether, the importance of the Danish market to American manufacturers should not be lost sight of.

LD'S INDUSTRIAL FORGE

News Editor

War Claims Board Experts Turn to Industrial Work

At the suggestion of a prominent Government official, the most active members of the Technical Advisory Committee, who were chiefly instrumental in the settling of more than three billion dollars' worth of war contract claims for the War Claims Board, have decided to offer their services to the industries of this country and recently opened headquarters at 132 Nassau St., New York. The majority of these engineering experts are New Yorkers and because they became widely known through their connection with the Governmental work, they have organized themselves under the name of the Technical Advisory Corporation. In the course of their war claims work they touched every branch of American industry, as the claims ran from small ammunition to the greatest power developments ever made.

Civil Service Examination for Safety Engineer

The United States Civil Service Commission, Washington, D. C., announces an open competitive examination for safety engineer on June 22. A vacancy at the Amatol Arsenal, Hammonton, N. J., at $2,500 to $3,000 a year, and vacancies in positions requiring similar qualifications, at these or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion. The entrance salary within the range stated will depend upon the qualifications of the appointee as shown in the examination, and the duty to which assigned. For further information write to the commissioner at Washington, D. C.

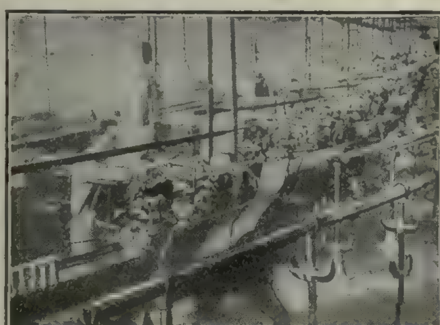
A Co-operative Banquet

The Victor Co-operative Club of the Victor Saw Works, Inc., Springfield, Mass., held a banquet recently. During the course of the evening each department reported on the work accomplished to date this year, which proved that they were all working on an altogether efficient basis. The different departments pledged themselves to continue to co-operate with each other to the greatest possible degree with an aim to exceed all records heretofore shown. It was voted to hold these get-togethers more often in the future than in the past, as these affairs help to stimulate enthusiasm in the members of the organization.

Thousands to Get Free Trips to Sullivan Plants

The Sullivan Machinery Co. believed that workers and engineers would have a better appreciation of its machines if they could be shown just where and how the machines are made. Being impossible to get the thousands of men to visit its Claremont, N. H., and Chicago plants, it was decided to place the plants aboard the celluloid magic carpet and take the industries around to the men. The Rothacker Film Manufacturing Co., of Chicago, was selected to make the film.

A three-reel film was completed in time to do considerable work this spring



Courtesy Rothacker Film Manufacturing Co.

AUTOMATIC TURRET LATHES IN SULLIVAN MACHINERY COMPANY'S SHOPS

in schools and this summer will be loaned to engineering societies, etc.

The Sullivan picture opens with panoramic views of the Claremont and Chicago works. The interior of the Claremont foundry and the pouring of air compressor castings are next shown. The air compressors, made at both the Claremont and Chicago plants, are then followed through the various stages of machining, assembly, erection and the final testing at full speed and load before shipment. Interesting details include the gigantic planer at Chicago on which twelve angle compound air compressor frames are planed at one operation; the assembling of water valves and of finger valves used in the different compressors; and the steam valve action on one of the company's 2,500 Corliss compound air compressors, in which the operation of the Corliss valve gear is clearly shown.

The second part of the picture is entitled "How Hammer Drills Are Made." The observer is shown the automatic machinery by which the different parts are milled, shaped, and ground to the close fits needed in this class of machinery. Materials are shown under test and the completed machine is finally shown at work.

Changes in Manning, Maxwell & Moore Corporation

At the regular monthly meeting of the board of directors of Manning, Maxwell & Moore, Inc., held on May 19, 1920, Percy M. Brotherhood, senior vice president of the corporation, was appointed executive vice president with the powers and duties attaching to the duties of president, succeeding Alfred J. Babcock, resigned on account of ill health. Mr. Brotherhood has been actively associated with Manning, Maxwell & Moore, Inc., for over twenty-five years and during recent years has been senior vice president in charge of the machine-tool business of the company. Eugene Maxwell Moore was recently elected vice president in charge of foreign sales. Henry D. Carlton was elected a director of the corporation, following his recent election to the office of vice president in charge of the brass goods sales, succeeding the late John N. Derby. Robert A. Bole, Pittsburgh district manager, was also elected a director.

National Engineering Societies Growing Rapidly

The membership of the National Engineering Societies has forged ahead rapidly since the signing of the armistice.

The latest membership figures are as follows:

American Society of Civil Engineers, 9,515 (May 4, 1920).

American Institute of Mining Engineers, 8,532 (May 10, 1920).

American Society of Mechanical Engineers, 12,258 (May 14, 1920).

American Institute of Electrical Engineers, 11,345 (May 1, 1920).

Society of Automotive Engineers, 4,798 (May 8, 1920).

Critical Ranges of Nickel Steels

The Bureau of Standards has printed a twenty-page pamphlet on "Critical Ranges of Some Commercial Nickel Steels."

This pamphlet may be obtained by addressing a request for Scientific Paper No. 376 to the Department of Commerce, Bureau of Standards, Washington.

Licensing of Engineers in New York State

The bill for the licensing of professional engineers and land surveyors in New York State, was passed by the Legislature April 24, and signed by the Governor on May 14, 1920.

Patent Office Salary Bill's Passage Insured

With the reporting to the Senate of the bill providing for an increase of the force and salaries in the Patent Office and the measure fixing a policy for dealing with inventions and patents developed by Government employees, the final enactment of these important pieces of legislation is practically insured.

The bill provides for a net increase of $511,840 in the amount to be paid in salaries to Patent Office employees. At the present time the Patent Office is far behind in its work as it has been found impossible to keep an organization of trained men with the existing salary scale. The increase of salaries is more than compensated for by the increase of fees.

The Senate already has passed the bill dealing with inventions by Government employees. In order to expedite that measure, however, it was added to the bill increasing the salaries in the Patent Office, thereby throwing that bill into conference without having to wait for its passage by the House. Since there is no objection to the measure in the House it is practically certain to become a law. The reasons for enacting the legislation dealing with inventions developed by Government employees, and other matters, are as follows:

The reasons for the enactment of this bill and its aims may be summarized as follows:

1. There is no fixed or general policy dealing with inventions and patents developed by Government employees in the course or as a result of their official duties, and consequently no governmental administrative machinery for translating such inventions and patents into actual public service.
2. In cases where patents are developed by the combined efforts of Government employees and others, difficulties at present arise concerning the administration of the same because of the conflict between the rights of the inventors and those of the United States.
3. There is no way at present by which patentees in or outside the Government service can dedicate their patents to the public with the assurance that the public will reap the full benefit therefrom, because an invention covered by a patent so dedicated does not interest capital, and because it may be excluded from public use by patents subsequently taken out by others.
4. Conditions brought about by the war, causing an unprecedented demand for inventions, and the industrial developments and readjustments now following the war, call imperatively for guidance. Also the host of inventions developed during the war in the many Government bureaus and other organizations, primarily for war purposes, but which have a peace application of inestimable value, should be co-ordinated, conserved, and translated into industrial use.
5. There is herewith provided a means aimed to be acceptable to the medical profession of patenting and consequently properly controlling inventions in the field of medicine and surgery, the control of patents by private interests being contrary to the ethics of the medical profession.
6. It is desirable to have governmental administration of a certain type of patents, not ordinarily attractive to manufacturers, in order to provide production of needed devices or materials for governmental or public purposes.
7. The President, under the authority of Congress, has set a precedent for the proposed legislation by authorizing and directing the Federal Trade Commission to administer enemy-owned patents.
8. The patent administration here contemplated provides for revenue sufficient to cover the expenses of its operation.
9. Provision is made for some remuneration to patentees, to stimulate invention.

Prospect of Trade With Russia Wanes

Agitation within the ranks of American business for the immediate reopening of trade between the United States and Russia has waned considerably within the past few weeks and at the State Department little pressure is being continued by export interests for Government action.

Lessened interest in Russia appears to be the result of recent advices from Europe to the effect that the country is not as attractive as American business men were led to believe by reports of agents of the Soviet government.

Engineering in Russia Given Attention

On Wednesday, May 26, 1920, in the Engineering Societies' Building, New York, a joint meeting of the various American Societies of Engineers was held, the subject being the resources and the engineering of Russia. Walter N. Polakov of the A.S.M.E. presided, while N. A. Stephanoff, president of the Russian Society of America, in the first speech told of engineering instruction and the status of engineers in Russia.

W. F. Dickson, director of the Russian Singer Co., who has been in Russia for over 20 years, told of some of the achievements of Russian engineers. J. M. Goldstein, Professor of Economics, Moscow University, gave an illustrated lecture upon the resources of Russia and the development of them in the past.

All of the men who spoke pointed out the value to the engineering profession of a liaison between the engineering societies of Russia and America, and they urged co-operation in engineering affairs for the advantage of both countries.

Spencer the Philosopher Opposed Metric System

Herbert Spencer, the great English philosopher, the centenary of whose birth has just been observed, was an uncompromising opponent of the metric system. A clause in his will provided for republishing his pamphlet against the system whenever the question of its adoption should come up in Parliament. In this pamphlet he introduces an argument between an imaginary advocate of the system and himself, some of the knotty questions he puts being, "What do you propose to do with the circle at present divided into 360 degrees?" "Why do you not make ten months instead of twelve?" and "You have not proposed to substitute ten hours for twelve. Why not?" To which last he himself replies triumphantly, "People will refuse to replace their old watches with new ones."

The Page Steel and Wire Co., New York, announces change of its central district sales office from 29 South La Salle Street to 208 South La Salle Street, Chicago.

Tentative Program for the National Conference of Business Paper Editors

The program for the National Conference of Business Paper Editors, to be held at the Congress Hotel, Chicago, Ill., on June 4, 1920, is announced as follows:

(Papers will be limited to 15 minutes, the opening discussion to 5 minutes and all other discussions to 3 minutes.)

Morning Session

9:30 a.m. Registration.

9:45 a.m. A word of welcome by Clay C. Cooper, Mill Supplies, Chairman, Business Paper Editors' Association of Chicago.

10:00 a.m. Improving the Appearance of our Editorial Pages (a discussion of the possibilities of raising the standards of typography, illustrations and make-up to make our papers more attractive and interesting to the busy reader), by C. J. Stark, managing editor, *Iron Trade Review*, Cleveland. Discussion led by B. H. Ikert, editor, *Motor Age*, Cleveland.

11:00 a.m. Where To Get Editors (journalists versus technical or trade specialists), by F. M. Feiker, vice-president, McGraw-Hill Co., Inc., New York. Discussion led by E. T. Howson, *Railway Age*, Chicago.

11:45 a.m. How I Expand My List of Contributors, by Charles Dobbs, *The Insurance Field*, Louisville, Ky. Discussion led by A. H. Brayton, *Merchants Trade Journal*, Des Moines, Iowa.

A question box will be open during the morning session for the receipt of questions which will be answered at the afternoon session.

1:00 p.m. Buffet luncheon at the Congress Hotel, as guests of the Business Editors Association of Chicago.

Afternoon Session

2:00 p.m. Executive session to discuss the real facts concerning the present situation and the future business outlook in:
(Scheduled discussions limited to 7 min., others to 3 min.)
The Iron and Steel Field—W. W. Macon, *Iron Age*, New York.
The Engineering - Construction Field—H. P. Gillette, *Engineering & Contracting*, Chicago.
The Automotive Industry—Clyde Jennings, *Automotive Industries*, New York.
Agriculture and Food Products—Alson Secor, *Successful Farming*, Des Moines, Iowa.
The Financial & Banking Field—J. M. Regan, *Bankers Monthly*, Chicago.
Business Conditions in the Foreign Field—A. D. Anderson, *Boot & Shoe Recorder*, Boston.
The Transportation Field—Samuel O. Dunn, *Railway Age*, Chicago.
The Field of General Business — L. R. Thomas, *Factory*, Chicago.

3:30 p.m. The Duty of the Editor in Interpreting the Present Business Situation for His Readers, by Richard H. Edmonds, *Manufacturers Record*, Baltimore.

Evening Session

6:30 p.m. Informal dinner at the Congress Hotel, to which members of the business departments of the trade and technical papers will also be invited. Douglas Malloch, *American Lumberman*, toastmaster.

8:00 p.m. The Paper Situation and the Outlook for the Future, by B. W. Anderson, Whitaker Paper Co., Chicago.

8:45 p.m. A discussion of the Breakdown in the Postal Service and its Remedy, led by E. C. Hole, *American Lumberman*, Chicago.

Business Items

The Electric Rod Mills, Inc., Rome, N. Y., has been merged with the Rome Wire Co., Rome, N. Y.

The Clark Equipment Co., Buchanan, Mich., manufacturer of high-speed drills and tools, will continue its policy, granting vacations with pay to all its employees. All employees with the company for one year will be allowed one week's vacation with full pay; vacations start on June 1.

The Worthington Pump and Machinery Corporation, New York, announced that in addition to the well-known lines of hydraulic machinery which it has manufactured since 1840, it has now completed preparations to furnish improved water-power machinery of all capacities for low-, medium- and high-head service, including oil-pressure system, water-wheel governors and other auxiliaries.

The Rome Manufacturing Co., Rome, N. Y., has increased its capital from \$850,000 to \$3,000,000. P. C. Thomas, Rome, N. Y., is president.

To render more efficient service and distribution in the Southwest territory, the Chicago Flexible Shaft Company has opened a St. Louis office in the Railway Exchange Building, in charge of Otto Bersch and Jack Stroman, both of whom are capable metallurgical engineers.

The Precision and Thread Grinder Manufacturing Co., Philadelphia, Pa., manufacturer of the Multi-Graduated Precision Grinding machines, announces that the United States patent on the machine was issued May 1, 1920.

The Standard Electric Tool Co., of Cincinnati, Ohio, has opened a branch office for the New York district in the Grand Central Palace, 44th St. and Lexington Ave., New York.

The Henry & Wright Manufacturing Co., of Hartford, Conn., manufacturer of its ball-bearing sensitive drilling machines and dieing machines, is now occupying the offices and showroom formerly leased by Hill, Clarke & Co., Inc., at 136 Cedar St., New York. Besides its own product it will carry a complete line of machine tools.

K-G Welding and Cutting Co., of 556 West 34th St., New York, manufacturer of welding and cutting apparatus, has opened a sales office at 12-14 E. Harrison St., Chicago, Ill., in order to accommodate its western trade.

Westinghouse, Church, Kerr & Co., Inc., has announced the removal of its offices from 37 Wall St., to 125 East 46th St., New York.

Kimelblatt, Ross & Sisti, Inc., has announced that after June 1 it will occupy new quarters at 117 Charles St., New York.

Hardinge Brothers, Inc., of Chicago, Ill., manufacturer of the Cataract line of precision bench lathes, is now being represented in New York by the Henry & Wright Manufacturing Co.

Personals

N. N. BAAD, who formerly had charge of the heat-treating department at the De La Vergne Machine Co., of New York, has resigned to accept a position as sales and service engineer with the F. A. Calhoun Co., 76 Montgomery St., Jersey City, N. J.

J. J. SHEEHAN has been made head of the curry department of the Graton & Knight Manufacturing Co., of Worcester, Mass., leather belting manufacturer.

FRANK SUESS, formerly New York manager for Hill, Clarke & Co., Inc., is now connected with Henry & Wright Manufacturing Co. in the same capacity.

E. E. BALDWIN, of New York and formerly employed by the Eagle Lock Co., has taken up his duties as sales manager with the Corbin Screw division of the American Hardware Co. Mr. Baldwin is a brother of Carl H. Baldwin, a vice president of the American Hardware Co.

B. L. CLEGG, who has been connected with the Westinghouse Electric Co., of 265 Broadway, New York, for the last eleven years, is now associated with the industrial department and is specializing in motors adapted for machine shops.

L. M. BAKER has resigned as supervisor of sales in the motor equipment division of the Hyatt Roller Bearing Co., to accept the position as exclusive representative in the State of Michigan for the Dittmer Gear and Manufacturing Corporation, Lockport, N. Y. Mr. Baker was also associated with the Bearing Service Co., as well as being sales manager of the United Motors Service Co., Inc. He will have his headquarters in the Book Building, Detroit, Mich.

Forthcoming Meetings

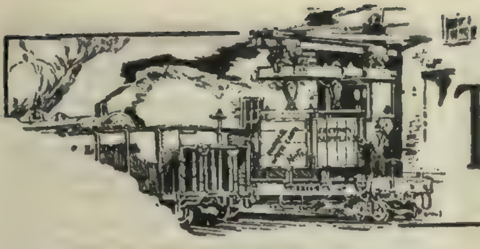
The Railway Supply Manufacturers Association will hold an exhibit on Young's Pier at Atlantic City, June 9 to 16, in conjunction with the annual mechanical conventions of the American Railway Association. Many of the leading machine-tool builders of the country will be among the 330 or more exhibitors.

The American Drop Forge Asssociation will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25, inclusive.

The American Steel Treaters' Society will hold a convention in Philadelphia, Sept. 14 to 18. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is the secretary.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$30.75
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	26.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	30.90
Grey Forge	43.50*	30.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	5.82	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.35
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
Blue Annealed					
No. 10	3.55-6.00	7.12@8.00	4.57	7.55	7.02
No. 12	3.60-6.05	7.17@8.05	4.62	7.65	7.07
No. 14	3.65-6.10	7.22@8.10	4.67	7.70	7.12
No. 16	3.75-6.20	7.32@8.20	4.77	7.80	7.22
Black					
Nos. 18 and 20	4.15-6.30	8.50@9.50	5.30	8.20	7.80
Nos. 22 and 24	4.20-6.35	8.55@9.55	5.35	8.25	7.85
No. 26	4.25-6.40	8.60@9.60	5.40	8.30	7.90
No. 28	4.35-6.50	8.70@9.70	5.50	8.40	8.00
Galvanized					
No. 10	4.70-7.50	9.75@11.00	5.50	8.50	8.15
No. 12	4.80-7.60	9.85@11.00	5.55	8.60	8.20
No. 14	4.80-7.60	9.85@11.10	5.60	8.60	8.35
Nos. 18 and 20	5.10-7.90	10.10@11.40	5.90	8.90	8.65
Nos. 22 and 24	5.25-8.02	10.25@11.55	6.05	9.05	9.05
No. 26	5.40-8.20	10.40@11.70	6.20	9.20	9.20
No. 28	5.70-8.50	10.70@12.00	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$25.50-30.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire	
⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00 to 30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Cast-Iron Welding Rods	
3/16 by 12 in. long	14.00
¼ by 19 in. long	12.00
⅜ by 19 in. long	10.00
½ by 21 in. long	10.00
Special Welding Wire, Coated	
⅛	33.00
5/32	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 3/32, 8½c. per lb.; ⅛, 8c.; 5/32 to ¼, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.50@7.00	8.00	9.00
Spring steel (light)	11.50	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.07	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅛, ¼ and ⅜	47%	20½%	¾ to 1½	34½%	18½%
½	51%	36½%			
¾ to 3	54%	41½%			
LAP WELD					
2	47%	34½%	2	28½%	14½%
2½ to 6	50%	37½%	2½ to 6	30½%	17½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	43%	25½%	¼ to ½	34½%	19½%
½	48%	35½%			
¾ to 1½	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	29½%	16½%
2½ to 4	48%	36½%	2½ to 4	31½%	19½%
4½ to 6	47%	35½%	4½ to 6	30½%	18½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¾ to 3 in. steel butt welded	40%	24%	40%	31%	54%	40½%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50%	37½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.25	18.50	16.50
Tin in 5-ton lots	50.00	61.00	72.50
Lead	8.80	8.87½	5.25
Spelter	7.50	8.50	6.60
ST. LOUIS			
Lead	8.60	8.50	5.00
Spelter	7.50	7.95	6.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	29.50	29.50	23.00	32.00	24.50	36.00	26.00
Copper wire (carload lots)	31.25	29.25	23.00	29.50	24.00	27.00	22.00
Brass sheets	27.50	26.50	20.50	29.00	24.00	27.00	21.50
Brass pipe	32.00	32.00	30.75	34.00	31.00	35.00	31.00
Solder (half and half) (case lots)	43.00	39.00	38.00	40.50	43.00	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	18.00
New York	23.75	19.50
Cleveland	27.00	24.00
Chicago	26.00	24.00

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June 10, 1920 American Machinist Vol. 52, No. 24

ROLLER-CHAIN

for Tractors and Power Transmission

Special Correspondence

The use of roller chain as a means of power transmission has, within a comparatively short time, been greatly augmented by the application of the chain to motor trucks, tractors, and other internal-combustion-motor-driven machinery. The service is exceptionally severe, not only because of the necessity for transmitting the maximum energy per unit of weight, but to a greater degree because of the shocks to which this class of machinery is subjected.

THE Spaulding Chain Co., of Bloomfield, N. J., manufacturer of chains for power transmission, are fitting up a large new shop for the manufacture of roller chain for use on motor trucks and tractors.

The demand for chain for this purpose far exceeds the present productive capacity of the makers, and orders are booked for delivery far in the future. The chain made by the Spaulding Co. does not differ materially from that made by other makers, some of whose machinery and processes have been described in this paper, but they have developed special tools and methods to meet their own peculiar requirements that may possible be of interest to our readers. The component parts of the Spaulding Chain are shown in Fig. 1. There are, of course, two forms of link used to make up this chain: the inner link, which carries the rollers that come in direct contact with the sprocket teeth and thus form the actual working members of the chain; and the outer link, which serves to string the working links together. While the outer links are subject to the same tensile strain as the inner links, they do not come in contact with anything and consequently the wear from friction is limited to a very slight turning movement of the studs within the tubes of the inner links. Each inner link is composed of two side bars, two tubes and two rollers; shown separately at *A* and assembled at *B*, in Fig. 1. At *C* may be seen the outer link, partly assembled; consisting of two side bars, two studs and two cotter pins. The studs are cut off and the ends rounded in an automatic screw machine. There are no shoulders on these studs; experience having shown that the shoulder introduces a weak point in the chain that is entirely unnecessary. The only machine operation on the stud after it comes from the screw machine is the drilling of the cross-hole for the cotter pin, and this is done on the semi-automatic machine shown in Fig. 2. In this machine six drill spindles run continuously, while a two-position reciprocating fixture before them holds twelve pieces to be drilled. The operator has only to remove six drilled pieces and insert six undrilled ones while the drills are working on the other six. When the drill recedes the fixture unlocks and moves back while the twelve levers, shown in the picture under the operator's hands, move to the right through an angle of about 30 deg. in which position they move forward, closing the jaws on the pieces to be

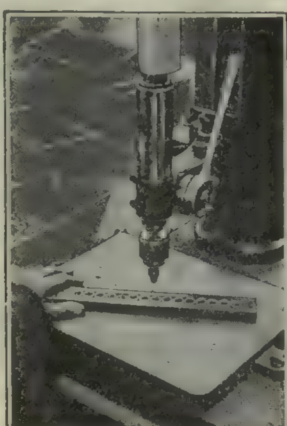


FIG. 3. BURRING THE TUBES

FIG. 1. PARTS OF SPAULDING ROLLER CHAIN

FIG. 2. SEMI-AUTOMATIC MACHINE FOR DRILLING COTTER-PIN HOLES

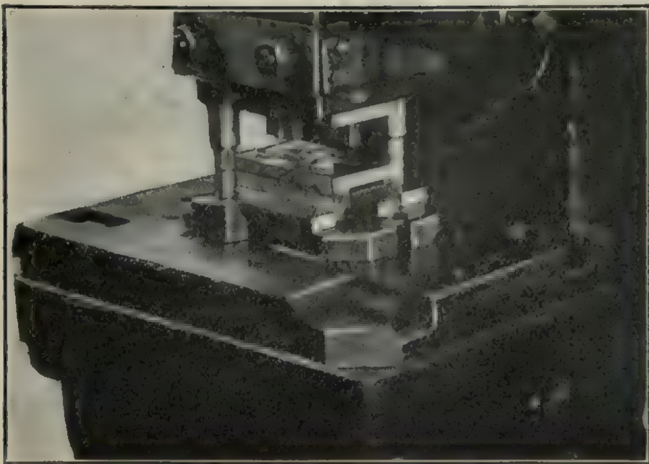


FIG. 4. THE BLANKING TOOLS

FIG. 5. THE PIERCING TOOLS

drilled and at the same time locking the fixture against the drill pressure. The drills are moved forward to their work by intermittent cams.

The movement of the fixture carries the six drilled pieces out of the line of drills while bringing into line the six that the operator has just loaded. At the same time the jaws holding the finished work are released. The operator now takes out the drilled studs and puts in others, ready for the reverse movement.

Little Trouble from Drill Breakage

The drills work under a flood of lubricant, and the intermittent movement imparted to them by the cam keeps them fairly free from chips; therefore there is little trouble from drill breakage. The operator is kept busy loading and unloading the fixture, the movement of which is continuous. It can be arranged, however, to stop after each reversal, in which case it is started with a pressure on a foot treadle.

FIG. 6. THE PIERCING OPERATION

The tubes and rollers are also products of the automatic screw machines and come from these machines complete except for a burring or chamfering operation to break the corners of the holes. The burring is done by means of a countersink in the chuck of a sensitive drill press.

Several rollers are stacked in a clamp as shown in Fig. 3, being held by the pressure of a thumbscrew at the end. Other sizes of clamps are used, some being made to take two rows of rollers. The countersink, or burring tool, is so constructed that it cannot cut too deep.

The side bars are made from a selected grade of cold-rolled steel, being blanked, two at a stroke, in tools like those shown in Fig. 4. The stock is fed through by hand and located by a finger stop that is tripped by a stud on the punch pad. The blanking tools are set in a substantial pillar press, which insures accurate alignment and long life to the tools. Piercing, swaging, and shaving tools are set in the same design of pillar press.

The Piercing Tools

A set of piercing tools is shown in Fig. 5. The pieces are fed in from the front to a stop and are ejected after piercing by a spring knockout in the stripper. Two spring-actuated plungers, *A*, Fig. 5, are set horizontally in the stripper block with their inner ends projecting perhaps $\frac{1}{16}$ in. beyond the vertical face of the block. They are high enough above the surface of the die so that a blank will pass freely under them, and their lower edges are bevelled.

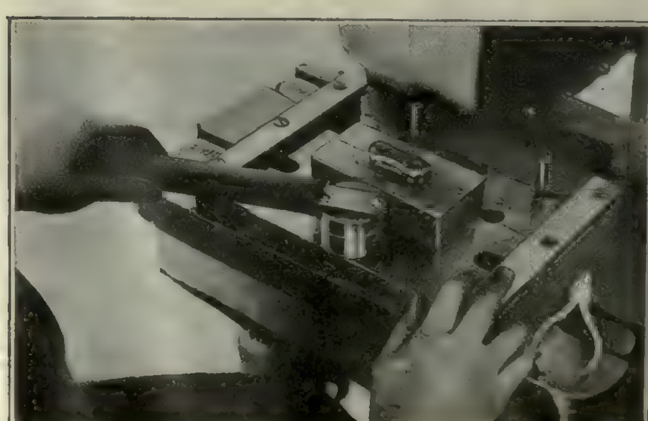


FIG. 8. FIRST ASSEMBLING OPERATION ON LINKS

FIG. 9. PUTTING SECOND SIDE ON INNER LINK

When the punches rise they naturally bring up a pierced blank with them until the latter is stopped by the under face of the stripper. In coming up this far the blank strikes the bevelled edges and forces the plungers back against the action of their springs. As soon as the punches draw clear out of the blank, the tension of the spring snaps the plungers forward until they are stopped by the collars on their outer ends, and

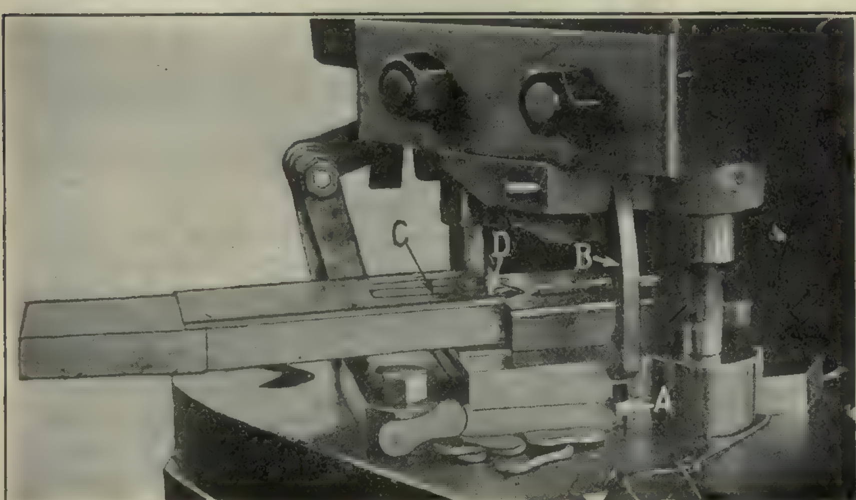


FIG. 7. THE STAMPING TOOLS

the sudden movement shoots the freed blank to the left out of the tools, and against a sheet-metal hood which deflects it into a box on the floor. Fig. 6 shows the piercing tools in operation.

Each outer link is stamped with the firm's trade mark, the tools for stamping being shown in Fig. 7. The stamp is in the lower die and is free to move up and down; resting in its lower position upon a support sufficiently sturdy to withstand the pressure necessary to stamp the impression into the work, but capable of being adjusted to give the desired impression on the work.

The support is cut away in the center to allow the lever *A* to extend under the stamp. When the press gate comes down the hinged latch *B* hooks under the projecting end of the lever *A* and as the gate rises the stamp rises with it lifting the link out of the depression in the die and allowing it to be pushed endwise out of the die by

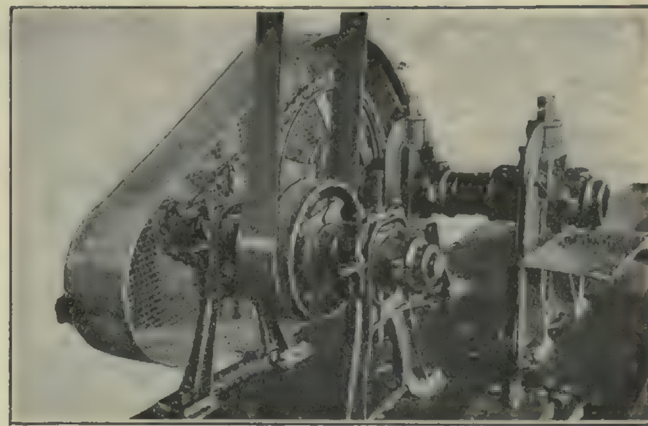


FIG. 11. THE CHAIN JACKING MACHINE

the next incoming link. The stamp does not get in the way of the incoming link for the reason that it lifts but a very slight amount and almost immediately drops back again; the movement being just sufficient to knock the stamped link out of the die.

The feed is by lever and slide, driven from the usual disk on the press shaft. The inclined stack, or hopper, of sheet metal, was not in place when the picture was made. The opening in the cover plate through which the links drop in front of the feeding-in slide may be seen at *C*, and immediately in front of it at *D* a spring finger holds the pieces from being thrown too far forward by their momentum.

A swaging operation is performed on the inner links, rounding the inner edges of the blank especially near the center of the link, for the purpose of lessening or eliminating the possibility of having a link "hang up" on a sprocket tooth. The tools used are similar in design to those already shown, but the surfaces that bear the brunt of the pressure are made upon the ends of inserted pieces so that they may be easily renewed.

The individual links are assembled in a press. Fig. 8 shows the first operation in the assembly of the outer links. The two studs are placed in a clamping fixture, the side bar placed over them and forced down by the upper tool. There is no shoulder on the studs, the relative positions of the parts being determined by the assembling fixture.

From this stage they go to an electric-welding operation where they are held in special devices in the weld-

FIG. 10. ASSEMBLING THE CHAIN

ing machines, which are arranged to make the two welds consecutively instead of simultaneously. The method of welding consecutively of course requires more time, but it was found that the current flow could not be satisfactorily controlled when there were two paths for it to follow and it sometimes happened that one joint would get more than its share of current, leaving the other one with a poor weld or no weld at all.

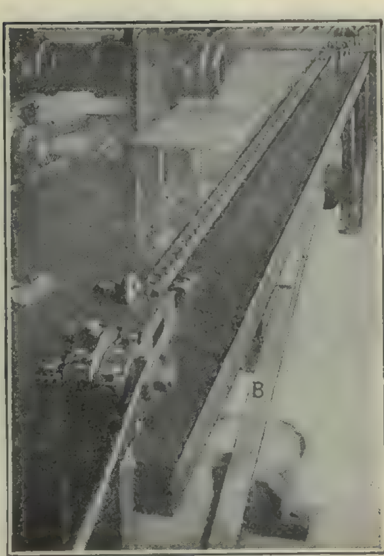


FIG. 12. THE TESTING DEVICE

As there is no way of testing the strength of the weld without destroying the link, the consecutive method was adopted, and one can be pretty sure of a good weld every time.

The first operation in the assembly of the inner link is performed in the same manner as upon the outer one. The second operation is shown in Fig. 9. The tools are very simple, the lower one being merely a gaging support for the partly assembled link. The operator puts the rolls in place over the tubes as shown in the picture; puts the side bar on the upper tool, where it is held by a small spring which may be seen at *A*, and trips the press.

The upper tool has a pair of short, piloted studs upon which the side bar is placed, and when the press gate comes down, the pilots enter the tubes and bring them into alignment with the holes in the side bar so that there is no possibility of their not entering properly.

The assembling of the links into the completed chain is shown in Fig. 10. The first part of this operation is the stringing together of the completely assembled inner links by means of the partly assembled outer ones. This is entirely a hand operation and is performed on the bench immediately to the right of the press shown in Fig. 10. As fast as the chains are made up to their specified lengths, they are run into the grooves in the receiving board shown to the right, from whence they are pulled, one link at a time, by the operator as the assembling proceeds.

After assembling, the chains are put on the jacking machine shown in Fig. 11, and run for a certain length of time to limber them up and bring all the joints to a proper bearing. At the same time any defect in the chain will show up, so that this operation, in conjunction with the following tensile test, constitutes a close check upon the product.

The operator who attends the jacking machine also applies the tensile test as shown in Fig. 12, by means of a system of weighted levers. The fulcrum of the main lever is so mounted that by turning the small lever *A* up or down, the strain is applied or released. The weight is under the floor and is directly controlled by the foot lever *B*, so that the tension can be in large measure released before moving the small lever *A*. Each chain is subjected for a certain length of time to a strain of ten thousand pounds.

A Micrometer Height Gage

By E. F. Tuttle, Jr.

The sketch shows the construction of a micrometer height gage similar to the one described by H. Kiehne on page 258, Vol. 51, of *American Machinist*. I should be afraid of trouble in trying to make the one pin he uses a good fit in each of the holes in the upright and with no looseness in the sliding block. The notched disk seems a good idea, however, for a marking point.

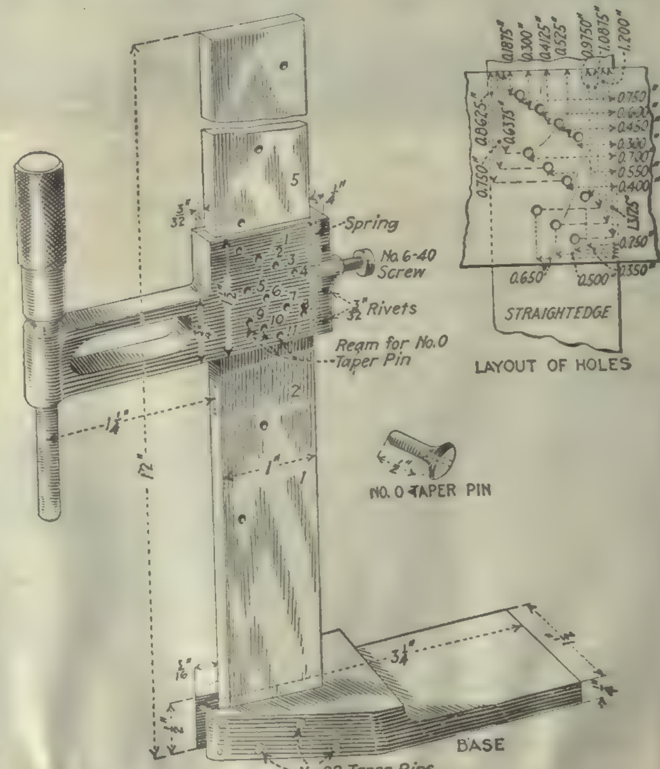
The blade of my gage is made from a standard 12-in. soft straight-edge securely pinned to the hardened and ground base and has a sliding member of soft steel which holds a regular 1-in. micrometer head. The hole in the sliding member must be made to fit this head as different makes vary in size.

The sliding block is laid out and the pin holes drilled with a small drill through one side and the micrometer head put in. Then, when the spring and screw are put in and it is put on the upright, it should be set so that the micrometer reads zero when touching the surface plate on which the gage is resting. The setscrew should now be tightened and the hole that is marked 1 in. drilled clear through the sliding block and straight-edge, and reamed for the taper pin.

Next, set the sliding block so that the micrometer reads zero when resting on a 1-in. piece and proceed as before. The other holes are drilled and reamed in the same manner and marks scribed on the straight-edge to facilitate setting.

The holes in the sliding block and straight-edge being staggered, only one pair will line up at a time so the pin cannot be put in wrong.

The accuracy of this gage depends upon the accuracy of the height blocks put under the micrometer when setting the block for drilling and as each hole is drilled separately there is no looseness in the fit of the pin in the block and straight-edge.



A MICROMETER HEIGHT GAGE

A Comparative Test of High-Speed Steels—III

By A. J. LANGHAMMER, M.E.
Industrial engineer, Thompson & Black, engineers and accountants, New York and Detroit.

This article gives a detailed description of the method of procedure in testing sixteen different commercial brands of high-speed tool steel, together with data as to the performance of each individual tool, its chemical composition, heat treatment, and hardness.
(Part II was published in our May 27 issue.)

VARIOUS steps in the preparation for the test were carefully planned and performed to insure ultimately correct data. The essential factors composed the following steps, each one of which will be briefly described: First procuring specimen bar of high-speed steel; second, making of tool; third, heat treatment of tool; fourth, grinding of tool; fifth, apparatus used and working details, and sixth, chemical and metallographic tests.

Procuring Specimen Bar of High-Speed Steel

A small order specifying the "best grade" of high-speed steel was placed with the various steel manufacturers. No mention was made of the fact that this steel was to be used for test purposes. A reasonably short time for delivery was specified. Upon receipt of shipment, each item was held for the personal attention of the man in charge of the test. After general physical inspection every bar was duly labeled and carefully stored until all the steel ordered had been received.

Making of Tool and Heat Treatment

A short piece was cut by a power hack saw (not nicked and broken) from the end of each bar and the latter then inspected at the "cut." Hereupon another piece was cut off for chemical and metallographical investigation. Finally, four pieces, each 6 in. in length, were cut for the test tools proper. Every tool was at once marked permanently with a symbol (A, B, etc.) representing the brand of steel and then stamped number 0, 1, 2 or 3 to differentiate among the tools of the brand. This designation was adhered to throughout the test and provided positive means of identification at all times as well as a concise method for comparison. The symbols chosen, too, were of such nature that they did not directly reveal the brand of the steel, which practice provides for absolute impartiality on the part of the experimenters. All the tools were then machined on a milling machine to the dimensions and tool angles indicated in Fig. 2, viz.: 6 deg. clearance at the nose and 10 deg. at the heel, 14 deg. side slope, 0 deg. back slope, 32 deg. horizontal clearance and 8 deg. vertical clearance, 84 deg. lip angle, and 90 deg. cutting angle. A slight cut was also taken from the base to insure a perfect seat. After machining, the tools were rough-ground to insure a minimum of finish-grinding upon hardening. All tools were then subjected to complete inspection and necessary corrections made, whereupon they were ready for hardening.

Once the tools were "made," and then only, every steel manufacturer or his representative was advised that a test was being conducted and they were given the choice of either hardening the tools themselves, having our man harden the tools under their direction, or send in their specifications for heat treatment and permit us to do the hardening without their supervision. It was understood, of course, that in each case the hardening had to be done in our plant and under constant observation. In the majority of cases the second proposal was accepted, i.e., our tool hardener performed the work in accordance with the verbal instructions of the steel companies' experts. Each representative had our entire equipment at his disposal and while he was at work no rival steel man was present. Our equipment was quite complete and the needs of each agent were easily satisfied.

Every man was told that the heat treatment was the only factor he could control and that but one test of four tools could be made. He was therefore duly cognizant of the great importance of his work and was perforce extremely careful. Complete observations were made as to the methods applied and the behavior of each tool carefully noted, especially while at the high heat. A separate data sheet and discussion of the different methods of heat treatment applied were given in Table II in conjunction with the summary of chemical analysis.

Two furnaces were employed, one for the low or preheat and the other for the high heat. In each case the temperatures were adjusted to the satisfaction of the steel men before the tools were put into the furnace. Semi-muffle type oil-fired furnaces were used.

Grinding of Tool

It is generally conceded that probably more tools are spoiled through overheating in grinding than in any other way. As pointed out above under "Making of Tool," all tools were rough-machined and rough-ground before hardening, thereby reducing the chances for ruining in grinding. A high-grade tool grinder performed the work under constant supervision, and in this way the danger of overheating was minimized and the correct values of cutting angles assured. The machine used was a Taylor automatic tool grinder and particular care was exercised to see that the copious stream of cooling water provided was applied to the nose of the tool directly at the point in contact with the abrasive wheel. After the tools had been finish-ground, each one was inspected for flaws in the material and all cutting and clearance angles were checked. The base of each tool, in addition, was inspected for deformation, since a perfect seat in the holder is essential.

After the tools were put through the first run they were reground to the original design except that the radius at the nose of the tool was double that of the original value, i.e., $\frac{1}{16}$-in. radius on the first run and $\frac{1}{8}$-in. on the second run. Of course, in the regrind there was more chance for injuring the tools. It is felt, however, that with the care and vigilance that was exercised, this possibility was eliminated.

Apparatus Used and Working Details

As stated in a foregoing paragraph, the machine tool used was a new 8-in. Lo-Swing lathe. The general set-up was shown in Fig. 1. Attention is especially

invited to the particularly rigid method used for holding and driving the work. It is also to be observed that the set-up included but one tool block and that the tool traveled from the point shown to the dome end of the cylinder. The method of clamping the tool has been clearly shown and attention is called to the unusual area of tool base clamped and supported, as compared with the ordinary lathe toolpost.

"Feeding" the Tool

When each cut was started the tool was carefully "fed in" until the proper depth of cut ($\frac{5}{32}$ in.) was reached. The tool was then fed by hand longitudinally for about $\frac{1}{4}$ in. for the purpose of checking the "turned" diameter. In this way the depth of cut was held very close—within the limits of plus or minus 0.0025 in., to be exact.

Only after the correct depth of cut had been attained was the longitudinal power feed engaged (0.054 in. for first run and 0.090 in. for second), the stop watch being started at the same time. As soon as the cut was "across," the watch was stopped and the time recorded. This was repeated until the tool failed, whereupon the total time or life of the tool was at once computed by the observer, and the figures later checked in the office. All other tools were then put through the test in the same way. Whenever a tool failed in cutting, the "burned" part of the cylinder that was caused by the tool failing was turned off with a tool that was not a test specimen, thereby relieving the succeeding test tool of the handicap of cutting metal hardened by burning. In this way every test tool started to cut under identical conditions, which was especially desirable in this test because of the relatively short length of the material cut.

As a further check on the life of each tool, the actual number of cylinders machined was recorded and then compared with the total time credited to the tool.

After the life of each tool was recorded and these data checked, the results were plotted and are shown in the graphical representation on "curve sheets," reproduced in Figs. 5 and 6. The time or life of each tool was plotted as abscissæ, while the brands were indicated as ordinates. In both runs the value representing the total life of each set of tools is shown on the same sheet. It will have been noticed that each individual tool was stamped with a symbol representing the particular brand from which it was made and that the tools in each brand were numbered 0, 1, 2 and 3. By using this differentiation and referring to the data sheets on chemical analysis, heat treatment, and the curve sheets, the why and wherefore of exhibited characteristics can usually be traced quite easily. To facilitate this work, however, a series of data sheets under "Notes on Performance" have been included below.

Chemical and Metallographical Tests

It has been pointed out that a short piece was cut from each bar of steel for the purpose of procuring the chemical analysis of each brand. The work was done in the Packard laboratory and as some of the data appeared questionable, check samples were sent to a local laboratory and again to New York, each report concurring in our analysis, except in the case of uranium.

Both outside laboratories reported more than 0.20 per cent uranium in brand "D" but only a possible trace in half a dozen other brands.

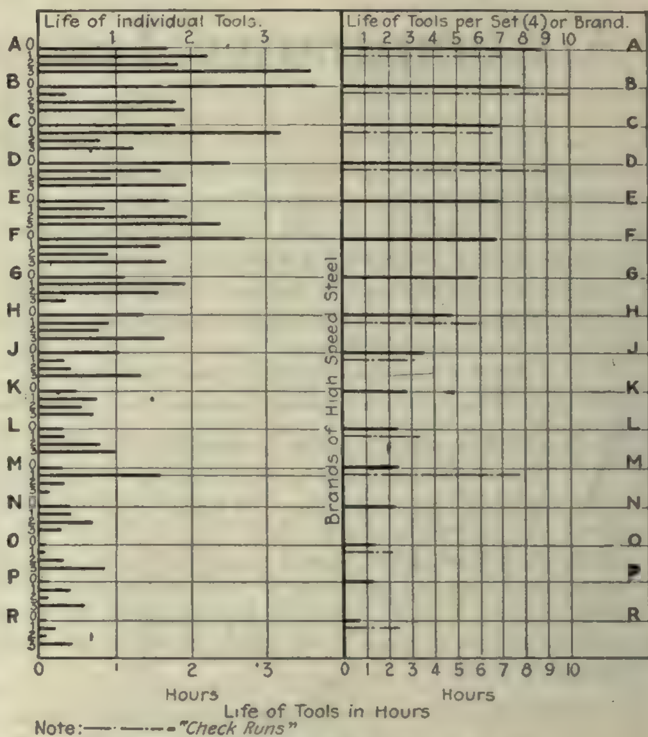


FIG. 5. CURVE SHEET OF FIRST RUN

Turning Liberty motor cylinders 5½ in. diameter. Tool with $\frac{1}{16}$-in. radius nose; cutting speed, 35 ft.; feed, 0.054 in.; depth, $\frac{5}{32}$ in.

Several microphotographs were made and will be published later with a separate discussion.

Table VII, giving the scleroscope hardness of each individual test tool, is included for checking purposes. It is contended that the degree of scleroscope hardness is in no way related to red-hardness, once a certain initial hardness (about 80) has been attained. In other words, if one tool registers 83 and another 88, it does

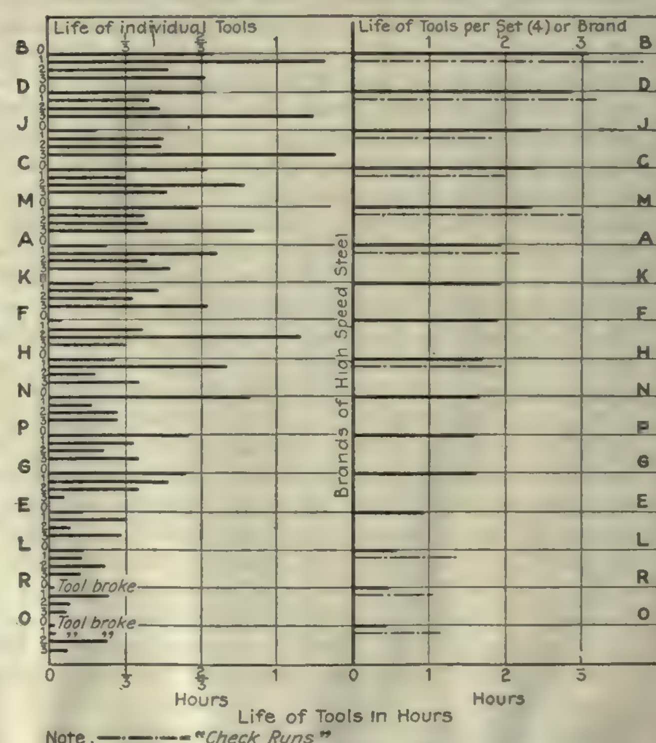


FIG. 6. CURVE SHEET OF SECOND RUN

Turning Liberty motor cylinders 5½ in. diameter. Tool with $\frac{1}{4}$-in. radius nose; cutting speed, 35 ft.; feed, 0.090 in.; depth $\frac{5}{32}$ in.

not follow that there will be any difference in the cutting qualities of the two. Hardness readings should be taken of each tool after the finish grinding for the first run and used as a general indicator. The given data were secured at that time. The readings taken at the nose tip are, of course, lower in value than those of the group taken farther back on the lip surface. This is due to the fact that in the first instance the drop hammer rebounded from an overhung surface, while in the latter case the footing was solid, the heel being directly beneath the point where the reading was se-

TABLE IV. NOTES ON PERFORMANCE OF FIRST RUN

Brand	No.	Time	No. of Cylinders	Remarks
L	0	20.6 min.	4	Dulled quickly; then failed.
	1	20.5 min.	4	Dulled quickly; then failed.
	2	47.8 min.	9	Failed slowly.
	3	56.2 min.	11	Failed quickly.
		Total time, 2 hr. 25 min. 6 sec.		
C	0	1 hr. 48.0 min.	21	Showed wear early but continued to cut.
	1	3 hr. 12.9 min.	38	Failed rapidly.
	2	49.0 min.	10	Failed suddenly.
	3	1 hr. 17.3 min.	15	Showed wear early but continued to cut.
		Total time, 7 hr. 7 min. 12 sec.		
A	0	1 hr. 40.4 min.	20	Tool indicated wear and then failed.
	1	2 hr. 14.5 min.	27	Failed slowly.
	2	1 hr. 52 min. 42 sec.	22	Failed slowly.
	3	3 hr. 39 min. 18 sec.	44	Failed gradually.
		Total time, 9 hr. 26 min. 54 sec.		
B	0	3 hr. 40.5 min.	44	Failed very slowly.
	1	21.6 min.	4	Nose chipped.
	2	1 hr. 51.5 min.	22	Failed slowly.
	3	1 hr. 56.7 min.	23	Failed after showing dullness.
		Total time, 7 hr. 50 min. 18 sec.		
O	0	4.6 min.	1	Tool broke.
	1	2.1 min.	½	Tool broke.
	2	20.5 min.	4	Dulled quickly; then failed.
	3	52.2 min.	10	Failed suddenly.
		Total time, 1 hr. 19 min. 24 sec.		
M	0	19 min. 17 sec.	4	Showed chipped cutting edge.
	1	1 hr. 36 min. 6 sec.	19	Failed suddenly.
	2	20 min. 56 sec.	4	Showed slightly chipped cutting edge and failed quickly.
	3	7 min. 15 sec.	2	Failed quickly.
		Total time, 2 hr. 23 min. 34 sec.		
H	0	1 hr. 21 min. 30 sec.	16	Failed slowly.
	1	56.0 min.	11	Uniform wear.
	2	47.0 min.	9	Failed quickly.
	3	1 hr. 39 min. 38 sec.	20	Failed slowly.
		Total time, 4 hr. 44 min. 8 sec.		
K	0	31 min. 14 sec.	6	Dulled quickly.
	1	46 min. 49 sec.	9	Failed suddenly.
	2	34 min. 56 sec.	7	Nose chipped slightly but continued to cut.
	3	44 min. 14 sec.	9	Failed quickly.
		Total time, 2 hr. 37 min. 13 sec.		
J	0	1 hr. 6 min. 28 sec.	13	Failed slowly.
	1	19 min. 8 sec.	4	Dulled; then failed quickly.
	2	27 min. 36 sec.	5	Dulled; then failed rapidly.
	3	1 hr. 20 min. 5 sec.	16	Failed quickly.
		Total time, 3 hr. 13 min. 17 sec.		
D	0	2 hr. 29.0 min.	30	Failed slowly.
	1	1 hr. 37.3 min.	19	Failed slowly.
	2	59.0 min.	12	Failed gradually.
	3	1 hr. 55.9 min.	23	Failed slowly.
		Total time, 7 hr. min. 12 sec.		
P	0	4.2 min.	1	Failed quickly.
	1	24.9 min.	5	Dulled early.
	2	6.4 min.	1	Failed quickly.
	3	36.0 min.	7	Failed suddenly.
		Total time, 1 hr. 11 min. 30 sec.		
N	0	23.0 min.	4	Dulled quickly but continued to cut.
	1	25.8 min.	5	Failed quickly.
	2	44.1 min.	9	Failed slowly.
	3	18.3 min.	4	Showed wear, then failed.
		Total time, 1 hr. 51 min. 12 sec.		
R	0	3.4 min.	1	Nose broke.
	1	9.8 min.	2	Failed quickly.
	2	0.8 min.	0	Failed quickly.
	3	27.3 min.	5	Failed gradually.
		Total time, 41 min 18 sec.		
E	0	1 hr. 44.0 min.	21	Failed quickly.
	1	52.3 min.	10	Failed rather slowly.
	2	1 hr. 58.9 min.	24	Failed slowly.
	3	2 hr. 24.0 min.	29	Failed slowly.
		Total time, 6 hr. 59 min. 12 sec.		
F	0	2 hr. 45.8 min.	33	Failed slowly.
	1	1 hr. 36.3 min.	17	Chipped but continued to cut.
	2	55.5 min.	11	Failed quickly.
	3	1 hr. 38.8 min.	20	Showed wear early.
		Total time, 6 hr. 56 min. 24 sec.		
G	0	1 hr. 8.1 min.	14	Showed wear but continued to cut.
	1	1 hr. 55.6 min.	23	Failed slowly.
	2	1 hr. 33.1 min.	19	Cut roughly but held the size.
	3	19.3 min.	4	Failed quickly.
		Total time, 5 hr. 54 min. 6 sec.		

TABLE V. NOTES ON PERFORMANCE OF SECOND RUN

Brand	No.	Time	No. of Cylinders	Remarks
C	0	41 min. 42 sec.	10	After 30 min. 54 sec., rapid wearing was apparent though the tool continued to cut.
	1	19 min. 13 sec.	5	Failed suddenly.
	2	51 min. 36 sec.	12	Showed wear three minutes before failure occurred.
	3	33 min. 12 sec.	8	Failed gradually.
		Total time, 2 hr. 25 min. 43 sec.		
N	0	53 min. 30 sec.	14	Failed suddenly.
	1	11 min. 24 sec.	3	Showed wear after the second cylinder.
	2	18 min.	4	Failed slowly.
	3	18 min. 18 sec.	5	Failed slowly.
		Total time, 1 hr. 41 min. 12 sec.		
E	0	9 min. 12 sec.	2	Tool indicated dullness and then broke.
	1	20 min. 30 sec.	5	Failed gradually.
	2	5 min. 24 sec.	1	Tool broke.
	3	19 min. 48 sec.	4	The nose chipped after 4½ min., but continued to cut, though irregular.
		Total time, 54 min. 54 sec.		
O	0			Broke on first run.
	1			Broke on first run.
	2	15 min. 30 sec.	4	Dulled quickly but continued cutting and then failed suddenly.
	3	4 min. 30 sec.	1	Tool broke.
		Total time, 20 min.		
M	0	38 min. 30 sec.	9	Failed very slowly.
	1	25 min. 22 sec.	6	Failed suddenly several minutes after showing wear.
	2	26 min.	7	Tool broke.
	3	54 min.	14	Failed suddenly.
		Total time, 2 hr. 22 min. 52 sec.		
P	0	37 min.	9	Failed slowly.
	1	22.5 min.	5	Failed rapidly after becoming dull.
	2	14 min.	4	Failed suddenly.
	3	24 min. 48 sec.	6	Failed gradually after first indication of dullness.
		Total time, 1 hr. 38 min. 18 sec.		
G	0	36 min. 18 sec.	9	Showed wear 1 minute before it failed.
	1	32 min. 18 sec.	8	Failed gradually in last 3 minutes.
	2	24 min.	6	Failed slowly.
	3	3 min. 36 sec.	1	Tool broke.
		Total time, 1 hr. 36 min. 12 sec.		
H	0	17 min. 42 sec.	4	Grew dull 4 minutes before failure.
	1	47 min. 6 sec.	9	Failed very slowly.
	2	12 min. 54 sec.	3	Began to dull on the second cylinder.
	3	24 min. 36 sec.	6	Failed suddenly.
		Total time, 1 hr. 42 min. 18 sec.		
A	0	15 min.	4	Nose chipped slightly after seven minutes running, then failed gradually.
	1	44 min. 12 sec.	11	Failed very slowly after first indication of dullness.
	2	26 min. 30 sec.	6	Failed gradually in the last four minutes.
	3	31 min. 6 sec.	8	Gave indication of dullness eight minutes before failure.
		Total time, 1 hr. 56 min. 48 sec.		
L	0	8 min. 36 sec.	2	Dulled quickly, wear increasing rapidly until failure occurred.
	1	8 min. 12 sec.	2	Failed slowly.
	2	14 min. 6 sec.	4	Showed wear on second cylinder but failed slowly.
	3	7 min.	2	Failed gradually after the cutting edges chipped slightly.
		Total time, 37 min. 54 sec.		
B	0	43 min.	11	Failure extremely slow after showing initial dullness.
	1	1 hr. 13 min.	18	Failed suddenly.
	2	30 min. 16 sec.	8	Failed slowly.
	3	40 min. 3' sec.	10	Failed very slowly after first signs of dullness.
		Total time, 3 hr. 6 min. 46 sec.		
J	0	12 min. 30 sec.	3	The nose of the tool broke off while feeding across.
	1	30 min. 48 sec.	8	Failed rapidly after indicating wear.
	2	29 min. 42 sec.	7	Showed wear two minutes before failure occurred.
	3	1 hr. 14 min.	18	Gave no indication of wear, the nose of the tool breaking while the power feed was engaged.
		Total time, 2 hr. 27 min.		
R	0			Tool broke when feeding in by hand to the proper depth.
	1	15 min.	4	Grew dull soon after the start.
	2	5 min.	1	Failed rapidly.
	3	4 min. 12 sec.	1	Failed rapidly.
		Total time, 24 min. 12 sec.		

TABLE V. (Continued)

Brand	No.	Time	No. of Cyclinders	Remarks
K	0	11 min. 48 sec.	3	Failed suddenly.
	1	28 min. 48 sec.	7	Became dull and failed within one minute.
	2	22 min. 12 sec.	6	Failed six minutes after the first signs of wear.
	3	42 min. 30 sec.	10	Failed very slowly.
		Total time, 1 hr. 43 min. 18 sec.		
D	0	47 min.	12	Failed very slowly.
	1	26 min. 42 sec.	7	Failed very slowly.
	2	29 min. 18 sec.	7	Failed gradually.
	3	1 hr. 10 min.	17	Gave indication of wear 35 minutes before failure occurred. Almost impossible to ruin the tool as it continued to cut while at a high red heat.
		Total time, 2 hr. 53 min.		
		A marked characteristic of this steel is the tendency to dull quickly but continue to cut. It is also very difficult to "burn," and cools quickly after the cut is finished.		
F	0	2.4 min.	1	Tool broke.
	1	25 min.	6	The nose of the tool broke but continued to cut for ten minutes before failing.
	2	1 hr. 7 min.	17	The nose of the tool chipped after 15 minutes.
	3	20 min.	4	Dulled quickly but continued to cut.
		Total time, 1 hr. 54 min. 24 sec.		

TABLE VI. RECAPITULATION OF TEST RESULTS

First Run						Second Run				
Brand	Total Time for Four Tools H.	Min.	Sec.	Average Time for One Tool H.	Min.	Brand	Total Time for Four Tools, Hr.	Min.	Sec.	Average Time for One Tool, Min.
A	9	26	54	2	21.7	B	3	6	46	46.6
B	7	50	18	1	57.5	D	2	53	..	43.2
C	7	7	12	1	46.8	J	2	27	..	36.7
D	7	1	12	1	45.3	C	2	25	43	36.4
E	6	59	12	1	44.8	M	2	22	52	35.7
F	6	56	24	1	44.1	A	1	56	48	29.2
G	5	54	6	1	28.5	K	1	43	18	25.8
H	4	44	8	1	11.0	F	1	54	24	28.6
J	3	13	17		48.3	H	1	42	18	25.5
K	2	37	13		39.3	N	1	41	12	25.3
L	2	25	6		36.2	P	1	38	18	24.5
M	2	23	34		35.9	G	1	36	12	24.0
N	1	51	12		27.8	E		54	54	13.7
O	1	19	24		19.8	L		37	54	9.5
P	1	11	30		17.9	R		24	12	6.0
R		41	18		10.2	O		20	..	5.0

TABLE VII. HARDNESS OF TEST TOOLS

Brand		Scleroscope Reading At the Extreme Tip of the Nose	Scleroscope Reading ¼ In. Back of Nose	Brand		Scleroscope Reading At the Extreme Tip of the Nose	Scleroscope Reading ¼ In. Back of Nose
J	0	70–75	80	H	0	68–70	82
	1	62–64	78		1	65–70	82
	2	65–68	82		2	65–70	77
	3	62–67	78		3	70–73	80
C	0	65–68	78	M	0	68–70	80
	1	65–70	80		1	65–70	80
	2	65–70	88		2	70–73	85
	3	65–70	78		3	70–72	87
A	0	68–70	82	L	0	70–75	85
	1	73–75	82		1	70–75	82
	2	65–70	82		2	68–70	75
	3	65–70	85		3	70–72	82
R	0	70–72	85	B	0	65–70	78
	1	68–70	82		1	65–68	75
	2	70–72	80		2	70–73	80
	3	70–75	80		3	70–75	85
D	0	73–75	83	P	0	60–65	72
		60–65	75		1	58–60	65
	2	65–70	79		2	60–62	72
	3	74–76	90		3	65–67	70
N	0	70–72	80	R	0	65–68	78
	1	62–64	80			60–65	77
	2	70–74	80		2	60–64	75
	3	70–72	87		3	60–65	72
F	0	70–72	82	K	0	65–70	78
	1	65–70	85		1	62–65	81
	2	60–65	78		2	60–65	74
	3	70–72	82		3	65–70	80
O	0	65–70	77				
	1	65–70	82				
	2	68–70	80				
	3	65–68	80				

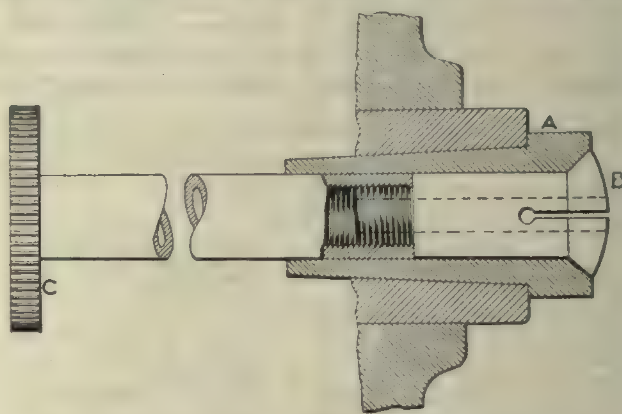
cured. It will be noted that in general the hardness varied from 75 to 85, or within 10 points.

(Part IV, the last of the series, will be published in an early issue.)

Collets for the Milling Machine

BY F. C. HUDSON

On experimental work or where manufacturing is being done in a small way, it frequently becomes desirable to use collets in the milling machine spindle. This was easily done in the case shown by simply mak-



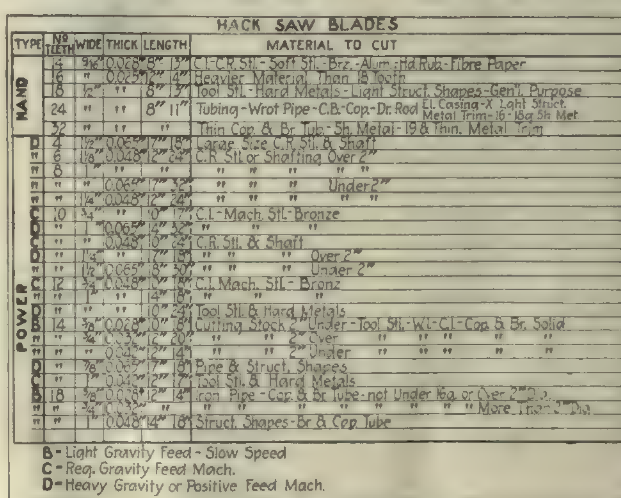
A COLLET IN THE MILLING-MACHINE SPINDLE

ing the outer or master collet, shown at *A*, to fit the taper in the milling machine spindle and boring it in place to fit the collet *B*, which belonged to a bench lathe in the same shop. The draw-in tube is threaded at one end to fit the collet, the wheel *C* on the other end being a discarded change gear from a small lathe, having teeth fine enough to answer very nicely for a grip. This is extremely simple and answers every purpose, utilizing collets from other machines to advantage.

Chart for Hack-Saw Blades

BY S. JONES NELSON

The chart shown in the illustration is a time saver when hung in the vicinity of hack-sawing machines, especially when, as is usually the case, these latter are



HACK-SAW BLADE CHART

run by men not any too well posted on the kinds of blade to be used for various materials. It enables even an indifferent operator to select the proper blade without trouble or delay; or if there is a battery of saws, to assign each bar of material to the machine best adapted to handle it.

Routing Gears and Machine Parts Through the Factory

By J. A. Urquhart
Brown & Sharpe Manufacturing Co.
Providence R. I.

*In treating the routing system which has been developed in a large and up-to-date plant, all the phases, such as ordering, planning, scheduling, dispatching and checking, are of importance. The author describes a system which has given good service for a number of years, the forms used being reproduced here to show the actual operating mechanism of the plan.**

THE purposes of routing are to enable the starting of a part at the right time over the shortest and best route, to have it finished in stock or available when required, and to have it in progress for no longer a period than is necessary to manufacture it. Our object at the Brown & Sharpe plant is to have the part finished or in storage for a short period of time before it will be required, and to have control of the part at all times during its passage through the factory. We also plan to give positive dates on future deliveries.

Before starting the description of routing I want to speak of a few of our factory consists of ten manutory consists of ten manufacturing buildings, including a gray-iron foundry. The employees number about 7,500 persons. We manufacture milling, grinding, gear-cutting and screw machines, both plain and automatic, in all a total of eighty-four sizes; also a complete line of small tools, cutters, sewing machines, and barber's clippers. For all this varied product the unfinished, semi-finished and finished parts must be routed. These conditions are mentioned because they differ from those to be found in a factory making only one line of goods.

Method Used Before Routing System Was Installed

The plan in use before adopting our present routing system was a central station with a set of progress cards. As the work left each department a move ticket was supposed to be sent to the central station notifying that the work had been moved to the next department, but in many cases the foremen would forget to send tickets to the central station when they dispatched the work. Also move tickets were recorded on the wrong progress card. At times operations would be changed due to various reasons, such as hard stock or because parts were sent back by the inspector for repairs, and for these and other causes the records were not satisfactory. We also used chasers, but they were expensive and did not get satisfactory results.

Before routing was introduced we had in use: Sample tags, chasers, progress cards, work-following tickets, dating of orders on progress cards, order books, dating of orders in foremen's order book, lists of stock, and lists of progress kept by the various foremen. Moreover, all drawings were mounted on metal plates or boards, which required storage. Duplication of cards and orders occurred; but most detrimental of all was the trouble caused by foremen and sub-foremen leaving their own departments and going to other departments while chasing work. The plan for routing gears is the outcome of our making estimates on gear work. In making these, especially for new work, it is our practice to get the time required for each operation and delivery dates from every department that has an operation on the gear.

When estimating we make use of printed forms, one of which is sent to each of the department foremen who has work to perform on the piece. On this form, Fig. 1, is given the number of pieces required, and a drawing of the piece, Fig. 2, is furnished for other information. The form and drawing are returned to the estimating department by each foreman with an estimate of the number of hours required to do the work, and also with a list of the special tools required by his department to make the piece. These estimates are filed for future reference.

When an order on which we have estimated is received, a production record card, Fig. 3, is sent to each foreman, giving him a record of his estimate. This record is to remind him of what he has promised to do, and on it a space is provided for keeping a record of the time spent on the job and for checking up each day.

The summary card, Fig. 4, is used to show the sum total of labor and machine time as estimated, and it has a drawing or photostat of the gear pasted on the back. These cards are filed in a cabinet according to the pitch diameter of the gear, and the record is valuable for quick estimating and also as a permanent record. It was the desire to make use of this recorded information that led us to incorporate it in the form of a route card, the form which we decided to adopt being very similar to a railroad time table.

How the Route Card Is Made

Many of our gear orders are for special gears and are generally wanted by the customer about the time

*Paper presented at the annual meeting of the American Gear Manufacturers' Association, Detroit, April 29, 1920.

we get the order to make them. This means that the best possible date must be given.

When an order for gears is received it is assigned a job number by the timekeeping department, and against this all labor and material used is charged. The drafting department furnishes the necessary draw-

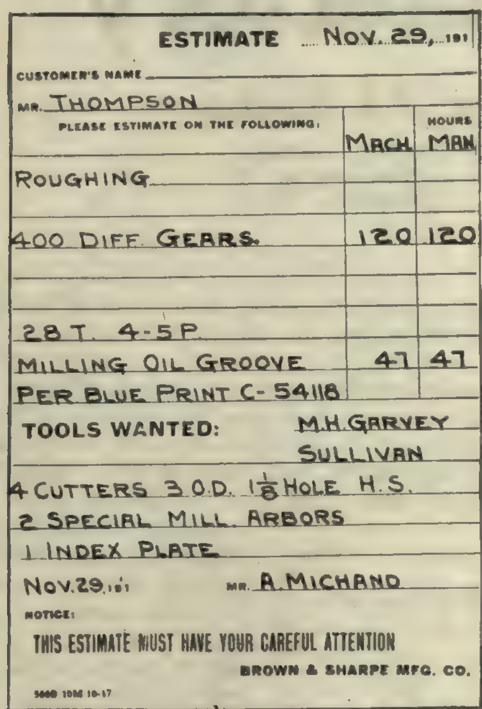

ESTIMATE Nov. 29, 191
CUSTOMER'S NAME
MR. THOMPSON
PLEASE ESTIMATE ON THE FOLLOWING: HOURS MACH. MAN
ROUGHING
400 DIFF. GEARS. 120 120
28 T. 4-5 P.
MILLING OIL GROOVE 47 47
PER BLUE PRINT C-54118
TOOLS WANTED: M.H. GARVEY SULLIVAN
4 CUTTERS 3 O.D. 1 1/8 HOLE H.S.
2 SPECIAL MILL ARBORS
1 INDEX PLATE
Nov. 29, 191 MR. A. MICHAND
NOTICE:
THIS ESTIMATE MUST HAVE YOUR CAREFUL ATTENTION
BROWN & SHARPE MFG. CO.
5000 10M 10-17

FIG. 1. FORM USED FOR ESTIMATING ON GEAR WORK

ing, Fig. 2, and a list of materials or parts. This drawing generally gives a list of any special tools that may be required, and the list or order of operations is furnished or approved by the foreman of the gear department.

The next step is to get actual or estimated time for each operation from the department that has the particular operation to perform. Each department foreman is told the date that the job will arrive in his department, and he gives the routing department the date on which the work will leave. The date given by the foreman who does the last operation gives a final route card date, but this may not be near enough to the delivery date asked for by the customer to be satisfactory. When this happens the foreman of the gear department checks the routing, and from his records or experience points out the operation time which in his opinion can be shortened; and, if possible, the routing department schedules a shorter time. The final date is then set and the route cards are made. The route card date is lengthened by a number of days, depending on the size of the job, to get a satisfactory shipping date for the customer.

The route card is typed with a hectograph ribbon, and a copy is made on a duplicating machine for each foreman that has an operation on the gear. The route card and drawing are put in an envelope and stay with the work until it reaches the final inspection. The copies of the route card are sent to the various foremen.

The route card, Fig. 5, has "operation" and "date due" columns, which correspond to the "station" and "time due" columns on a railroad time table. There are in addition three other columns, one to show the date the parts were received, one to show the number of pieces sent along, and one to show the number of pieces spoiled, if any. The number of pieces sent along plus the number spoiled should always equal the number started. The route card is also used as a casting order for cast-iron gears.

Route Card Rack

Each department in the factory is provided with a rack, Fig. 6, containing forty-eight pockets, four for each month, in which are placed the copies of the route card as fast as they are issued. The copies are filed according to the date that they are due out of the department. This arrangement enables the foreman to tell at all times the quantity of work that he has to get out each week and, also, all work on order. It gives him this information in advance and shows up any work that he has not moved according to schedule.

Spoiled Work

If any pieces are spoiled a "spoiled-work" notice, Fig. 7, is sent to the routing department. On the receipt of this notice it is ascertained whether the spoiled pieces have to be replaced and, if so, the number required is started on a new route card, so that they catch up with the main lot as soon as possible.

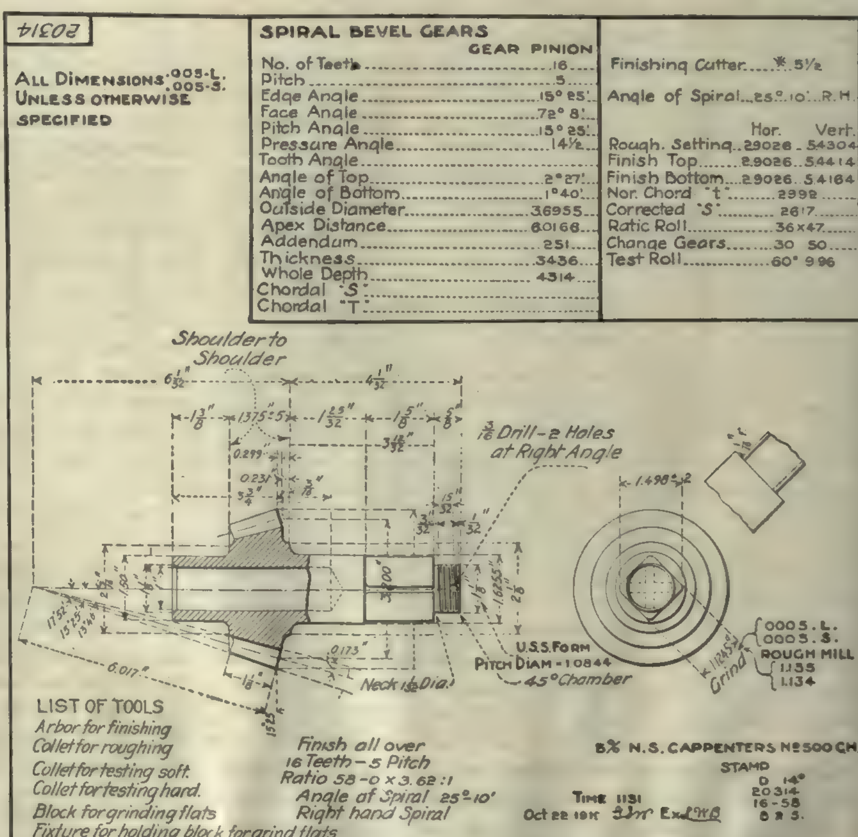


FIG. 2. SAMPLE OF DRAWING FURNISHED FOR ESTIMATING ON GEAR WORK

547 3 9M 7-19 PRODUCTION RECORD

Mr. POTHEN Date 11-13-19

Name Firm

Time No. 7214 Time Estimated Mch. 150 Man 75

Operation THREADING No. of Pieces 1900

Remarks

DRIVING GEARS 17T. 6-8P.

Hours Estimated should be on this card before starting work. If you cannot do as well or better than Time Estimated notify Foreman of floor. If he cannot produce better results, he will notify the man responsible for this Record.

DATE	HOURS	PIECES	DATE	HOURS	PIECES	DATE	HOURS	PIECES
	MACH.							
Nov. 15	13.	257			MACH.	MAN		
" 16	7.	143	2500 =					
" 17	6.	128						
" 18	19.	381						

FIG. 3. PRODUCTION RECORD CARD USED FOR RECORDING WORK IN EACH DEPARTMENT

257-5 1M 9-15 Kind COMPENSATING GEARS Work No. T 28 Quantity 10000

For P 7-9 Face

Time No. Hole

	MACH.	MAN		MACH.	MAN
Drawings		20	8 Ft. G. Cut Machine 5 BRUSH WHEELS		
Patterns CHUCKING	1248	624	O. 5 Machines, and P. 23		
Forging BRUSH		225	28 in. Spiral G. Cut Machine		
Cleaning Castings			Double Tool Gleason Planer		
Machinist's Work		890	12, 24 & 36 in. Gleason Planer		
Screw Machines			Bilgram Planer DRILLING		800
Milling Machines			Auto. Rack Cut Machine		
Milling Machines, P. & W.			~~Index Drilling Machine~~ B.V.G.P.	1400	1400
J. Lathes, Special			72 in. Index Hobbing Machine		
~~Hollow~~ Lathes	3000	1500	Emery Wheel Grinding	1400	1400
Potter & Johnson Lathes			Filing		550
Small Vertical Boring Mill			Hardening $ ——		
Large Vertical Boring Mill			Hobs		
O. S. G. Cut Machines			Tools $ ——		
Hob Machines			Cutters $ ——		
P3, P4, P11 and P13 H.S.	1600	1600	Inspection		624
P5, P6, P14 and Duplex			Boxing		150

Material 10-15 CAR. ST. Date of Estimate Date of Order Remarks

FORGINGS $ ——

FIG. 4. SUMMARY CARD TO SHOW TOTAL OF MACHINE AND LABOR TIME. DRAWING OF PART IS PASTED ON BACK

It is necessary at times to change the dates on a route card, due to various reasons, such as delay in receiving raw materials, to get an earlier delivery date, men not working, machines broken down, neglect on part of foreman or too much work. To take care of this condition a rerouting ticket is provided, Fig. 8, which gives the routing department the information necessary to reroute and to locate the job after rerouting. Whenever a foreman learns that the date on a route card in his department is not going to be kept, he must notify the routing department at once, and at the same time give a new moving date if possible.

With the information on the rerouting note the routing department can take steps to hold the final date or to make the extension as short as possible. This can be handled in several ways, such as overtime or getting help from another department, as there are several departments doing similar work. The important thing is for the foreman to give prompt notice to the routing department in order that the control of the job may not be lost, and as a rule the foremen give this notice. No chasers or follow-up men are used, except in special cases. When a date cannot be kept a reroute card is made out and taken to the department which has the work, the drawing is put in the new reroute envelop, and the old route card taken away. The fact that there is always a route or reroute card with the work helps the routing department to control all work in progress at all times.

TIME NO.	TOTAL ON ORDER	PATT. MARK OR SYMBOL	QUANTITY ROUTED
2925	190 Sets	20314	last 50

NAME OF PART: Bevel Pinion - Mercer 3755D

MATERIAL	HUB DIAM.		HUB LENGTH		CORE	COMPLETED DATE
See Print						9-12-19

OPERATIONS	BENCH FLOOR MACH	DATE PARTS ARE DUE IN DEPT.	DATE PARTS WERE RECEIVED	NO. OF PCS. SENT ALONG	NO. OF PCS. SPOILED
Print received		6-9-19			
Deliver forgings to McGhee Roche		6-10-19	6-10-19	50	
Turn McGhee		6-10-19	6-10-19	50	
Inspect Baird		7-7-19	7-3-19	50	
Drill Huse		7-9-19	7-7-19	50	
Grind White		7-11-19	7-9-19	50	
Thread Pothin		7-15-19	7-10-19	49	1
Chuck Earle		7-19-19	7-14-19	49	
Rough and Finish cut Maxfield		7-23-19	7-23-19	48	1
File Huse		7-31-19	7-30-19	48	
Inspect Baird		8-1-19	8-18-19	48	

FIG. 5. WORK ROUTE CARD FURNISHED TO THE FOREMEN

SCHEDULING TO DEPARTMENTS

Work is scheduled to departments and not to machines, except on certain machines such as gear planing machines and hobbing machines, where the number of machines is limited. On the common classes of machines, such as lathes and drilling machines, we depend on the foreman, with the aid of his route card rack, to call the attention of the general foreman to any work that he is not sure of getting out according to schedule. This plan has its weak points, but any cure that we have seen would involve more trouble than we are having at the present time.

DISPATCHING AND TRUCKING

Each foreman dispatches the work from his own department. The moving is done by the trucking department, but the foreman who works on the job last is responsible for the work until it reaches the next department. Call stations of the trucking department are located in each department of the factory and there is one central transfer station. In the morning each

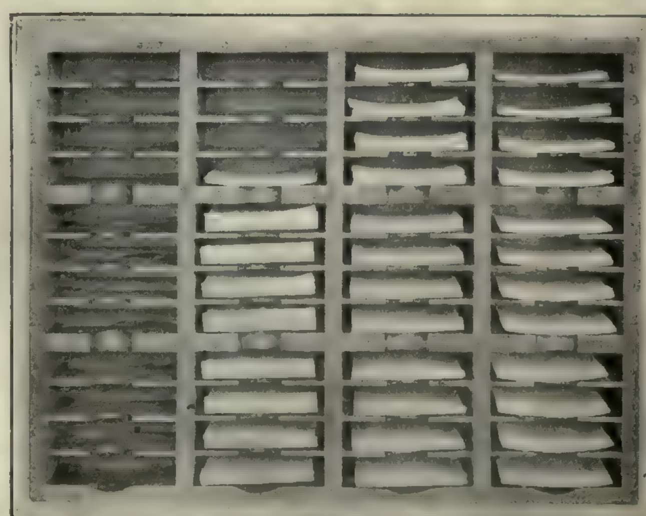
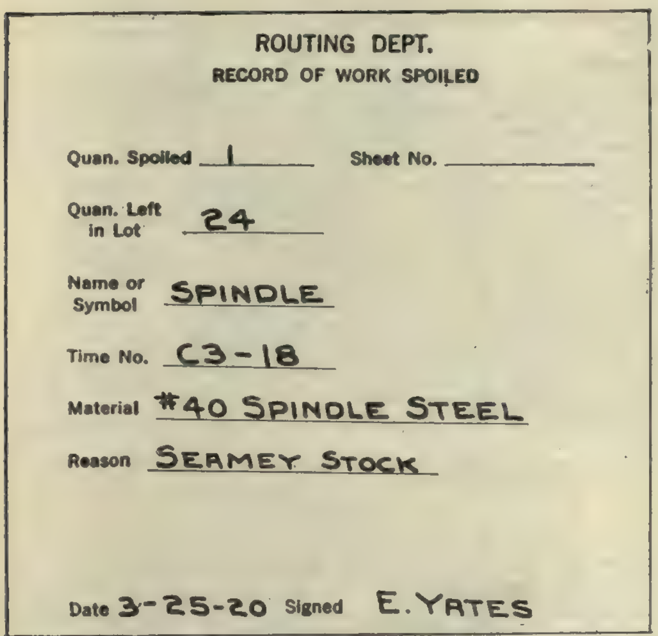


FIG. 6. DEPARTMENTAL RACK FOR FILING ROUTE CARDS



ROUTING DEPT.
RECORD OF WORK SPOILED

Quan. Spoiled 1 Sheet No.

Quan. Left in Lot 24

Name or Symbol SPINDLE

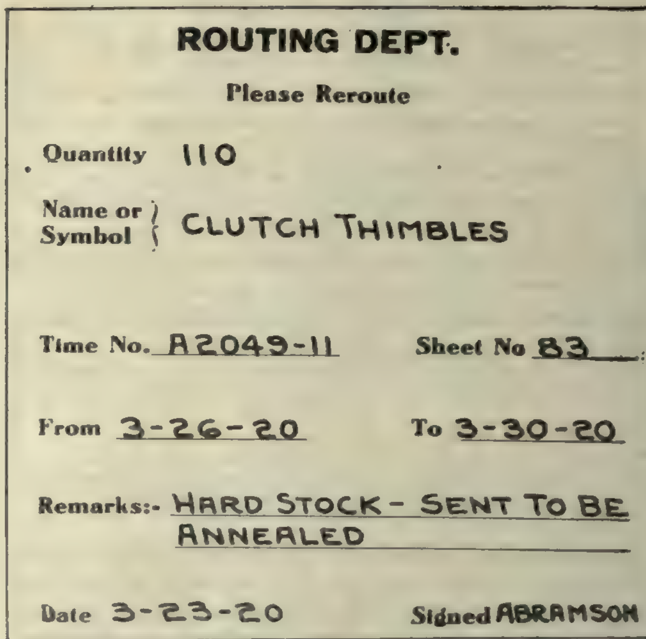
Time No. C3-18

Material #40 SPINDLE STEEL

Reason SERMEY STOCK

Date 3-25-20 Signed E. YATES

FIG. 7. NOTICE OF SPOILED WORK SENT TO ROUTING DEPARTMENT



ROUTING DEPT.
Please Reroute

Quantity 110

Name or Symbol CLUTCH THIMBLES

Time No. A2049-11 Sheet No 83

From 3-26-20 To 3-30-20

Remarks:- HARD STOCK - SENT TO BE ANNEALED

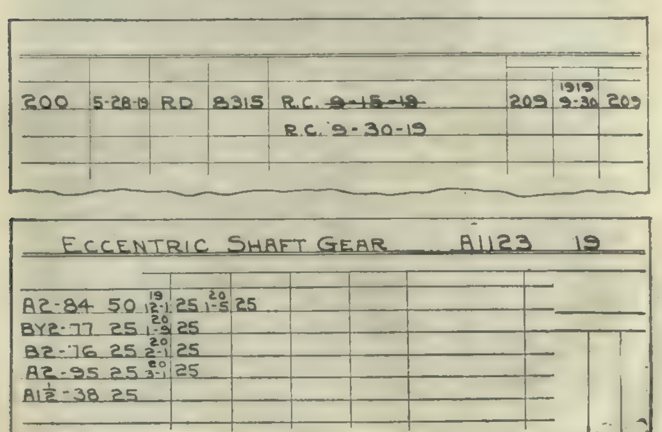
Date 3-23-20 Signed ABRAMSON

FIG. 8. FORM USED FOR REROUTING WORK IN CASE OF DELAYS

trucker starts from the transfer station with any parts that are going to his station. Upon his arrival at the floor where his station is located he distributes his load, and then loads up with parts going to the transfer station. The route card with the work is the trucker's order to move.

How Stock Orders Originate

Machine parts are generally routed to go into stock, and as a rule they are allowed more time for manufacture than are special orders. This permits the use of some methods different from those used in routing gears, but most of the rules are the same. All orders for standard machinery originate in the sales department and copies of the orders are sent to the following departments: First, the timekeeping and cost departments, which open accounts for time and material and figure the cost at the completion of the job; second, the drafting department, which furnishes all necessary drawings and lists of fittings, including stock parts; third, the foreman erecting the machines, who gives the date when the machines will be finished. This date must be approved by the routing department and be satisfactory to the sales department. Fourth, the routing department, which, on receipt of the lists and drawings, makes requisitions for all stock parts and materials. These requisitions bear the date that parts will be wanted in the assembling or erecting departments. All special materials or parts are ordered through the purchasing department. Parts not carried in stock but manufactured as required are routed through the factory.



200	5-28-19	RD	8315	R.C. ~~9-15-19~~	209	1919 9-30	209
				R.C. 9-30-19			

ECCENTRIC SHAFT GEAR A1123 19

A2-84 50	19 12-1 25	20 1-5 25	
BY2-77 25	20 1-5 25		
B2-16 25	20 2-1 25		
A2-95 25	20 3-1 25		
A1½-38 25			

FIG. 9. FRONT AND BACK SIDES OF STOCK ORDER CARDS

Ordering

When the lists of materials for a lot of machines are received in the routing department from the drafting department, the stock-parts order clerk immediately checks the list with his stock-record cards, Fig. 9. All the items required that are not in stock are ordered. Items not required for some time are held in the "tickler" until an advisable date for ordering. A copy of the order is sent to the drafting department, which in turn sends to the routing department drawings for each piece called for on the order. The material order clerk in the routing department examines each drawing and makes out requisitions for all stock parts and special parts. The drawing, together with all requisitions and a route card (without the operations or dates, but giving the number of pieces required, time number of job and name of part) are then sent to the route clerk, who proceeds to schedule and route the work. These stock-record cards are a great help to the route clerk in setting dates.

The material order clerk keeps a record, Fig. 10, of all the drawings received in the routing department. This record gives date received, when sent to routing department, and when routed.

Master Card and How Used

The method of routing is as follows: For each piece to be routed there is a master card, Fig. 11, which gives the operations, the number of hours or days required for each operation and the name of the foreman who is to do the work.

The lists of operations on our master cards are made by recording the operations in the order in which they have been performed in the past, and are changed from time to time as new methods of manufacturing require.

Time No.	Total on Order	TYPE OF MACHINE
B00-14	25	#00 HAND. MILLING MACHINES
Ordered 10-3-19		

Cast Only	General Remarks
Go Ahead 10-3-19	
Stopped	

Sheet	Received	Cast Order	Sent R. D.	Routed	Remarks	Sheet	Received	Cast Order	Sent R. D.	Routed	Remarks
						43	10-9-19		10-24-19	11-1-19	
						44	10-9-19		10-24-19	11-3-19	
						45	10-9-19		10-24-19	11-3-19	
						46	10-9-19		10-24-19	11-3-19	
						47	10-9-19		10-24-19	11-1-19	
6	10-9-19		10-24-19	11-3-19	STAND.	~~48~~					
7	10-9-19		10-24-19	11-3-19	KNEE	~~49~~					
8	10-9-19		10-24-19	11-3-19	SADDLE	50	10-9-19		10-24-19	11-3-19	
9	10-9-19		10-24-19	11-3-19	TABLE	51	10-9-19		10-24-19	11-3-19	
10	10-9-19		10-24-19	11-3-19	DRIP PAN	~~52~~					
11	10-9-19		10-24-19	11-1-19	STAND DOOR	53	10-9-19		10-24-19	11-6-19	
12	10-9-19		10-24-19	11-3-19	C'WEIGHT.	54	10-9-19		10-24-19	11-3-19	
13	10-9-19		10-24-19	11-3-19	BOTT. "	~~55~~					
~~14~~						~~56~~					
15	10-9-19		10-24-19	11-3-19	SADDLE GIB	~~57~~					
16	10-9-19		10-24-19	11-3-19	TABLE GIB	58	10-9-19		10-24-19	11-3-19	
~~17~~						59	10-9-19		10-24-19	11-3-19	

FIG. 10. DRAWINGS RECEIPT CARD OF MATERIAL ORDER CLERK

The time required for each operation is taken from the contract or job work cards when available. On new work an estimated time is gotten from the foreman having charge of that particular job. The erecting foreman gives the date on which the machines are to be finished.

The company has records obtained by experience, to show the time when each part or group must be finished in order to keep the date set for the completion of the machine. With all this information it is a comparatively simple job to divide the available time between the various operations. In the majority of cases the time given on the route card is greater than the actual time required for the operation. This helps to hold the original date on the route card when we have to reroute. On rush orders the route card is put in a red envelope, which helps the foreman to keep the job moving on time.

Record of Work in Progress

The routing department has two sets of filing cabinets, one for all work in process of manufacture, and one for work that has been finished. The work-in-progress cabinet contains a copy of the route card for every job in progress filed according to name or job number.

The completed file contains a copy of route cards for all jobs finished on which the cost has been figured. As fast as the cost department figures the job, the cards are pulled out and destroyed. With the aid of these two cabinets any job can be quickly located and the condition of all the parts for any lot of machines under construction can be found. The general rules of the routing system are:

1. Dates on route cards should be kept or bettered.

2. If a date on route card cannot be kept, the foreman should notify the routing department at once and not wait until work is finished, and on the same note give the date on which the work will go to the next operation. This reroute note should be written in duplicate, the original should be sent to the routing department and the duplicate should be pinned to the foreman's route card and filed in the rack according to the new moving date. This will remain in the rack until receipt of the new reroute copy from the routing department. Printed forms are provided for this purpose.

3. Foreman should write "Being Rerouted" on route card and sign his name and the date, whenever notifying the routing department to reroute work.

4. Routing department must reroute work promptly, but work must be kept moving during the time it is being rerouted. If a route card arrives in a department and has been marked "Being Rerouted" but has not been rerouted within three days after the date of notification, the foreman having the work must send through a new reroute note.

5. If a job should get so far behind that it is difficult to reroute to meet machine date, the routing department will notify the foreman building the machines.

6. The route card and blueprint in an envelope must be kept with the work, not on the foreman's desk.

7. The foreman's copy of the route card must be filed in the rack provided for that purpose according to the date the work is due out of the department, excepting the assembling and erecting departments on groups of machines. They should file route cards by time number.

8. Copies of route cards for jobs that have been rerouted or finished must be removed from rack promptly.

9. Foremen must not use racks to store all sorts of junk. If jobs are stopped the copies should be marked.

10. All foremen must enter on their copy of route card the date on which they receive the work. Then the routing department can get this information without troubling the foreman.

11. Route card with blueprint must be returned to routing department promptly upon completion of job.

12. The routing department is responsible for getting best dates on all outside repair orders, "customer

MASTER CARD	NO OF PIECES	PATT. MARK OR SYMBOL	MATERIAL
TIME NO.		JB 10	
JB10	25	1	C.I.
NAME OF PART Bed Front Plate Sheet #9			
U OPERATIONS	FOREMAN	ACTUAL TIME IN DAYS	REMARKS
Print received at	R.D.		
Make castings	Foundry	25	
Clean	Arbour	3	
Mill	Malmberg	4	
All drilling	Larson	6	
Finish Milling	Malmberg	4	
Final Inspect	Platt	2	
Supply Department			
#7 Bldg. 1st Floor			
Buckley			
These JB10 Bed Front Plates complete are required six weeks ahead of the delivery date on the finished machines.			
TOTAL ACTUAL TIME		76	

FIG. 11. MASTER CARD USED FOR ROUTING WORK

waiting orders," etc. It is expected that the foremen will assist them in every possible way.

13. The foreman whose name appears on the bottom of each route card is responsible for the work and will give information on any mechanical question that may come up.

Results of System

Routing started in the gear department in 1912, and is now in general use throughout our factory. The results obtained can best be shown by the following table, giving the percentage of work finished on or near the scheduled date:

Year	Total	On Time, Per Cent	One Week Per Cent	Two Weeks Per Cent
1913	24,990	76.5	84	89.5
1914	28,037	80.9	90.5	94.3
1915	43,795	68.5	80.3	88.7
1916	61,173	71.5	79	86.5
1917	66,926	87.6	90.7	93.8
1918	66,817	85	88	91.7
1919	61,622	85	87.6	90

This record would be better but for the tendency of our route clerks to play safe. They sometimes call for parts sooner than actually required and quite often the foreman making the parts knows this and breaks the rule on rerouting, making the excuse that he knew they would not be required on the date set. This applies principally to the foreman on the last operation. However, we try to impress the foreman with the fact that dates on route cards must be kept, and if in their opinion the dates are not correct, they should call them to the attention of the routing department.

In conclusion I want to call attention to two points in this plan of routing. One is its simplicity. All we ask of our foremen is to keep the schedule or else report that they cannot do so. The other point is the fact that we have been using it for five years and are getting fairly satisfactory results.

A Question in Etymology

By Francis W. Shaw

Manchester, England

"The English (or any other) language is not a fixed unsentient thing, ironbound by a set of arbitrary rules and conditions, but a living, growing entity, born of necessity and reared by custom to give expression to the intelligence of men."

In these words does Harry Senior support the language as it now is. Since "grinder" is perfectly intelligible to some men, while "grinding machine" more powerfully appeals to others, and as both terms are sanctioned by long and common usage, both are right.

Judged from the standpoint of sanction, both *are* right, but judged from the capability to give expression to the intelligence of men "grinding machine" is right and "grinder" wrong; for, by analogy with other words, "grinder" may be either a machine, a tool, or a man. Too often are we forced to circumlocution to be able to claim for the term "expressivity quite complete."

It is just the same with other words derived from terms expressive of processes or operations. What, for instance, is a "mill"? Side mills, face mills, slot mills are, of course, cutters. But is a vertical mill or a horizontal mill a cutter for vertically or horizontally cutting? The Cincinnati Milling Machine Co. mixes machine nomenclature with that of the cutters. They make universal milling machines and plain milling machines but their manufacturing machine is a "miller." This is the classification in Chapter I of their Treatise. If I asked Mr. Senior to provide me with a good "miller" would he send me a man or a machine?

Users Do Not Control Names

I do not agree that the people who use the machines control the name. It is the makers who advertise their wares, the technical journals that describe the machine, the divers writers who furnish the interesting matter we get in the *American Machinist*, who now-a-days make the names by which machines are known, if not honored, in common workshop use. The ordinary workman on this side is fast discarding his gantries, his poppets, his rings, his cogs, his pins, his knives, for the more modern bed, foot stocks, collars, gears, screws, cutters, etc.

An instance of the "power of the press": In the early days of the *American Machinist*, when it began to get distributed among the more intelligent of the shop men, there arose quite a fad for calling the drilling machine a drill press. The new name spread rapidly until discussion had shown its discordance with the real office of the machine, and now when "machine" is replacing "press" in America the new term is fast being abandoned here.

If a "mill" why not a "plane"? The Yorkshire toolmaker habitually uses "plane" as his name for planing machine, and, I fancy, would find support by analogy. If a "plane" why not a "slot" or a "gear-tooth round"? A Fellows "gear shape"? Any of these is quite as logical and equally illogical as "plane."

Over here we call a man who busies himself with mechanics a "mechanic." He is a mechanic still, though his sole work be turning, planing or other kind of machining. You in America have improved on this, calling a "machiner" (or should he be a "machine") a "machinist." And machinist being a more expressive term, it is fast growing here.

Mr. C. H. Norton may dislike the term "grinder" as an appellation for his product. It will, however, persist unless he begins to use in his literature a better (and shorter) term than "grinding machine." Might I suggest "grindor" and leave "grinder" to describe the operator.

Standardizing the Use of Suffixes

Or would it be preferable to standardize the use of the different suffixes we have expressive such as "he who," "that which," and so on: as "er," or "ar," and "ist" or "ast"? There's plenty to go around and to spare. Thus: the operator would always be an "ist," as pianist, turnist, millist; the machine would generally be an "er," as miller, planer, slotter, driller; the tool would be either without suffix or would carry the suffix "or," as "drill." "mill," "saw," "reamor." But where special terms like "lathe"—different from the name of the operation—exists, one would not say "turner" for instance, but would adhere to "lathe."

There is no need to bother about terms like "turning took"; after a time someone might start the term "turnor" for example, which, if it pleased the public, would gradually become common. Such terms as "fitter," "polisher," and "assembler" could remain, for their implements are "machines" and "tools" not particularized.

The Manufacture of Single-Cylinder Gasoline Engines—II

By J. V. HUNTER
Western Editor, *American Machinist*

The special tools and methods which have been developed to expedite the manufacture of small gasoline engines in quantity lots, have materially aided in establishing the quality and reliability of this class of machinery. Attention is called to a few of the special tooling methods.

(Part I was published in our May 20 issue.)

IN THE plant of the Fuller & Johnson Manufacturing Co., Madison, Wis., the finishing of the flywheel is expeditiously accomplished on a Gisholt vertical boring machine, Fig. 16, using the two toolposts with special tools for the different cuts. The left-hand toolpost holds the tools for boring, facing and turning the hub, while in the right-hand toolpost is placed a special toolholder *A* which carries the tools for three different cuts. The first is a roughing cut on the face of the flywheel which is done by the tool *B* held in the lower section of the holder and fed downward with a feed of approximately $\frac{3}{16}$ in. per revolution. With the toolholder in the position shown, the post is moved toward the hub and the two cutters *CC* face the sides of the rim. The form cutter *D* follows and produces a smooth finishing cut on the face and rounds up the corners at the same time.

A jig, Fig. 17, mounted on ways, is provided for boring and reaming the holes for the wristpin and crankpin bearings of the connecting rod. The position of the jig *A* is regulated with reference to the spindle by means of a stop *B* mounted on the lug *C*. The drilling of the grease-cup hole, at an angle through the large end of the connecting rod, is done in the jig shown in Fig. 18, the drill being guided by the bushing in the leaf *A* which may be swung out of the way for tapping, and for the removal of the rod.

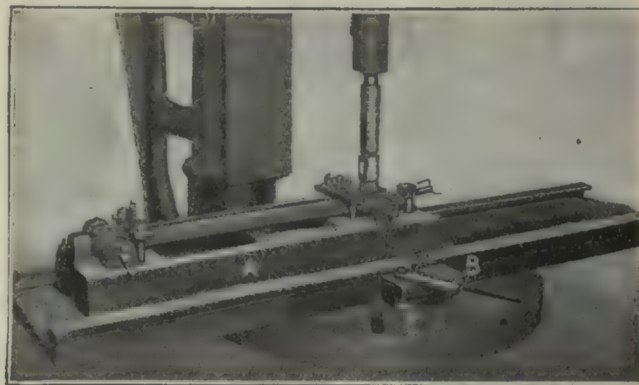


FIG. 17. SLIDING DRILL JIG FOR CONNECTING RODS

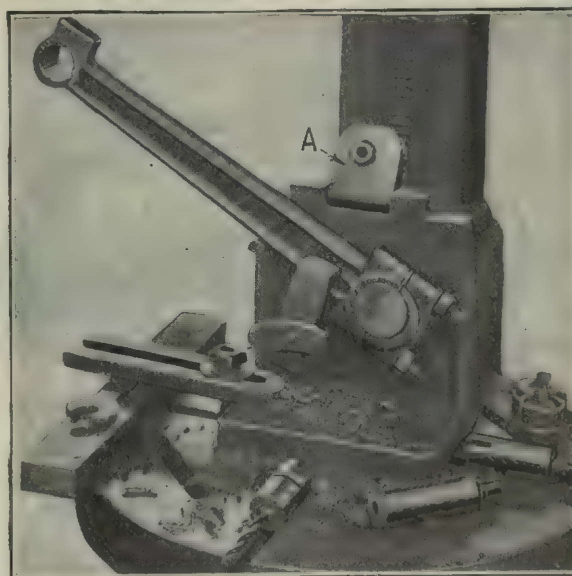


FIG. 18. JIG FOR DRILLING GREASE-CUP HOLE

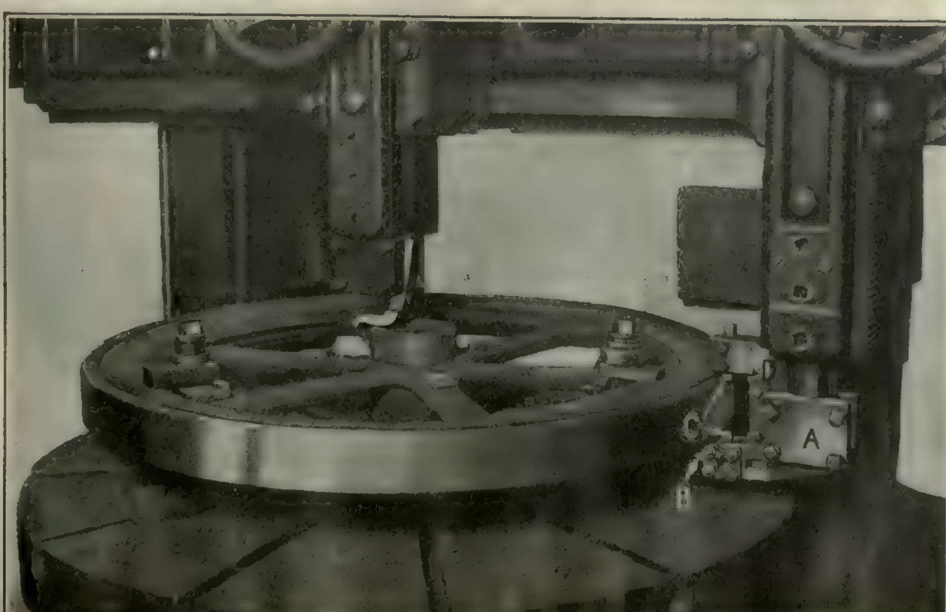


FIG. 16. SPECIAL BORING MILL TOOLS FOR TURNING FLYWHEELS

Fig. 19 shows the finish-turning operation on the crankpin of the crankshaft which is mounted in the throw blocks *A*. The struts *B* are provided to compensate any undue stress while turning, while the narrow finishing tool *C* is supported by the small jackscrew *D*.

The crankpins of the smaller sizes of crankshafts are turned in a lathe equipped for this purpose. A long extension head *A*, Fig. 20, is mounted on the headstock of the lathe and is supported by the out-board bearing *B*. The head is arranged to take various chucks *C*, in which are steel bushings *D* correctly spaced from the center of the headstock spindle for

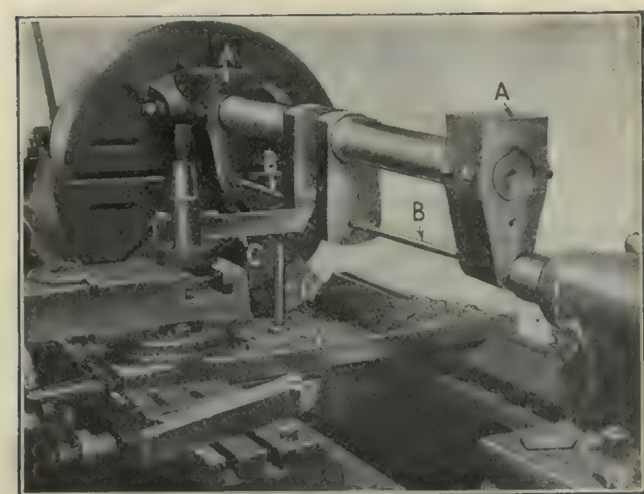


FIG. 19. TURNING CRANKPIN BEARINGS OF LARGE CRANKSHAFTS

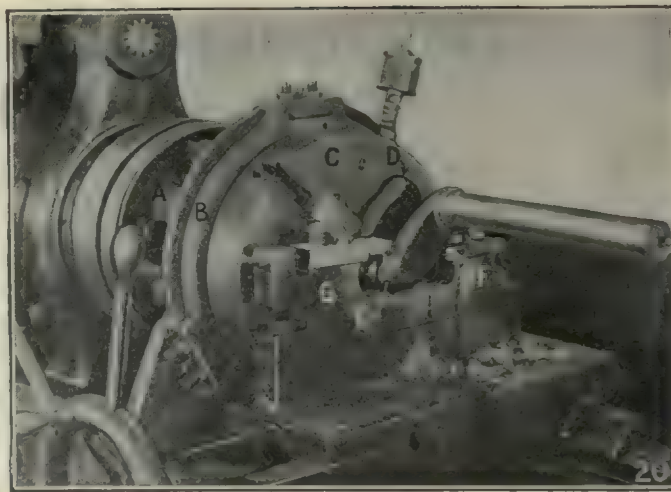


FIG. 20. SPECIAL CRANKPIN LATHE FOR SMALL SHAFTS

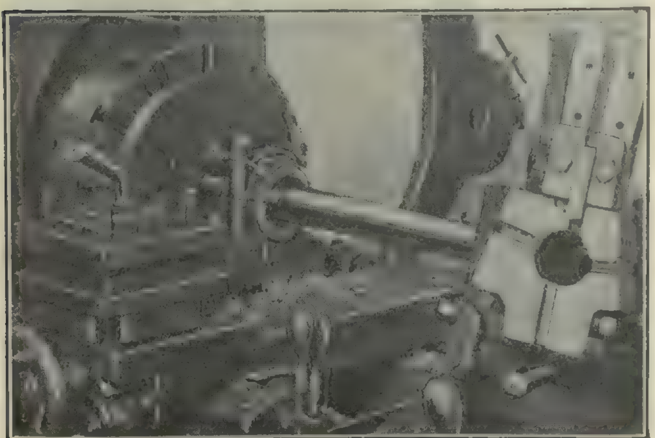


FIG. 21. BORING BEARINGS ON A TURRET LATHE

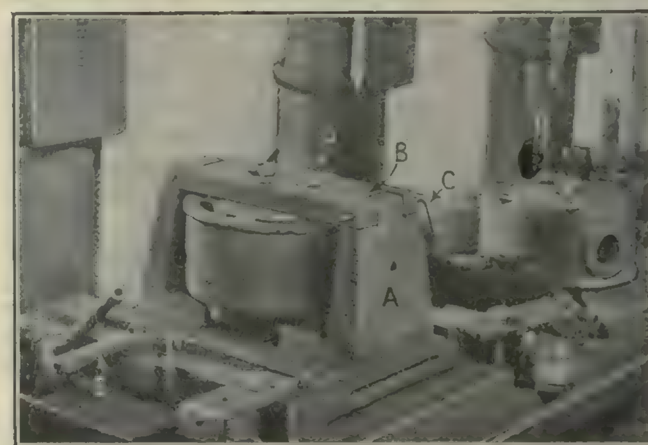


FIG. 22. SLIDING DRILL JIG FOR CYLINDER HEADS

the throw of different cranks. The turning is accomplished by an overslung roughing tool *E* and a formed finishing tool *F*, which are carried on the special cross-slide *G* that is attached to the special lathe carriage.

Satisfactory results in point of accuracy and finish have been obtained and it has not been found necessary to grind the cranks after the finishing cut.

Fig. 21 shows the manner in which the brass- and babbitt-lined bearing blocks *A* of the larger engines are bored and reamed by suitable tools carried in the turret head of a Gisholt turret lathe.

The cylinder heads are machined in a turret lathe and are then transferred to a gang drilling machine, Fig. 22, for the various operations of drilling the valve and cap bolt holes. The drill jig *A*, somewhat similar to the one used on the connecting-rod job, is provided with a hinged bushing plate *B*, which is held in place by the locking pin *C*. The drill is guided by the bushing *D*, and the jig located in drilling position by means of the spring-actuated stops *E*.

Grinding the Valves

The grinding of the valve seats in the cylinder heads is accomplished by a special valve-grinding

FIG. 24. GROUP ASSEMBLY FOR ENGINES

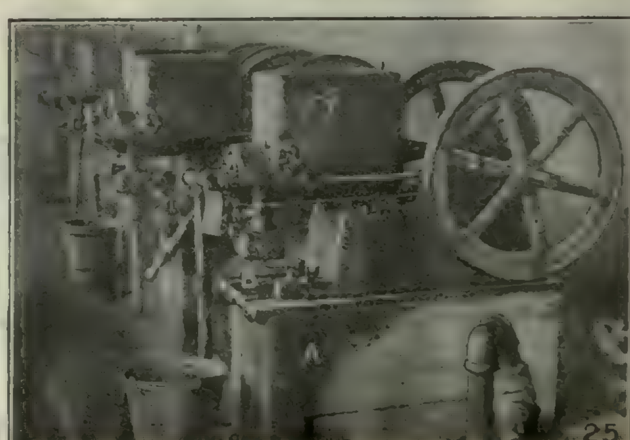


FIG. 25. TESTING THE COMPLETED ENGINES

machine, Fig. 23, which was designed and built in this shop. This work is expedited by handling three cylinder heads and grinding the two valves contained in each head in the same set-up. The cylinder heads *A* are mounted on suitable wood blocks *B* and at the position *C* both grinding spindles are in position and ready for operation. At *D* one spindle is in place and the other one is in position for the removal of the work. The spindles are raised or lowered by means of the lever *E*. The valve heads are slotted to take the screwdriver bits which transmit the rotary reversing motion of the spindles during the grinding operation. This motion is obtained by means of a reciprocating rack and gear drive mounted behind the guard *F* and operated by a crank which is connected to a belt-driven gear inclosed in the housing *G*. The rack reciprocates rapidly and practically gives the spindles a complete revolution in each direction. While this motion is being given to the valves, a worm gear driven by the belt *H* slowly revolves the camshaft *I*. Cams on this shaft operate the plungers *J* which lift the valves momentarily from their seats in the cylinder head, thus eliminating the possibility of having grooved and leaking valves.

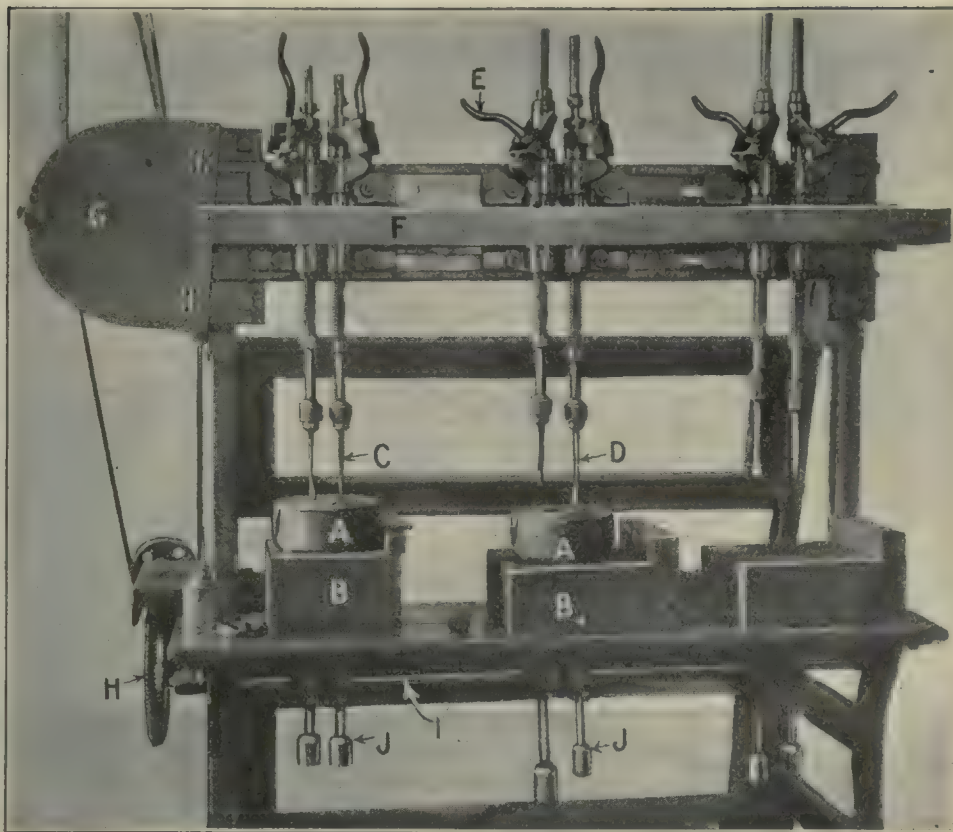


FIG. 23. MACHINE FOR GRINDING VALVES

Fig. 24 shows a row of engine beds of the same type mounted on work benches in the assembling room. In assembling, the assemblers pass from one unit to another, performing on each a single operation of a sequence through the entire lot before passing on to the next operation.

The Final Test

A foundation, Fig. 25, is provided for mounting the engines in the testing room. This consists of a monolithic concrete block *A*, upon the top of which is mounted a cast-iron bed *B*, which is provided with T-slots. The engines on test are connected to an underground exhaust system which keeps the air of the testing room clear and free from the products of combustion and in proper condition for the health of the employees.

Through Trade Routes Essential to Foreign Trade

"Three kinds of transportation are now required by our foreign trade," said R. M. Calkins, vice-president of the C. M. & St. P. Ry., in addressing the Foreign Trade Convention at San Francisco, May 12. "The transportation of thought by wire or wireless; the transportation of communications and statements by letter, and the transportation of passengers and cargo by railroad and steamship lines; and the best results can only be obtained by the unification of all three into prompt, regular and dependable service.

"It seems to me that the simple and yet indispensable things in connection with the building up of our foreign commerce have been given the least attention of all. In the first place, the American citizen, in spite of the vast mileage included in his own country, is usually alarmed by great distances.

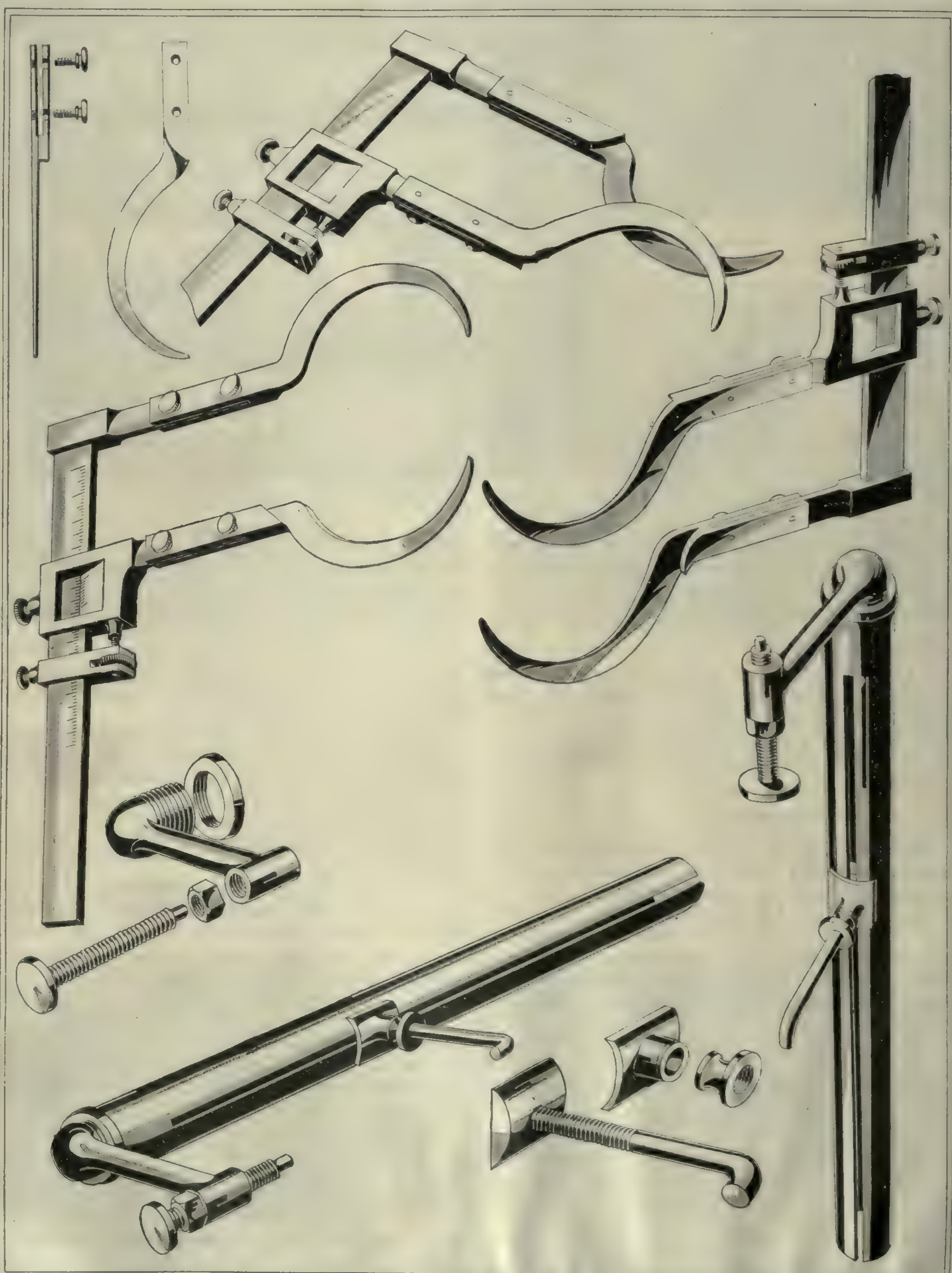
"When transportation and communication shall have been established on all well-known trade routes, advertised thoroughly through the various channels open to the organization operating over these trade routes, the buyer and seller of raw material or manufactured article will in the natural course of business be promptly brought together.

"In mapping out and establishing the through trade routes, they should be closely allied with the principal railway lines of the country. In fact, there should be a very close working arrangement between the railroad and the shipping interests to the end that through rates and fares between foreign ports and all principal American centers be established and published, and through bills of lading and tickets be obtainable. The wharfage or terminal charge on all through business should be uniform at all of our principal ports.

"More elasticity should be given to the adjustment of these joint water and rail rates. We must not lose sight of the fact that, in the handling of this foreign commerce, we will at all times be subjected to the keenest foreign competition with water rates which will not be subjected to regulation but will, in all likelihood, be based upon the principle of what the business will stand."

FOR SMALL SHOPS and ALL SHOPS

By J. A. Lucas



Problems of Industry and Trade

[Interviews with Men Who Know Conditions]

By C. W. Park

An Interview With B. B. Quillen

B. B. QUILLEN

Changes in the circumstances influencing production are so rapid that they cannot be reduced to a rigid classification. The historian of the reconstruction period may write an interesting story later, when all the evidence is in. Just now, the most significant facts and the most helpful suggestions come direct from the men who are engaged in actual production day by day. These men are too busy making industrial history to comment at length, but what they have to say is well worth reading. From time to time the "American Machinist" will publish interviews with prominent manufacturers and others on subjects of current interest.

"I HAVE no faith in artificial methods of stimulating production," said B. B. Quillen of the Cincinnati Planer Company, the other day, in discussing some of the efforts now being made to increase the output of American manufacturers. "As soon as 'production' becomes a catchword, like 'efficiency' or 'the high cost of living,' look out for it. The production of talk is about all that will result. Somebody will start a 'movement,' or make an investigation, or adopt a set of resolutions, and there the matter will end. We can't depend on enthusiasm alone to work ourselves up to a high pitch of production, and even if we could, it would not mean a healthy industrial condition, or a solid foundation on which to build for the future."

"What do you consider the *natural* means of increasing production?" Mr. Quillen was asked.

"Opportunity for the individual. The individual firm under free competition, and the individual employee under free working conditions, will be sure to increase their output. They will do this, not because more production is a fad or a slogan, but because it is to their advantage. The only things that hinder maximum production are those that interfere with the legitimate ambition of the firm or the workman for increased earnings. By 'earnings,' of course, I mean something fairly earned, and not mere income or profit.

Factors Which Discourage Larger Outputs

"Just now there are a good many factors which discourage a larger output. One trouble is a shortage of labor, both skilled and unskilled. In the machine tool industry we need to develop a larger force of trained workmen. An improved apprentice system will help, especially where it can be combined with a continuation school. In plants employing 250 or more, the vestibule school affords the best means of training skilled workers. If working conditions are favorable, a large proportion of the men trained will become permanent employees. On those who go elsewhere, the time will not have been wasted, for we owe it to the industry to train new men. Also, it should not be forgotten that a man who has learned to operate a certain type of machine becomes a good advertiser for it."

"Where will you get the unskilled labor?"

"Personally, I am in favor of encouraging desirable immigrants to come to this country as fast as they can safely be absorbed. This will insure a steady supply of labor, now much needed for construction, manufacturing, agriculture, and many other purposes."

"How much this influx of foreigners affect the American worker?" was another question asked.

"It would gradually raise him to higher levels of skill, responsibility and earning power; that is, if he had the ambition and ability to work ahead. If he hadn't, his position would at least be no worse.

"Besides the shortage of labor, a big hindrance to production just now is the widespread unrest. This is not confined to industry, but affects business and other interests at the same time. In part, too, the unrest is caused by underproduction and the consequent rise in prices. This situation creates a vicious cycle, with underproduction causing unrest, and unrest cutting down production.

"Although in this sense the restless attitude of labor is part of a general condition, there is no doubt that in many instances the main trouble has been the outside agitator. In so far as he is able to persuade some men that their employer is their natural enemy, he succeeds in slowing down production. His followers are usually a small minority, and are likely to be well organized and capable of embarrassing the loyal majority. Anyway, destructive activity is easier than constructive."

"What would you suggest as the best means of improving industrial conditions?"

Bonus System Helps

"I haven't any patented remedy. For one thing, we must distinguish between the present highly abnormal situation and the general question of justice between employer and employee. A permanent labor policy must include for one thing some means of giving every worker a direct interest in production. The bonus system seems to me the best plan yet devised for handling this problem in the shop. For the office force, including all employees holding responsible positions, I believe an extra reward based on the firm's output for a given period should be paid. This is what I meant awhile ago by individual opportunity. It emphasizes the employee's interest in the firm, to the mutual benefit of both. I don't know what the details of the best solution for the labor problem will be, but I feel sure that one of the most important principles will be that which guarantees the worker a right to profit in proportion to his individual skill and effort."

Oil-Electric Propulsion for Vessels

The yacht "Elfay"—the first yacht to be driven by the Diesel electric system of propulsion—left New London Jan. 15 for Cuba, Bermuda, and other Southern ports.

This vessel, originally the "Katoura," was built by Herreshoff in 1914. She is essentially a sailing schooner, 152 ft. over all, 30 ft. beam, and 313 tons gross. Her present owner, desiring to install auxiliary propelling apparatus, decided on the most modern variety. Her propelling equipment consists of a 6-cylinder 115-hp., model 54 Winton-Diesel oil engine direct connected to a 75-kw. Westinghouse generator. This supplies power to a 90-hp. Westinghouse motor, of 360 r.p.m., direct connected to the propeller.

FIG. 1. THE DECK CONTROL

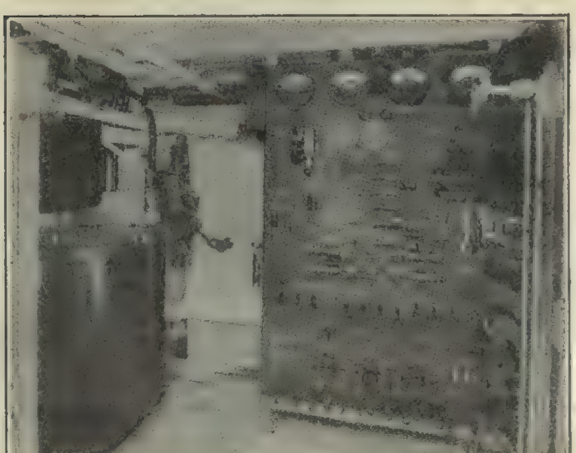


FIG. 2. THE SWITCHBOARD

The control of this motor is centered in a single handle located on the deck. By turning this handle in one direction, the propeller motor is started from rest and brought through several steps up to full speed ahead. By turning the control handle in the reverse direction, the motor is reversed in a similar manner, and the change from full speed ahead to full speed astern can be effected in 5 sec. There are no signals to the engine room and the officer in charge has full control of the propelling equipment. A set of meters gives the navigator full information as to the performance of the machinery.

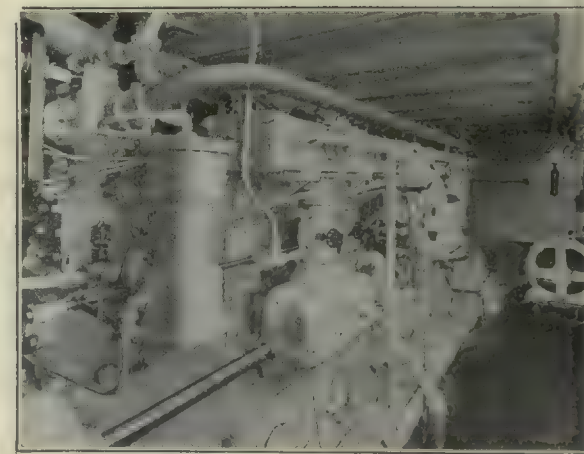


FIG. 3. THE WINTON-DIESEL ENGINE

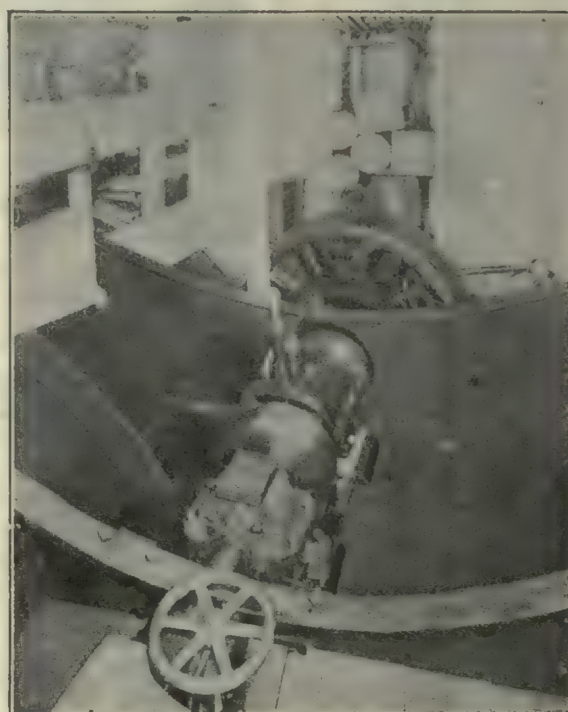


FIG. 4. CLUTCH CONNECTING MOTOR AND PROPELLER SHAFT

This simplicity of control is due to the fact that the controller handles neither the main engine nor the main motor current, but only the small generator-field current. The engine itself is operated from the engine room, but is merely kept going at normal speed in one direction only.

All of the auxiliary equipment of the "Elfay" is electrically operated, including the winches, pumps, fans, blowers, ice machines, etc. She is also electrically heated, but cooking is done by an oil range supplied with electrically pumped oil.

The "Elfay" will depend mainly on her sails, but she has a cruising radius of 2,000 miles on her motor

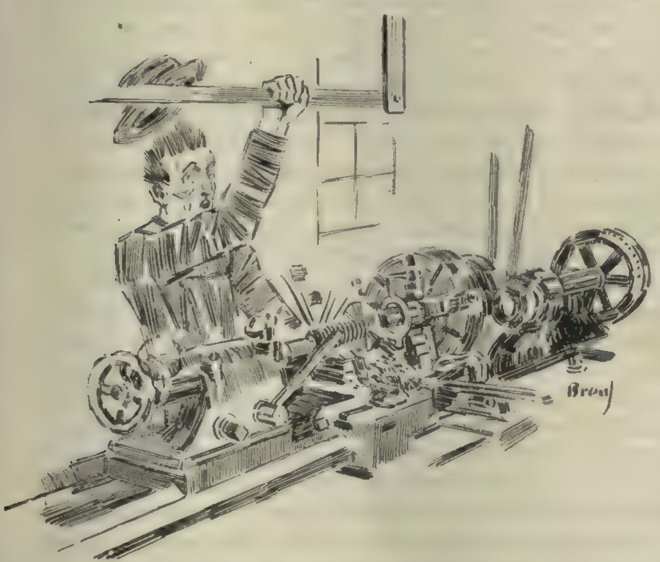
drive, since she can carry 2,400 gal. of fuel oil and consumes $7\frac{1}{2}$ gal. per hour. Her speed at the full power of the motor is $8\frac{1}{2}$ knots.

Which Side Do You Stand On?

By F. M. A'Hearn

Answering the above question, which was raised by Sandy Copeland on page 1064, Vol. 51, of the *American Machinist*, it is the belief of the writer that the operator stands at the right side of a planer when operating it, and that the operating side is commonly recognized as the right side.

Some of the older makes of planers were operated



from the opposite side, one in particular that I have in mind was built by J. H. Gage, Nassau, N. H.

The builders of double-head lathes, such as locomotive driving wheel and car wheel lathes, usually refer to the movable head, which is to the right of the operator as he faces the machine, as the "right-hand head." The same practice seems to be followed by builders of boring and turning mills.

The crank-shaping machines leave room for arguments as two well-known machine-tool builders manufacture traverse-head crank-shaping machines commonly known as double-head shapers, having a long bed with a head operating from each end to the center or even past it, each head having its own drive and feed works entirely independent of the other and usually an operator for each end of the machine. I believe that in this case the operator who works the end of the machine to the right as he faces it operates the right side or the right end, and also believe that the single-head shaper, which I assume Mr. Copeland refers to, is operated from the right side.

A venerable lathe which the writer was once assigned to operate, had what was called in the shop, a "left-hand carriage." This tool may have been designed by an honest Christian gentleman, but it was invariably the opinion of the luckless "goat" who had it wished on him, that the machine was premeditated with malice aforethought. The handwheel of the carriage was located at the right end of the apron, bringing the cross-feed crank to the left hand of the operator. The lead screw was carefully concealed along the back of the bed which practically prevented the operator from using the half nuts when chasing a thread.

It was always a source of entertainment to see the uninitiated victim get balled up before he trained himself to the new movements required when cutting a thread, especially when it finished close to a shoulder, as an engine-lathe hand will without thought or effort go through the motions of backing the tool away from the cut and reversing the machine at the same time.

On this lathe these habitual movements would be made with the wrong hands and the show would end with frantic clawing for the shipper and all the operating handles and knobs at the same time, while the tool was "Marching Through Georgia," ruining the job and the foreman's disposition.

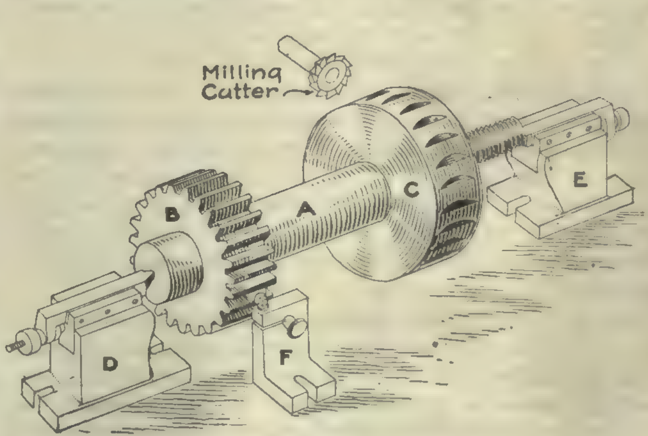
The suggestion and advice offered by near-by workmen at this stage depended on how husky the new guy looked, or didn't look, for verily sometimes "Silence is Golden."

A Simple Indexing Device

By I. B. Rich

A friend of mine who runs a small shop, recently had some accurate indexing to do in order to cut a number of pockets in a brass casting. These had to be accurately spaced on account of the necessity for securing as perfect balance as possible in the completed instrument. In order to avoid the possibility of backlash in the indexing head, he rigged up the following simple device on a plain milling machine. Turning up an accurate mandrel *A*, he made substantial centers in both ends and fastened an accurately cut 24-tooth gear at *B*.

The other end was turned down true with the centers, and provided with a nut and collar for holding



A SIMPLE INDEXING DEVICE

the piece to be milled as at *C*. These were then placed between a pair of plain milling machine centers as shown at *D* and *E*. The angle plate *F* carries the index pin *G* which was carefully shaped to fit and hold the indexing gear rigidly in position while the cut was being milled in the casting. The screw *H* clamped the index pin rigidly in position at each indexing. This simple arrangement was found to be quicker than an indexing head and it also entirely avoided the possibility of incorrect indexing, as, even if the operator missed a tooth, it was only necessary to come back to it, while missing the count on an index plate might spoil the casting.

Knowing Your Insurance Policy—IV

BY CHESLA C. SHERLOCK

"Honesty is the best policy" might be changed, for insurance purposes, into "Honesty produces the best policy." When both the insurer and the assured are entirely truthful in their dealings with each other an insurance policy that is capable of giving real protection is nearly certain to result. The differences between representations and warranties in insurance policies are not generally understood. What the law in different states has held regarding these matters is carefully treated in this discussion, quotations from many decisions being used to develop the thought.

(Part III was published in our May 20 issue.)

Representation and Warranties

THE effect of representations and warranties or their breach upon the contract of insurance is a matter of utmost importance to the insured. If he makes a misrepresentation in order to secure an insurance policy, or assents to a warranty which is incorporated into the policy and then is guilty of noncompliance with it, what effect will this have upon the contract and the rights thereunder?

There has always been more or less confusion as to the meaning of the terms "representation" and "warranty" and the distinction between the two. Some are of the opinion that they are one and the same thing, while others confess that they haven't the slightest idea as to what they mean. No one need be ashamed of himself on this score, for a great many of the courts confuse the terms at times and seem to have only a meager idea as to the real meaning of them.

Joyce defines a representation as "an oral or written statement which precedes the contract of insurance, and is no part thereof, unless it be otherwise stipulated, made by the assured or his authorized agent to the underwriter or his authorized agent, and relates to facts necessary to enable the underwriter to form his judgment whether he will accept the risk and at what premium."

The same authority defines an express warranty as follows: "An express warranty is a particular stipulation inserted on the face of the policy or clearly embodied therein as a part thereof by proper words of reference whereby the assured agrees that certain facts are or shall be true, or that certain acts have been or shall be done, and upon the literal truth or exact fulfilment of which stipulation concerning the same the validity of the contract depends. . . . A warranty may relate to the past, present, or future, or each or all."

Chief Difference Between Representation and Warranty

One can readily see that there is a big distinction between representations and warranties. The one is not a part of the contract but relates to facts and circumstances arising at the time the contract is proposed, while the other is an express part of the contract and usually a condition precedent to the contract itself and the liability of the insurer.

McArthur draws this distinction between the two: "A representation differs from an express warranty in this respect, viz.: That the former does not and the latter does, appear in the policy. A statement which, if collateral to the policy only amounts to a representation, acquires the force of a warranty if inserted in the instrument."

Ellis, another authority, states: "There is a material difference between a representation and a warranty; a warranty is always a part of the written policy, and must appear upon the face of it; but a representation is only a matter of collateral information on the subject of the insurance, and makes no part of the policy. A warranty must be strictly and literally complied with; but it is sufficient if a representation be substantially correct."

In an Oklahoma case, it was pointed out that fraud is the ground upon which a contract is made void by a misrepresentation while noncompliance with a warranty operates as an express breach of the contract.

Another authority points out the instances when a representation is material to the contract: "A representation in insurance is in the nature of a collateral contract, either by writing or not inserted in the policy or by parol, and is a communication of facts and circumstances relative to the insurance made to the underwriters, with a view to enable them to estimate the risk and calculate the premium to be paid. A representation is said to be material when it communicates any fact or circumstance that may be reasonably supposed to influence the judgment of the underwriters in undertaking the risk or calculating the premium, and whatever may be the form of expression used by the insured or his agent in making a representation, if it have the effect of imposing upon or misleading the underwriter, it will be material and fatal to the contract."

Material Facts in the Contract

The United States Supreme Court has said that to constitute a representation there should be an affirmation, or denial of some fact, or an allegation which would plainly lead the mind to the same conclusion.

The point to be made here is that the person seeking insurance should be most careful as to the statements or representations that he makes. If they are as to matters irrelevant to the life of the contract they will not invalidate it, but if they are as to matters which are material to the contract and the risk which the insurer is about to assume, they will certainly invalidate the contract of insurance and the assured is in the position of having talked himself out of court by his failure to adhere to the facts.

Where the representation is substantially correct and it is not to be deemed as a part of the expressed contract, it will have no effect upon the policy, but where it is stipulated as a part of the contract, it becomes a warranty and it must be literally true, or literally complied with, if the assured is to hold the insurer to the policy.

A representation may be either oral or written, but it is not a part of the policy; a warranty is always written and it is a part of the policy itself, and must be written

on the face thereof, or attached to a part of the policy and a specific reference made to it in the policy itself.

A representation *per se* is always collateral to the contract and is not of the essence of the contract. Flanders, in his work on Fire Insurance, states: "A representation precedes the contract of insurance, and is not a part of it. . . . A warranty is a part of the contract, and must be exactly and literally fulfilled. . . . A warranty is a binding agreement that the facts stated are true. The assured by his warranty engages that whatever may be the condition of things when he makes his application, the facts shall be as warranted when the policy attaches."

Misrepresentation of a Material Fact

In a New York case, the following was brought out: "In an application and a policy the statements of the assured were declared to be warranties and the basis of the contract, but in other parts of the application it was stated, in substance, that nothing but fraud or intentional mis-statements would void the policy, and that payment of the sum assured would be contested only in case of fraud. It was held that the statements were not to be regarded as warranties, and that to sustain a defense to an action on the policy, the defendant must show that not only the statements were untrue, but that they were known to the insured so to be, and that they were made intentionally and with a fraudulent design."

As to when the misrepresentation is material so as to invalidate the contract, there is a well-defined test at law. It has been said that it must be of a fact material to the risk. But this is not always the case.

Joyce points out the true test in the following words: "While it is true that a misrepresentation will avoid the policy if it is of a fact actually material to the risk, it is not true that it must be material to the risk as such in all cases. It need not actually have any bearing upon the state or condition of the subject matter. The rule already given as to what constitutes a material fact in cases of concealment is generally applicable here. The question is, did the fact or circumstance represented or misrepresented operate to induce the insurer to accept the risk or to accept it at a less premium? If it offers a false inducement which is acted upon in either case, the insurer being misled or deceived, the representation is material."

The test, then, is: Did the misrepresentation deceive or mislead the insurer? We think that this is the true statement of the rule of law, although the fact that a representation is to a fact material to the risk will not hold the assured blameless if it is untrue.

Importance of Truth in All Statements

Those seeking insurance should learn that in making statements, even where they are merely representations, that the truth is none too good. Protection is the outstanding aim of insurance and it is with the idea of securing protection that people seek insurance contracts. They cannot hope to secure protection by fraud and deceit, for the law recognizes the right of the insurer to protection from fraud and deceit. Unless the person seeking insurance can act in good faith and without an intent to take advantage of the other by concealment or fraud, he has no more protection than he had before he induced the insurer to accept the risk. The mere fact that one has an insurance policy is not, in all cases, evidence of protection. The insurance contract is a mutual agreement and there are liabilities imposed upon the person seeking insurance just as there are rights acquired against the other party where the contract is valid and binding.

A representation that is based upon expectation, belief or opinion is not material to the risk and it cannot affect the validity of the agreement. Where the representation is as to facts which are material, and it is false, but is not relied upon by the insurer, it is not sufficient to avoid the policy. The test is whether it misled the insurer and not as to the actual fact of its falsity or mis-statement of facts.

If the insurer asks questions in the blank application form and states that they are material questions, the rule will be rigidly enforced. In one case, the court said: "Nothing can be more reasonable than that the parties entering into the contract should determine for themselves what they think to be material, and if they choose to do so, to stipulate that unless the assured shall answer a question accurately, the policy or contract which they are entering into shall be void, it is perfectly open to them to do so, and this false answer will then avoid the policy."

Rulings on Misrepresentations

Many of the states have by express legislation sought to break down the distinction between representations and warranties. In Massachusetts, the civil code provides: "No written or oral misrepresentation of warranty therein made, in the negotiation of a contract or policy of life insurance, or in the application therefor or proof of loss thereunder, shall defeat or void the policy, or prevent its attaching, unless such misrepresentation is made with actual intent to deceive, or unless the matter misrepresented increases the risk of loss."

In Connecticut, it is provided that "In all policies of insurance against loss by fire, made by companies chartered by or doing business in this state, no condition shall be valid unless stated in the body of the policy." And elsewhere, the statute states that "no statement made by the applicant for insurance not included therein shall avoid the policy or be used in any legal proceeding hereunder."

In Georgia, the code provides: "Every application for insurance must be made in the utmost good faith, and the representations contained in such application are considered as covenanted to be true by the applicant. Any variation by which the nature of extent, or character of the risk is changed will void the policy."

Again, the same statute states: "Any verbal or written representation of the facts by the assured to induce the acceptance of the risk, if material, must be true, or the policy is void. If, however, the party has no knowledge but states on the representation of others, bona fide, and so informs the insurer, the falsity of the information does not void the policy."

And again the statute in Georgia provides: "A failure to state a material fact if not done fraudulently, does not void; but the wilful concealment of such fact which would enhance the risk, will void the policy."

In Kansas, the statute provides: "No oral or written misrepresentation made by the assured or in his behalf, in the negotiation of insurance, shall be deemed material or defeat or void the policy or prevent its attaching, unless made with intent to deceive and defraud, or unless the matter misrepresented increases the risk."

In Kentucky, a statute which has been in force since 1874, reads: "All statements or descriptions in any application for a policy of insurance shall be deemed and held representations and not warranties; nor shall any misrepresentations, unless material or fraudulent, prevent a recovery on the policy."

The Louisiana Statute

In Louisiana, the statute provides: "All statements purporting to be made by the insured shall in the absence of fraud be deemed representations and not warranties. Any waiver of this section shall be void."

In Massachusetts, the court said: "But it has been decided by this court that the statute was only declaratory of the common law as to representations, but that it changed the rule as to warranties by putting them in the same category as mere representations."

In Missouri, the statute provides: "The warranty of any fact or condition hereinafter incorporated in or made a part of any fire, tornado or cyclone policy of insurance purporting to be made or assented to by assured which shall not materially affect the risk insured against, shall be deemed, taken and construed as representations only in all suits at law or in equity brought upon such policy in any of the courts of this state."

Flexibility of the Law on Warranties

The effect, as we have seen, from this quotation from representative statutes and authorities, is to prevent the insurer hiding behind any iron-clad conditions which are not strictly material to the risk or to the amount of the premium paid.

It is needless to say that there are many instances in the earlier insurance decisions where the insurer escaped his obvious liability by means of a technicality grounding in the law of warranties and representations. If the assured has been charged guilty of fraud and concealment, the insurer was equally apt and disposed to take advantage of the other party when it was to his interest to do so.

The statutes have attempted to correct this abuse of the law by lowering the bars in regard to representations and warranties just so far as they could consistently do so and still maintain justice between the parties.

Conclusion

It is well settled now, both in the statutes and in the expressions of the courts, that unless a warranty is material to the risk or to the amount of premium paid that its mis-statement will not avoid the policy any more than a mere misrepresentation will.

As we have noted in this discussion, a misrepresentation will not ordinarily void the policy unless it served to mislead the insurer and unless he acted upon it in accepting the risk. Representations which are false do not affect the policy unless they were taken to be true by the insurer and were acted upon with that thought in mind.

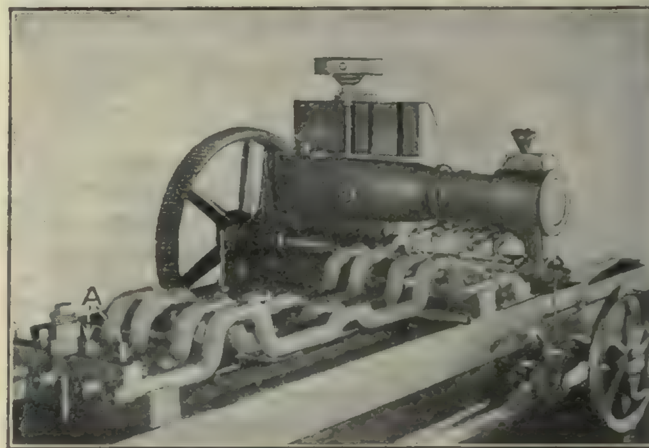
The House on the Sand

The foundations were laid by Ignorance, the bricks were cemented with blood by Carelessness, the supports were installed by Recklessness, and the decorations were by Thoughtlessness. Do you live in this house? asks the National Safety Council.

Milling Keyseats in Separator Crankshafts

By J. H. Vincent

The method used in the plant of the Minneapolis Threshing Machine Co. for milling the keyseats in their separator crankshafts is shown in the accompanying illustration. Four shafts are keyseated at a time and



MILLING KEYSEATS IN SEPARATOR CRANKSHAFTS

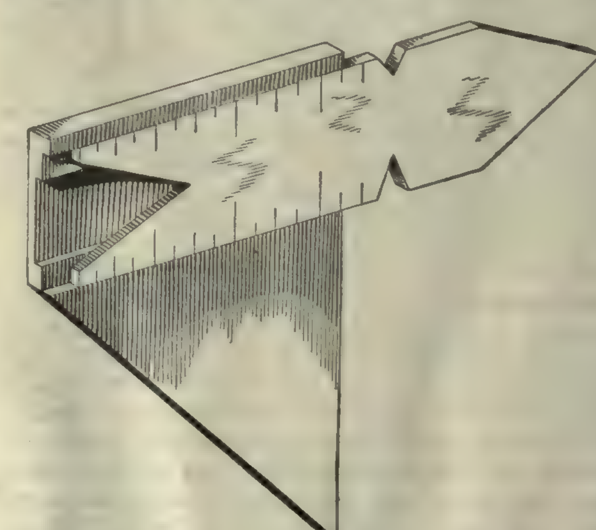
are supported at both ends in V-blocks and clamped down by crossbars which carry equalizing screws at *A*. The arbor carries four high-speed cutters which are run with a small amount of coolant. After cutting the keyseats in one end the cranks are transposed and keyseats are cut in the other end.

No special care is required in determining the position of the cut.

Attachment to Center Gage

By Roy F. Leighto

A handy little adjustment to the center gage is shown in the accompanying illustration. It can be made by anybody, and its use makes it easier to grind thread



ATTACHMENT TO CENTER GAGE

tools, either straight or at an angle. It may also assist in setting thread tools in awkward places if the angles are accurately made.

Machining the Liberty Crankcase—I.

By H. A. CARHART
Mechanical Engineer, Lincoln Motor Co., Detroit, Mich.

This article contains not only interesting examples of jigs and fixtures, but data as to the cost of hand labor and some of the problems which had to be solved in the production of Liberty motors. The hand scraping of the cases alone, with the constant shifting of men, was of itself, quite a serious problem.

ONE of the first principles in the construction of airplane-engine crankcases is to have the case thoroughly scraped on the inside so as to remove every particle of sand. So much depends upon the proper and continuous functioning of an airplane motor that no chances can be taken with the possibility of sand or other loose particles getting into the bearings. The equipment of scraping tools is shown in Fig. 1, and the scraping bench in Fig 2. This bench was designed to bring the casting at the most convenient height for the operator, but, even with this assistance, only 60 per cent of the men put on this job were able to stand the work for 90 days, and only 25 per cent of the remainder could stick to it for a longer period. The extreme physical exertion required made it necessary to constantly recruit this force, and as it required from 8 to 15 days to train an operator, this became quite a problem. The output is one case every 12 hours per operator. It will be noted that in addition to the twelve scraping tools there is also a dentist's mirror and a brush to enable the operator to see and also remove loose particles in out-of-the-way places. Previous to the scraping, the fins and other projections are removed by small air chisels. Thorough inspection follows the scraping, not only to see that it is well done but to be sure that the casting will clean up at all points. Suitable inspection gages are provided for the various vital points.

The first milling operation, as shown in Fig. 3, is done on an Ingersoll milling machine, holding six fixtures on the table. These fixtures hold the crankcases in two positions; those on one side present the cylinder flanges to the fixed angular milling cutters, while those on the other side present the joint faces of the cylinder cases. The method is to load one pair of fixtures and start the machine; while the machine is at work the next pair is loaded in the same way, and finally the third pair. The work from the first pair is removed as soon as finished and the fixtures again loaded, making this an almost continuous milling operation.

The fixtures are of the open-box type of construction, each having three hardened steel pads or equalizing points upon which the case rests. An equalizing jaw at each end clamps against the side walls of the case. Thirty-seven spring plungers, well distributed, are used to support the case and flanges while being milled. A

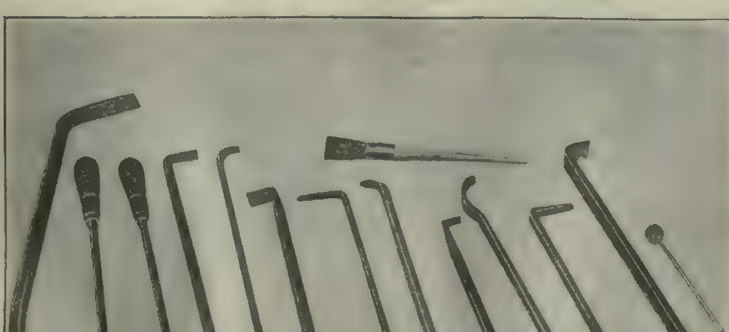


FIG. 1. THE SCRAPER'S OUTFIT

FIG. 2. THE SCRAPING BENCH

AUTOMOTIVE CONSTRUCTION

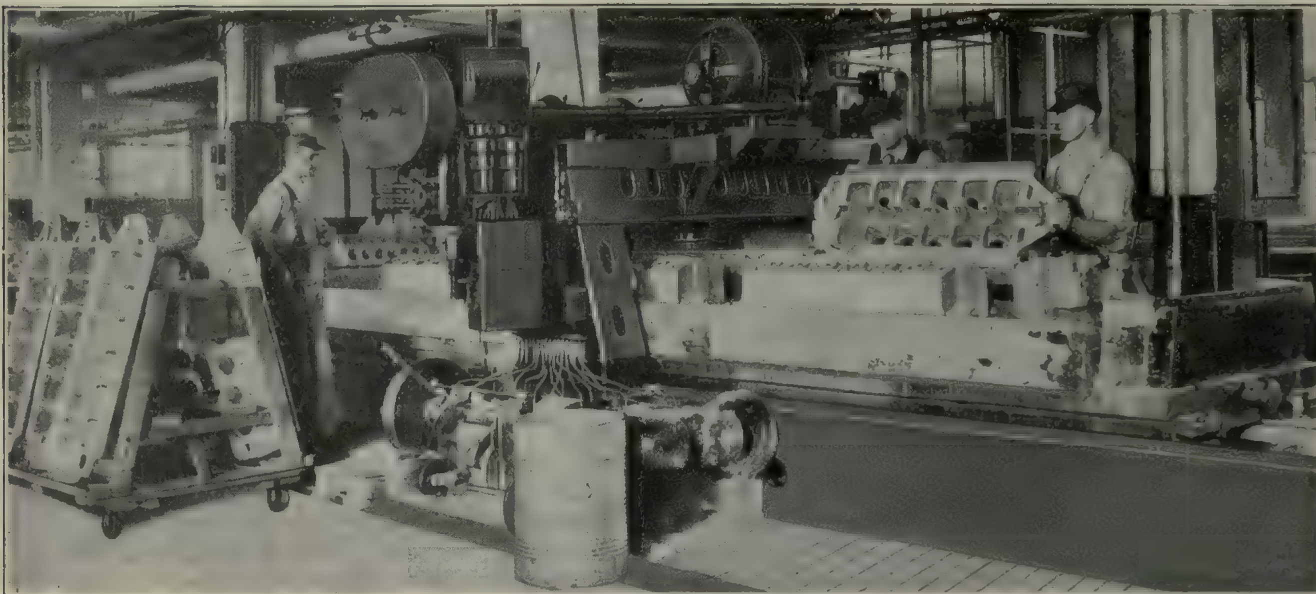


FIG. 3. MILLING THE CRANKCASE

centrally located stop screw at the rear of the fixture is used for positioning the case endwise. The case is temporarily clamped over the three equalizing points by special clamps. Then the spring plungers are released, and the case permanently clamped by four strap clamps acting against the inner cylinder walls. The temporary clamps are then removed. The other fixture on which the case is placed face down, consists of a cast-iron base having twenty-two hardened steel blocks upon which the flange rests. A centrally located pin positions the case endwise, while two hardened steel blocks on the inner side are used to locate the case sidewise, six well-distributed strap clamps holding the case in position.

Cutter Speeds and Feeds

Some of the milling data in connection with this work will be of value in other cases. The cylinder-pad facing cutters are 8 in. in diameter and have sixteen inserted high-speed steel blades. They run at 295 r.p.m. and have a feed of 14 in. per minute, removing approximately $\frac{3}{16}$ in. of metal. The cutters require regrinding approximately every eighteen pieces, which means a little oftener than once in two hours as the output is ten per hour. The lubricant is sixteen parts of water to one part of "Cutrite." The finishing cut only removes $\frac{1}{32}$ in. of stock with the cutters running 275 r.p.m. with a feed of 13 in. per minute. The difference in the amount of metal removed adds comparatively little to the life of the milling cutters, as these must be reground approximately every twenty-one cases.

After a thorough inspection the half bearings are bored on an engine lathe by the fixture and boring bar shown in Fig. 4. The case rests on six hardened-steel blocks and the boring bar is carried in four steel bushings, three of which revolve with the bar. The outer bushing remains stationary. The bar carries sixteen cutters made up of $\frac{3}{8}$-in. square steel and held in slots by means of headless setscrews. The bar has a keyway its whole length in which the keys of the three revolving bushings slide, keeping the cutters and the clearance slots in the revolving bushings always lined up. The advance cutter roughs the bore to 2.945 in. and the following cutter bores to 2.97 in. The speed of the bar is 250 r.p.m., with a feed of 0.008 in. per revolution. The cutting tools require regrinding about every sixty cases,

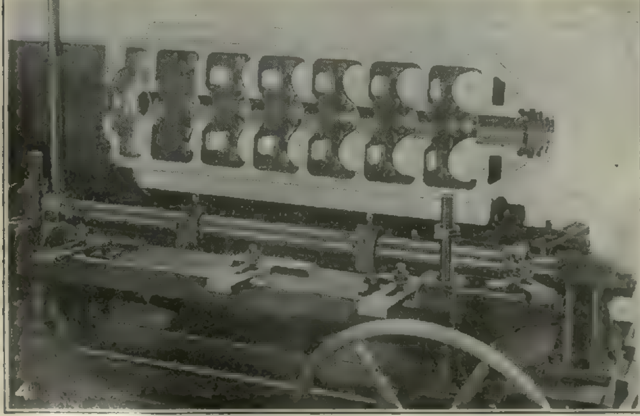


FIG. 4. BORING THE BEARINGS

FIG. 5. BORING FIXTURE FOR CAMSHAFT DRIVES

AUTOMOTIVE CONSTRUCTION

and a single machine can handle about fifteen cases per hour. The same cooling solution is used as in milling. The finish-boring to 2.985 in. is done in a similar fixture and with similar cutters.

The holes for the generator and camshaft drive are bored in the fixture shown in Fig. 5 under a vertical drilling machine. This requires very little explanation, the end of the crankshaft being clamped in the fixture, which consists of a sub-base and two standards which act as trunnions so that it can be swung into the different positions. The crankcase is located by a pilot plunger which fits the end-cylinder bore, after which the case is clamped in position.

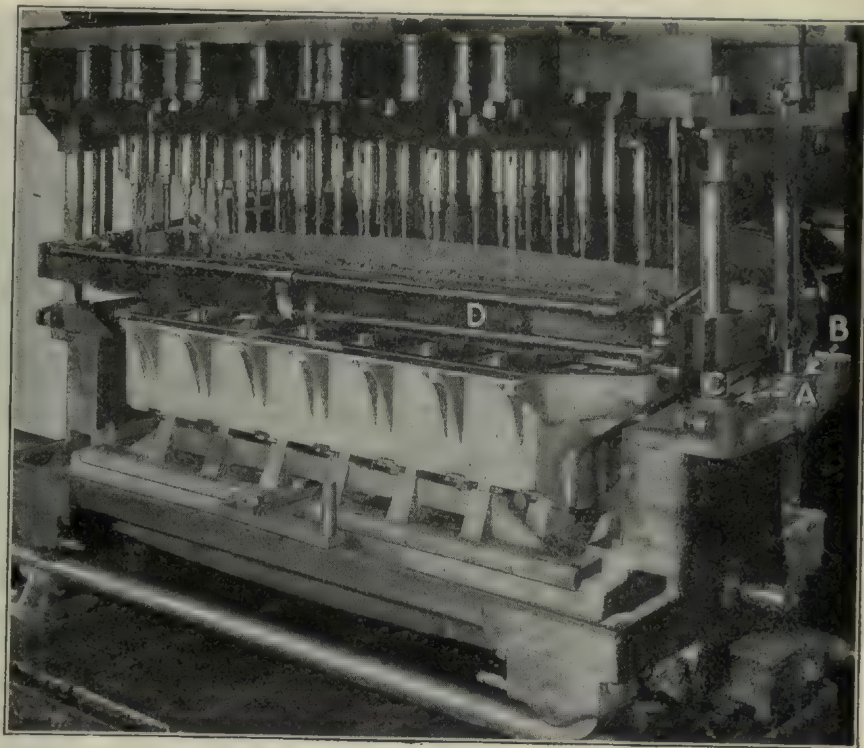


FIG. 6. DRILLING FIXTURE FOR FLANGE

The drilling fixture is shown in Fig. 6, sixty-eight spindles being utilized in this operation. There are four drilling operations which are performed on a battery of four machines by a progressive system. These machines are inclosed in a return-track system shown in Fig. 7, which consists of cold-rolled-steel shafting mounted on suitably arranged brackets. These fixtures run upon this track, being loaded at one end of the track and passing under the various machines consecutively. The fixtures are then run onto a cross-carriage at each end of the line, which transfers them back to a track in the rear of the machine, on which they can be returned to their original starting point.

Each fixture, which includes a cast-iron carriage mounted on four rollers, carries two hardened guide bushings at each end, two of these being shown at *A*

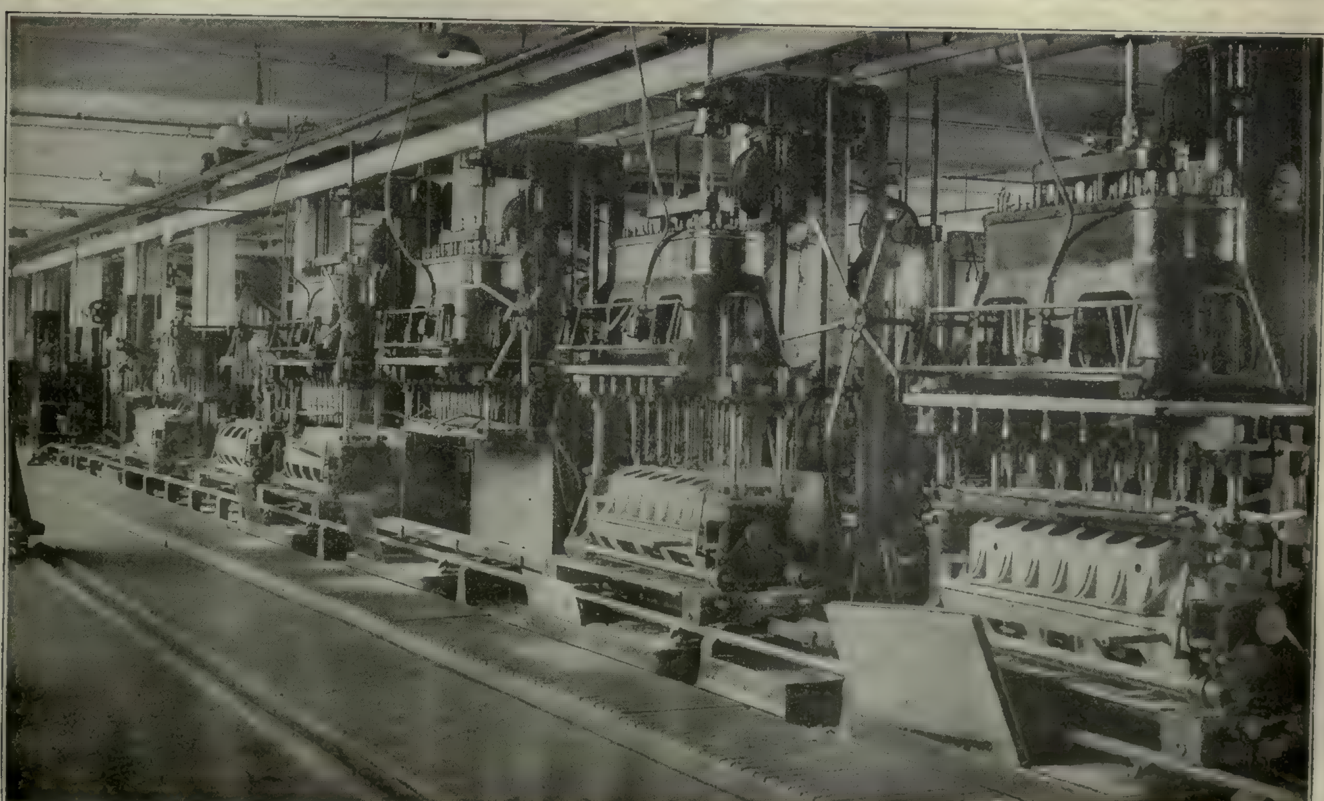


FIG. 7. THE DRILL TRACK SYSTEM

AUTOMOTIVE CONSTRUCTION

FIG. 8. DOUBLE HAND MILLING MACHINE

FIG. 9. FIXTURE FOR MILLING THE ENDS

and *B*, Fig. 6. After being loaded the carriage is rolled under the first machine and the head brought down slowly, allowing the pilot bar *C* to enter the guide bushing. A continued downward movement of the head leaves the guide plate *D*, carrying the drill bushings, in contact with the crankcase, and feeds the drills through the bushings and into the work. The drills vary in size from $\frac{9}{32}$ to $\frac{25}{64}$ in. and run at 1,200 r.p.m., the feed being 0.002 in. per revolution.

A Double Hand Milling-Machine Job

For milling the oil-filler pads on the side of the case, two No. 6 hand-milling machines are used in tandem by connecting the two tables with the cast-iron plate *A*, which makes them move as one unit, as shown in Fig. 8. The crankcase rests on the two hardened-steel bars *B* and *C*, the lugs at the back end positioning the sides of the case. The swinging cross-arm *D*, supported on a pin at *E* and carrying the two links *F* and *G*, raises the head and its milling cutter on one machine at the same time the other is lowered. This movement, combined with the backward and forward movement of the carriage, mills the oil filler pads.

Another type of fixture is shown in Fig. 9, which holds the crankcase while the nameplate on the synchronizer pad is being milled. This fixture locates the crankcase by means of the crankshaft bearings, which fit over the blocks *A* and *B*, the block *A* having lugs to locate the case endwise. The details of the operation itself are very apparent.

The drilling fixture shown in Fig. 10 is very similar to that illustrated in Fig. 6, the main difference being the addition of a rack and pinion for moving the base in and out under the bushing plate. This is an indexing jig so as to enable the holes for the cylinder studs to be drilled at their proper angle of 45 deg.

An unusual milling attachment is shown in Fig. 11. Owing to the lightness of the aluminum casting a large crankcase can be easily handled on a comparatively small machine, as shown. This is a hand milling machine and by making the fixture itself as light as possible it was easily able to handle the work as shown.

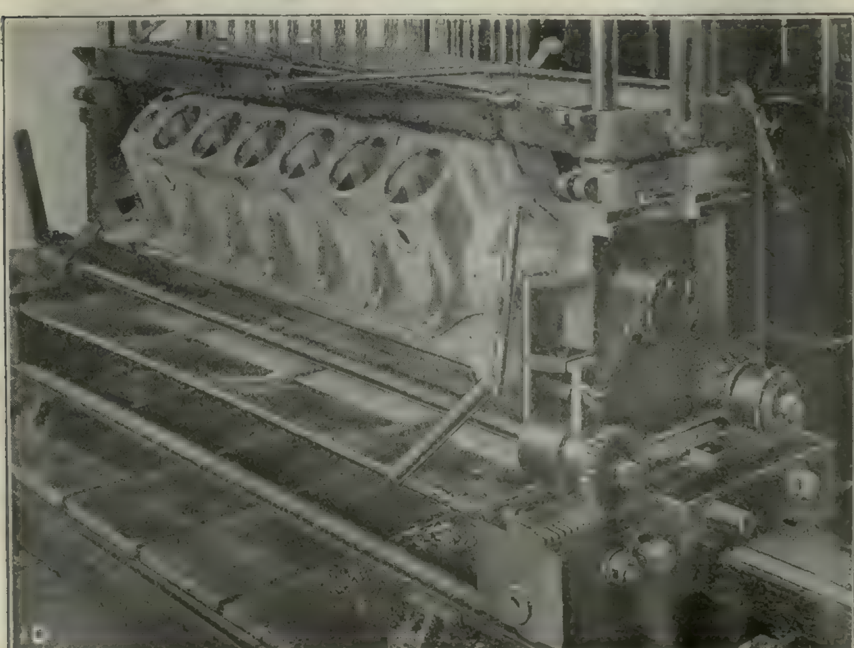


FIG. 10. DRILLING CYLINDER STUD HOLES

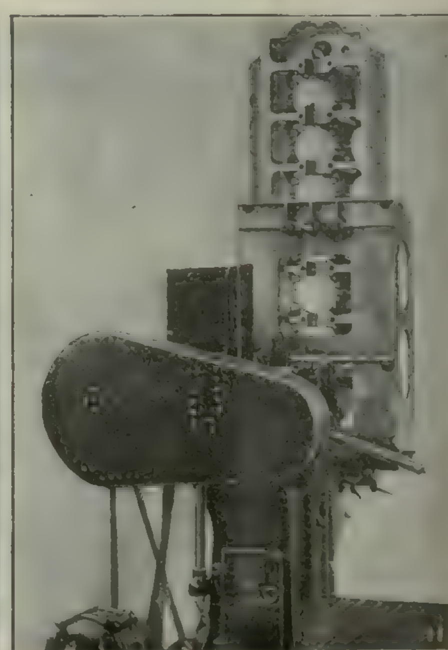


FIG. 11. UNUSUAL MILLING FIXTURE

AUTOMOTIVE CONSTRUCTION

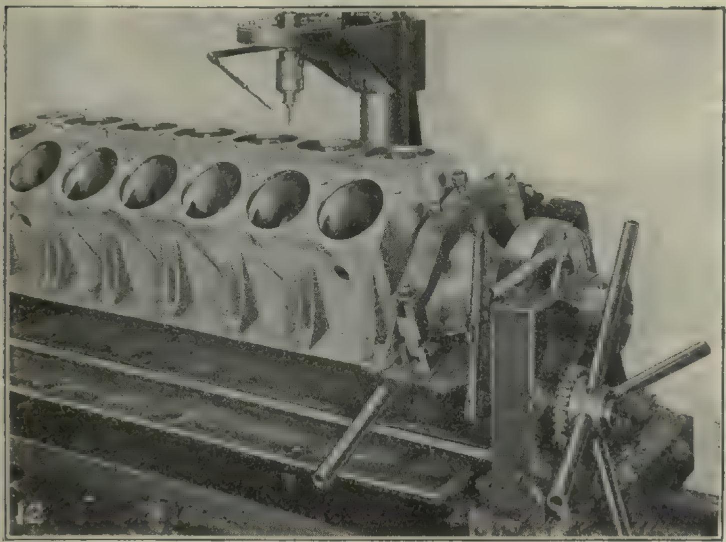


FIG. 12. FIXTURE FOR RAPID TAPPING

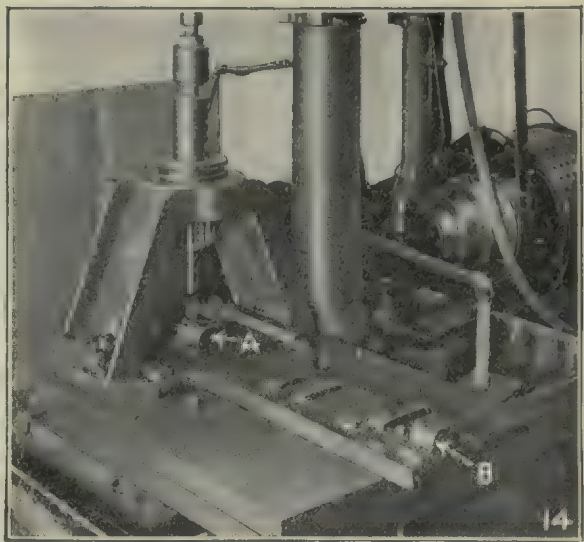


FIG. 14. BORING FOR OIL-PUMP HOLE

A convenient tapping fixture is shown in Fig. 12. The crankcase is mounted on trunnions so as to be readily swung from one position to the other, and the fixture is provided with a rack-and-pinion movement to enable the work to be moved sideways in either direction. The whole fixture is on wheels, and the rails, made of cold-rolled-steel shafting, allow it to be easily moved endwise. Details of the tap holder are shown in Fig. 13. The Oldham coupling *A* drives the floating shaft *B* which runs in the bushing *C* and drives the tap and nut. The bushing *C* is held in a spider *D*, the flange carrying a double ball bearing as shown, this ball bearing floating between the plates *EE*, which are held stationary and supported by an extension arm from the drilling-machine column.

It will be noted that there is an annular space between the hub of the spider and the plates which allows free movement in any direction. The amount of this movement, however, is limited by the play between the pin *F* and the holes in the lower plate. This device proved satisfactory and handled a large amount of tapping.

The inspection of the lower half of the Liberty motor crankcase includes a water test for leaks, a pressure of from 3 to 5 lb. being used for this purpose. It is then inspected all over to insure there being sufficient

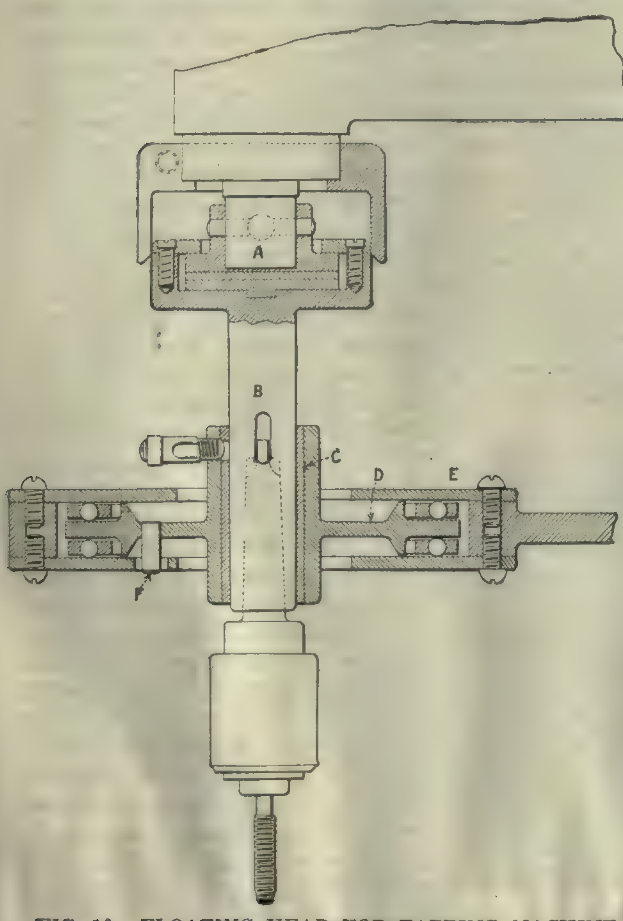


FIG. 13. FLOATING HEAD FOR TAPPING MACHINE

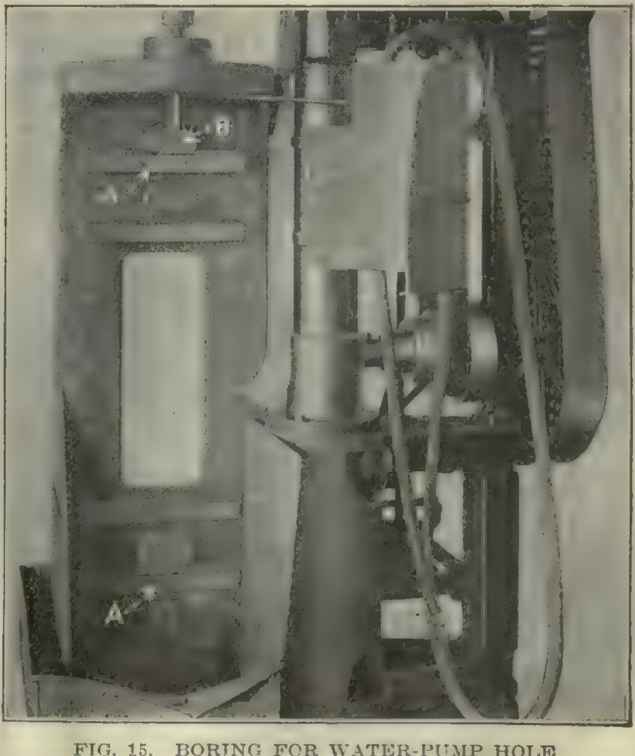


FIG. 15. BORING FOR WATER-PUMP HOLE

AUTOMOTIVE CONSTRUCTION

metal for machining at all points. Two men can water-test eighty-five cases per day, while a crew of six men can completely inspect 150 cases per day. The joint face is milled in the usual manner, fixtures having spring plungers being used for this purpose. When the first fixture is loaded the machine is started, and the second and third fixtures loaded while it is at work. The cases are, however, all removed from the fixture before reversing the table. The cutters, some of which are 9 in. in diameter, run at 235 r.p.m. with a feed of $13\frac{1}{4}$ in. per minute. These cutters remove approximately $\frac{3}{16}$ in. of stock and will usually mill twenty-four cases between grindings.

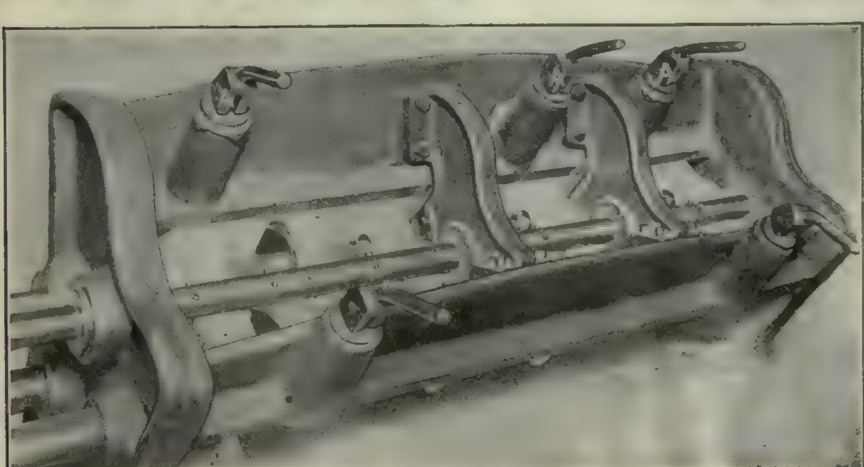
The half bearings are bored in a fixture almost identical with that shown in Fig. 4. Then after one or two minor operations the bevel-gear bearing and oil-pump hole are bored under a 25-in. sliding-head drilling machine, using the fixture shown in Fig. 14. The work is centered by means of the blocks *A* and *B*, which fit into the bearing seats. The yoke carries a heavy guide bushing for the boring tool and directly beneath is a bushing for the pilot, so as to afford a guide at both ends of the boring tool.

Another boring operation is for the water-pump hole, the fixture being shown in Fig. 15. The work rests on four hardened-steel crossbars *AA*, while at the lower end is a half-round bearing block which fits into bearing No. 7, centering the case at that end. At the upper end is a pilot *B*, which enters the bevel-gear hole previously bored. This pilot carries a hardened-steel bushing for guiding the body of the cutter by means of the pilot.

Crankcase Boring Fixture

By Frank C. Hudson

The method of boring the Franklin crankcase is to clamp the aluminum casting in the heavy fixture shown and use a single-point fly cutter for boring the bearing seats. The casting is clamped to the fixture by hook bolts operated by the cams *AA* which clamp the cylinder rigidly and quickly. The boring bars have two intermediate guides as well as those at the end, and in this way accurate alignment is insured. This is simply another example of the dependence placed on the single-point cutter when two holes are desired.



CRANKCASE BORING FIXTURE

Demountable Truck Bodies as Standard Unit Freight Containers

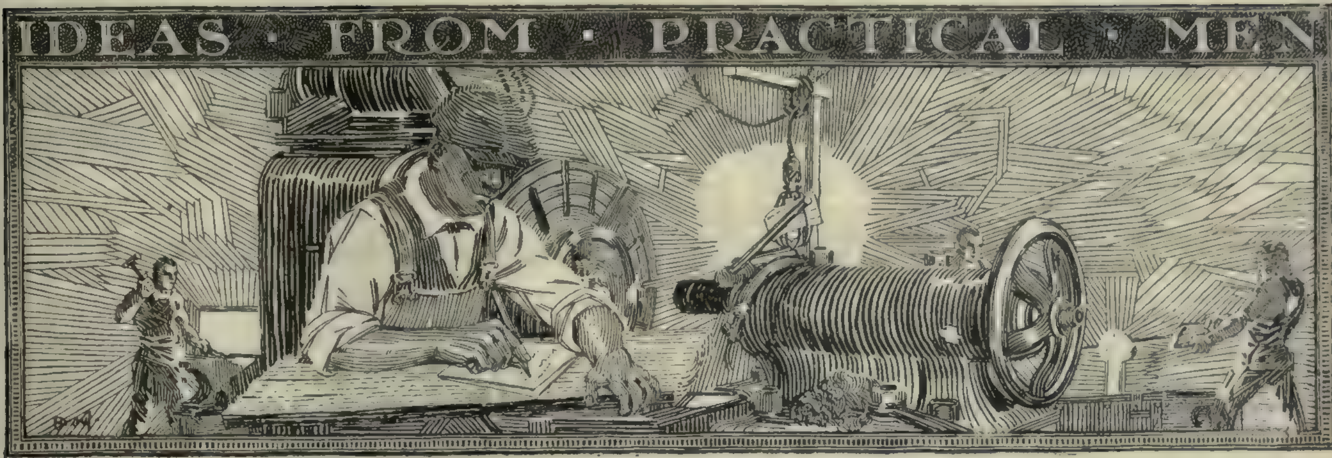
Recent changes in the cost of labor and labor's inefficiency have brought about conditions in the handling and distribution of freight which make imperative the adoption of economies. As a solution to the problem of bettering these conditions, Calvin Tomkins, president of the Material Machinery Manufacturers' Association of New York, N. Y., suggests the use of demountable truck bodies as standard unit containers for interchange between flat cars, auto trucks, warehouses and water carriers. The following is an extract from his paper:

There are many good freight-handling machines, tractors, trailers, micro-elevators, belt conveying machines, hoists, cranes, tiering machines, the efficiency and more universal use of which is being retarded by the lack of standardized unit containers. Successful handling of uniform packages is accomplished at New Orleans (where the best handling of freight in this country is done) by machinery, but little has been done to facilitate the handling of packages varying in size, form, weight, strength, construction and character of contents.

The Motor Terminals Co. service, at Cincinnati, now uses the demountable truck body for railroad transfer service between terminals, where it has been demonstrated that the necessary organization of terminals will be neither complicated nor expensive.

Labor costs of handling such standardized unit containers will represent a very small part of the present outlay necessary for the handling of miscellaneous package freight. The importance of minimizing the effect of a labor shortage for this work is self-evident when it is known that the scarcity, inefficiency and high cost of manual labor have caused the suspension of numerous coastwise services and threatened the future successful conduct of the Erie Canal, Mississippi River and the Great Lakes Services.

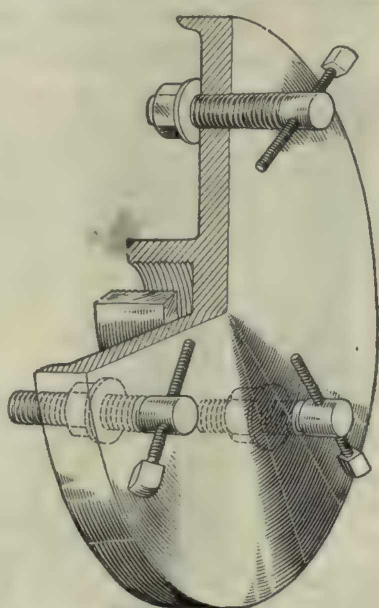
The standard container proposed is a demountable closed auto truck body, which can be readily transferred by cranes between railroad flat cars, auto chassis, warehouse floors and vessels. They should be designed so that they can be stacked on flat cars, should be weather-proof and should be arranged to contain smaller unit packages. A method would have to be devised to mark and efficiently handle the less-than-car-load and less-than-container-load shipments. Such materials as cement, sand, etc., could be loaded at the factory directly into the container and transferred directly to the point of use. Among the results of the use of unit containers such as suggested, in addition to the direct saving on handling, would be the elimination of the use of many kinds of packages such as bags, barrels, boxes and crates, and the partial elimination of the inconvenient box-car.



Adjustable Studs for the Lathe Faceplate

By H. H. Parker

The sketch shows a modification of the usual form of studs that are used for holding irregular shaped work to the lathe faceplate. They are threaded and holes are tapped into the faceplate, into which they are screwed. Locknuts and washers are provided, either at the back or the front of the faceplate, depending upon the position and shape of the work. This arrangement allows the clamping screws to be located at varying distance from the faceplate by screwing the studs in or out and locking by means of the nuts. They may also be turned to face any direction.


ADJUSTMENT STUDS FOR FACEPLATE

They can be applied to any faceplate and make a very handy means of holding irregular pieces.

Repairing a Gear with Broken Teeth

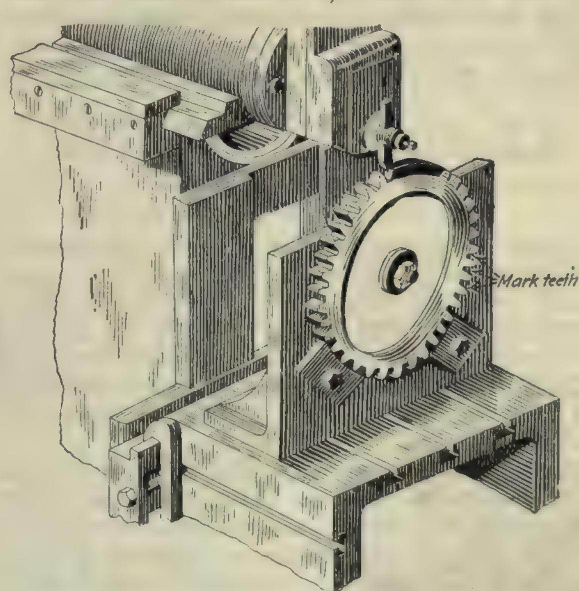
By John J. Burke

The illustration presented herewith shows a method I used to repair a gear with broken teeth.

After building up the broken space with the welding machine and finishing the top and sides, I placed the gear on an angle plate, putting two clamps under it to keep it central.

After clamping it fast with a bolt at the center, I took a sharp scriber and marked the outline of three teeth on the angle plate at one side, for use as a guide. I then ground a tool to fit the teeth and set it in one of the good teeth.

Then I raised the tool, loosened the nut at the center, and turned the wheel to the place that was welded. After making sure the lines on the angle plate matched the teeth I tightened the gear and cut the first tooth. This was repeated till all the teeth were cut. The



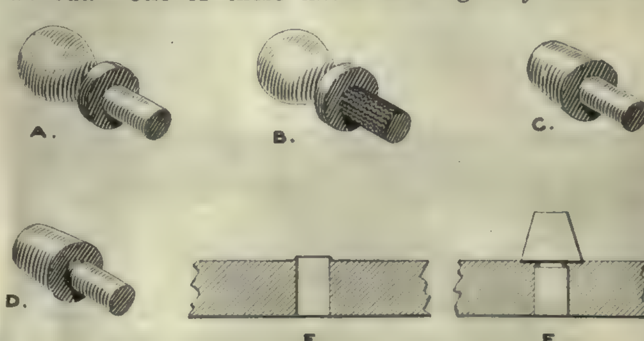
PUTTING NEW TEETH IN A BROKEN GEAR

result was a good gear with little trouble or worry. If the teeth are very coarse it might require a roughing and a finishing cut.

Methods of Holding Short Studs

By H. J. Ventner

At one time the Pullman Co. used brass butt-hinges in many places on its cars, and the vibration caused the small knob, which goes in the bottom of the butt, to fall out. One of these knobs as originally made is



METHODS OF HOLDING SHORT STUDS

shown at A in the illustration, and these were lost in such large numbers that the screw-machine shop received orders for 50,000 of them at a time.

Finally the scheme of knurling the stud end, as show at B, was hit upon with the outside of the knurling large enough to be a tight driving fit for the hole in the butt. This change seemed to turn the trick for the replacement orders rapidly grew smaller in quantity and less frequent in occurence, so that finally the small production caused the superintendent to kick about the increasing cost of the individual pieces.

The man who told me about this went on to say that he had applied a different kink to his own work, for he had some studs which he had been making as at C and driving them into the plates in which they were used. The studs were made as at D with a small groove turned just below the head. The plates were drilled from the reverse side to that in which the studs were driven so that the burr from drilling stood up from the top face as at E, then when the stud D was driven into this hole the small burr was turned down by its head into the groove as at F. The clinching of the burr in this manner was sufficient to hold the studs tightly.

A Drill for Use in Cored Holes

By S. J. Bedford
Morse Twist Drill and Machine Co.

On page 738 in the April 1 issue of the *American Machinist* there is an article telling how an expert mechanic overcame some of his troubles in drilling cored holes. With this article a sketch was given of the improvised drill that was used in doing the work. The article was especially interesting because the Morse Twist Drill Co. had arrived at the same solution some time before.

In April, 1913, a representative of that company was sent to the Middle West to investigate some trouble which one of the large companies was having with drills. He found that they had used all kinds of forged and milled drills, but without the results that they had hoped to accomplish, their particular trouble being breakage, caused partly in drilling cored holes, and in some instances by non-alignment of the pieces to be drilled.

It was suggested that these people use either three- or four-groove drills, but their superintendent did not look upon this suggestion with favor, because he wanted drills that would work in solid stock as well as in cored work.

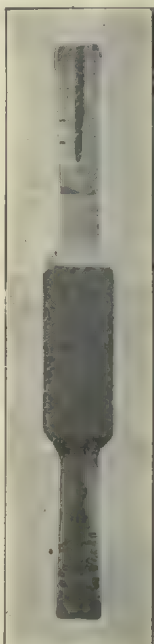
After giving the matter some thought the suggestion was made that special two-lipped drills be used, these being cleared in such a way that there would be a bearing on both edges of the land, that is, on the cutting face and on the rear edge or heel. There were some special drills of this description made at that time, the accompanying figure being a photograph of one of the original drills made in April, 1913. These drills were tried out and the results obtained were even better than anticipated.

TWIST DRILL WITH BEARING ON BOTH EDGES OF THE LAND

Changing a Scrapped Press Into an Efficient Slotter

By Peter F. O'Shea

Old machines no longer needed for their original purpose may often be converted into special tools, especially if the foreman is awake to the needs of his shop. In one of the factories of the Greenfield Tap and Die Corporation, where patent tap wrenches of both large and small size are made, one of the operations is to slot out a wide run-way for the jaws of the wrench, the rectangular hole going completely through from face to back. This hole used to be machined on a shaper, one side at a time, thus necessitating four changes of position in the vise.



ONE OF THE CUTTING TOOLS

There was an old obsolete punch-press in the shop and the foreman conceived the idea of utilizing it for machining the hole in question. At first he fitted it with a single cutting tool shaped like a chisel so as to cut one side of the slot at a time, the stroke being vertically downward; but the tool could not be kept from springing away from the steel to be cut.

The result was a poor job, and the tool worked loose and fell out. It was then decided to put two of these cutting tools back to back with the proper distance between them and to have them cut the two opposite sides of the slot at once. This was done and it worked very well, because the lateral thrust on each tool was neutralized.

Besides having the tools made in duplicate and put back to back, each tool itself was made double-ended, as can be seen in the illustration, which shows the front view of one of the tools. Therefore, when the lower ends of the two tools wore out or got dull, the vise could be loosened, both tools turned about and the sharp ends put to work, without the trouble of returning to the toolcrib for fresh tools. This arrangement made a more symmetrical tool, and also made the tools long enough to get a solid bearing between their backs and along a considerable length of the vise without wasting any tool steel.

When cutting, the tools are held between two V-shaped pieces, which are inserted where the die is ordinarily placed in a diamond-shaped vise on the bottom of the slide. A special table was put on the machine. An old chuck was found in the shop and new jaws were made for it in the toolroom so that it fit the two sizes of work. Now the slotting is done some four times as fast as it was before. This is a good example of what can be accomplished in adapting old equipment to special work.

San Francisco Business Men Repudiate Pro-Metric Propaganda

IN proof of our assertion that all business men and manufacturers who understand the situation are against the compulsory metric propaganda, we call attention to the fact that on the evening of May 13, 1920, a group of the most influential business men and manufacturers of San Francisco met in the Engineers Club there and made public the statement and resolutions here given:

In view of the organized and aggressive campaign now being conducted in favor of legislation providing for the compulsory adoption of the metric system in the United States, as the sole and exclusive standard of weight and measure, it is proper that representative business organizations indicate their position with reference thereto.

The metric system was legalized by Act of Congress in 1866 and is fully available to all who find it to their advantage to use it. We see no occasion for making its use ***compulsory.***

Especially at this time, when industry is being pushed to the limit by new and different problems, the introduction of this radical issue, as a further disturbing element, would be peculiarly unfortunate.

Whatever sentiment there is for metric legislation appears to be of artificial creation, manipulated by those who have made it a private hobby.

Irrespective of any merits the metric system may have, it is clear that under a compulsory LAW, this country would have to face a long transition period; the introduction of a dual system, a confusion between the two systems furnishing a most prolific source of error and expense; a cost appalling in its magnitude involved in new equipment, fixing new standards and making new drawings, disturbance of our system of interchangeable parts, recalculations of formulas, tables, price lists, etc.; reeducation of employees in the use of new units of weights and measures and other fundamental changes, such as would inevitably result in complexity and confusion where now there is uniformity and order.

That there is no trade demand for such a revolutionary scheme is shown by the fact that American manufacturers are almost solidly arrayed against it, and that the overwhelming preponderance of the World Trade is on the basis of the inch and pound. The following resolutions were unanimously adopted:

"That we unqualifiedly condemn the efforts now being made for the compulsory adoption of the metric system of weights and measures in the United States as being inimical to the industrial and commercial interests of the country.

"That we hereby register our protests to the persistent and radical propaganda now being conducted from this city (San Francisco) to secure compulsory legislation of the character mentioned. We are convinced that such efforts do not represent the prevailing sentiment of the substantial business interests of San Francisco."

* * *

Appended to these resolutions are the names of responsible officials of thirty-five of San Francisco's leading industrial firms, representing many millions of investment.

This—please note—is in the "home" of the World Trade Club, which has been making such extravagant and preposterous claims regarding the unanimity of San Francisco's business men in favor of a compulsory metric law.

Ethan Viall

Editor

Labor and Industry

(This is the conclusion of William H. Barr's address, the first part of which was published last week.)

"In 1914 immigration was increasing in volume steadily. Assuming that immigration and emigration would have continued at the 1914 rate, we would have received in round numbers 7,000,000 immigrants for the five-year period from 1915 to 1919 inclusive. And at the rate of emigration for 1914, about 3,170,000 would have returned, so that we would have had an excess of immigration over emigration of more than 3,800,000. From 1915 to 1919 there arrived 1,612,743 persons and 1,180,859 departed from the country. Deducting the net immigration for the war period, amounting to about 430,000, the number shut out from America by the war was approximately 3,370,000.

"In reaching its estimate that the industries are short from 4,000,000 to 5,000,000 immigrant workers, the Inter-racial Council also considered the new basis of employment in many of the industries where larger forces are required as a result of the average reduction of the work-day from a ten-hour to an eight-hour period. There are approximately 8,000,000 foreign born wage earners in manufacturing, mining, transportation and other industries.

The more or less general acceptance of the eight-hour day by industry has resulted in an approximate loss in 'production man-hours' which represents the labor from 1,000,000 to 2,000,000 foreign born workers. The industries have reported that it is almost impossible for them to get men and that there has been a continuous drop in production.

"The table of official immigration and emigration, as recently 'unofficially issued,' introduces irrelevant material. It goes back to the panic days of 1907 and 1908 when emigration was abnormal. It does not show the relation of the various races to the basic industries of the country. The Inter-racial Council based its statement on an analysis of the period immediately preceding the war when immigrants were coming in at the rate of more than a million a year. Obviously, in determining what the normal rate of immigration and emigration would have been from 1915 to 1919, the figures for the period immediately preceding would be used as a basis of calculation. Conditions for 1914 or 1920 cannot be determined by statistics as far back as 1907.

"The figures credited to immigration officials do not indicate the number of aliens going into industry, and, in contrasting the immigrants coming in and those going out, they do not mention the fact that the recent immigration has been composed for the most part of men and children.

"Analysis of immigration and emigration for the period of twelve months following the armistice shows that 214,421 persons left the country and 201,475 persons arrived. Twelve of the races listed as arriving during this period supply skilled and professional labor chiefly, and for these the figures are 109,028 entering and 43,325 departing from the country.

"But the figures on the unskilled labor coming to and going from America tell a different story. For the twenty-two white races supplying unskilled labor, chiefly in the iron and steel mills, textile factories, railroads, farms and construction work, the official figures show that 68,790 came into this country and 166,925 went out, and of those coming 38,000 were Mexicans who did not relieve the labor situation except in three southern states. Eliminating Mexicans, we have a total of 30,000 unskilled immigrant workmen and their families. This demonstrates that approximately five times as many unskilled male immigrant workers left this country from November, 1918, to October, 1919, as came in during that period.

"In view of the fact that there has been no official survey to determine accurately the extent of the shortage of unskilled workers, the Inter-racial Council holds to its estimate of a shortage of from 4,000,000 to 5,000,000 immigrant workers, which is borne out by a close study of conditions and by inquiry among the industries in the country."

Just as long as a shortage of labor can be maintained in the United States the power of the unions will grow and that power is a sinister and a dangerous one, although it could be made, were the leaders honestly constructive, an effective and useful one. It is necessary for you to carefully follow Congress in connection with the legislation affecting immigration and emigration enacted there. We have been making efforts, through the Inter-racial Council, to secure from Congress a rational immigration law of a selective character, which would admit the honest but illiterate worker who is now excluded, and would exclude the sinister radical who is well educated and a source of poison to this country. The honest worker, who cannot write, is sent home, while the well educated scribbler is welcomed and turned loose in the community. All these questions are bound up in the suggestion which I make that you take an active interest in politics.

We are prone to forget that as individual Americans we have a duty to protect our country, not merely against external or internal enemies, but against the weakness of politicians and the influence of those who are seeking the promotion of selfish purposes. The badge of Americanism is the citizenship which is vindicated at the polls. Unless you take an active interest in politics you are not doing your duty. I know that every man here is patriotic, but it has not been brought home to him that he must vitalize that patriotism today in political activities as he did during the war in patriotic exertion, self denial and hard work. Let us awake to the real situation, and to the knowledge that we have in our own hands our own future and the future of the country. But let us realize that sleepless activity is the price which we must pay for preserving our own rights and the maintenance of constitutional government.

This country is suffering from the over-regulation of business, the under-regulation of labor unions, and the indiscriminate attempts of politicians to utilize classes to foster their own political ambitions. Business men are under the careful supervision of the Department of Justice, the Department of Commerce and the Federal Trade Commission. The Sherman Anti-Trust Law has wide ramifications. The Department of Commerce, essentially at least, is also an investigating body. The Federal Trade Commission watches all corporations carefully. Although I do not admit that this Commission exercises its powers with an understanding

of the fact that it was originally created to be a link between business and Government, I would prefer to see business operated under limited direction of the Government, with sane restrictions, than see it degenerate into a condition where it would attempt to set up its own standards, irrespective of the rights of the public. In other words, the fundamental idea of a certain amount of regulation for business is good, and such regulation is necessary. It is unfortunate that Government officials often arrogate to themselves arbitrary powers, but we have the protection of the Courts for a final determination of those issues. This has been demonstrated in the case of the Federal Trade Commission, where attempts at the exercise of such arbitrary power have been checked by the Courts.

If it is desirable to regulate business how much more necessary it is that the labor unions of the country should be made responsible to Government control. The Government regulation today is jughanded.

The business man is hailed before somebody for an alleged and ofttimes imaginary infraction of the law. The labor unions, on the other hand, disturb industry, because in may fields they can produce paralysis by striking. They can tie up the railroads, the coal mines, the steel mills, the express companies. They can freeze you or starve you. They can demoralize commerce, and they seem to have the will to do all these things. But the Government does not regulate, restrict, or control union labor. Congress will neither enact a law to give the Executive such power, nor would the Executive Department enforce such a law to the limit if it were enacted, as it does enforce the restriction laws against business. Labor unions are utterly irresponsible, both legally and financially, and out of your own experience you must say that they are decadent morally. Agreements with them are scraps of paper, and where there is a possibility of coming in contact with the law we see so-called premeditated outlaw strikes, which would prevent the Government from interfering with the unions, because the strikers are supposed to be insubordinate. The Government, under its war powers and through the Lever Act, has a certain amount of control over certain unions. That control was first exercised in the coal strike, and you will remember in what a lukewarm manner the control was put into effect. But this, too, is a war power which will cease with the declaration of technical peace. In the meantime, the unions have learned how they can avoid the law, and the outlaw strike is a direct development of their methods. Furthermore, let me recall the fact that when the Lever Act was in process of enactment it was held up by the labor unions and only permitted to pass when agreements had been reached with certain executive officials that it would never be invoked against labor. When the Attorney General dared to invoke it, Samuel Gompers charged bad faith, and told of the agreement. That agreement, of course, was a violation of the oath of office of the officials possibly entering into it.

Is it not our duty, therefore, to urge that the unions must be put in a position where they will be responsible to the people, to the Courts, to the Government? Until that time comes we shall have a class autocracy attempting to dominate industry, and clearly dominating politics and the industrial welfare of the country. It is our duty to see to it that a Congress and an Executive are elected who will deal equitably with business, with labor, and with the American public.

It is probable, too, that our labor both American born and immigrant do not altogether appreciate the wonderful opportunities that our land offers, for we have been lavish with possibilities for material advancement.

We have more than 700,000 farms under cultivation, most of them being originally Government grants. We have thousands of acres of cut-over land ready to be granted, cleared and cultivated, waiting for anyone who will operate them.

We have nearly 250,000 schools and colleges where the studious ambitions of any person may be translated into development. We have hundreds of thousands of industries employing as many separate talents.

We have 250,000 miles of railroad, immeasurable water power, mines, factories, farms, club life, educational centers, sports, amusements, opportunities. Anyone can have everything he needs if he has the spirit of enterprise and honest effort.

Therefore, why then should not our workmen, many of them being employers in the making, concentrate not in group criticism of those who have been successful in industry or profession, but rather in a rigorous attempt to contribute their own best effort to the highest development of those resources which will help America to retain its international commercial leadership. Cannot we in groups or individually help to foster this spirit instead of that unfortunate antagonism now expressed by union labor.

In conclusion, I will quote a sentence from the utterances of Abraham Lincoln: "Capital has its rights which are as worthy of protection as any other rights. Nor is it denied that there is and probably always will be a relation between labor and capital producing mutual benefits.

"The strongest bond of human sympathy outside of the family relation should be the one uniting all working people of all nations, and tongues and kindreds. Nor should this lead to a war upon property or the owners of property. Property is the fruit of labor; property is desirable; is a positive good in the world. That some should be rich shows that others may become rich, and hence is just encouragement to industry and enterprise.

"Let not him who is houseless pull down the house of another, but let him work diligently and build one for himself, thus by example assuring that his own shall be safe from violence when built."

Newton Sees Bright Business Outlook

The following is an extract from the address delivered by Albert E. Newton, president of the National Machine Tool Builders' Association, at the opening of the convention of that body at Atlantic City, N. J., May 20, 1920.

At our last convention, we were rather surprised that business conditions had held so favorably since the signing of the Armistice. We had been promised, and most of us had looked forward to a real depression, at least, in our own line of industry.

We thought so many machine tools had been produced during the war period, and that so many of those were to be released by our government, that it was reasonable to believe that we should have to meet an over-supplied market. Fortunately for us, things have turned out quite different. Instead of the depression, we have experienced a most unusual and an easy-selling market, and have had a very prosperous half year.

Government-owned machine tools have not unduly flooded

the market, excepting those of educational institutions. An absorption of a large quantity of machine tools by these various schools is bound to benefit the whole country.

The need for mechanical training is greater today than ever before, and it will be still greater in coming years. I believe that we are just starting a new period of trade and technical school development, and that the importance and necessity of these institutions is becoming more and more apparent, because of our actual dependence upon machinery and mechanical devices, for the maintenance of our present, and any future betterment of our living conditions.

Today, most of us are experiencing a shortage of new orders, although having plenty of unfilled orders on our books.

I am looking forward to the resumption of good business conditions in a few months. In other words, if we are to have a business depression, it will be of short duration.

The price-cutting wave now attracting attention throughout this country, is caused by the calling of loans, or the refusal of loans, rather than the over-supply of materials; and in most cases these same materials which are being disposed of by the retailers, could not be replaced at a price as low as they are now being sold.

In the machine-tool industry, I know that we could not in the near future, replace our inventories of finished and semi-finished materials at anywhere near the cost of our present inventory.

I also know that during the past several months, our costs of production have increased much faster than our selling prices. Therefore, the prices of machine tools will remain at least as high as the present level.

During the next few days we will distribute to our members copies of a revised uniform cost-accounting book. Some of our newer members may not know of the efforts we have made to interest all of our members, and the idea of having uniform methods of cost accounting adopted, especially among competitors, as if we all knew our true costs, then no one would be liable to suffer from the results of ignorant competition.

I sincerely hope that we all know approximately what our costs are at this time, and if you do not know, you should lose no more time in getting started, as it takes a good while to obtain this knowledge.

Perhaps you will remember that at our last convention we had the Miller-Franklin representative here talking to us with reference to carrying our ideas further along the lines of uniform cost accounting. In other words, I think most of our manufacturers have adopted a system of cost accounting that compares favorably one with the other. But in order to get the best results among competitors, we feel that it would be advisable if some plan could be adopted along the lines as suggested by the Miller-Franklin people. Whether it might be carried out by those people or not that is another matter; but along the lines of having a man doing patrol work; in other words visiting each member of our Association and giving him the benefit of the knowledge that he has picked up in his past experience, and also in visiting other members, and see to it that each member includes every item of cost or other item that should be included in his costs.

It was pointed out last year that sometimes we think we have our true costs of machines; but, at the end of the year, we find that we have a whole lot to write off. That which is written off at the end of a year is really a part of your true costs; and if we have to go a whole year before finding out what our true costs are, we are liable to be selling goods cheaper than we should.

Extracts from National Foreign Trade Convention Addresses

"The Relation of Our Industrial Capacity to Our Foreign Trade," by James A. Farrell, chairman National Foreign Trade Council and president U. S. Steel Corporation:

American industrial development has reached the stage when the United States must become, in all that the words imply, a foreign trading nation. That involves the further requirement that the American people generally must understand their personal relation to the international commerce of the country as a whole; they must realize that it is not only those directly connected with foreign trade, but every inhabitant of the land, wherever located and however occupied, that shares in its benefits and bears a direct responsibility for its continued success.

Fifty years ago the total of our exports was less than one-twentieth of their value in 1919. Of the total, raw materials and foodstuffs together contributed more than 81 per cent and manufactures less than 19 per cent. In 1919 manufactures, including manufactured foodstuffs, accounted for over 70 per cent and raw materials and foodstuffs in crude condition for only 29½ per cent. In other words, we have definitely shifted from being a nation whose preponderant products were agricultural to a nation whose production is chiefly industrial.

The European war made of us a foreign trading nation, one of the main causes being its stimulation of the expansion of an industrial capacity. It is the effect of that greatly enlarged basis of production with which we are now vitally concerned. The salient fact is that the war greatly stimulated production in a large number of lines, which, with the return of peace, were equipped, as never before, for export production. We see that we have created an enormous machinery for production all over the country, while our machinery for salesmanship and distribution to the foreign consumer requires further development in order to compete with countries which have been at war but can now increasingly compete with us in manufacture for the world's trade.

The fact has always to be borne in mind that foreign trade is at least two-sided, and that it can be successful only when both sides derive profit from it. Imports pay for exports, and we have a huge balance of exports to be paid for. We have no longer a great annual interest bill to meet in London; that has been replaced by an interest bill twice as large to be met in this country. Necessarily, a large part of this bill will be met with goods, and those goods will come into a market equipped industrially to produce much more than it can consume. There is, of course, always room for certain classes of imports; no country is capable of producing all that its people need and desire. We shall continue to sell large quantities of our products in the very countries of Europe which are deeply indebted to us. We shall be confronted, in a quite unmistakable way, with the fact that we are able to produce more than we can sell at home. We shall face, accordingly, such an urgency for foreign trade as we have never before experienced.

The development of our industrial productive capacity during the war, coupled with the change in our national financial status, might, if unintelligently handled, be the forerunner of distress. But if only it be handled with intelligence, energy and courage, there lies in it a vastly greater potentiality for general benefit through foreign trade.

"Why Direct Selling," by William L. Saunders, president American Manufacturers' Export Association:

Just as a straight line is the shortest distance between two points, so is direct selling the shortest and surest way to sell goods. This axiom applies as well to domestic as to foreign trade. Manufacturers at home have the means

to reach customers by direct methods; they know the country, the ways of doing business and the facilities for financing orders, hence domestic trade attracts first attention and returns come in in large volume. Not so with foreign trade. With the exception of a few of the larger manufacturers there has been little determined and fruitful effort to reach foreign fields. Every one has at all times been willing to give special discounts to agents for foreign trade, to send catalogs, to advertise, and even to share the expense with others in sending a traveling man abroad; but this only approaches the situation; it is a mere picking process which sometimes enables one to get rid of a surplus stock at a sacrifice; but it does not, and cannot, establish those relations which are a necessary precedent to a permanent and enlarging business. Such methods are amateurish and not professional. We all practice them in the beginning. When we get wise through experience, we turn to direct selling.

At first, except with large concerns with plenty of money, it is best to get desk room in a house of established reputation. This enables one to get accustomed to the ropes, to learn the ways and means of doing business and to obtain credit. After a while, if all goes well, the branch can be extended. Not only does direct selling bring the maker and buyer in closer contact and afford means of mutual sympathy and interest, but it enables the maker of the goods to more nearly meet competitive conditions. It shows him how to build his product to meet the needs or the fancies of his customer. He gets closer to him. There is also a psychological value in direct selling. The customer thinks and feels that he is in a position to get better prices and terms. Close contact between principal and agent always makes for the best results; there is created a mutual bond of interest. All trade to be permanent and profitable must contain the elements of mutuality of interests. Direct selling promotes this; it is like seeing a man yourself and talking things over with him rather than writing letters or sending some one else to talk to him and represent your case.

Direct selling through advertising alone cannot fully meet the situation. It does some good in certain lines which are simple, or of a common or standard nature; but it is at best unsatisfactory and of temporary value. All buyers in all countries like to place orders with some one who is on the spot. In machinery trades, this is of the greatest value. The buyer feels that there is some one nearby to take care of the product, to see that it performs properly and to aid in overcoming difficulties and in repairing trouble.

"Methods of Surveying New Markets," by E. Wilhelmi Droosten, of the Robbins & Myers Co.:

You study your domestic business, so must you study your export business; and in a way, it is similar to the business done in the different States of our country here at home. You should analyze each foreign country and find out if what you have to offer is saleable or not. You may have a product that will sell in one or more countries while in some of the others there would be no demand.

The matter of delivery is an important factor, as the foreign buyer is a long way from the source of supply. He has to figure, even at best, when he places an order, it takes two to six months before he can get his goods; and when it is a matter of a year before he receives them, which I have known to occur frequently, he is without the stock of goods he has figured on having, and this means a loss of business to him with his expenses going on just the same. So, if you want to build up a foreign trade, you should be particular that your export orders are given prompt attention and that prompt shipment is made. Also the packing of your goods should be carefully looked into so that they arrive in the best possible condition, and that no errors are made, as it takes a long time to rectify mistakes and they are bound to be expensive to someone, either you or the buyer.

If you fill your factory with a lot of domestic business which prevents you from giving your export orders the proper attention, and you neglect your foreign customers, giving your domestic business the preference, and you wait for a slack time in your home market and then decide to devote your attention to getting foreign business, then to try to get it quickly is impossible. It takes a long time to build up a foreign business, and you have to do everything you can to hold it so that it is there where you want it.

It depends largely upon the men you employ, an honest representation, and the fulfilment of your promises in giving full weights and maintaining the standard of your goods as they are represented to the foreign buyer, along with a give-and-take policy, always bearing in mind that the buyer has his side of the question as well as you, and that he appreciates you when you study his interests and his welfare. If you give your foreign customers service, they appreciate this more than anything else; and when you do this, you can depend on holding their trade against all competition.

Do not attempt foreign trade unless you intend to make it a part of your business. Analyze your markets before you start, and your ability to do the business right. Do not look upon the foreign market as a secondary condition or a dumping ground for left over or imperfect goods. If you make a start with a foreign customer, stay by him. England, Germany, France and Austria put in intelligent effort to develop the big foreign trade they had, and you will have to do the same. The concerns in this country who have made a success of their domestic business owe it to a thorough knowledge of their home market conditions. They can make the same success in foreign lands if they plan as carefully. Educate your employees at the factory in the export business so that the different departments may become familiar with it and know how to take care of it intelligently, so they do not feel that there is some mystery about it, as many of them now do. For this reason it is frequently sidetracked and domestic business, with which they are more familiar, is given the preference. To the man who has made a study of the export business, it is easy, as certain rules and conditions have to be complied with to the satisfaction of the foreign buyer. You can hold his business against competitors who come with lower prices and more attractive propositions because, as I have already stated, he realizes he is a long distance away from the market of supply, and if he is given the service so that he gets what he orders and within a reasonable time, and his goods arrive in good shape so he can go on with his business, he appreciates it, and it is difficult for anyone to take his business away from you.

"The Work and Service of American Chambers of Commerce Abroad," by Charles W. Whittemore:

The primary mission today of American Chambers in foreign fields is to do their part in the battle to retain existing commerce. If we can hold what we have already secured, we will be in the best sort of position to extend and expand. In fact, if we can hold what we have, extensions will come inevitably and automatically. The struggle at present is to avoid loss of ground; to prevent foreign competitors from succeeding in their efforts to dislodge us from positions we now hold. The fields in which a Chamber abroad can do most to protect existing trade and stimulate greater volume is in the arbitration of commercial disputes. A speedy, practical and satisfactory adjustment of differences of opinion by the interested parties themselves will do more to create good-will toward American commerce than any other one individual factor.

Apparently the weakest link in our industrial chain is the packing room, where a desire to handle a maximum volume at a minimum expense or a lack of flexibility in the men in charge, lead to deficient packing with the result that either the merchandise arrives in bad order or the cost of transportation is in excess of what it should be. These results naturally hamper us in competitive efforts. Lack of knowledge of foreign standards and terminology causes many complications.

Foreign trade is a frame of mind. As a nation we have not acquired it, as is shown with disconcerting clearness by the scarcity of Americans qualified to assume administrative positions abroad. Our foreign trade has grown so much

faster than has the education of our young men to take care of it that we see many of the largest American companies represented by non-Americans.

A situation similar to this does not exist among any of the competitor nations. A company will naturally and properly entrust its interests to the man best qualified to protect and enhance them, irrespective of nationality; and I am glad to say that the non-Americans I know, and they are many, who represent American houses, are as a whole, able, loyal and efficient administrators. It is not that there is anything but praise to be said about these non-American representatives, but it is deplorable that a condition exists which makes their appointment a necessity.

It is surely an anomaly that after having gone as far as we have in foreign trade, we still have to select non-Americans as agents abroad, just as we still have to depend on foreign bottoms for much of our mail, freight and passenger transportation.

The question of the admission of non-American representatives to membership in the American Chambers abroad has provoked considerable discussion in Buenos Aires and elsewhere, and some of our citizens feel strongly about the subject—perhaps too strongly. From the point of view of the welfare of foreign trade, it is not desirable that changes be made, but when with the passing of the years, positions of responsibility abroad become vacant through natural causes, properly equipped Americans should be ready to step into them.

A hopeful sign that foreign trade as a national frame of mind is making progress is to be seen in the gradual increase of the number of American houses which are withdrawing their accounts from local dealers and are opening up direct representations. It has been a matter for wonder why American manufacturers of mining, agricultural and industrial machinery, among other lines, have been willing to allow established merchants, generally German or British, to handle their products year after year, earn enormous profits and acquire all of the local merit. They have been willing to subordinate their names to the names of the local dealers and to submerge their identities under the prestige of the merchant on the spot. The war brought a number of these long-standing arrangements to a sudden close, and other houses are establishing direct representation under advice of specialists sent to study the foreign fields. Chambers abroad welcome this development, for they feel that Americans should handle American goods, and are anxious to do all they can to stimulate the tendency, for it is bound to result in increased volume of our export trade.

An American Chamber abroad can do much to ensure the maintenance of sound moral ethics in overseas business. The success of the firmly established houses is due to adherence to high standards, and these houses in self-defense, as well as for patriotic reasons, must see to it that the newcomers in the foreign field are guided by the same rules. In the export field, the older and more experienced house is certainly "his brother's keeper," and both must stand together or both will be the losers. It is said occasionally that it is rather too much to expect American concerns, which have spent years and much money and effort in building up a foreign business, to go out of their way to encourage competitors to enter their field of activity, but this is not the attitude of most Americans who live abroad. Competition is to be anticipated in every line of business, but competition from our own people is for many manifest reasons preferable to competition from other nations. Moreover, the mere element of national volume brings appreciable advantages which, in the long run, are bound to be factors of importance.

Without fear of the competition which may result, the established houses have been consistent in their support of the Chambers abroad. The one uniform lament of all the Chambers with which I am acquainted is that the houses just entering the foreign field, or which are intending to do so, do not join.

They are the ones a Chamber can most effectively serve; they are the ones which can bring out the full measure of a Chamber's usefulness. Chambers abroad do not ask them for contributions, they ask them to become members. They ask them to realize that Chambers abroad are important factors in the development of American foreign trade, that their support is a matter of patriotic duty, and the time the support is needed is now, today, and not next Fall or next month. With adequate support Chambers abroad can expand into channels of usefulness now closed to them and can perform their part in the great national effort to increase foreign trade, for which, by location and opportunities, they are peculiarly fitted.

"Reorganization of the Foreign Service of Our Government," by W. W. Nichols, Allis-Chalmers Manufacturing Co.:

A congressman is in duty bound to interpret and support the sense of his constituency, only a small minority of which comprehends the importance of our foreign trade. Too many of us try to delude ourselves, however, with the utterly fallacious conclusion that, because we do not want to have anything to do with the rest of the world, we need not. If we agree, therefore, that the fault lies not with Congress but rather in the undecided or misguided opinions of our citizens, the Congressional Record becomes an index of Public Opinion. Any appeal to Congress may have but a temporary and very uncertain effect when permanent measures are contemplated; we must go direct to the People instead. We know that now better than ever, since events of five years have proved it beyond a doubt. We cannot emphasize too strongly that concentrated action at Washington may fail of its purpose of improving our foreign service; we must depend on the positive assertion of enlightened Public Opinion for the constructive legislation so imperatively needed. Our first step, then, is to arouse a powerful and insistent public sentiment everywhere favorable to a reorganization; then reorganization will follow inevitably.

We should be so obsessed by our desire to promote foreign trade for the country's good and so convinced of the close relation of government to it, that consciously and unconsciously we shall exert a contagious influence on the sentiment of our particular community.

Time and again, as we fully know, well laid plans of foreign traders are unexpectedly checked by some legal restriction abroad, which is nothing other than governmental interference that can only be countered by governmental action. Such action will be just as effective as the strength of the organization back of it. All negotiations are battles of wits and participants should be at least of comparable skill else an unfair and temporary result obtains. To hold our own in our dealings with foreign nations our governmental agents must be competent to meet every situation. This requires intellect especially trained in difficult and complicated diplomacy and capable of a sympathetic response to foreign thought methods, habits, customs and all that constitutes dispositions incomprehensible to the inexperienced. This should be esteemed as of first importance. Such knowledge does not come by native intuition and cannot be expected in the provincial who too often in the past has been called upon by partisan preference to represent and protect American interests abroad.

Truly, a highly organized foreign service is to our civilization a necessity whose importance cannot be overestimated but deserves our best thought. Other nations, like Great Britain, France and Italy, who have demonstrated a superior capacity for foreign trade, are now reorganizing and enlarging their foreign departments in the light of the better knowledge of their needs derived since the war. This is remarkable in view of their invariable rule to appoint only trained specialists of long experience. A national sagacity to condemn our indifference!

Without a strong foreign service to forestall misunderstandings, adjust differences, extend trade and other peaceful relations, and above all to exert our high influence in the preservation of international peace, our future becomes indeed mysterious and uncertain. Foreign service departments function only in times of peace; the last act in the severance of peace ties between nations is the withdrawal of all those forces who have no place in war. The army and navy are taught to fight; foreign service departments seek peace only, and their usefulness ceases when war begins.

Reorganization of the Foreign Service of our Government is now receiving the attention of a joint committee recently appointed by the National Foreign Trade Council, American Manufacturers' Export Association and the National Civil Service Reform League.

"How to Use the Federal Information Services," by E. A. Brand, secretary Tanners' Council of the U. S. A., formerly Assistant Director Bureau of Foreign and Domestic Commerce:

The two great agencies for promoting the foreign trade of the nation are the Bureau of Foreign and Domestic Commerce and the American Consular Service. Only since 1908 has the Bureau of Foreign and Domestic Commerce grown from an office occupying a three-room cubby-hole, with an annual appropriation of $15,000, to a service with a big central information office at Washington, and many branches in the United States, commercial attachés in the principal embassies, and traveling trade experts scattered all over the world.

After a first-hand study of most of the governmental bureaus in Europe, I can truthfully say that our own Bureau at Washington is the best in the world. The central office is well organized into geographical divisions and has the most detailed data about foreign buyers, tariffs, trade-mark laws, commercial travelers, statistics and every other subject connected with the promotion of foreign trade. In years past I have seen copies of replies to hundreds of letters from consuls to American firms furnishing information that could easily have been secured at Washington and a number of weeks saved in securing same. In short, it has the finest commercial library in the country. There are probably 20,000 volumes in it and it is open to everybody interested in foreign or domestic commerce.

It is pointed out that trade promotion is only one of the many functions of a consular officer. He certifies to all shipments from his port to the United States, visés passports, looks after ship clearances, pays wages of American seamen, reports on quarantine and immigration matters, makes fiscal statements to Treasury and crop reports to Agriculture. In China and Turkey he has judicial functions. He even certifies to marriages and deaths of Americans in his district. In the large cities such as London, Paris, Shanghai and Buenos Aires, he has several deputies or vices, and the work is partitioned. For example, there is usually one man who handles inquiries from firms in the United States and receives traveling salesmen visiting abroad. At the smaller posts the consul and one deputy usually do the whole job.

As far as trade getting is concerned, our consuls are far more active than those of any other nation. Indeed, some British consuls are said to believe such work beneath the dignity of the office. Our people also do a better job than Germans, notwithstanding the boosting talk to the contrary.

An Old Method of Working Out Indicator Diagrams

By John S. Watts

In these days of labor-saving devices, the younger members of our profession are very prone to be at a serious disadvantage when the instruments they are accustomed to using are not available.

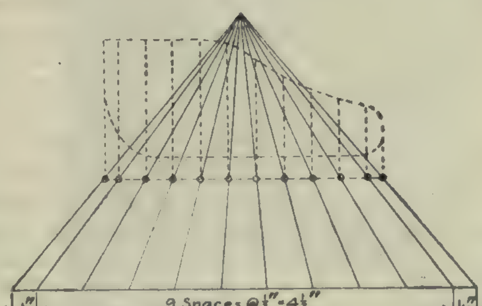
Take the planimeter for example: If you ask the average young engineer to work out the area of any plane figure, with an irregular boundary line, such as an indicator diagram, or a plot of land, he is all O. K. so long as the planimeter is handy; but if it is not, he is likely to spend as many hours as an old-timer (who remembers when there was no planimeter) will spend minutes in solving the problem.

The young engineer is hardly to be blamed for this, but the moral is that it is worth while to be conversant with the old methods as it is inevitable that one will some time or other be in a position where problems will require to be solved without the aid of the most modern equipment.

The method of determining the approximate pressure recorded on an indicator diagram by taking the average of the heights measured on ten equally spaced points, is I believe still well known, but the time spent in spacing off these lines, can be considerably reduced by following the method outlined below, which, while being an old one, I have never seen published.

Take a piece of tracing paper and draw on it a base line, which must be longer than the length of the diagram to be divided (for indicator diagrams 5 in. will do) and mark on this base line the ten divisions as shown in the sketch herewith. Join all these divisions to a point at any convenient height, say 5 in. above and vertically over the central point of the base line.

Lay this piece of tracing paper over the diagram or figure to be divided, sliding the tracing up or down until the length between the outside diagonal lines on the tracing coincides with the length of the diagram.



AN OLD METHOD OF WORKING OUT INDICATOR DIAGRAMS

By pricking through on each divisional line, the diagram will be divided into ten spaces with the end spaces one-half the width of the other spaces, which is the spacing we require.

In using the tracing paper, keep the base line of the triangle parallel with the atmosphere line on the diagram or a slight error will be introduced in the spacing.

The diagram, being divided up, the quickest way to get the mean height is to take a strip of paper and mark on it the length of each line consecutively in addition; or, in other words, add the lines up graphically on this strip and then divide the total length by ten. The answer will be the mean height, which multiplied by the scale of the indicator spring will be the mean pressure.

If a piece of tracing paper is not available, the same method can be used by drawing the lines in a similar way directly on the diagram, the apex of the triangle being located by the junction of the outside diagonal lines.

Obviously, also, the same principle can be used to determine the area of any irregular figure. Having found the mean height as explained above, simply multiply it by the extreme length of the figure, and the product will be the area.

A tracing of this kind made to a fairly large size is a handy thing to have in any drawing office, as it is very convenient for spacing off holes, or dividing up lines to any number of points within its capacity.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS · A weekly review of modern designs and equipment

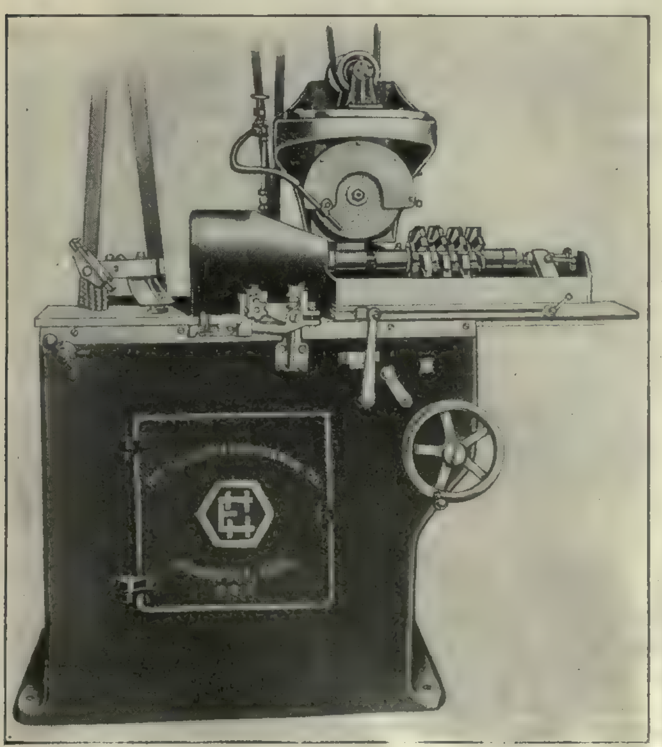
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX A continuous record of modern designs and equipment

Harris Automatic Hob-Grinding Machine

A recent addition to the line of the H. E. Harris Engineering Co., Bridgeport, Conn., is the No. 815-B automatic hob-grinding machine, illustrated herewith.

This machine will grind hobs with any number of flutes up to 26 and not exceeding 8 in. in diameter and 10 in. in length. Hobs with straight or right- or left-hand helical flutes can be ground. A fine adjustment controls a forming slide coupled to the table and work spindle in such a way as to rotate the hob during longitudinal travel of the table. This adjustment is graduated to read to one-half minute of arc and can be changed while the machine is running. The index plate is readily accessible and can be removed by loosening a knurled nut. Indexing is automatic and takes place when the table is in one position only. The table travel can be operated either automatically or by hand. The grinding head is mounted on a circular base and can be swiveled horizontally so that the wheel may be set to the required angle for grinding a hob with helical flutes. The diamond truing device will true either side of the wheel to the desired angle. It will also true the periphery of the wheel and can be used without interfering with the set-up. An automatic feed is provided which can be set so that a predetermined amount will be ground off the face of the hob teeth and when that amount has been reached, it will be disengaged. It is claimed that the pump is self-priming and non-clogging and will deliver a copious stream of coolant at the point of grinding.

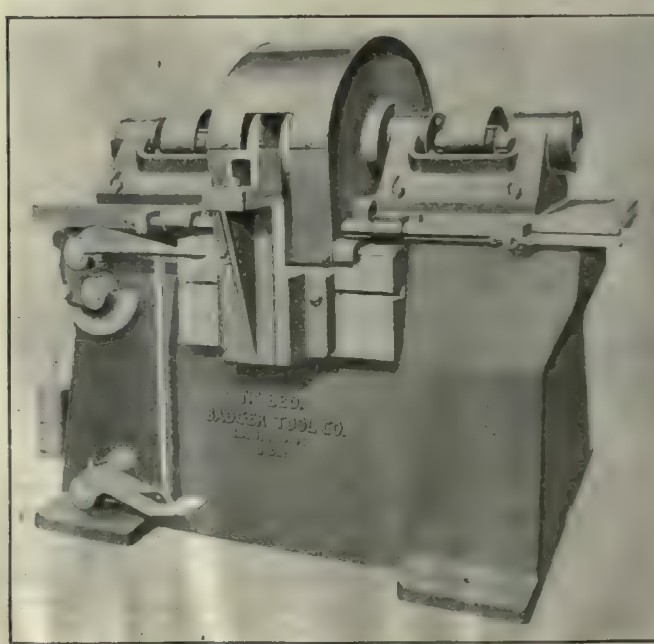


HARRIS AUTOMATIC HOB-GRINDING MACHINE

Badger Double-Spindle Disk-Grinding Machine

The Badger Tool Co., Beloit, Wis., has recently put on the market the double-spindle disk-grinding machine shown in the accompanying illustration. The machine, classified by the maker as No. 220, is intended for finishing the two opposite parallel faces on such work as piston rings, nuts and drop-forged wrenches.

Two 20-in. disk wheels are carried on spindles $2\frac{3}{16}$ in. in diameter mounted in both radial and thrust ball bearings. Two 16-in. abrasive cylinders held in chucks are interchangeable with the disk wheels, and extra equipment can be furnished by the maker so that water may be used. Among the features of this machine are the provision for excluding grit from the ways under the sliding head, the positive micrometer stop for the

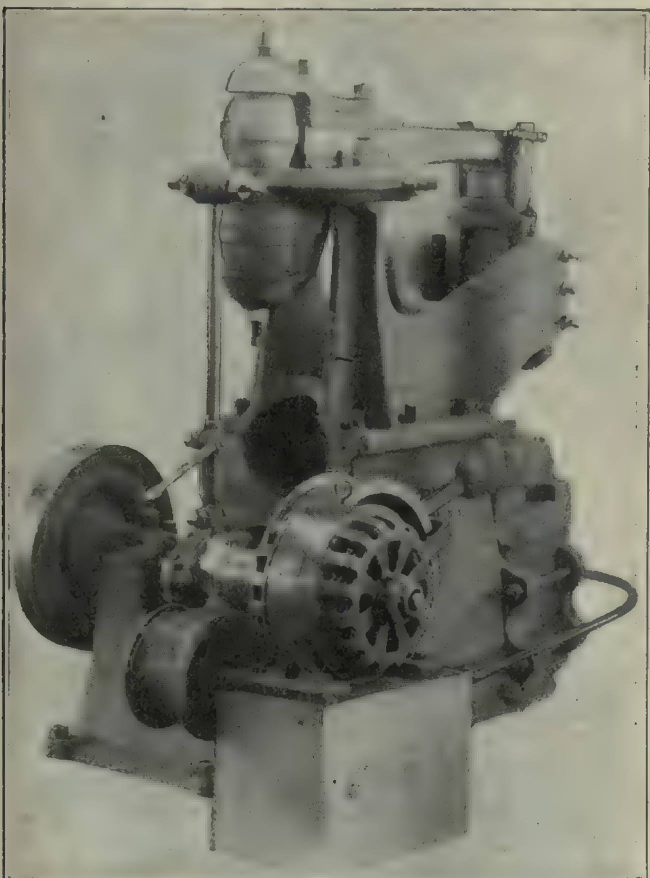


BADGER NO. 220 DOUBLE-SPINDLE DISK-GRINDING MACHINE

sliding head and the rigid construction of the work support. The machine can be furnished equipped for either belt or direct-motor drive. The height of the spindle from the floor is 38 in., the over-all length of the machine is 70 in. and the net weight is 4,700 lb.

Bradley Motor-Driven Hammer

Motor-driven helve hammers made by C. C. Bradley Inc., Syracuse, New York, are now being furnished with the drive arranged as illustrated. The hammer is con-

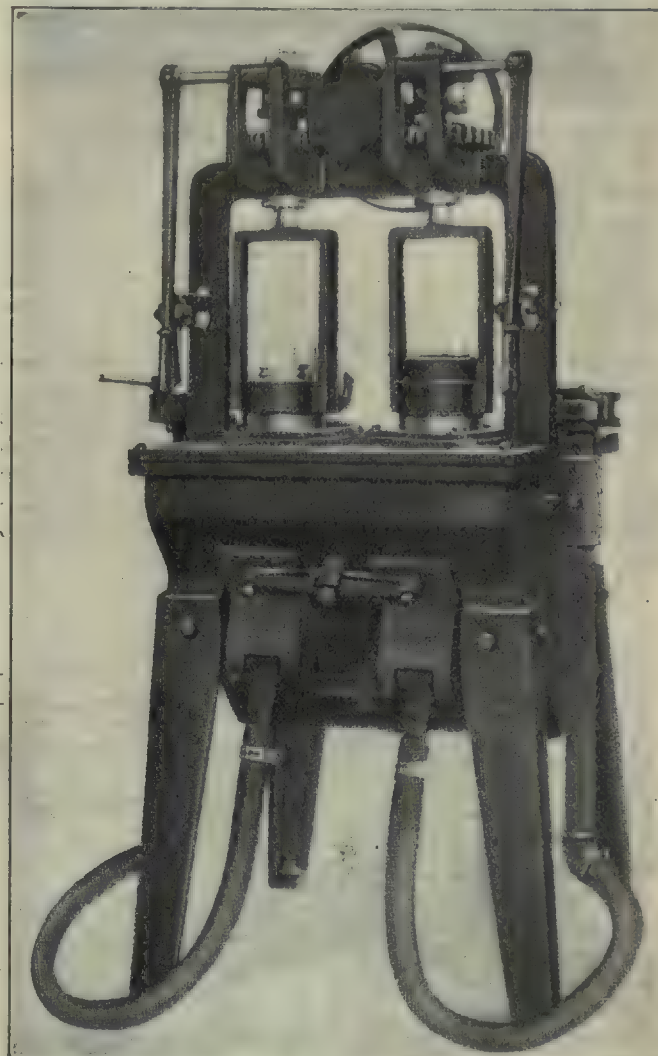


BRADLEY MOTOR-DRIVEN POWER HAMMER

trolled in the usual manner by a foot treadle which applies and regulates the pressure of the idler pulley against the loose running belt. Formerly a motor was not included as part of the hammer equipment, and if used for the drive a separate countershaft, with two loose pulleys between the motor and hammer, was required.

Gray Piston Blasting Machine

The machine shown is adapted for cleaning the inside of pistons with steel grit or shot and is said to be capable of doing this work at the rate of 140 to 150 pistons per hour. The machine is manufactured by the Gray Machine Tool Co., Inc., Buffalo, N. Y., and employs the same principle as that of a similar machine made by the same company for blasting shells. In operation the piston is placed in the holder, open end downwards, and a cover placed over it. The piston when lowered by a lever to the correct position automatically starts rotating. A lever operated quick-opening valve in the air line is used to control the blast. The work holders operate independently thus allowing the work to be changed in one, while the other is revolving. The nozzles are adjustable to any desired position and usually operate at the mouth of the piston opening. The drive pulley is 12 in. in dia., runs at 100 r.p.m. and is



GRAY PISTON BLASTING MACHINE

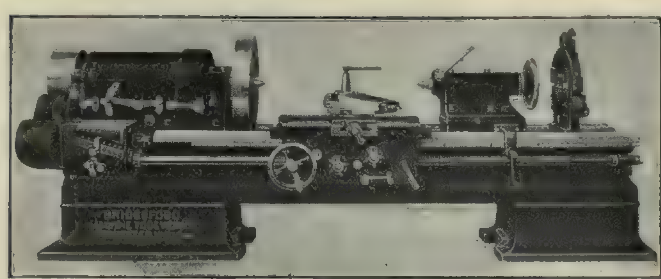
driven by a 2-in. belt. The machine shown will handle pistons up to 3½ in. dia. The air consumption amounts to about 40 cu.ft. per min. at 70 to 90 lb. pressure. The machine occupies a floor space of 36 x 42 in. and weighs 800 lb. packed for shipment.

Betts-Bridgeford 26-In. Geared-Head Lathe

The Betts Machine Co., Rochester, N. Y., has added to its line the lathe shown in the illustration herewith.

The headstock is of the all-geared inclosed type, and is operated by a powerful expanding ring friction clutch upon which is mounted the driving pulley. This clutch is operated from the apron, a position which is always convenient to the operator. The same movement which disengages the clutch automatically applies the friction brake, thereby stopping the machine almost instantly.

There are nine spindle speeds of the selective type arranged in geometric progression. Three direct speeds, three high back-gear speeds, and three low back-gear

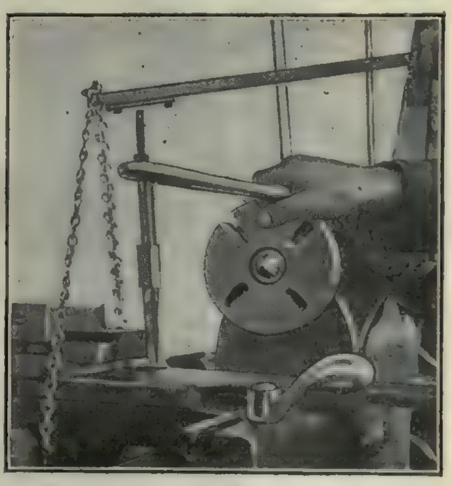


BETTS-BRIDGEFORD 26-IN. GEARED-HEAD LATHE

speeds are obtained almost instantly by conveniently located levers in front of headstock. All speed changes are through hardened-steel sliding gears and positive clutches running in oil, the sliding-gear teeth being rounded to allow easy and instant engagement. No two speeds can be engaged at the same time. All shafts and gears are located in the lower half or base of headstock, thereby allowing easy access to all of the parts, it being necessary only to remove the cover. All shaft bearings are bronze-bushed and lubrication is by means of a splash and chain oiling system. When machine is motor driven the motor is mounted on top of the headstock cover and directly connected through gearing to the main driving shaft.

The Ackland Screwdriver

The Ackland Specialty Co., 146 College St., Springfield, Mass., has brought out the screwdriver and attachments illustrated herewith. It is claimed that a few pounds pressure on the upper bar and the ratchet handle will remove the most stubborn screw. The extension post is attached to the screw-driver blade by a case-hardened socket. A ratchet wrench which permits using the tool in restricted places is arranged to slide up or down the extension post so that it can be used in any desired location. The upper bar is attached to the extension post by a ball joint, permitting movement in all directions. Three screwdriver blades—⅜, ½ and ¾ in. are furnished. The ratchet wrench is double ended—one end fitting Ackland sockets and the other end fitting standard sockets.

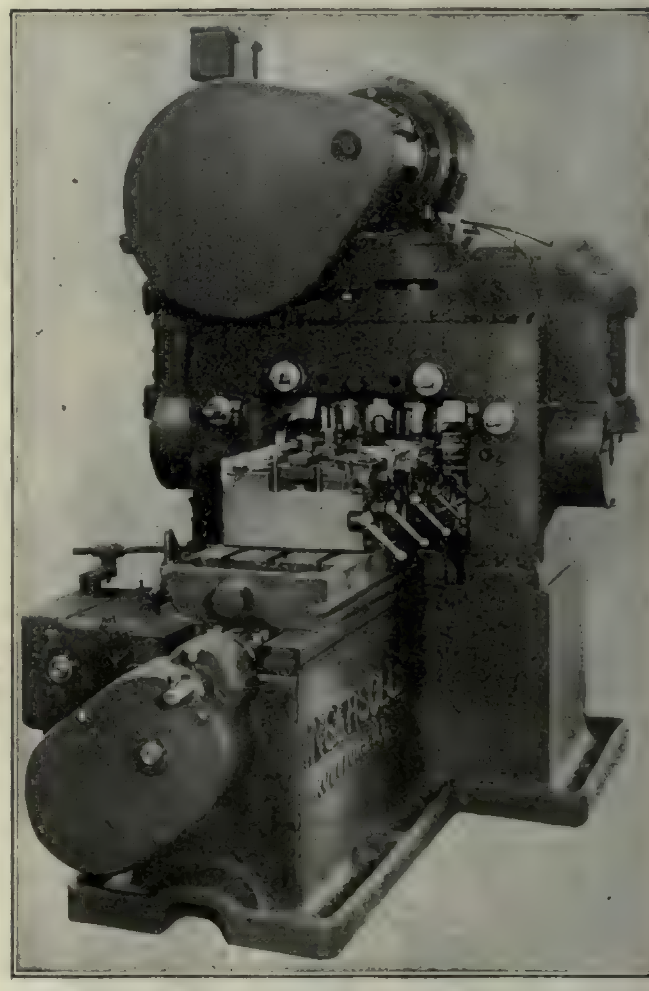


THE ACKLAND SCREWDRIVER

Ingersoll Semi-Automatic Milling Machines

Recent additions to the line of the Ingersoll Milling Machine Co., Rockford, Ill., are milling machines with automatic and semi-automatic feeds, one of which is illustrated herewith. Ordinarily they are built as single-purpose machines, but by the application of suitably designed fixtures they can be employed for finishing different pieces of work.

The machines are similar in some respects to the reciprocating-type machines, but differ in the feed characteristics of the table. The table feeds past the cutters through its entire length, the operator removing the pieces as fast as they are finished. When the last cut is finished, the table rapidly advances a short distance and then stops. The operator can then remove the last casting and by a lever control throw in a rapid return traverse which carries the table back to its original position, where it again automatically stops for reloading. After loading the first fixture the table is



INGERSOLL SEMI-AUTOMATIC TYPE MILLING MACHINE

Specifications: Four-spindles. Table, 14 x 67 in. Floor space 34 sq.ft. Weight 10,000 lb.

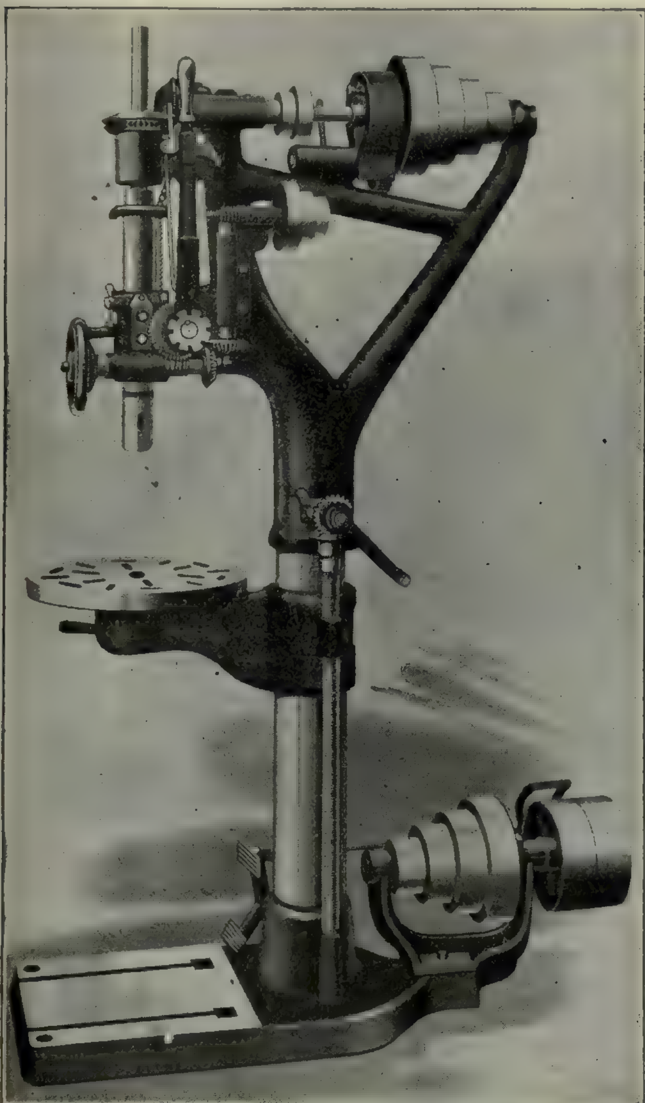
started and rapidly traverses until the work almost reaches the cutters, when the normal feed is automatically engaged. The balance of the fixtures are loaded while the cutters are operating.

The machine shown is equipped with fixtures which each hold two pieces of work back to back.

A variation of this type of machine is built for handling large pieces which have an obstruction at one end of the cut that prevents them from passing clear of the cutters. To handle this work the table feeds the work into the cutters to the end of the cut and then automatically returns at a high rate of speed to the loading position where it stops. Machines of this type can be fitted with a number of spindles to finish several surfaces at the same time.

Hoosier 20-In. Vertical Drilling Machines

The Hoosier Drilling Machine Co., Goshen, Ind., is manufacturing a 20-in. vertical drilling machine in four different styles, one of which, the No. 4, is shown in the accompanying illustration. The No. 1 machine is fitted with plain drive, has a round base, and adjustable



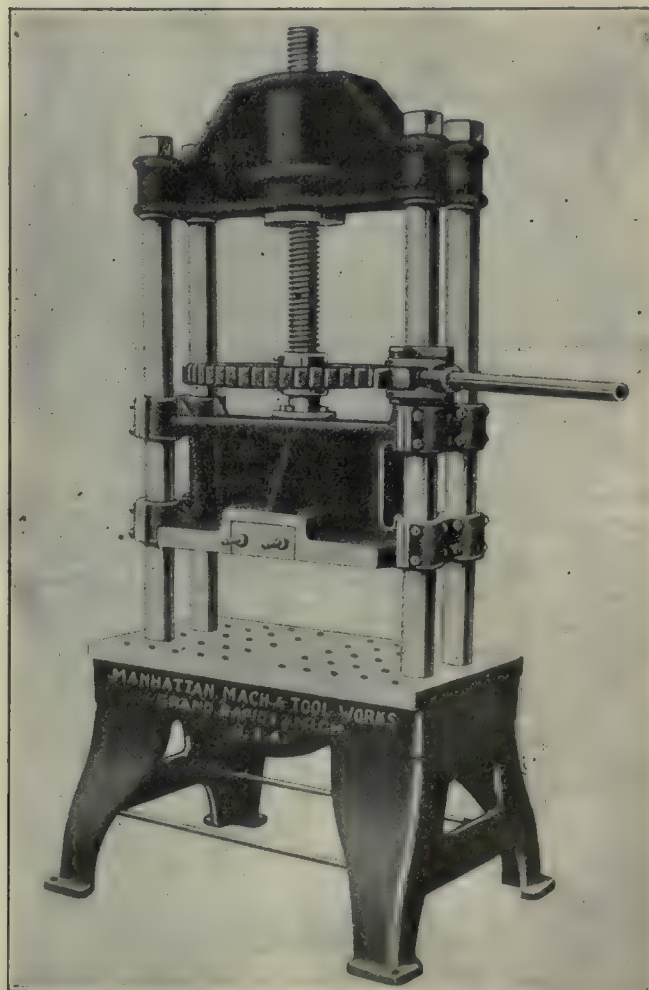
HOOSIER 20-IN. VERTICAL BACK-GEARED DRILLING MACHINE WITH POWER FEED

Specifications: Distance; column to center of spindle, $10\frac{1}{4}$ in. Maximum distance, spindle to table, 27 in.; spindle to base, minimum, 32 in.; maximum, $41\frac{1}{4}$ in. Travel of spindle, $9\frac{1}{4}$ in. Hole in spindle, No. 3 Morse taper. Diameter of table, 16 in. Travel of table on column, 18 in. Number of spindle speeds, four on plain-drive machine, of 90, 141, 228 and 360 r.p.m. Speeds of back-geared machine, 8; range of speeds, belt drive, 90, 141, 228 and 360; with back gears, 14, 25, 41 and 65 r.p.m. Number of power feeds, three, 0.003, 0.005 and 0.008 in.

lever feed. The No. 2 machine is similar to the No. 1 except that it is fitted with a rectangular base, and the No. 3 is the same machine with the addition of a combined lever and worm feed. The No. 4 has back gears and power-feed and is designed for heavy-duty service. The spindle is equipped with a high-grade ball-thrust bearing and is counterbalanced by a weight in the column. The spindle sleeve is graduated. The machine is provided with eight speeds, four of which are obtained without, and four with, the use of the double back gears. It also has three power feeds in addition to the hand-screw and lever feed. An automatic stop attachment is arranged in connection with the graduated spindle sleeve which is of service to the operator in accurately drilling or boring to depth. The hole in the center of the round table is machined in alignment with the spindle so that it may be used for piloting a boring bar if it is desired to use the machine for such work.

Manhattan Four Post-Screw Press

The Manhattan Machine and Tool Works, Grand Rapids, Mich., is placing on the market the type BB four-post screw press shown in the accompanying illus-



MANHATTAN TYPE BB FOUR-POST SCREW PRESS

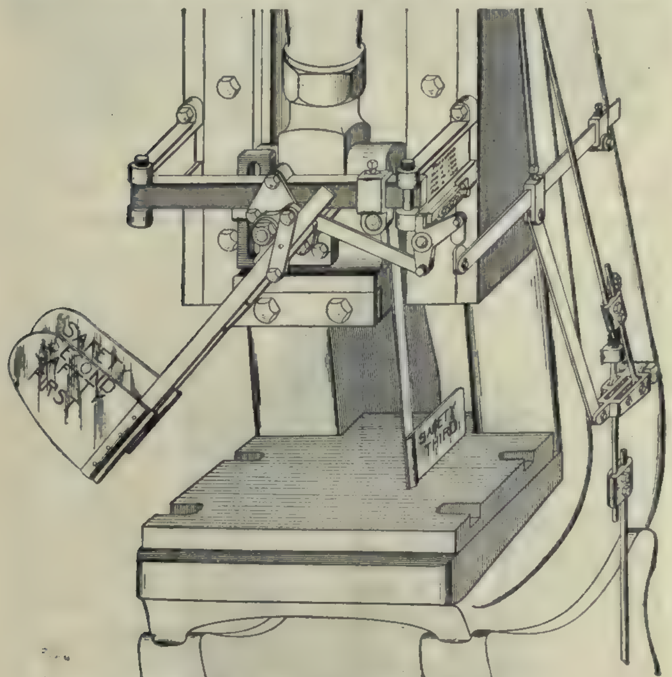
Specifications: Capacity, 80 ton. Bed; size 20 x 36 in.; thickness, $8\frac{3}{8}$ in. Standards; space between, 26 in.; diameter, 3 in. Maximum distance bed to ram, 22 in. Diameter of screw, 3 in. Height; over all, 77 in.; floor to bed, 24 in. Floor space, 31 x 41 in. Weight; net, 2,270 lb.; for shipment, 2,425 lb.; boxed for export, 2,600 lb. Cu.ft., 58.

tration. The press is intended for testing punches and dies and for other experimental work where a hand press having more than usual power is required.

D. & M. Safety Press Guard

The safety guard shown is intended as a protection to the power-press operator, and is a product of the D. & M. Guard Co., 6 State St., Rochester, N. Y. The device has three guards that are arranged to swing independently in proper time with each operation of the press. Normally, two of these guards stand at the left of the operator. The outer guard labeled "Safety First," moves with each stroke of the treadle, while

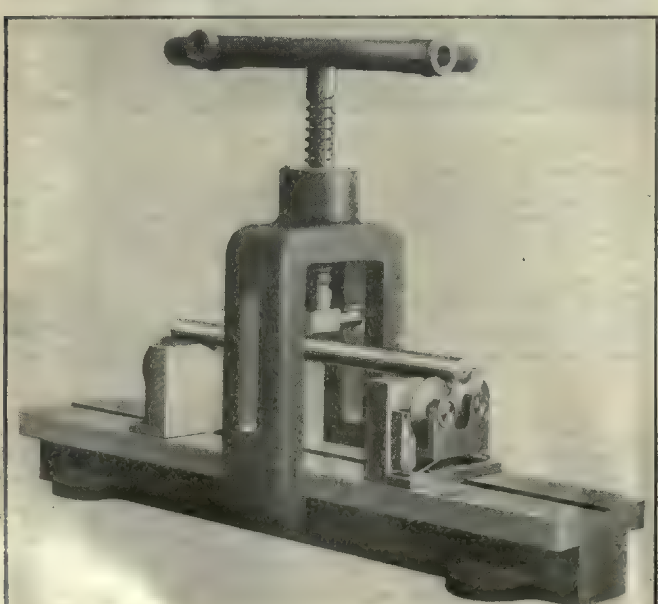
the inner guard, "Safety Second," moves with each stroke of the ram. Each moves independently of the other and serves the same purpose of pushing the operator's hands to one side. If the ram repeats unexpectedly from any cause the inner guard kicks with a quick movement as it moves faster than the ram. As a further safety measure a blinker, or side guard, labeled "Safety Third," prevents the press from being fed from the side. The bridge carrying the three guards is hinged and fastened by a pin and padlock. When unlocked the bridge may be swung to one side, making the pitman, press head, etc., accessible. The device is said to be easily attached to a press.



D. & M. SAFETY PRESS GUARD

Whitney Straightening Machine

The Whitney Metal Tool Co., Rockford, Ill., has recently introduced the straightening machine shown. It is designed to straighten bar stock up to 2 in. in diameter. The work is supported on V-blocks while being subjected to the action of the screw. Upon elevating the screw, the two sets of spring-actuated rolls lift the bar above the V's, so that it may be easily rotated.

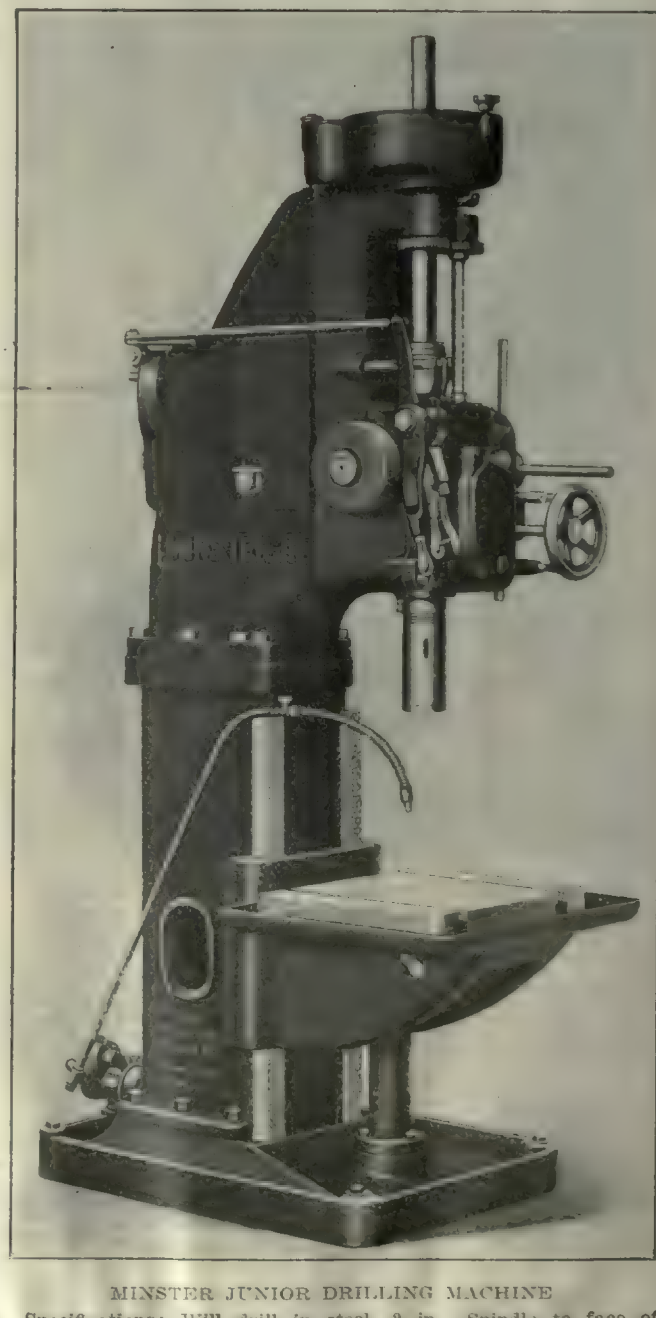


WHITNEY STRAIGHTENING MACHINE

Minster Junior Drilling Machine

The Minster Machine Co., Minster, Ohio, has brought out the drilling machine illustrated herewith and known as the No. 12 Minster Junior.

This machine is simply constructed with as few parts as possible and is intended for use on quantity production. Power is transmitted through hardened stub-tooth transmission gears. The sliding gears for changing speeds have rounded teeth. The feed is



MINSTER JUNIOR DRILLING MACHINE

Specifications: Will drill in steel, 2 in. Spindle to face of column, $12\frac{3}{4}$ in. Length of feed, 16 in. Spindle to plain table, $32\frac{3}{8}$ in.; to compound table, $28\frac{5}{8}$ in.; to base, $46\frac{7}{8}$ in. Plain table, size, 18 x 20 in.; vertical adjustment, 16 in. Feed changes, four. Speed changes, six. Net weight, with plain table, 2,800 lb.; with compound table, 3,200 lb.

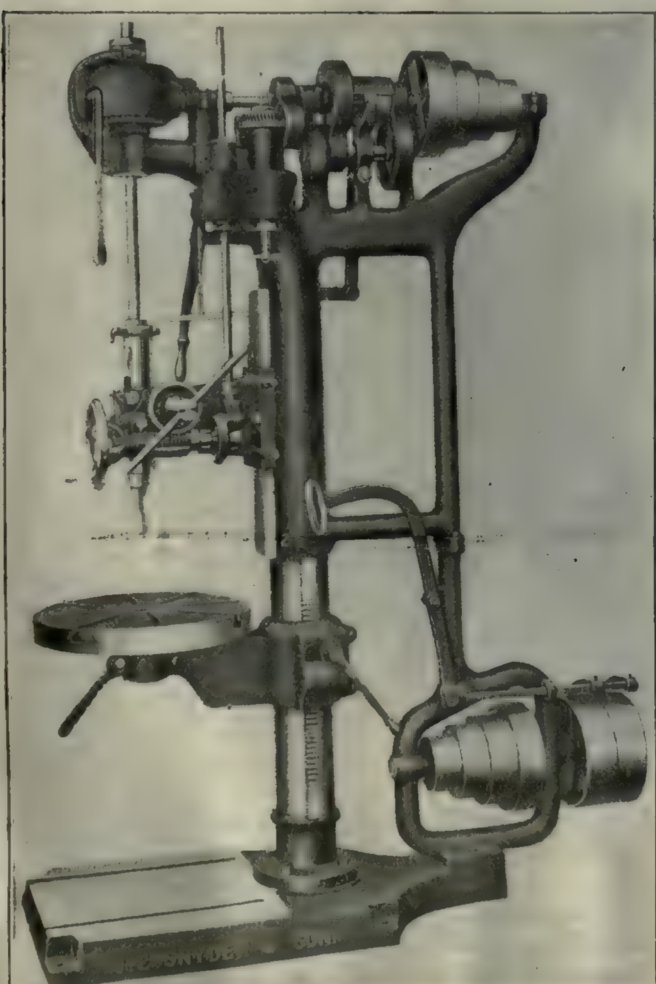
through gears contained in a gear box. The machine is regularly equipped with two sets of speed change and one set of feed transposing gears. Sets of gears giving varying speeds and feeds can be supplied. The depth of feed is controlled by a dial which, when set for the desired depth, will disengage the feed when it reaches the zero mark.

The spindle is driven by gears through a driving sleeve having two keys set diametrically opposite each other for dividing the strain. The thrust is taken by a ball bearing.

The machine is regularly equipped with tight and loose pulleys, but provision has been made for attaching a reversing clutch when the machine is to be used for tapping as well as drilling. Provision has also been made for attaching a motor. Either a plain or a compound table can be furnished. The tank for cutting compound is located inside the column.

Snyder 24-In. Drilling Machine

The upright drilling machine illustrated herewith is a recent product of J. E. Snyder & Son, Worcester, Mass. The machine has an adjustable head and tapping attachment and is designed for medium work. It can be furnished with motor drive, belt or chain connected. A compound table is furnished when required. All gears are protected and the power feed is driven from the top shaft instead of the main spindle. The crown bevel gear is 8 in. dia. and the hub runs in a solid cast-iron bearing.



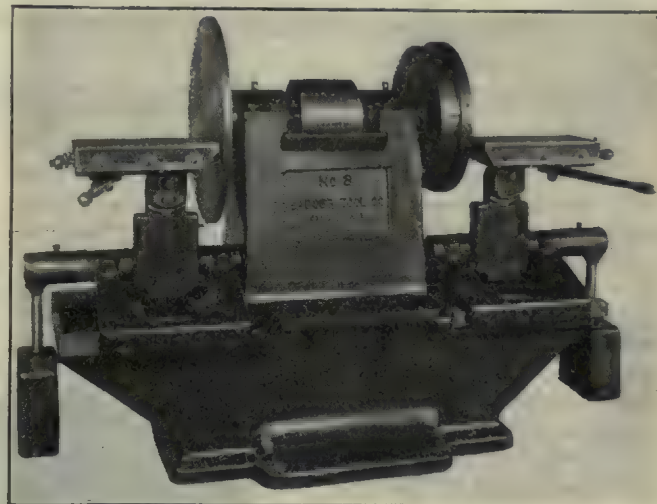
SNYDER 24-IN. DRILLING MACHINE

Specifications: Capacity; drills to center, 24 in. Maximum distance; spindle to base, 48 in.; spindle to table, 41 in. Automatic feed, 10 in. Traverse; head on column, 17½ in.; table on column, 17 in. Diameter of table, 21 in. Hole in spindle, No. 4 Morse taper. Floor space, 22½ x 64 in. Ratio of back gears, 5½ to 1. Speeds; 8, 22 to 430. Feeds; 4, 0.004 to 0.017 in. per rev. Motor, 2 hp.

Badger No. 8 Disk Grinding Machine

The Badger Tool Co., Beloit, Wis., has added to its line the disk grinding machine shown in the accompanying illustration.

The machine embodies the general principles of design that have been found successful in other sizes. The rockshafts are carried by saddles sliding on extensions cast integral with the base. The sides of the extensions slope at an angle of 10 deg. forming slight dovetails to which the saddles are adjusted by gibs. The spindle runs in ball bearings. The work tables are provided with lever feed and stops having micrometer adjustment. A pump and hoods for wet grinding can be furnished and the machine can be equipped with chucks for abrasive cylinders in place of disks.



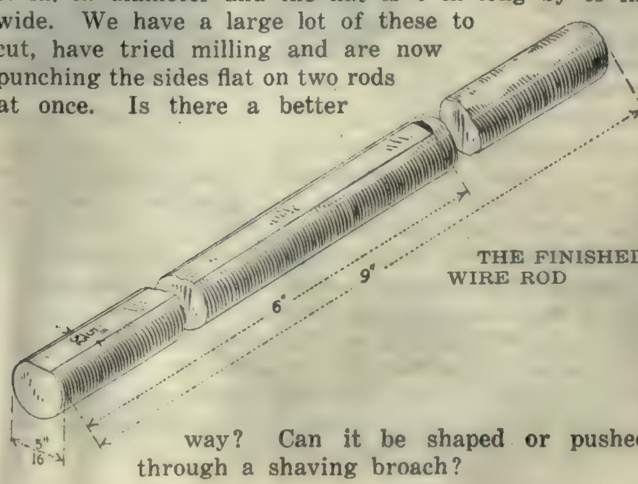
BADGER NO. 8 DISK GRINDING MACHINE

Specifications: Disks, 26 to 30 in. dia. Cylinder chucks, 18 to 20 in. dia. Speed; with disks, 6,000 ft. per min.; with chucks, 5,000 ft. per min. Work tables 8 x 15 in. Shipping weight; domestic 4,000 lb.; export, 4,500 lb. Export box, 130 cu.ft.

Is This a Punch-Press Job?

BY F. C. HUDSON

Which is the best way to cut a flat on the wire rod as shown in the illustration? The rod is 9 in. long, $\frac{5}{16}$ in. in diameter and the flat is 6 in long by $\frac{5}{32}$ in. wide. We have a large lot of these to cut, have tried milling and are now punching the sides flat on two rods at once. Is there a better way? Can it be shaped or pushed through a shaving broach?



THE FINISHED WIRE ROD

WHAT *to* READ
—*for the man in a hurry*

Suggested by the Managing Editor

"ROLLER-CHAIN" is the title of the article which begins this issue. The methods of manufacture described include exemplifications of some very cleverly performed operations.

In the third installment of his treatise on testing high-speed steels, A. J. Langhammer gives details of the extremely careful preparation for the tests and tabulates the performances. Such a test, with all tools having exactly the same size and shape, and tested under exactly the same conditions, is a valuable contribution to anyone's high-speed steel data—page 1227. Routing will always retain its importance as a factor in plant operation and management. There are five pages, beginning with 1231, devoted to this subject. The author is J. A. Urquhart, who deals with the system used by Brown & Sharpe. Francis W. Shaw's short article, "A Question in Etymology," page 1236, presents the English point of view on nomenclature of machine tools, cutting tools and operators.

More of Western Editor Hunter's manufacturing data—this week the conclusion of his series on "The Manufacture of Single-Cylinder Gasolene Engines."

We present on page 1241 another of the series of "Interviews with Men Who Know Conditions"—this week B. B. Quillen of the Cincinnati Planer Co. For the reader who wants to check his own conclusions on many subjects—watch these interviews.

CHESLA C. SHERLOCK

One of our staff artists has been making sketches of Chesla C. Sherlock, as he imagined him to be. The various subjects treated from time to time seemed to change the artist's impression. We give, surrounding the photograph on this page, four of his efforts; they differ one from the other, but have in common certain characteristics indicative of the serious-minded scholar. The photo shows Mr. Sherlock "as is" and puts an end to speculations. It also more intimately acquaints the reader with the man who wrote "Knowing Your Insurance Policy," the fourth section of which begins on page 1246. Our automotive construction this week is the first of two articles on "Machining the Liberty Crank Case," by H. A. Carhart. The second will follow in an early issue. Page 1247. Readers in seaport cities—the second column on page 1252—doesn't the unit container idea strike you as pretty good?

As promised last week—we have the extracts from Foreign Trade Convention addresses—page 1258; and the second half of William H. Barr's "Labor and Industry," page 1256.

In our "What Other Editors Think" page we have culled from *The Electric Furnace* the editorial, "A Short Cut to El Dorado." It says: "Every father's son of us is seeking a short cut. We want contentment without paying the price of weary miles of striving to achieve it." See page 1273.

Service of the Business Press to Foreign Trade*

Many American manufacturers have devoted too little of their time to consideration of the importance and value of foreign trade to themselves, and to American commerce and industry. Education and service are needed and the business press stands ready to do its share in providing both. Mr. McGraw's address gives some hint of what may be expected along this line from the business papers under his control.

FOREIGN trade to hundreds of manufacturers in this country has been a name only. It is trite to say that the average American manufacturer has thought only in terms of his domestic business for so long that it is usually the exception, rather than the rule, for him to be thoroughly familiar with his opportunities and his responsibilities with regard to foreign trade.

It is because the National Foreign Trade Council has seen its opportunity to help lead and mold public opinion in the development of a foreign trade policy for American manufacturers that I see the particular opportunity for its partnership with the business press. The development of a better understanding of our foreign trade needs and our foreign trade responsibilities is an educational movement, and through the medium of the business press the manufacturers may learn in detail in their several industries, something of the opportunities for trade extension in their particular fields.

Newspapers have been and are performing a splendid task in developing a better public appreciation of our general responsibilities in foreign trade, but the industrial public, the manufacturers, the engineers, the merchants of our country, want to know how they can take advantage of the general opportunities which the National Foreign Trade Council has so definitely urged.

There are two broad classes of business journals in this country which are functioning to help meet this great problem. First, there are those journals published in this country whose circulation is primarily in the United States. It is the function of these journals to take up the problems of the American manufacturer as an exporter of goods in connection with the other problems that they present to him, and this large group of business papers can do much to arouse the manufacturer to his opportunities in the foreign field.

Then there is a large group of journals which are published in this country, but are presented from the viewpoint of the foreign buyer and the importer in other countries, whose circulation is found in the countries outside of the United States. These papers are printed in different languages, and concern themselves fundamentally with the problems of the buyer of American goods, rather than with the problems of the seller of American goods.

Three Functions of the Business Press in Reference to Foreign Trade

There are three directions in which the business press can function in reference to foreign trade. It can

1. Assist in awakening the business man to the effect of foreign trade as a stabilizer, and of its necessity as an outlet for indefinite increase of our industrial production;

2. Gather and publish information regarding the conditions in foreign lands which affect our trade opportunities; and

3. Spread the knowledge of American goods in foreign lands.

The need for exercising the first of these functions—the awakening of the business man to the stabilizing effect of foreign trade and of its necessity as an absorbent of surplus production is still one of very great importance indeed. It has been the theme of many a paper before foreign trade gatherings. Nor is it necessary to emphasize again the reason why the business press has a special mission in this regard. That has been amply developed in the introductory remarks to this paper.

It is pertinent to point out, though, that foreign trade will never become the factor it should be in the commercial life of this country until there is a "mass movement" into export trade. This must be preceded by an understanding of its importance, and then accomplished by intelligent co-operative effort. The relatively small corporatons, as well as the few dominant ones in each industry, must sell goods abroad. The mass movement should receive its greatest stimulus through the sort of educational work which the business press is particularly fitted to do. Even a business paper with as small a subscription list as 5,000 reaches far beyond the confines of the dominant corporations in its industry and is in a position to preach the doctrine of foreign trade to every organization with strength enough to engage successfully in export work.

Creation of International Thinking Necessary

Nor is educational effort along the lines of the effect and advantages of foreign trade alone sufficient to bring about the result we desire. It is necessary to awaken international sympathies and to create international thinking in all lines of business. We must break down the insular barriers in both our thinking and our action. They will not fall easily, but only after constant hammerng and bringing to bear every resource of fact and logic.

Moreover, while we are working toward the desired goal, the business press can do yeoman service in bringing heavy influence to bear on specific issues. For example, when the Appropriations Committee of the House of Representatives in February cut the appropriations for our foreign trade promotion work, the business press in every line pointed out the certain serious effect of such curtailment and urged upon its readers the expression of their views to their representatives in Congress. The need for crystallization of views on such issues will occur constantly and the business press can be counted on to do its part in unifying and securing action.

No reference will be made here to the part the business press must play in the discussion of the need for foreign investment, of the financing of foreign trade, of the necessity for a large and healthy merchant marine, or of the place of the export commission house. Obviously, discussion of such subjects is a necessary part of the only kind of foreign-trade educational campaign which can develop permanent results.

*Address by James H. McGraw, President of the McGraw-Hill Co., Inc., before the Seventh National Foreign Trade Convention at San Francisco.

Until recently, the business press has functioned mainly in relation to domestic affairs. Since 1914, however, there has been a rapid increase in the variety and intensity of business paper effort on foreign trade, and, as you well know, it has been a very potent factor in stimulating interest and activity in this trade.

There has been a very lively recognition by the business papers of the importance of foreign trade news, and slow and difficult as it has been to establish proper connections and open the necessary sources of information much has been accomplished along these lines and from now forward the task will be easier.

The reason for our former neglect of foreign trade interests is obvious enough. The vast volume of our trade in manufactured goods has, in the past, been largely domestic and our business papers, serving their field, were satisfied to act as purveyors of information regarding domestic conditions and developments only. But as American business takes on an international scope, so must the business paper expand. It will no longer do to be concerned with domestic conditions only. World conditions must be interpreted. The American manufacturer and merchant must be able to get from their business paper the same information regarding foreign trade that they get regarding domestic trade.

Already substantial progress has been made along these lines. The sources of information are various, but the leading journals are working toward reliance on carefully selected representatives. It is not the function of these representatives to uncover and report for publication specific orders that are shortly to be placed, but rather to report general conditions that effect our foreign trade and to indicate in a broad way the needs of the country along the special lines in which the particular journal is interested.

Business Press Bringing News of Development in Foreign Countries to American Manufacturers and American Buyers

One vital way in which the business press is functioning in connection with the promotion of a better understanding of foreign trade is to bring to the attention of the American manufacturers what is being done by competitors abroad who are seeking the same markets. In England today in every line manufacturers' associations have either been developed or knit closer together by the war emergencies. Following the war they have taken active steps in promoting their own export relations to other countries, and the business press has the opportunity through its foreign correspondents and the establishment of editorial offices to keep in touch with and to report these developments.

More than that, because of the close association that exists between the business press and its own clientele, there has been on occasion the opportunity to emphasize the mutual values of important export relations between our manufacturers and the manufacturers abroad. The *Dry Goods Economist*, published by the Textile Publishing Co., of New York City, for example, has had a very close relation to the development of the Irish Linen Association, and the representatives of that journal have found a unique opportunity to be the emissaries of a better understanding between the merchants of this country and the Irish linen makers.

This illustrates also the fact that because the business paper is close to its field and because it sees the necessity for making first-hand studies and investigations of situations, it has an unique opportunity for leadership in the establishment of a better understanding of export or import trade relations of our own manufacturers or consumers.

Spreading Knowledge of American Goods Abroad

The third function of the business press is to act as an advance agent for American goods abroad. In this respect, the business press already has an enviable record—a record stretching back a score of years. Business paper reading matter, as well as advertisements, is constantly stimulating sales of American goods and machinery abroad. Tales are common of even heavy machinery ordered by cable on the sole basis of a business paper description, record of performance or advertisement.

This foreign propaganda function was a byproduct, not stimulated prior to 1914. No attempt was made to secure foreign subscriptions. They were bought, not sold. Since 1914, a new attitude has developed and publishers of business papers are making and will continue to make the strongest efforts to put their periodicals into the hands of influential foreign readers.

Nor are these efforts confined to placing our American editions in foreign hands. Special foreign editions are being printed in a number of instances, while several new business papers, printed exclusively in foreign languages, have been established. The "World-Wide" numbers of the *Dry Goods Economist*, published by the Textile Publishing Co. of New York, are an instance of the first class of expansion, while *Ingenieria Internacional*, published by the McGraw-Hill Co., Inc., of New York City, a general magazine in Spanish, and *El Automovil Americano*, published by the Class Journal Co., of New York City, a magazine in Spanish devoted to American automobiles and motor trucks, are examples of publications printed in foreign languages.

Editing American Publications From the Foreign Buyers' Viewpoint

I have indicated that there are two classes of papers in this country interested in foreign trade, first, a class of domestic circulation primarily having to do with the problems of the American manufacturer and merchant as an exporter, and, second, the papers having to do with the problems of the foreign buyer as an importer. The establishment of the engineering journal in Spanish, *Ingenieria Internacional*, is an example of the purpose and function of the business papers in the second group. There existed no general engineering journal in Spanish before the establishment of this paper. Eminent engineers in Spanish-speaking countries had pointed out that they would welcome a journal which took up fundamentally the engineering problems of their country, and they indicated that the industrial development of their nations rested in no small way on the engineering development of those nations. They urged that a journal having to do with the engineering problems of those countries would be of real service to them.

It was on the basis of a careful analysis and study of conditions in these countries that the paper, *Ingenieria Internacional*, was started, written not from the point of view of the American manufacturer as an exporter, but from the point of view of the Spanish-speaking engineers and industrialists as importers, and acquainting them from this point of view with the methods in their country or in the United States which would help them solve their local problems.

How intimately an engineering journal may enter into the export problems of this nation is illustrated as follows:

Buying of electrical machinery is based upon certain specifications. The standards for specifications of Germany, of England, of the United States, and of France, differ. In order that the South American engineer might know what these standards are the editors of *Ingenieria Internacional* have analyzed and are presenting in the journal, fundamental American standards, and are showing the relation of these standards to the standards of other countries, so that American electrical machinery may be bought hereafter with an understanding on the part of the South American buyer of exactly what the specifications mean.

An Example of Foreign-Trade Promotion

Still another class of foreign-trade promotion by business papers is illustrated by the editions of American papers published abroad. Of these the European edition of the *American Machinist*, published by the McGraw-Hill Co., Inc., of London, for some 22 years, is a good example.

There have been various projects for opening the Russian market with specialized magazines in Russian devoted to American methods and products, but these are necessarily in abeyance under present conditions.

American periodicals, particularly the engineering periodicals, have penetrated into many lands. Engineers the world over have certain purposes in common, and those who speak the English language have come to rely upon engineering periodicals of both the United States and Great Britain as an interchange of ideas and information on the best practise. *London Engineering*, published in London, for example, is an international paper, and several journals in the United States have a high percentage of their circulation among engineers and others abroad. *The Engineering and Mining Journal*, for example, published by the McGraw-Hill Co., Inc., of New York, reaches into practically every mining field in the world.

Conclusion

Although the great work of the business press in its relation to foreign trade has only just begun, it is safe to say that every business paper in the United States is awake to its opportunities, its responsibilities and its duty. The general recognition of these factors is already in evidence—the final form into which action will crystallize is yet to be reached. It is too true that their preliminary work has not been above criticism. But they, too, have suffered from the inertia that has characterized the general attitude of our business men toward foreign trade, though, in justice it must be said that the more progressive of them previous to 1914 tried preaching a doctrine which they knew to be sound, bu' which apparently fell on deaf ears. Now, with the business mind in a more receptive mood, they are improving through mutual criticism and appreciation, preaching the doctrine of the stabilizing influence of foreign trade, throwing light on pertinent foreign conditions and going forth to spread in foreign lands the knowledge of American goods and equipment.

And where American business goes, it will find the American paper already in the field.

For it is as a herald and pioneer that the business papers pledge themselves today to the service of the export trade of the United States.

Selecting the Proper Babbitt

(From an address delivered before the Automotive Service Association by H. S. Hood of the United American Metals Corporation.)

For connecting-rod service and for main engine bearings, the important qualifications of a babbitt is toughness. Lead is soft, tin is tough. A bar of good babbitt with plenty of tin exemplifies toughness, as it will bend double and not show a crack. A metal like this will take any kind of punishment with hardly a quiver. A bar of metal in which lead is predominant will bend double too; but strike the soft one against the tough one and the tough one doesn't show a mark, while the soft one has a deep dent. Hit this tough metal and it chimes like a wedding bell; hit the lead-based metal and it sounds like a muffled drum at a funeral. That's one difference between a tough metal and a soft one.

Next to a bearing pounding out or creeping out because it lacks body, the most important bearing trouble is that of running hot. There are any number of reasons for a bearing running hot, such as inferior oil, carrying particles of grit imperceptible to the eye but capable of heating the bearing by abrasion, an oil with a viscosity too light to hold the film or too heavy to make and retain one. Dust creeping into the bearing will cause it to heat. The bearing may be set too tight and so seize the shaft, or it may be set up too loose and heat up, due to the pounding that follows. But the one cause for hot bearings more than all others put together, is the using of a babbitt with too high a coefficient of friction. There are manufacturers who lose sight of the importance of bearings with a low coefficient of friction and consider only strength. They put in a babbitt considerably stronger than is necessary for the service, sacrificing the coefficient of friction for the surplus unnecessary strength.

Babbitt Composition

It is advisable to choose a babbitt only after careful analysis of the conditions under which it will be used. Lead is soft and ductile and has fine qualities for a babbitt that is not subjected to severe impact, but where pounding occurs you've got to use a babbitt with a body of tin, hardened with antimony and toughened with copper. But this is not all. A little too much antimony, even with a high tin content, will make the bearing brittle, and it may disintegrate under the impact; too much copper will make it too hard and it will run hot under slight provocation. You must have a babbitt in connecting-rod bearings (and this applies to other main bearings as well) that will not pound out under impact or pressure and will not heat up under speed. There are several different formulas that make a good babbitt for this purpose; but few people know from actual and practical knowledge which is really best, because so few have taken the trouble to find out.

Talking about formulas, let me advise you not to place too much reliance on formula alone. What I mean is, don't buy a babbitt simply because it contains so much of tin, so much of that and so much of something else. No matter how good a formula you may select for a certain service, if it is not properly and skilfully alloyed, you're going to have trouble with your bearings. Take a formula with 69 per cent of tin, 7 per cent of antimony and 4 per cent of copper, a good babbitt formula. Now antimony itself has a strong affinity for copper, and a

content of 4 per cent of copper is quite high, so that, unless the mixture is alloyed with exacting care and skill, bits of antimony will run away with bits of copper and form an amalgam known as "hardpoints." They are about the size of a pin head, or even smaller, and hard as steel. If one of these hardpoints should happen to be close to the contact surface of the bearings, it does not take much imagination to realize what will happen when the bearing wears down to the point. Many a scored shaft can lay its injury to the door of these dangerous hardpoints, if the truth were known.

Besides, unless the alloying is skilfully done, and given all the time necessary to make a perfect amalgamation, the mixture can not be uniform, and when the bearings are poured some will be high in copper and others low in copper, some will run hot because they are too hard and others will pound out because they are not hard enough. Or, what is more apt to happen, when the babbitt is melted, the copper, together with some of the antimony, will separate from the tin and hide in the bottom of the pot while bearings of nearly pure tin are being poured. Where the copper separates and settles it can be seen in the pot; but in the case of the hardpoints, or the bearings too high in copper or antimony, there is no superficial evidence to warn that the bearings are going to cause trouble sooner or later. If the babbitt was bought on formula and on a competitive price basis, you have no kick coming, because the manufacturer gave you a mixture up to the formula specified, and that's all you can expect. The wisest plan, therefore, when buying babbitt, is to buy a brand metal from a reliable house who will back up that brand to do certain work; if it doesn't, you have a come-back.

Advantage of Brand Metals

A babbitt manufacturer does not and cannot make a formula babbitt with the exacting care and skill he puts into his own brand; he cannot profitably give it the full time in alloying, because formula babbitts are keenly competitive and he must cut his manufacturing cost to quote a price that will get the order. But, if he is making a brand, and has spent a lot of money in advertising that brand to do certain work, he cannot afford to be careless, and is going to give it all possible care and attention; he is going to use the purest tin, lead and antimony. It is going to cost him more to make his brand than it would to make the same formula as a nameless metal, but he is going to get more money for it. It is worth more to you than the difference, if only for the insurance it carries.

Don't try to save money on babbitt, for if you do, you will probably lose money. Suppose you pay as much as 5 cents more a pound for a brand babbitt from a reliable house than you would have to pay for a formula babbitt on which you get competitive prices. Better to pay this than to sacrifice the guarantee with which the manufacturer backs up his own brand.

In closing, let me urge you not to underestimate the important function which babbitt metal plays in industry. Should you at any time run up against a bearing problem, seek the advice of a babbitt expert. The modern babbitt manufacturer will be only too glad to advise you.

The man who will not listen to Safety rules may have to listen to the sound of the ambulance, says the National Safety Council.

Two Unique Toolposts

By Charles H. Willey

A somewhat unique toolpost that was gotten up to hold bar forming tools on the cross slide of a turret lathe is shown in Fig. 1. The object of its design is

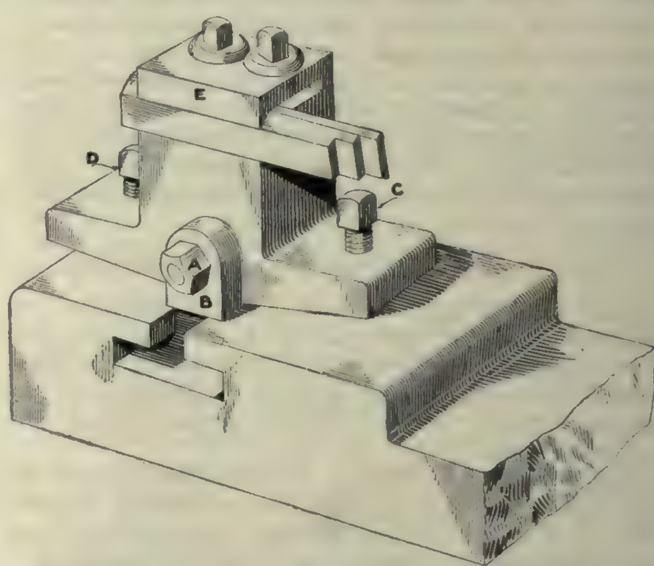


FIG. 1. TOOLPOST FOR THE SCREW MACHINE

to secure adjustability for height as well as to bring the tool close to the face of the chuck. Rigidity, simplicity and cheapness are also attained.

The block is held by pivot screws, one of which is shown at *A*, passing through lugs upon the part *B*, which fits into the T-slot of the cross-slide. The height of the cutting edge is adjusted by tilting the block by means of the setscrews *C* and *D*.

The bevelled clamp *E* fitting over the correspondingly bevelled corner of the tool shank draws the latter back against the shoulder and holds it down at the same time by simply tightening the two collar headscrews.

In Fig. 2 may be seen a quick clamping toolpost for the lathe. The hinged finger *A* gives more rigidity to the lathe tool and eliminates a great deal of the troublesome chatter due to the tool not being clamped down near its cutting edge.

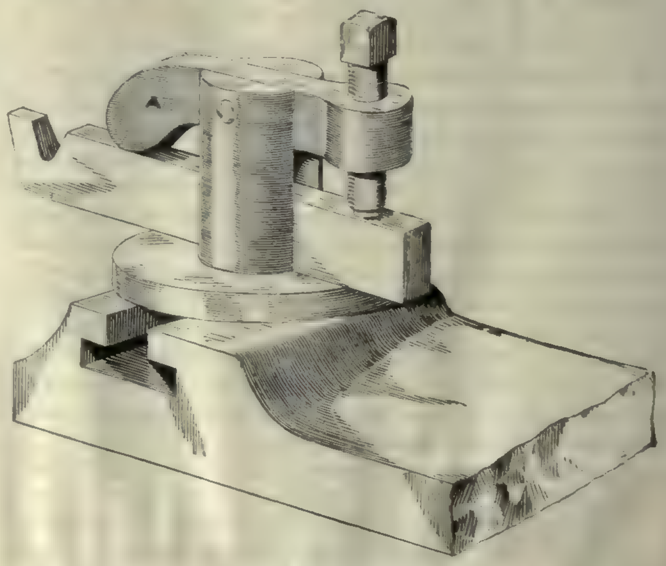


FIG. 2. TOOLPOST FOR THE LATHE

What Other Editors Think

A Short Cut to El Dorado

From *The Electric Furnace*

WE all do it. It is just as much a great National game as Base Ball or the Old Homing which Ellis Parker Butler talks about. Every one of us has tucked away inside of him a Goal which he firmly believes would represent perfect satisfaction and success, could he but attain it. Fortunately for us, although we may keep the Path, we never do reach this Goal. Every worker, be he engineer or manufacturer, sets some such goal ahead of him and bends every effort to reach it; then, when he nears it, he moves it still higher and higher, and plods on. In the good old days this was in a large measure the secret of American progress. A man was willing to follow the Long Road because of the reward at the end of the trail.

Nowadays all this is changed. Every father's son of us is seeking a Short Cut to El Dorado. We want contentment without paying the price of weary miles of striving to achieve it. We forget that contentment is appreciated only by the man to whom hardships have repeatedly come.

The War started the new order of things. Officers for the army had required a lifetime of preparation before, but now they were produced over night by the Plattsburg plan. If engineers were scarce, six weeks at any university turned out the expert required. Even music took the short cut and substituted clanging jazz for the quietier stimulus of the oratorio or opera. People wanted all the chords to strike the ear at once; they wanted a lively sensation and they wanted it in a hurry.

Even the colleges have fallen in line with this dangerous tendency. Because in the wartime a student was trained to do a particular job in a few weeks, now the university is seeking to give tabloid courses to meet all demands. They are talking of teaching only essentials, so that industry may have plenty of college trained minds in short order.

Grant, if you will, that this modern tendency is producing students who are fitted for a specialized industry. Of what benefit is such a student, either to himself or his employer, in case some business conditions or personal inclination forces him to change his occupation? He has no grounding in fundamental things. Industry has no use for such a man because he cannot adapt himself readily or efficiently to new work.

No doubt every post-bellum period experiences such troubled times as these. When 1920 is being studied as history by a class in North Somewhere High School, probably the instructor will point out that these dangers were purely psychological and that the old world was, as ever, very sound at the core. Nevertheless, we who live, move, and pay the landlord in this year of uncertainty, cannot keep from longing for the day when a sign "No Thoroughfare" will be nailed up over the Short Cut to El Dorado. The old way was longer, but it was a great deal safer and surer. Let us keep the Goal, but never be afraid to spend the time necessary to reach it. To El Dorado, there is no royal road.

Food Dangers Ahead

From *Manufacturers' Record*

IN WASHINGTON some people have been suggesting that, in order to reduce the cost of foodstuffs, an embargo be placed on exportation of grain and meats. Do these people not realize that the moment the price of farm products is driven down below the cost of production the farmer will steadily decrease his cultivated acreage and hasten the day when a food famine, greater than the public has any conception of, will be upon us?

It is absolutely certain that this year's food products will be very short. The winter wheat crop is 33 per cent short of last year's yield, and the rye crop shows, by present indications, about the same decline. Other crops will be short, for farm labor is not available.

We have ignored the farmer's needs. We have yielded to the demands of industrial workers for an eight-hour day and given them steadily advancing wages, and we have told the farm laborer that by quitting his job and coming to the city he can cut his hours of labor almost in half and at least double the amount of wages received.

Can anyone imagine that the farmer boy will continue to work with the drudgery of farm life from daybreak to dark when, by leaving the farm, he can get twice as much pay for half the hours of work, and then have all the allurements of city life?

And then, when one talks about an embargo on shipments of foodstuffs, does he realize that the farmer will have something to say on that subject and will demand his rights so that no embargo shall be placed on his product unless an embargo also be placed on cotton and iron and steel and lumber and everything that we are now exporting? What is sauce for the goose will be equally good sauce for the gander.

He who talks about an embargo on the shipment of farm products in order to reduce the cost of foodstuffs for the American people is only arguing in favor of a famine of food which would stagger the nation.

For many years, due to the trend of the population from the farm to the city, there has been in evidence a decline in the per capita production of food, and the end is not yet in sight. We are facing a very dangerous food situation, and the best brains of the nation should be concentrated upon the development of agriculture that it may be made as prosperous as merchandising and manufacturing in the city, so that the farm laborer may get as high wages as the city laborer, relative to the cost of living, or otherwise we soon will reach a point when we shall have to search the world for food to add to our own scanty production. And yet we have a soil which in extent and fertility ought to be able to feed five times our present population, but it will not feed our existing population unless the country soon comes to a realization of the whole situation and ceases to fight a profitable price for the farmer, and, on the contrary, does all in its power to make farming profitable and to lessen the burden of farm life. In that is our only safety.

SPARKS FROM THE WOR

Valentine Francis

Seventeenth Meeting of American Iron and Steel Institute

On Friday, May 28, 1920, over six hundred members of the American Iron and Steel Institute gathered in the grand ballroom of the Hotel Commodore, New York, for the seventeenth general meeting of that organization. The meeting lasted all day and was divided into three sessions. The morning session was opened by an address by Judge Elbert H. Gary, president of the Institute. Mr. Gary's words carried a forceful message to the steel makers of the country. In his extemporaneous remarks leading up to his prepared speech, Judge Gary referred to the faithful service of the iron and steel interests to the country during the war.

"Now, again," he added, "we are passing through a critical period, but you have your place and influence and you may be depended upon to carry on the work which is laid out by the necessities of the occasion in protecting the people and business of the United States.

"Again you are called upon to 'play the game and play it fair.' You will respond and you will exert great influence as steady and loyal citizens to protect your own interests and those of your associates and your employees, and above everything else the public welfare."

The full text of Mr. Gary's address will appear in an early issue of the *American Machinist*. A paper prepared by C. L. Close, manager, Bureau of Safety, Sanitation and Welfare, U. S. Steel Corporation, was read. Mr. Close traced the history of the steel industry to its present stage, bringing out particularly the absence of the human side of business in the early days. He brought out the many improvements which present day management has made to benefit working conditions for employees.

Safety devices, first aid hospitals, shop papers, insurance, community dwellings, clubs, restaurants and many other advantages which were lacking in the olden days, have been established in nearly all large corporations. Moving pictures of the social activities at the Gary Steel Works, were shown on a screen.

The afternoon session was opened with an address, "Fatigue of Metals Under Repeated Stress," by H. F. Moore, research professor of engineering material in the University of Illinois, Urbana, Ill. Mr. Moore's address covered the tests of metals as made by the National Research Council. His remarks were accompanied by lantern slides showing the effects of certain kinds of stress on steel.

F. C. Cottrell, assistant director, Bureau of Mines, Washington, D. C., spoke on "The Future of Oxygen Enrichment of the Air in Metallurgical Operations." Mr. Cottrell spoke of the recent improvements made in the production of oxygen and the tests being conducted at present to discover quicker and cheaper methods of producing this valuable gas.

Following this came addresses by Albert Sauveur, professor of Metallurgy, Harvard University, on "The Microscope and the Heat Treatment of Steel"; C. A. Witter, of the Provident Engineering Co., Philadelphia, Pa., on "A Method of Producing Pipeless Rolled Products from Annular Blooms"; B. De Mare, of the Midvale Steel and Ordnance Co., Philadelphia, Pa., on "The Acid Open Hearth Process."

The evening session was taken up with a banquet in the grand ballroom of the hotel. Several impromptu speeches were made by various members who were called upon by President Gary.

Lieutenant Jean Jean's Mission

Lieutenant Jean Jean, formerly of the Construction Metallique, has returned to the United States and is now located in the machine-tool section, Office of the Director of Sales, Room 2504, Munitions Building, Washington, D. C.

Lieutenant Jean Jean is in the United States on a special mission for the Belgian Government and is not at this time making purchases of machine tools of any description. Because of the present rate of exchange the Construction Metallique is not buying machine tools or materials of any nature.

Summer Course in Management

The Department of Industrial Engineering of Pennsylvania State College, State College, Pa., is offering, for the fifth consecutive year, a two-weeks' summer course in industrial organization and management to extend from Aug. 9 to 21. There are to be included courses on factory employment, industrial betterment, planning and production control, purchasing, cost accounting and kindred subjects. Edward J. Kunze is head of the department.

Aëronautic Committee Advises Use of Duralumin

The National Advisory Committee for Aëronautics, at its recent semi-annual meeting, acted favorably upon the recommendation of the committee on materials for aircraft and adopted the following resolution:

"Resolved, That the executive committee be instructed to communicate with various manufacturing companies, inviting their attention to the importance of duralumin products, especially tubing, for airplane wings, and endeavoring to secure their co-operation in the development of duralumin products for airplanes."

It is considered to be a highly essential matter that duralumin and similar wrought aluminum alloys, as well as aluminum castings alloys, be made available for military use. It is also anticipated by the metallurgical experts that a large commercial future can be expected for these materials, not only in commercial exploitation of airplanes, but also in automotive construction and in other industrial work where strong, light alloys are much needed.

Metal parts of Zeppelins were made of aluminum alloys and the later ships were all of duralumin. In the United States a small amount of duralumin metal has been produced in simple shapes, while in England, France and Germany the production has been carried to almost all conceivable wrought shapes.

For example, Fokker all-metal airplanes have duralumin wing coverings replacing fabric, duralumin frame work in various welded and formed shapes and duralumin tubing for the supporting members, this tubing reaching about 3 in. in diameter.

Exposition and Convention of American Steel Treaters

In the Commercial Museum, Philadelphia, the annual exposition, convention and sales market of the American Steel Treaters' Society will be held. The event will run for five days, Sept. 14 to 18. Plans are being made to make this a banner year in the history of the society and from the present indications it will be more than successful.

While the booths containing the exhibitions will be situated on the main floor, the conveners will meet in another part of the building. An excellent program, covering all phases of heat treating, has been arranged and several prominent engineers and manufacturers will address the convention.

LD'S INDUSTRIAL FORGE

News Editor

Duplicate of Express Receipts Required

On and after July 1, the American Railway Express Co. will keep a duplicate copy of every receipt it issues when receiving business from shippers. The duplicates will be retained by the express company for the purpose of record and reference, and will be held at the shipping office.

Shippers who have been accustomed to prepare their own receipts or who have their own forms have been requested to make provision for supplying duplicates of such receipts to the express driver or receiving clerk who signs them.

As a matter of convenience to shippers, the regular receipt forms of the express carrier will be revised to permit their use in duplicate form.

In cases where prepaid receipts are now being issued in duplicate, the extra copy being used as a record of charges paid, a third copy will be required under the new system, and in such instances prepaid receipts will be issued in triplicate.

One of the objects of the new system is to bring about better protection for and methods of recording the movement of express packages in transit.

N. Y. State Industries Not to Hire Farm Labor

Industry in New York State will refuse to hire farm help to work in factories or mercantile establishments. The board of directors of Associated Industries of New York State, the largest employers' state association in the United States, went on record as opposed to the employment by manufacturing and mercantile institutions of farm labor, and recommends to every member of the association and to all other employers, that they refrain from advertising for, or hiring, farm labor.

"One of the most important and pressing problems we face today," says E J. Barcalo, of Buffalo, president of Associated Industries, "is quantity production in foodstuffs on the farms. For the public generally it is more important than any problem facing industrialists. The position of the state association is obvious. We want our members to flatly refuse to hire farm help and, so far as possible, send back to the farm such experienced farm labor as has been lured by high wages into industry. It may help reduce the cost of living."

Members of Associated Industries employ more than one-half of all the factory employees in the state, the greater part of them outside of New York City in the rural and semi-rural districts. It is expected that the association's action will relieve, in some measure, the shortage of farm labor.

Latest Additions of the Black & Decker Co.

One of the latest additions to the plant of the Black & Decker Co., at Towson Heights, Baltimore, Md., is a cafeteria, a photograph of which is shown herewith.

This lunchroom takes care of over 300 employees for the noon-day meal—all being eligible to eat there, from office boy to president. A player piano and a grand piano have been installed

THE B. & D. CAFETERIA

and after the meal is over those who are musically inclined—and others—provide some amateur entertainment. This is but one of the ways which the Black & Decker Co. is taking to promote real satisfaction among its employees.

During the recent railroad strike and the embargoes immediately following, the B. & D. Co. was not to be outdone in making deliveries of its products or in getting supplies of raw materials. Two Pierce-Arrow trucks were purchased. One, a five-ton truck, has made three round trips to Fort Wayne, Ind., making stops at Pittsburgh and Cleveland. The other, a three-ton truck, has made three round trips to Cleveland, Ohio.

The Black & Decker Co. manufactures electric air compressors, portable electric drills and electric valve grinding machines.

The Wayne Machinery Co., of Fort Wayne, Ind., has opened a branch in Louisville, Ky. The purpose of this branch is to take care of the needs of the trade in Louisville, New Albany, Jeffersonville and the southern Indiana and Kentucky territory.

Foreign Credit Insurance Now a Reality

Announcement has been made of the organization of a mutual company for the insurance of credits in foreign countries. The new company is to be known as the American Manufacturers' Foreign Credit Insurance Exchange. The purpose of this mutual exchange will be to supply that element in foreign trade that has heretofore been lacking—adequate information on the financial status of foreign merchants and a reasonable safeguard in individual business transactions. Being a company organized on reciprocal lines the insurance will be written at net cost and not for profit.

This is a step in the right direction and should fill a want long felt by American manufacturers, whether at present active in export trade or interested in its potential possibilities. The question of credits—the uncertainty of the financial responsibilities of foreign merchants—is at the base of the aversion to export trade on the part of many American manufacturers and the fact that insurance on foreign credits can now be had, through a mutual company, should do much to overcome the inertia on the part of our manufacturers to cultivate the fertile and profitable markets in foreign fields.

The organization of the American Manufacturers Foreign Credit Insurance Exchange is the result of several years search by various state and trade associations, for a ways and means to solve the problem of foreign credits. At the annual meeting of the Foreign Trade Council at Cincinnati three years ago George R. Meyercord, first vice president of the Illinois Manufacturers' Association, and president of the American Manufacturers' Foreign Credit Underwriters, presented a rough plan for the insurance of foreign credits. Since then the foreign-trade committee of the Illinois Manufacturers' Association, in conjunction with associations such as the Tanners' Council, has been working to whip into shape a flexible and effective plan to provide such a service to the American manufacturer.

The net result is that there has been formed by officials of the Illinois Manufacturers' Association, and with its approval and endorsement, the American Manufacturers' Foreign Credit Insurance Exchange.

The plan and scope of insuring foreign credits through the American Manufacturers' Foreign Credit Insurance Exchange has received the endorsement of the various state and trade organizations before which it has thus far been discussed—notably the

Illinois Manufacturers' Association, the West Virginia Manufacturers' Association, the Tanners' Council, etc.

This scheme of foreign credit insurance is predicted on the necessity of the compilation and publication for foreign credit guides for the different world zones. These credit guides will be on the order of similar books published by mercantile agencies in this country in connection with domestic business. They will contain the names of the responsible importing merchants in the respective zones—names which are insurable unless otherwise marked.

Exporters may subscribe to one or more of these credit guides at a fixed rate per annum and then may insure their entire time draft or open account business with the district or districts covered, by the payment of a premium based on the volume insured. As with domestic mutual liability insurance companies, the initial payment will be determined by the normal average exports and will be adjusted at the end of the policy year by the actual transactions covered. It is understood that the basic rates will be low, ranging probably between 1 and 2 per cent. Only the solvency of the debtor will be insured for obvious reasons. However, delay in acceptance of goods or payment of bills is covered by another protective clause. When the exchange has issued as much insurance on any one consignee as his strength justifies, it will refuse to insure further shipments to him until part of the line is cleared.

The Exchange has had foreign-credit experts working for some months rating the credit files of international banking houses, similar files of export associations, credit men's associations, etc. With the sources of information at the disposal of this mutual exchange it will have information on the financial status of all foreign customers.

Of course a point that is of immediate interest and value to American manufacturers is the fact that through this mutual exchange, not only is foreign credit insurance to be brought at net cost, but in the credit guides which can be procured by members of the Exchange will be presented to the manufacturer a pre-analyzed and selected market for his product.

It is anticipated by the exchange that it will be in a position to sell insurance on specific foreign shipments by August.

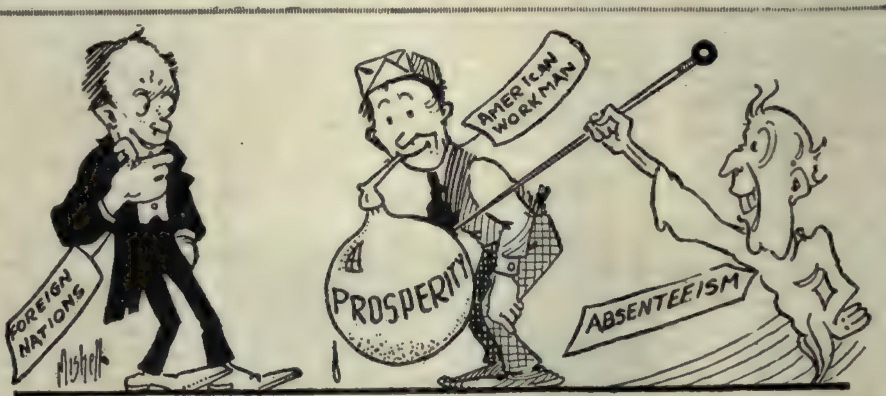
The general offices of the American Manufacturers Foreign Credit Insurance Exchange are in the Chamber of Commerce Building, Chicago.

Sponsors for Safety Codes Selected by A. E. S. Committee

Definite arrangements have been made for the formulation of a considerable number of safety codes under the auspices and rules of procedure of the American Engineering Standards Committee. The subjects of the codes for which arrangements have been completed, together with the organizations which have been designated by the committee to act as sponsors, and who have accepted such responsibility, are as follows:

ABRASIVE WHEELS. — The Grinding Wheel Manufacturers of the United States and Canada, and the International Association of Industrial Accident Boards and Commissions, joint sponsors.

EXPLOSIVES.—The Institute of Makers of Explosives, sponsor.



From *Speed Up.*

THE SIN OF ABSENTEEISM

Loss of Time Alone Cuts One-sixth of Possible Output in Country's Industries

FOUNDRIES.—The American Foundrymen's Association and the National Founders Association, joint sponsors.

GAS SAFETY CODE.—The U. S. Bureau of Standards and the American Gas Association, joint sponsors.

HEAD AND EYE PROTECTION.—The U. S. Bureau of Standards, sponsor.

POWER PRESSES. — The National Safety Council, sponsor.

PRESSURE VESSELS, NON-FIRED.—The American Society Mechanical Engineers.

REFRIGERATION, MECHANICAL.—The American Society of Refrigerating Engineers, sponsor.

WOODWORKING MACHINERY.—The International Association of Industrial Accident Boards and Commissions and the National Workmen's Compensation Service Bureau, joint sponsors.

A number of additional codes are under consideration. A large representative advisory committee of specialists, organized by the National Safety Council, the National Workmen's Compensation Service Bureau, and the Bureau of Standards, at the request of the committee, to act as its advisor, is actively working on the question of what additional codes are most urgently required and what organizations are in the best position to undertake sponsorship for such codes.

American Machinery in India

Although the Indian market for industrial machinery has been somewhat neglected by American manufacturers and exporters in the past, customs returns up to March 31, 1919, show that the percentage of machinery furnished India by the United States has annually increased from 2.3 per cent in 1914-15 to 24.5 per cent in 1918-19. Trade Commissioner Rastall comments upon this evidence of growing demand as indicative of the satisfaction given by the American product, which should encourage the further development of a strong foothold in this market by American interests.

Westinghouse Officials Decorated by the Emperor of Japan

On May 12 the Emperor of Japan decorated with the Order of the Rising Sun E. M. Herr of Pittsburgh, president of the Westinghouse Electric and Manufacturing Co., and L. A. Osborne of New York, president of the Westinghouse Electric International Co.

These American manufacturers have been several months in Japan studying Oriental industrial conditions. The company which they represent has always had close relations with Japan and has supplied that country with a great deal of power machinery. It has also undertaken the training of a number of Japanese students at its works.

The Order of the Rising Sun is the highest honor the Emperor can bestow.

Buffalo Section of A. S. M. E. Elects New Officers

The Buffalo section of the American Society of Mechanical Engineers, at a meeting held at the University Club, elected the following officers for the season 1920-1921: B. S. Hughes, chairman; W. J. Gamble, vice-chairman; W. W. Boyd, secretary; W. M. Dollar, treasurer.

Mr. Hughes is vice-president and chief engineer of the Taremba Co.; Mr. Gamble, superintendent of the Vulcan Steam Forging Co.; Mr. Boyd, an engineer with the Niagara Machine and Tool Works; Mr. Dollar, a consulting engineer.

W. B. Powell, member of the A. S. M. E. and formerly chairman of the membership committee work for this section, is now president of the Engineering Society of Buffalo.

Co-operative Course Beneficial

A co-operative course in electrical engineering, which was conducted for the past year by the Massachusetts Institute of Technology and the General Electric Co., has proved a success. The company is going to enroll 60 men in this year's class—twice the number of the last one—and has secured larger accommodations for the men.

Charles N. Hess Organizes New Company

Charles N. Hess, formerly manager machinery department of W. N. Pattison Supply Co., Cleveland, Ohio, one

CHARLES N. HESS

of the best posted machinery salesmen in the Middle West, has organized the Hess-Schenck Co., to handle new and used machine tools.

Employees' Store Proves Successful

Nearly a quarter of a million dollars in cash sales was handled by the employees' store of the Westinghouse Electric Manufacturing Co., East Pittsburgh, Pa., in the first five and a half months of its existence.

According to a report just issued by J. E. Bonham, secretary-treasurer of the co-operative buying committee of employees, the total sales amounted to $226,673. After expenses for the period were deducted there remained a surplus of $11,550, which is being used as a working fund.

The employees' store has been in operation since Oct. 18, 1919, selling merchandise practically at cost to workers. It is the intention to enlarge the capacity of the store as the patronage of the employees warrants.

Business was transacted in grocery, tailoring, shoe and miscellaneous departments, more than nine-tenths of the total sales being made by the grocery department. The tailoring department sales totaled $8,113, the shoe department sales were $6,342 and $9,666 was obtained in sales of miscellaneous goods.

American Concerns in Italy Need Not Have Italian Managers

A recent newspaper dispatch from Rome stated that all American and other foreign companies possessing factories, mines, and other establishments in Italy would be compelled to assume Italian nationality, and that the head directors and managers of such companies must be Italians, domiciled and resident in Italy. The above report is not in accordance with the facts, as is evidenced by the following cable sent from Rome to Prof. B. Attolico, Italian Minister Plenipotentiary:

> News published not correct. Applies only to sulphur mines, decree of July 18, 1918, and to alkaline and phosphate salt lands in which instances it is desired that concessions and assignments be made to Italian citizens. In both cases at least two-thirds of capital of companies to which concessions are made must be Italian, and administration must be retained by Italians. There is no plan to extend said dispositions to other mining and industrial branches.

Metric System Condemned

In addition to the recent order of Secretary of War Baker directing the discontinuance of the use of the metric system, the Navy Department also, through prominent officers, expresses its opposition to that system.

Admiral Griffin, Chief of the Bureau of Steam Engineering, in an interview said "that to make a change to the metric system in the Navy would cause havoc with repair work and that he had no idea Congress would be ready to make the large appropriation required to meet the cost of a change."

Admiral McGowan, at the head of the Division of Supplies, points out the serious burden which a change would place on his department.

The commandant and superintendent of the Naval Gun Factory, Washington, says, "It is not believed the time is ripe for the adoption of the metric system."

Standardization of Ball Bearings

At the request of the Swiss Standards Association, Baden, Switzerland, for co-operation in the work of standardization of ball bearings, the American Engineering Standards Committee requested the American Society of Mechanical Engineers and the Society of Automotive Engineers to act as joint sponsors for the project. These societies have accepted the responsibility and are now organizing a sectional committee for the work. The sectional committee will be thoroughly representative of all the interests involved and is the body which will be responsible for the detailed formulation of the standards.

Personals

C. C. BAUSCHKE, former Ohio representative for the Kearney & Trecker Co., has organized the Bauschke Machinery Co., to distribute several lines of machine tools.

E. W. KENYON, former Ohio representative for the W. F. Davis Machine Tool Co., and C. B. HARDING, former Eastern representative for the Lees-Bradner Co., have become associated with C. C. Bauschke Machinery Co.

FRANK A. CLARK, 603 Floyd Ave., Rome, N. Y., who has been with the Rome Brass and Copper Co. for the past 26 years, has resigned and will become associated with the National Conduit and Cable Co., of Hastings-on-the-Hudson.

GEORGE E. LONG, senior vice president of the Joseph Dixon Crucible Co., Jersey City, N. J., recently retired from that position. He has given 43 years of service, and will continue to act on the board of directors. His associates and friends hope that he will enjoy his well-earned "vacation" for many years to come.

HARRY M. FRECKER, formerly with Hill, Clarke & Co., Inc., of New York, is now connected with the New York machine sales department of the Henry & Wright Manufacturing Co., New York.

W. F. MYER has been appointed directing transmission engineer of the industrial bearings division, Hyatt Roller

Wittstein Leaves Chapman Co.

Herman L. Wittstein has resigned as works manager of the Chapman Valve Manufacturing Co., Springfield, Mass.,

HERMAN L. WITTSTEIN

to assume charge of production of the Morris Metal Products Corporation of Bridgeport, Conn. The company is engaged in the manufacture in quantity of castings, die castings and metal parts of machinery. Mr. Wittstein is best known for his work at the United States Armory at Springfield, Mass., during the war, where he was in a large measure responsible for the large production records established, and where he superintended the installation and operation of more than a half-million dollars' worth of modern ordnance machinery without diminishing the production.

Mr. Wittstein was born in New Haven, and is a graduate of the Sheffield Scientific School of Yale University.

Bearing Co., New York. In his new position Mr. Myer will be responsible for the sale of Hyatt lineshaft roller bearings.

HARRIS WHITING, formerly with Graton & Knight Manufacturing Co., of Worcester, Mass., has taken the position as factory manager of the Edward R. Ladew Co. Inc., at Glen Cove, L. I.

CLYDE E. DICKEY, president of the Dickey Steel Co., Inc., New York, has been elected first vice president and general manager of the Hammond Steel Co., Inc., of Syracuse, N. Y., manufacturer of high-grade alloy and carbon tool steels.

THOMAS A. LINCOLN, who has been connected with the New Departure Manufacturing Co., Bristol, Conn., since 1912, has advanced from fireman to foreman of the heating-treatment department of this company.

CARL HOLL, formerly with the Persons Manufacturing Co., of Worcester, Mass., is now connected with the Graton & Knight Manufacturing Co., of the same city. Mr. Holl was superintendent with the Persons Co.

JAMES H. FARRELL, formerly with the Hopkins & Allen Arms Co., Norwich, Conn., and at one time with the Yale & Towne Manufacturing Co., and also the Greenfield Tap and Die Corporation, has recently been appointed foreman of the toolroom of the New Departure Manufacturing Co., Bristol, Conn.

WILLIAM CUMPSTEY, formerly assistant foreman of general maintenance for the Connecticut Telephone Co., Meriden, Conn., has been appointed foreman of millwrights for the New Departure Manufacturing Co., Bristol, Conn.

E. J. BOGGAN, factory manager of the U. S. Metal Co., Cleveland, Ohio, has resigned his position to become sales engineer of the Dittmer Gear and Manufacturing Co., Buffalo, N. Y. Mr. Boggan was formerly production manager for the Covert Gear Co., and sales engineer for the Frontier Chuck and Tool Co., both of Buffalo, N. Y.

G. H. DAWSON, who has been plant engineer for the Remington Arms plant in Ilion, N. Y., for the last four years, has severed his connections with that firm and on May 15 will take an engineering position in the general production department of the Library Bureau Corporation, Cambridge, Mass.

JOHN KILDUFF, for the last twelve years associated with the New Departure Manufacturing Co., Bristol, Conn., has been appointed foreman of the section bearing machine department.

W. H. DIEFENDORF, A. S. M. E. and S. A. E., formerly chief engineer of the New Process Gear Corporation, has resigned the general managership of the Weekes-Hoffman Co., of Syracuse, N. Y., to establish his own gear business at 118 Dickerson St., Syracuse, N. Y., under the title of the Diefendorf Gear Corporation. The new corporation will manufacture the staple line of gears, spur, bevel and worm, in metal, rawhide and fiber or other composition. The company is capitalized at $150,000. It will manufacture special gears for the machine building industry. Mr. Diefendorf is a member of the executive committee of the American Gear Manufacturer's Association.

SIDNEY HUGHES has taken up his duties as assistant works manager of the Gilbert & Barker Manufacturing Co., of Springfield, Mass. Mr. Hughes was formerly with the Colts Patent Firearms Co., at Hartford, Conn., and has broad shop experience along engineering lines. He is a graduate of Mercersburg Academy and also of Princeton University.

AUGUSTUS S. SHORT has recently been appointed factory accountant of the Gilbert & Barker Manufacturing Co., of Springfield, Mass. Mr. Short was formerly with the firm of Fedde & Pasley, of New York.

L. M. BAKER, supervisor of sales of the motor equipment division of the Hyatt Roller Bearing Co., has resigned to take over the exclusive representation of the Ditmer Gear and Manufacturing Co., in the State of Michigan. Mr. Baker's headquatrers will be located in Detroit.

WALTER H. WOOD, assistant treasurer, of Gilbert & Barker Manufacturing Co., of Springfield, Mass., has returned home after a month spent in Florida. The southern trip did him a world of good and he finds his strength much restored.

Business Items

The New Jersey Brass Corporation has changed its address from 61 Broadway to 480 Lexington Ave., New York.

W. R. McDonough & Co., with offices in the Citizens' Bldg., Cleveland, Ohio, is now the sales representative of the Ward Tool and Forging Co., Latrobe, Pa., in the Cleveland territory.

The Chamberlain Machine Works and the Metcalf foundry, Waterloo, Iowa, were destroyed by fire on May 17. The loss is $150,000. F. L. Chamberlain, president, states that work on a new, modern factory to replace the one burned will start as soon as insurance is adjusted. The Metcalf foundry made a large amount of castings for the Chamberlain Works and other factories in Waterloo.

The American Tractor and Foundry Co., Charles City, Iowa, has changed its name to the American Engine and Foundry Co. W. J. Joyce, president and manager, states that the change is made to indicate its manufacturing business more accurately as it is not manufacturing tractors as was intended when the former name was taken.

The Rich Tool Co., Chicago, announces that the Garlock-Walker Machinery Co., Ltd., with offices in Toronto, Montreal and Winnipeg, has been appointed its exclusive agent for Canada.

E. Lagerholm Co., Inc., has announced the removal of its offices and stockroom to 9 South Clinton Street, Chicago, Ill.

The Lycoming Foundry and Machine Co., Williamsport, Pa., announces the change of its corporate name to Lycoming Motors Corporation and will continue the manufacturing of automobile motors.

The Simmons Economy Tool Corporation has started construction of a building in North Albany, N. Y. The building will be of steel construction; the floor space will be approximately 10,000 sq.ft. on two floors. Equipment of the plant will consist of the most modern and up-to-date machinery obtainable. At the start, 150 skilled mechanics will be employed. The company will manufacture and sell the Simmons hold-em-all tool holder, patents, patterns and plans of which are the property of the corporation. Other products to be made at the plant are the Simmons dividing head, Simmons patent drill socket, precision lathes, for instrument makers, drill presses, laundry machinery and a variety of machine tools.

The McKneat Manufacturing Co., a corporation organized under the laws of Pennsylvania, has leased a factory building at Easton, Pa., for the purpose of manufacturing the "McKneat" line of oil burners and equipment. The officers of the company are: C. P. Astrom, president; E. R. Euston, vice president; W. I. Gassert, secretary; A. J. McVey, treasurer; A. A. Neave, chairman board of directors.

The personnel of the Beaver Machine and Tool Co., Newark, N. J., has somewhat changed and the officers are: Ernest B. Slade, president and treasurer; Harold E. Slade, vice president and secretary; Arthur T. Doud, vice president and general manager. Mr. Doud just recently joined the organization and was formally manager of the press metal division of the American Tube and Stamping Co., of Bridgeport, Conn. Robert C. Nelson is factory superintendent, and Mr. Moore is tool room superintendent. J. Downing is chief engineer.

The Walker-Stewart Foundry Corporation, of Meriden, Conn., has been organized to deal in castings, machinery, etc. The organizers of the new company are: V. E. Walker, Amos Doolittle, J. J. Roach, H. E. Bradshaw, all of Meriden, and William Stewart of Torrington, Conn. The capital of the new company is $50,000.

The Factory and Mill Supply Co., of Boston, Mass., has taken a larger warehouse in the center of the machinery district, 390-400 Atlantic Ave., Boston, where it will have over 15,000 feet of floor space for its machine tools. The general offices and showroom will remain at Oliver and Purchase Sts.

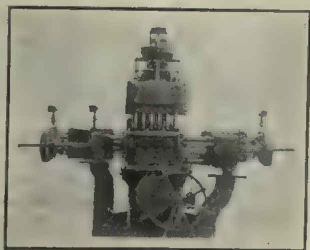
The following manufacturers announced the opening of New York offices in the Grand Central Palace, New York, in charge of L. S. Devos, formerly at 120 Liberty St., New York:

(*Continued on page 1278b*)

Condensed-Clipping Index of Equipment

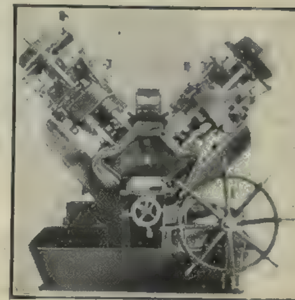
Patented Aug. 20, 1918

Tapping Machine, Three Way.
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," May 6, 1920.



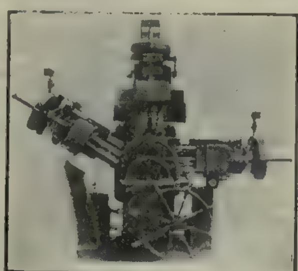
The drive for spindles is carried through a main shaft to a separate reduction gear in a housing on the frame at rear of each spindle head. The sizes tapped by the same spindle head may range from 1⅛ to a ½ in. hole. It is stated that the use of a large size tap in a spindle head adds to the success of results obtained from the smaller taps that may be in use at the same time, since the larger tap tends to pull the smaller ones more uniformly into the work. It is not always advisable to tap from underneath and in this tapping machine the cylinder block casting is inverted before being placed in the machine.

Tapping Machine, Two Way Inclined Head.
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," May 6, 1920.



The drive for spindles is carried through a main shaft to a separate reduction gear in a housing on the frame at rear of each spindle head. The sizes tapped by same spindle head may range from 1⅛ in. down to a ½ in. hole. It is stated that the use of a large size tap in a spindle head adds to the success of results obtained from smaller taps that may be in use at the same time, since the larger tap tends to pull the smaller ones more uniformly into the work. In this machine both spindle heads are inclined at an angle of 45 deg. and are counterbalanced by weights.

Tapping Machine, Combination Three Way.
Foote-Burt Co., Cleveland, Ohio.
"American Machinist," May 6, 1920.



The drive for spindles is carried through a main shaft to a separate reduction gear in a housing on the frame at rear of each spindle head. The sizes tapped by same spindle head may range from 1⅛ in. down to a ½ in. hole. It is stated that the use of a large size tap in a spindle head adds to the success of results obtained from the smaller taps that may be in use at the same time, since the larger tap tends to pull the smaller ones more uniformly into the work. In this machine one inclined spindle head is shown and a cylinder block lying in fixture reveals how the machine is employed. The inclined spindle heads are each equipped with a roller running on a guide plate.

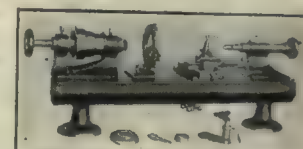
Pulley, Iron Split.
The Skefko Ball Bearing Co., Ltd., Luton, England.
"American Machinist," (English Edition) April 17, 1920.

Pulley has interchangeable rims, shaft bushes, and ball bearing bushes for the conversion of fast pulleys to loose pulleys. Is made in sizes from 8 in. to 60 in. diameter, with interchangeable rims ranging in width from 3 in. to 16 in. up to 20 in. diam. With rims from 3 in. to 9 in. wide, either flat or crowned, a single spider is used, pulleys for belts of greater width having two spiders and flat-faced rims only. Pulleys from 12 to 40 in. diameter are standardized with three hub bores, 2½, 4, and 6 in. The shaft bushes are made in 22 sizes, from 1 to 5¾ in. diameter.

Lathe, Locomotive Crank Axle.
Fairbairns, Leeds, England.
"American Machinist," (English Edition) April 10, 1920.

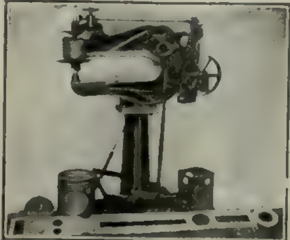
The 36 in. center locomotive crank-axle lathe takes axles up to 12 ft. in length between the centers. Bed is of the twin type, 8 ft. 3 in. across the top, bed piece up to gap being 16 ft. 6 in. long. Headstock mounted on separate baseplate, a 30 hp., 3 to 1 variable-speed motor driving through double-helical and spur gears to faceplate gear. By means of handwheel and lever the gear box at the front of the head gives three speeds. All the gears throughout the machine are of steel. The overall length of the lathe is 30 ft. and the approximate weight is 45 tons.

Lathe, P. M. C. Precision Bench.
Package Machinery Co., Springfield, Mass.
"American Machinist," May 20, 1920.



Special features are: Ball thrust-bearings in headstock; split-nut clamp in tailstock, and adustable nuts on compound-rest feed screws. Countershaft furnished with either bench or wall hangers. Two sets of tight and loose pulleys are furnished. Large pulley for driving, is made of aluminum. Specifications: Length of bed, 36 in. between centers, 16 in. Swing over bed, 8½ in. Collet capacity. Distance, ⅝ in. Diameter of spindle nose, 8½ in. Thread on spindle nose, 12 per in. Speeds (6), 350 to 1,200 r.p.m. Bench space, 6 x 39 in. Weight, net, including countershaft, 235 lb., boxed 295 lb.

Shear, Gray's Rotary Turret
Southwark Foundry and Machine Co., Philadelphia, Pa.
"American Machinist," May 20, 1920.



Cuts openings of any shape without cutting in from edge and without turning sheet. Turret carrying upper cutter, while cutting, can be revolved about lower cutter. Simultaneous driving of both cutters automatically pulls sheet through shear. Line is accurately followed by turning guide wheel which controls turret. Cuts openings in widths equal to double the throat depth and without limit on length. Machine is built in five sizes. The three smaller machines will cut metal of 18, 16 and 10 gage, respectively, the two larger sizes will shear plate up to 1 in. thick. Throat depths are from 18 to 36 in.

Milling Machine, No. 1 Hand.
Superior Machine and Engineering Co., Detroit, Mich.
"American Machinist," May 20, 1920.

Specifications: Table, surface, 22 x 4½ in., T-slots, ⅝ in. wide; longitudinal travel, 6 in.; traverse travel of saddle, 6 in.; vertical travel of knee, 12 in. Spindle, No. 10 B. & S. taper in nose; vertical travel, 4½ in. Overarm, 2½ in. dia. Distance from center of spindle to underside of arm, 3⅝ in. Driving pulley, dia., 10 in.; width of face, 3⅛ in.; speed, 300 r.p.m. Spindle has 12 speeds, from 150 to 600 r.p.m. Speed-change pulleys, 4½, 6¾, 8 and 9 in. dia. for 2⅜-in. belt. Floor space, 34 x 41 in. Net weight, 860 lb.

Clip, paste on 3 x 5-in. cards and file as desired

Monarch Machine Tool Co., Sidney, Ohio; Whipp Machine Tool Co., Sidney, Ohio; Stockbridge Machine Co., Worcester, Mass.; Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.; Ott Grinder Co., Indianapolis, Ind.; American Milling Machine Co., Cincinnati, Ohio; U. S. Machine Tool Co., Cincinnati, Ohio; U. S. Drill Head Co., Cincinnati, Ohio; La Salle Tool Co., La Salle, Ill.; T. R. Almond Manufacturing Co., Ashburnham, Mass. A permanent demonstration exhibit as well as a limited stock of the above manufacturers' products will at all times be maintained at the Grand Central Palace.

The Gilbert & Barker Manufacturing Co., of Springfield, Mass., issues service pins to all its employees at the end of five years' service with the company. President McNall recently issued six of these to employees whose service of five years was completed in May.

The Willard Tool Co., Inc., of Stratford, Conn., has been organized and incorporated with a capital of $25,000 to engage in the manufacture of tools, etc. The incorporators of the new company are: M. W. Schillberg and F. W. Schillberg, of Stratford; and A. O. Seastrom, of Bridgeport.

The Millersburg Reamer and Tool Co., of Millersburg, Pa., recently incorporated, is erecting a shop of steel and concrete construction, which will be in full operation by July 1, 1920. W. Edward Wilt, is president; W. Shatts, treasurer, and W. Bauer, secretary.

Morey & Co., Inc., Broome and Lafayette Sts., New York, dealers in machinery and supplies, has purchased the entire equipment of the cartridge plant of the New York Air Brake Co., at Watertown, N. Y., which includes all of the large presses.

The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has removed its Chicago office from the People's Gas Building to the company's own building, 323 North Michigan Ave., Chicago. H. L. Dawson is manager of the Chicago office, which handles the business of nineteen states with sub-offices in Cincinnati and Detroit.

Obituary

William Chambers Meyers, sales manager of the Earle Gear and Machine Co., Philadelphia, died May 3, 1920, after a short illness. Mr. Meyer was about forty years old. During the war he served as a captain in the Ordnance Department, U. S. A.

J. Frederick Buel, a manufacturer of machinery and an inventor, dropped dead at his home in Woburn, Mass., on May 19, from heart disease. He was born sixty-two years ago and with his father, James Buel, invented the automatic fire sprinkler, which later developed into the Grinnell system, now used in stores and factories all over the country. He also invented an elevator.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A corporation in France desires to purchase motor trucks suitable for two-wheel trailers, four-wheel tractors hauling four-wheel trailers, four-wheel trailers, speedometers adapted to metric system, equipment and trailers with a carrying capacity of 25 to 30 tons, and rapid loading apparatus for trucks and trailers. Telegraphic quotations c.i.f. French ports are requested. Correspondence may be in English. Reference. No. 32,880.

A commercial representative in Mexico of an American firm desires to secure an agency on a commission basis for the sale of hardware and mining and machinery supplies. References. No. 32,883.

A merchant in Canada desires to purchase molders' tools. Quotations should be given f.o.b. destination. Cash will be paid. Reference. No. 32,845.

A company of ship repairers in Canada desires to purchase boiler and tank plate, boiler tubes, copper pipe, bronze fittings, pipe and pipe fittings. Quantities will not be large but needed in regular deliveries over long periods. Quotations should be given f.o.b. Canadian port. References. No. 32,888.

An agency is desired by a commercial agent in The Netherlands for the sale of wrought iron gas tubes, seamless steel boiler tubes, cast iron coated pipes for gas and water, malleable pipe fittings, and all other articles in the gas, water, steam, heating, and electrical trades. Reference. No. 32,889.

Catalogs Wanted

The Morrison Machine Products, Inc., 15 Commercial St., Rochester, N. Y., would be pleased to receive catalogs from lathe and screw machine manufacturers.

The Auto Metal Parts Co., 624-628 East Locust St., Des Moines, Iowa, would be pleased to receive catalogs for its files of metal working machinery, machine tools and small tools.

New Publications

Aircraft Year Book, 1920 Edition. 333 pp., 6 x 9, with numerous illustrations. Published by Doubleday, Page & Co. for the Manufacturers Aircraft Association, Inc., 501 Fifth Ave., New York, N. Y.

This 1920 year book of the infant industry of aviation gives a clear idea of the present condition of this much-handicapped art and also recounts the developments that have taken place in the last five years. The first chapter, on aircraft in commerce, tells what has been done in the last year in mail-carrying, record-breaking flights like that of the NC-1, forest patrol service, sport, aerial transport and airplane photography and mapping. The second chapter deals with the problems of private cross-country flying with particular attention to the vexing problem of proper landing-fields, and the third with our war record in the air. Chapters four and five give in full the international air navigation convention and the report of the American Aviation Mission. Six and seven take up technical developments in both heavier- and lighter-than-air machines and eight is devoted to the 1919 activities of the various member companies of the association. Chapter nine is a chronology of aërial events in 1919 and the fifteen parts of the appendix give voluminous statistics regarding various details of interest to those who follow the course of aërial events.

Trade Catalogs

Grinders. Wisconsin Electric Co., Racine, Wis. Catalog, 8 x 10½ in. This catalog is printed on coated stock and is divided into four sections, each one describing and illustrating the Dunmore products which are as follows: grinding machines, electric drilling machines, fractional horsepower motors and electrical appliances.

Roller Bearings. Hyatt Roller Bearing Co., New York. A two-page folder giving one solution of that high-wage problem.

Collets. Morrison Machine Products, Inc., 15 Commercial St., Rochester, N. Y. Circular, 3½ x 6¼ in. A small circular describing the ins and outs of the Inanout double-acting collet.

Hand Tachometers. O. Zernickow, 15 Park Row, New York. Circular 6 x 7 in. gives a description and one illustration of its hand tachometers.

Safety Equipment. The F. W. King Optical Co., Cleveland, Ohio. Catalog No. 12, pp. 24, 6¾ x 10 in. This catalog is a handbook of safety equipment for the protection of the eyes and heads of industrial workers. Separate price list is enclosed.

Grinders. The F. C. Sanford Manufacturing Co., Bridgeport, Conn. Circular, 8½ x 11 in. This circular describes its model "B" Sanford precision centerless cylindrical grinding machine, also a few illustrations are given.

Classified Scrap Iron is the title of a new booklet which has been compiled by Briggs & Purivas, Inc., 1309 Westminster Building, Chicago. The booklet contains a brief classification of the different grades and qualities of all kinds of scrap ferrous material; also a number of pages of tables giving tonnage weights and other items which may be of interest to the scrap man in compiling the weights of his various scrap materials.

Tool Steel. Vanadium-Alloys Steel Co., Pittsburgh, Pa. Booklet, 3½ x 6½ in. The Vanadium-Alloys Steel Co. has issued an attractive booklet descriptive of Vasco Vanadium tool steel. This booklet contains much information of value: also suggestions concerning heat treatment, etc. Copies may be had upon request.

Grinding Wheels. Norton Co., Worcester, Mass. Catalog, pp. 22, 3¾ x 6¼ in. This booklet is intended for men using or interested in the use of Blanchard vertical surface grinding machines.

Forthcoming Meetings

The Railway Supply Manufacturers Association will hold an exhibit on Young's Pier at Atlantic City, June 9 to 16, in conjunction with the annual mechanical conventions of the American Railway Association. Many of the leading machine-tool builders of the country will be among the 330 or more exhibitors.

The American Drop Forge Asssociation will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Gas Products Association will hold its summer convention at Mackinac Island on June 21 and 22. A boat will leave Chicago on June 19 for the island. The association is composed of the leading manufacturers of electrolytic oxygen and hydrogen. D. B. McCloud, 140 South Dearborn St., Chicago, is secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25, inclusive.

The American Steel Treaters' Society will hold a convention in Philadelphia, Sept. 14 to 18. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is the secretary.

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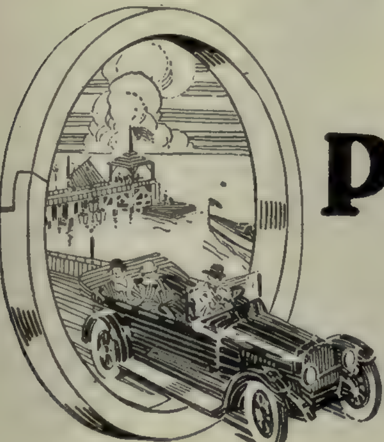


Making Piston-Rings

By
Ellsworth Sheldon
Associate Editor American Machinist

AN HUMBLE, though vital, part of the internal combustion engine which has become so important an adjunct of our social and industrial life, is the thin and somewhat fragile ring of cast iron that surrounds each piston, sealing the annular space that must of necessity exist between the piston and cylinder walls to prevent the former from cutting and scoring the surfaces in contact.

The great and ever-growing number of service stations, garages and repair shops handling automobile repairs, etc., has brought into being a comparatively new industry entirely aside from automobile and motor building. This is the supplying of parts to replace those that have become worn so as to be no longer serviceable. One part, the independent production of which reaches literally into millions, is the common snap ring used in the cylinders of nearly all gas engines. The methods followed by one large manufacturer of these parts are here described.

Cylinder walls, though parallel when new, do not long remain so. The corrosive action of the burning gases and the excessive pressure due to the explosion, as well as the friction of the rapidly reciprocating pistons, soon wear the walls of that end of the cylinder in which the explosion takes place so that it becomes an appreciable amount larger than the other end; the wear sometimes being as much as $\frac{1}{16}$ in. Obviously, a solid body tightly fitted to the small end of the cylinder would be loose in the worn end, and to take up this space and prevent the escape of the gas pressure without delivering its energy to the machine a resilient body is required; one that will automatically grow larger or smaller as the piston travels back and forth in the cylinder, thus adjusting itself to whatever position it may be in and effectually closing the aperture against the escape of the gases. Such an accommodating body is found in the piston ring (commonly called the split ring, or snap ring), two or more of which may be found in each cylinder of the greater part of the engines used in automobiles, motor boats, airplanes, tractors, etc.

There are also many varieties of patented "sectional" rings made in two, four, six, or even more parts, depending upon some form of tempered steel spring to expand the ring as the piston approaches the larger diameter of the cylinder by pressing the softer bearing parts outward against the cylinder walls.

Notwithstanding the fact that cast iron is far from being an ideal material upon which to depend for resilience, the simplicity of the snap ring gives it such an immense advantage over the more complex special forms of ring in the matter of first cost and ease of replacement, that such rings are used in probably 90 per cent of the gas engines at present in service.

Because of the enormous demand for these rings from service stations and dealers in engine supplies, their manufacture, entirely independent of the manufacture of engines, is a business that within the last few years has grown to huge proportions.

The Houpert Machine Co., of Long Island City, which several years ago started in a small way to manufacture essential parts of engines without manufacturing the engines complete, is an example of the rapid growth of this business. This firm does not manufacture engines, but confines its attention to the production of pistons and piston rings and to the re-grinding of worn cylinders and crankshafts, in which work it occupies 30,000 sq.ft. of floor area and employs 150 men.

The material of which a piston ring is made is of prime importance. It must be softer than the cylinder walls, or at least no harder, else the latter would wear unduly. The material must possess to a considerable degree the property of resilience in order that it may adapt itself to the constantly changing diameter when moving backward and forward in a cylinder that is worn large at one end.

Another important consideration is weight. The direction of movement of the piston is reversed many hundreds of times per minute in a rapidly running motor, and every ounce of weight adding its inertia to the moving mass represents a definite loss of energy. All these things being considered, the vast preponderance of cast-iron snap rings over rings of any other material or kind would seem to indicate that cast iron was best for the purpose.

Cast-iron piston rings are made in two ways: By the "pot-casting" method, in which a long shell is cast, turned and bored, and finally cut up into individual rings; and the individual casting process in which the rings are cast from a gated pattern, usually in connection with a match plate or molding machine.

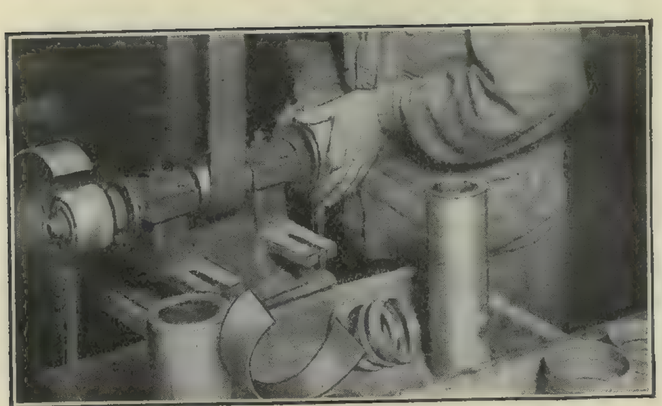


FIG. 1. "SNAGGING" INSIDE OF RING CASTING

The above company use only the individual cast rings, and the first operation is the rough grinding of the inside of the ring, or "snagging," as it is called in the shop. This is a hand operation, each ring being placed over a revolving grinding wheel that is an inch or so smaller than the inside diameter of the ring and the ring itself given a circular motion that causes the wheel to travel over its inside surface. This operation is shown in Fig. 1, the exhaust hood having been removed for the purpose of photographing. No attempt is made to maintain a definite size, although the second succeeding operation involves the use of a mandrel, but the size is so accurately maintained by the foundry that little difficulty is experienced. The main thing for the operator to take care of is to see that the inner surface of the ring is fairly smooth and free from lumps or fins. The second operation, shown in Fig. 2, is the grinding of the sides of the ring. The piston-ring grinding machine is built not unlike a shaper, except that in place of the toolpost is a grinding wheel that is mounted upon an arbor lying lengthwise of the ram. In place of the vise that is usually to be found upon the knee of a shaper, is a rotary magnetic chuck mounted upon the upper end of a vertical shaft.

The rotative speed of this chuck can be varied to suit the diameter of the work and the movement of the ram can be adjusted for length of travel and point of reversal very much as in a friction-driven shaper. An electric switch is operated by the ram to throw the current on and off the chuck at the proper moments.

The operator is armed with a hook-shaped contrivance, the business end of which is made of brass so that it will not stick to the chuck, while in his left hand he holds a supply of rings to be ground. The machine runs continuously and while the ram is at the back end of its stroke the operator lays a ring on the revolving chuck; a touch upon the inside of the ring with the brass hook serving to bring it to center so that it runs approximately true.

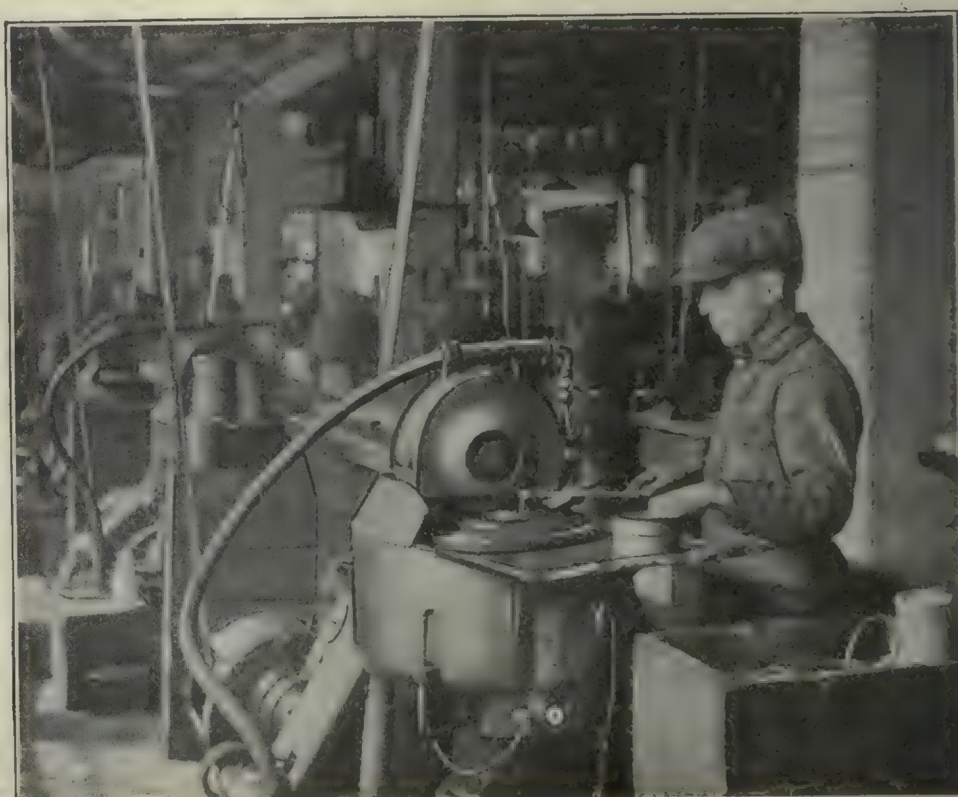


FIG. 2. SIDE GRINDING ON HEALD GRINDING MACHINES

The ram, as it comes forward, switches the current on to the chuck and the wheel passes over the side of the ring, the ram reverses and passes back to the starting point, cutting off the current as the wheel clears the work on its return. As soon as the chuck releases its hold on the ring the operator with a quick movement of the hook, which has not left the inside of the ring, sweeps it off onto the table and at almost the same instant lays an unground ring in its place. The movements are rapid and continuous, but the operators are quickly trained to the work and it becomes a matter of pride with them not to miss a stroke of the machine.

The operation of grinding the second side of the ring is performed on the same machines in the same way, but the operator is obliged to exercise greater care in keeping his chuck clean and in gaging the work

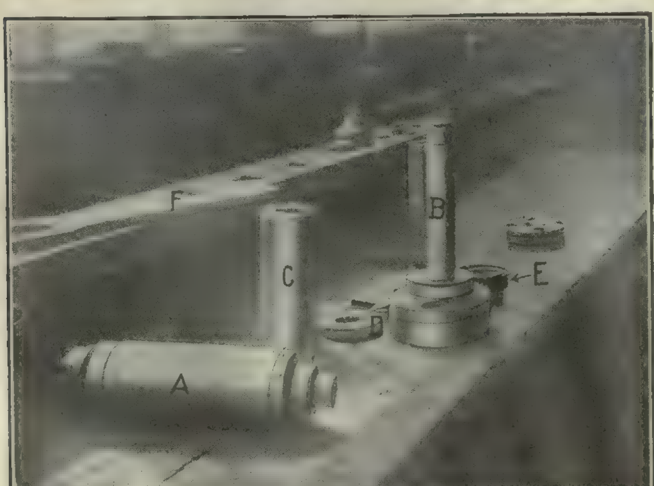


FIG. 3. MANDRELS FOR GRINDING PERIPHERY

for thickness, as no appreciable departure from nominal width or variation in parallelism is permitted.

From the second grinding the rings go to the loading bench where they are put on to mandrels for the first grinding operation on the periphery. Here a row of round castings, each one having an irregular-shaped hole in the center, are firmly fastened to the bench by lag screws. The mandrels, one of which is shown loaded at *A*, Fig. 3, are made at one end to fit the hole or recess in the upper face of the above-mentioned castings, and have a stout cross pin through this end so that when they are stood upright, as in a socket, they will resist any turning movement that may be brought to bear upon them. A mandrel, unloaded, is shown in a socket at *B*.

The collar at this end of the mandrel is permanent and is turned to a diameter a trifle under the nominal size to which the rings are rough ground. A bushing of cast iron, shown at *C*, is of right diameter to enter the rings. The loose collar, *D*, is set over the stack of rings, resting upon the rings and not upon the bushing. A nut *E*, with its hexagon boss fitting the large

FIG. 4. LOADING THE MANDRELS

wrench *F*, when set up as in Fig. 4, holds the stack of rings firmly by endwise pressure.

As will be remembered, there is as yet no finish on the inner surface of the ring except the rough grinding that was done on the snagging wheel. The bushing therefore is not depended upon to drive, but only to center the rings. A stack of rings from the side-grinding operation is placed on the table of an arbor press located nearby, a bushing is placed on top of the stack and forced in by the ram of the press.

Some of the rings will fit loosely, others will be tight, and occasionally one will burst, but this seldom happens as there is little variation in the castings. The stack of rings must contain the right number to make a cylinder a little longer than the bushing, as it is the clamping pressure between the collars of the mandrel that drives the rings against the resistance of the cut.

When a mandrel is loaded and the collars tightened, as in Fig. 5, the loader takes it to the grinding machines, lays it in a rack, and takes out one that is full of rough-ground rings. Proceeding to the loading

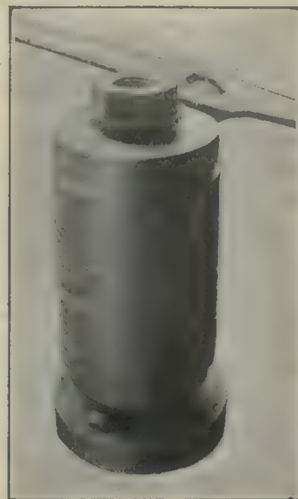


FIG. 5. A LOADED MANDREL

bench he unscrews the collar, lifts off the bushing and sets it, ring and all, on top of the stack of new rings which he has previously placed on the table of the arbor press, as at Fig. 6. One movement of the ram forces the bushing out of the ground rings and into the unground ones.

When the ram is raised the ground rings are brushed aside into a box while the bushing, with its contained load of unground ones, is ready to be transferred to the waiting mandrel on the bench. The whole operation of unloading and reloading the mandrels is very quickly performed and one operator is therefore able to keep several grinders busy.

Following the rough grinding the rings go to the cutting operation where they are split and the ring becomes, for the first time, a "spring ring."

There are two ways of splitting a spring ring. A double cut may be made at an angle of 45 deg. (or any other angle) across the section of the ring, removing a sufficient amount of material to allow the ring to close together as much as may be necessary. A ring cut by this method will have a continuous narrow groove for the escape of pressure, even under the most favorable circumstances. This is known as the angle cut.

The other method, called the step cut, is made from opposite sides to the center of the ring section, but the two cuts are offset so that two tenons, each of half the width of the ring, are left to close the joint. The effect is shown in Fig. 7, the full lines showing the cut as first made and the dotted lines the appearance of the joint when the ring is closed to its nominal diameter.

The angle cut is made by clamping the ring on an angle plate that is tilted to the desired angle, usually

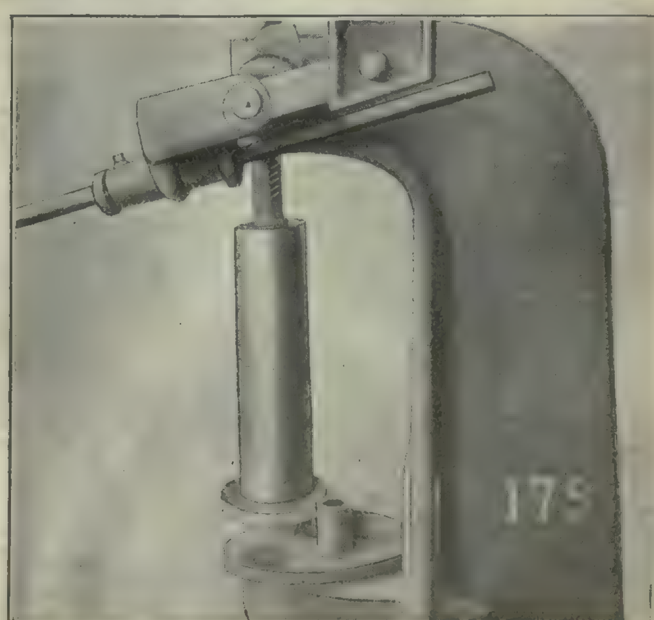


FIG. 6. UNLOADING AND LOADING A MANDREL AT THE SAME TIME

45 deg., the angle plate being attached to the table of a hand-milling machine the spindle of which carries two slitting saws spaced the right distance apart. The step cut is accomplished quite as quickly by means of the machine shown in Fig. 8.

A machine is used having the same movements as a hand-milling machine but having two opposed spindles carrying small end mills. The two spindles do not lie in the same line; one being offset above the other a distance that slightly exceeds the width of the notch cut by one of the mills. The ring is held for the operation by being clamped to the vertical face of the angle plate that is bolted to the table of the machine. The endwise adjustment of the spindles is such that each mill cuts exactly to the center of the ring-section, leaving the ring, after the passage of the mills, almost but not quite, cut in two; the ends being still joined by few thousandths of an inch of metal at *A*, Fig. 7.

The next operation is performed on thin elastic grinding wheels mounted in bench grinding heads and running at high speed. Each wheel is provided with a

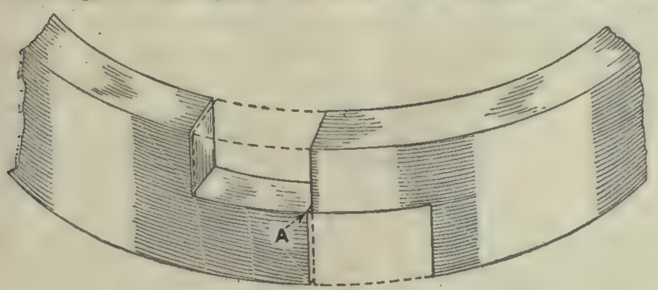


FIG. 7. JOINT OF A STEP-CUT RING

flat table, or rest, upon which a ring may be laid at a height about level with the center of the wheel, the table having a deep notch cut into the side nearest the wheel so that the ring when sprung open can be passed onto the wheel, as if the latter was a circular saw, and the ends of the ring still being supported by the table.

The rings come to this operation with the ends still held together by a very narrow band of metal. As the operator picks up each ring he gives it a smart blow against the corner of the table, causing it to break apart at the point of least resistance. He now spreads the ring open with his finger and passes the severed ends over the sides of the wheel, grinding both ends smooth simultaneously and removing any slight irregularity or raggedness left by the break. He then holds the ring to the light and closes it as far as the joint will allow, noting as he does so that the tenons slide freely upon each other and that there is no thickening of the ring widthwise when the joint closes, as might easily be the case if the mills were not properly set in the preceding operation. If any trouble exists it is soon remedied with a small file, but this is seldom necessary and the operator places the ring directly into the loading device for the final grinding operation.

A piston ring, to be round when in a cylinder, must be finished upon its outer surface while closed in to the same extent that it will be when in the cylinder of a motor, therefore the loading device is designed to bring about this condition.

A round plate with radial slots, similar to the faceplate of a lathe, is bolted to the bench in a horizontal position handy to the grinding wheel upon which the jointing operation is done. Attached to the faceplate by T-head bolts are four jaws somewhat like those of an ordinary lathe chuck, but much longer; long enough

FIG. 8. MACHINE THAT MAKES THE STEP CUT

to hold twenty ½-in. rings at once. They are adjusted by rapping with a piece of soft metal and held in place when set by tightening the holding bolts. Their position is determined by means of a dial indicator mounted to turn on a spindle which stands upright in the central hole of the plate.

The mandrel for the finish grinding is the same as the one used for rough grinding except that no bushing is used. Such a mandrel is placed in the central hole of the faceplate, and as the man on the jointing operation finishes with each ring he squeezes it into the jaws of the loading device, pressing it against the collar or against preceding rings until he had built up a stack to the top of the jaws. He then puts on the loose collar and nut and tightens it up with a wrench. The rings are thus held by pressure upon their sides in the position that they will occupy in their respective motor cylinders. They are far from being round at this stage, but the grinding operation will make them so and at the same time will reduce them to their true nominal size.

Situated just beyond the bench on which the jointing and loading is done is a battery of Landis plain cylindrical grinding machines. The loading and unloading of mandrels is taken care of by others, leaving the grinding machine operators free to devote their entire attention to the sizing of the rings. Both snap gage and micrometer are used on this work, and sizes are held within very close limits.

During all the foregoing operations the scale remains on the inner surface of the rings. No work has been done on this surface except the snagging, and that only

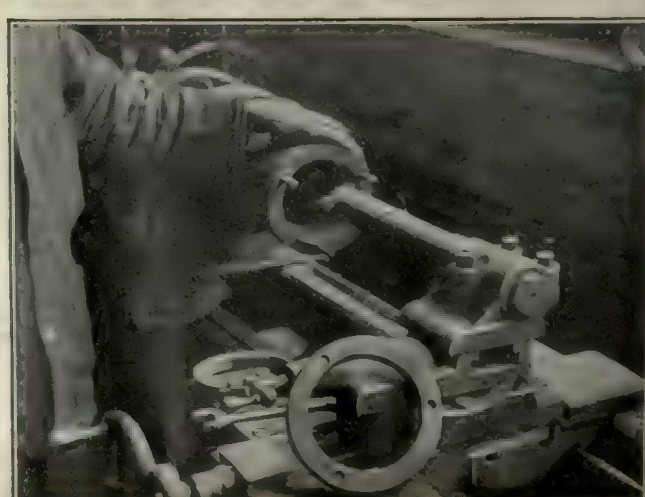


FIG. 9. BORING INSIDE DIAMETER OF RINGS

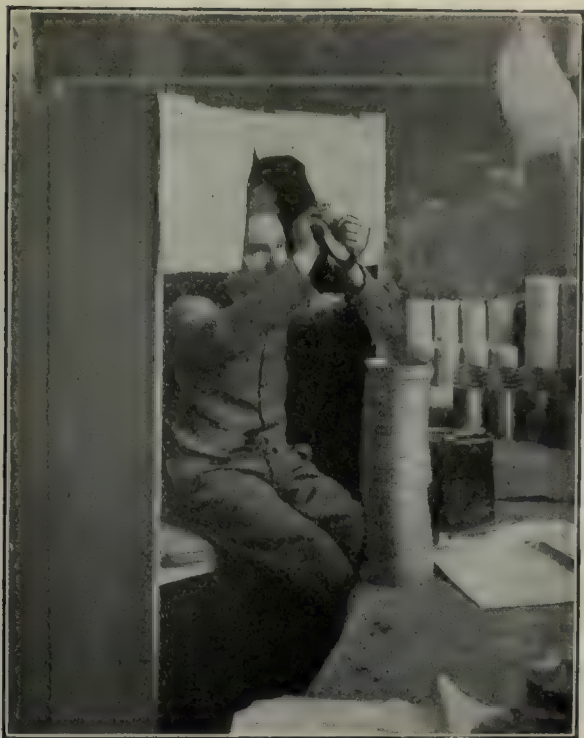


FIG. 10. INSPECTING FOR ROUNDNESS, WHICH INVOLVES DIAMETER

for the purpose of removing slight irregularities in the casting. The final machine operation on the rings is therefore the boring of the internal diameter.

This operation is shown in Fig. 9, where may be seen one of several lathes adapted to this work. A cast-iron cylinder screwed to the spindle nose of the lathe is bored accurately to the nominal diameter of the rings they are to handle. The operator closes the rings with his fingers and springs them into the cylinder until the latter is full, when a gland is put on the outer end and clamped tightly with nuts on the studs set in the end of the cylinder.

The number of rings a cylinder will hold depends on the width of the rings; usually the number is about twenty, but the length of the stack of rings must always be a trifle greater than the depth of the cylinder, or a special packing piece must be used, so that the pressure of the gland will come upon the rings. The boring is done by a high-speed-steel cutting tool held in a specially large boring bar rigidly attached to the lathe carriage.

The final operation on the rings is the inspection and oiling to prevent rust. The inspector's booth is shown in Fig. 10, with the inspector giving the ring the sight test for roundness. The rings are tested for width and thickness and are finally slipped into a hardened-steel ring gage that is ground to the nominal diameter of the ring. The inspector, sitting back in the booth facing a frosted glass window and partially protected from the light by cardboard screens, looks for an open space between the ring and gage. If light appears anywhere around the periphery of a ring that ring is rejected. This light test for roundness constitutes also a rigid check upon the diameter of the ring, for, though any ring anywhere near the nominal size would go in the test gage, it would not fail to show light somewhere around its periphery unless it was of exactly the same size as the gage.

A Cam-Operated Trimming Die

By Chas. M. Brehm

One of the points that has been partly neglected since punching machines came into use as a means for drawing sheet metal into various shell shapes, is the trimming operation. The writer has devised the die, shown in the illustrations, for that purpose that can be operated in an ordinary punching machine. This tool uses cams in a new way.

The principal point of interest to the manufacturer is that, although his blanks may be round, square or irregular, he can get an increase in production from one hundred to as high as four hundred per cent over the present system of performing the trimming operation. Although the die is cam operated, the grinding of the die throughout its life does not effect the timing of the cams in any way, the grinding being done on a plain surface grinding machine, the same as an ordinary blanking die. The die is very simple in construction, the die block with three connecting pins for holding springs in position being the only movable parts.

The main difference between this and the old cam die is the die block. This part, as a whole, is supported by springs and does its cutting with a side or lateral movement obtained by the use of cams. The blank to be trimmed is placed open end upward in the die block having an opening the same shape and size as the outside dimensions of the blank, that part of the blank to be cut off extending above the top surface of the die.

On the downward stroke of the ram a punch the same size and shape as the inside dimensions of the blank enters the blank, but is prevented from going below the top surface of the die by means of studs. The die, during the cutting operation, has a lateral movement from three directions, varying 120 deg., and the punch is capable of cutting slightly less than half the blank in each movement.

Taking the movement of the die block, as the

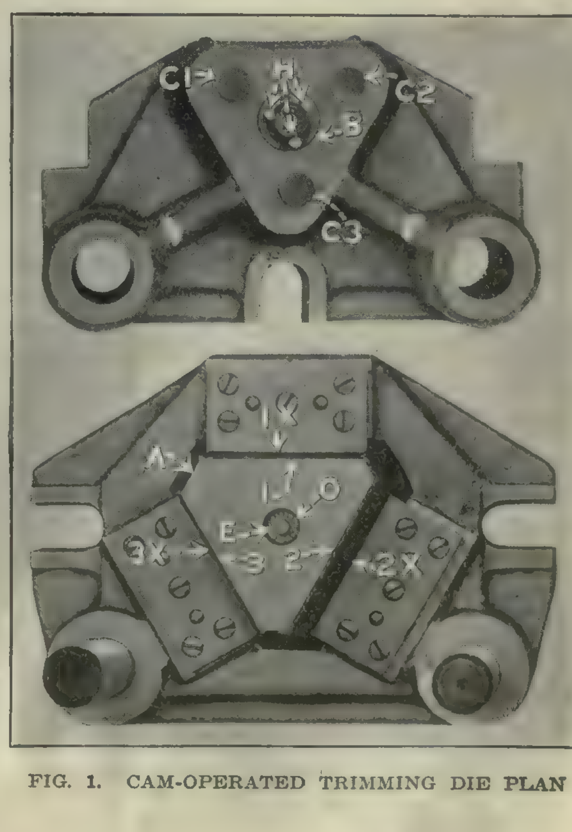


FIG. 1. CAM-OPERATED TRIMMING DIE PLAN

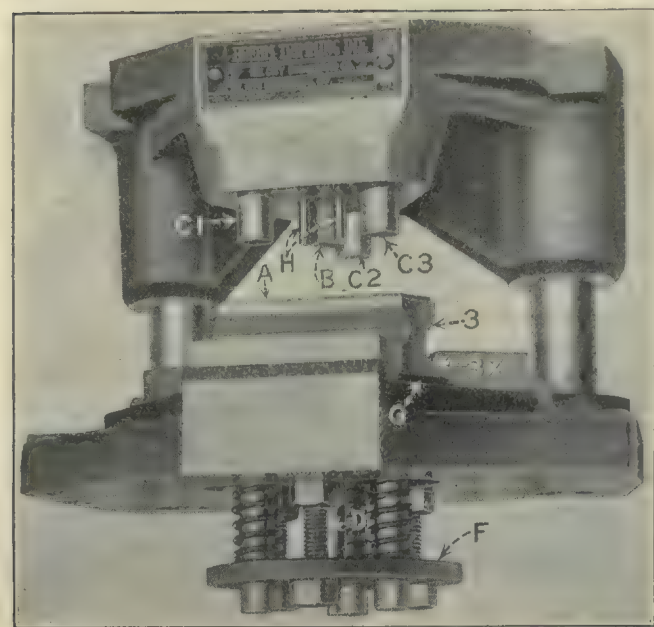


FIG. 2. CAM-OPERATED TRIMMING DIE ELEVATION

punch holder descends with the stroke of the ram, the pressure studs *C1*, *C2* and *C3* in Figs. 1 and 2, force the die block *A* down on its springs, holding it parallel at the same time. On the three longer side faces of the die block *A* are cams cut in such a way as to operate in rotation, as they are numbered. With the stroke of the ram, cams *1* and *1X* operate first, forcing the die block toward the back of die shoe, this operation trimming slightly less than half of the blank. Face *3* takes the thrust from cam action of *1* by being undercut. This can be plainly seen in Fig. 2. The stroke of the ram continuing and *1* having performed its full function, *2* and 2*X* operate while *1* takes the thrust; and, next in order *3* and *3X* operate, *2* taking the thrust.

In Figs. 1 and 2 can be seen the punch *B*. This piece, made to inside dimensionus of blank and with shear ground on side next to cam *1*, never goes below the top surface of die block. This relation between the punch and the die is maintained by means of pressure studs *C1*, *C2* and *C3*, mentioned above. These studs are ground parellel and are left longer than the punch *B*. This difference corresponds to the clearance between the punch and the die in an ordinary blanking die and varies according to the thickness of the metal from which the blank has been drawn.

In Fig. 1 in the opening in the die block *A* can be seen the top of the threaded stop *D*, Fig. 2, which determines the height of the finished blank. This stop, locked when the die is in use, can be lowered to compensate for grinding. The eight small hardened studs in the top of the stop support the blank during the trimming operation. In the center of this stop can be seen the spring ejector *E*, Fig. 1, which lifts the finished product partly out of the die. This ejector can be removed, allowing compressed air to be used to remove the blanks.

In both figures, the spring pins *H* rest on the edge of the blank during the trimming operation.

In Fig. 2 are seen the springs which support the die. These springs rest upon plate *F* and exert their tension upward against plate *G*, which is fastened to die block by dowel pins and screws. By removing cam *1X*, Fig. 1, the die block can be taken from the die shoe and the removal of plate *G*, Fig. 2, leaves the die block in condition for surface grinding for sharpening.

In certain shaped blanks, it has been found necessary to build the die block square, the cams working in rotation around the die, or opposite cams working in rotation, as first *1*, then *3*, *2* and *4*. This order of cam movement is governed by the thickness of the stock or the character of the blank.

In trimming some pieces, similar to electric-light sockets where a tube has been drawn smaller on one end than the other, giving it two diameters, it is necessary to reverse the punch and die by putting the punch below where it has the side or lateral movement while the die is fastened to the press slide. This style of die is also used on shells that have portions of the bottoms drawn up, making an internal draw.

Another point of advantage in a die of this type is that, no matter how thick or thin, or of whatever shape the blank may be drawn, the trimming operation does not distort the form of the piece. Shells for electric sad irons, peculiarly shaped parts for electric appliances, jobs that ordinarily are hard to trim, are as easily trimmed as the round ones. Blanks, drawn from extremely thin metal, that are hard to hold, owing to the probability of springing them, come from the trimming operation in their original shape.

Portable Electric Drill Speeds Up Shipbuilding

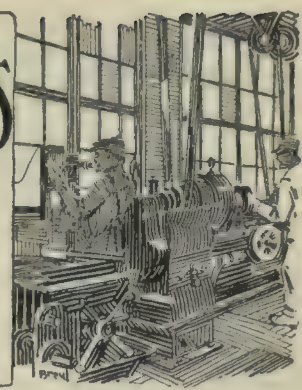
BY GEORGE F. PAUL

One of the latest developments of post-war activities in shipbuilding has been the perfecting of a special device for countersinking ship plates. Button-head rivets on the bottom of vessels tend to retard the speed of ships; they also pick up obstructions such as sea weed, etc.; consequently the order went forth that these rivet heads should be countersunk so that the surface would be perfectly flat, making a rustproof and airtight joint. The machine designed for countersinking is 22 in. long, weighs 125 lb., and takes direct current at 220 volts. Its maximum speed is 125 r.p.m. It will countersink holes up to 1 in. in diameter. It is claimed that a ⅞-in. hole can be countersunk in 7 seconds. In operation the plates are laid out on the floor, and in this position it is a simple matter to pass the buggy, on which the drill is mounted, from one hole to another as the work progresses.

COUNTERSINKING SHIP PLATES

MODERN PRODUCTION METHODS

By
W. R. Basset
of
Miller, Franklin, Basset & Co.



WHEN we speak of production planning we mean the planning of each individual order through the plant so that every part which goes into a finished assembly will reach the assembly floor in proper time and amount to allow continuous, uniform shipments of the finished product to leave the plant.

Before this condition can be achieved, it is necessary to lay out the machines which will be used in the best sequence and in proper balance. If the machines are not in the correct sequence, there will be unnecessary trucking and probably snarled-up production due to congestion.

VI. Laying Out the Machines

In the present installment we reach a phase of the general subject that is more closely related to the planning department than anything that has gone before. Two types of machine layout are discussed and an actual case of laying out a plant is taken up in detail.

(Part V was published in the June 3 issue.)

There are in general two ways in which machine tools may be grouped. The old idea was to have all machines of a type together; that is, all lathes in the same department; all drill presses in another; and so on. In shops doing entirely special work to order, this "battery" arrangement is frequently the most economical, but inasmuch as it is seldom advisabe to attempt to plan that kind of work definitely, we need not go deeply into the arrangement of machines under this plan.

The other arrangement consists in laying out machines of various types as nearly in a straight line as possible and in the order in which they will perform their operations on the product. In this way, we will have approximately a department or unit of machines for each principal part of the product, although, of course, it is often possible to route more than one part through a given department. It is in laying out the machines in units that greater economies may be effected.

Advantages of Straight-Line Production

It is commonplace nowadays to speak of straight-line production. The advantages to be gained from progressive production in as near a straight line as possible are too obvious to need argument. The practical obstacle often comes when, in a plant, the same machine is used to perform two or more operations between which other operations intervene. If neither of these operations require the full possible capacity of a tool, it is usually most economical to move the material back to the machines for the later operation. While such a procedure breaks into the ideal straight-line flow of material, it is preferable to purchasing two machines, each of which may be in operation only a small part of the time.

A group of machines comprising a unit is able to produce quantitatively in accordance with the capacity of some one machine or group of machines of a type, either of which may form the minimum or restricting point in manufacture of the unit. This point is best known in shop practice as the "neck of the bottle." It therefore becomes necessary, in establishing a machine unit, to know thoroughly the operations that are to be undertaken, principally with respect to the amount of time required by each operation.

If, for instance, the work going through a unit differs so radically that on some parts certain machines are not used at all but are standing idle, the unit is apt to be an unprofitable form of manufacture. Where, however, the parts closely resemble one another and the variations are not very considerable, the losses of time resulting from such variations are generally found to be less expensive than the cost of handling and carting the same parts from battery to battery in the old-fashioned way.

Before a unit can be laid out, it is obviously necessary to know accurately the time required by each machine for performing its operations. This requires careful study of the times needed, by thoroughly trained time-study men. In one plant where we were employed to install a planning system, the machines were already laid out on the unit basis for progressive manufacture. Unfortunately, however, the machines had been selected on the basis of incorrect time studies. This was true in all departments. The department most nearly in balance was that turning out camshafts. Here are the conditions we found in that department.

The Limiting Operation

The limiting operation in making camshafts was the first polish. By maintaining the standard of output to which it was restricted by the capacity of the first polish, the unit could turn out about 360 camshafts per day. Obviously, it was useless for the other units to produce more than 360 pieces per day, even if tooled up for greater production. It should be apparent that if only 360 camshafts can be produced, it is useless to average 450 crankshafts, 520 cylinder blocks and so on.

In other words, every unit is dependent upon all other units and the maximum capacity of each unit is only as great as the capacity of that unit's restricting operation.

Any unnecessary excess equipment is merely taking

up space and is a needless investment of capital. If manned, the added equipment adds to the labor cost. I realize that to many readers I may seem to be laying unnecessary emphasis on an obvious subject, but my experience has taught me that more plants are suffering from under-production solely because of one or two restricting operations than for any other reason. If of all machines in a unit but one can complete 500 operations in a day, but that one machine can complete only 350, then that unit, despite its 500-piece potentiality, can still only turn 350 pieces. If all the other units turn out 600 pieces each, it is still possible to turn out only 350 complete assemblies per day because of one limiting machine hidden away down in a single unit. This condition is not unusual. It is so important that I cannot lay too much stress upon the need of carefully balancing the machines, based on accurate time studies, before any attempt is made at further planning.

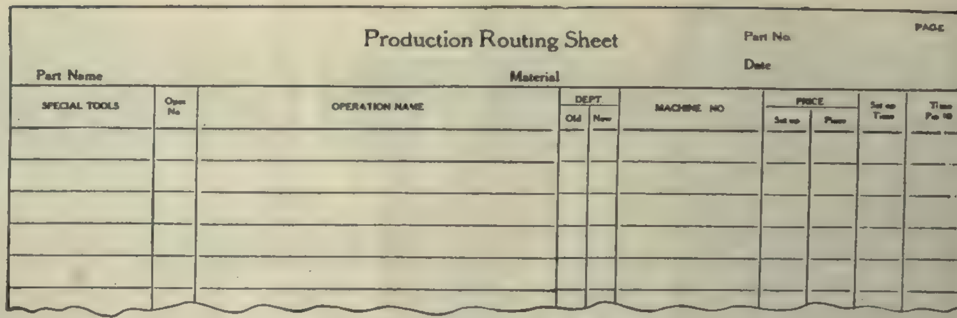


FIG. 27. PART ROUTING SHEET

Placing Machines

It is thus apparent that this step in getting greater production is worthy of careful attention. To show just how the correct balance of machines may be attained, thus eliminating "bottle necks," I am going to describe the methods which we used in laying out the machines for the Warner Gear Co. This plant, while equipped with the most modern machine tools, had, because of lack of proper space, been forced to expand irregularly. Our work in planning the production was coincident with the erection of new factory buildings, which enabled us at least to approximate the best layout.

At the very first, it was decided to group the machines as nearly progressively as possible in order to keep down the trucking expense and also to avoid the trouble which existed in many places because operations which depended upon each other were so far apart.

In order to place these departments so that there would not be an over-abundance of one kind of machine and at the same time a shortage of another, we first had to determine the total volume of production of which the shop was capable, and then to lay out the shop accordingly, utilizing the existing machine tools as a nucleus.

A conference with the executive gave us figures for the estimated production of all types of gears, transmissions, differentials, controls, clutches and so on. This information enabled us to lay out the shop so that it would be fitted to accept orders on those products in the quantities which it was expected would be sold.

A chart was then drawn up of the assemblies which it was decided to manufacture, to show the individual parts going into each. With this we were able to group these parts which were standard, and determine which standard ones were used in more than one assembly. This showed us the quantity of parts needed to meet the maximum production and was the basis on which we worked up the "load" of the various departments.

For each part we now made up a routing showing the operations in the correct order. The sheet on which this data was collected is shown in Fig. 27. Due to the fact that the time studies did not show the type of machine on which the jobs were run, we found it necessary to call in the foremen of the various departments and get their advice as to the kind of machine which was to be used for each operation. At the same time, the operation times were reduced to tenths of an hour and all of this information was put under the new routing form, Fig. 27.

By this time we had an accurate knowledge of the product and the plant, and we proceeded to lay out the departments tentatively. We then sorted the routings into these departments, keeping work with a similar sequence of operations in one department. In this way we classified most of the parts, a few only being left which did not seem to fit any of the departments. These were reserved until the final layout was made and then distributed to the various departments to the best possible advantage.

Inasmuch as this method is of the cut-and-try kind, it was necessary to sort the routings into departments several times before a completely satisfactory layout was obtained. That which finally evolved was:

1. The shaft department, consisting of screw machines, turret lathes, lo-swing lathes, engine lathes, light drill presses and milling machines. Solid gears were made in this department; that is, gears on a shaft throw-out, steering-gear tubing and so on.

2. The spur gear blank departments consisting of high power drill presses, chuck type turret lathes, plug type turret lathes, broaching and keyseating machines. In it were made only the gears with holes in them.

3. The retained department, very similar as to machines to the shaft department, but in which were manufactured retainers, differential and steering-gear cases and small hand-screw machine work.

4. The bevel gear blank department, consisting largely of heavy turret lathes and semi-automatics, made bevel ring gears and clutch-driven drums.

5. The control lever department composed largely of milling machines and drill presses, handle control and brake levers and all of that class of parts that required only milling and drilling operations.

6. The transmission case department was already lined up more or less progressively. We rearranged the machines, however, into an actual progressive line-up.

7. The gear cutting department, automatics, grinding machines, enameling, assembly and stockrooms were left intact with the exception that they were all arranged so that the work might flow through more smoothly and evenly.

Economic Distribution of Machines

We now built up a complete card index of every machine tool in the plant. We have found that it is not safe to take any existing records as to what machine

Retainer Department

MACHINE TOOLS	MACH. NOS	PART NO	OPERATIONS	TIME	WEEKLY PROD	MACH HOURS
16" Lathe	307	T29 - 6	3	025	35	0.9
		T32 - 6	5	0375	233	8
		T46 - 6	6	0375	133	5.6
		T49 - 6	4	025	102	2.5
		T49B - 7	7	032	102	3.3
		T52 - 6	5	0292	59	1.7
		- 54	3	0167	59	1.0
		T54 - 5½	2	0417	26	1.1
		T54F - 64	7	025	26	0.6
		T55 - 136	2	100	07	0.7
		5013	5	0342	195	7.0
						32.5
Rack Feed Mill	416	T29W - 5	4	0300	35	1.0
		T32 - 6	6	0292	233	6.8
		T38 - 7	5	0025	233	0.6
		5a4a	7	0172	195	3.3
		S37B - 75	7	.0083	364	3.0
						14.7
B & O Chuck. Turret Lathe	371	5512	4	112	195	220
		5515	3	089	195	170
		5540	3	0417	195	80
		5555	5	100	195	200
		5556	3	111	195	220
	Do Diff cases here					
						89
Garvin Tapper	73	T29W - 5	5	0033	35	0.1
		T49B - 7	6	0167	102	1.7
		T54 - 5	4	0013	26	0.4
		F - 5½	5	0013	26	0.4
		T54 - 7	7	0233	26	0.6
		5013	4	05	195	10.0
		5012	7	032	195	6.4
		S37B - 75	8	.0042	364	1.6
						20.8
Drill Press - 22"		6326	6	.4	225	46
		6326	6	.4	225	45
						90

FIG. 28. FORM FOR LISTING WORK OF EACH MACHINE

tools are in the plant, as these records seldom check, because of unauthorized moving from department to department. I therefore recommended that an accurate, physical count be made. A 3 x 5-in. card was made up for each machine; also a card for each type of machine. On the card for the individual machine is shown the standard name of the machine, its capacity, makers, the floor space required and any special features that require it to be kept for certain jobs.

In the mean time, we had rough forms like that shown in Fig. 28 printed on a duplicating machine. We used one of these forms for each department. From the routings we listed on the forms each machine in its correct order and under each machine we listed all of the parts which had operations performed on that machine. We also listed opposite each part the number of operations performed on it by that machine, the time of the operation, the weekly production which had already been determined as desired, and the machine hours needed to attain that production. If a part had more than one operation on the same type of machine, physically widely separated, these items were entered separately, as at this point at was impossible to tell whether or not certain work could double back. The totals of these machine hours showed us the total time necessary for each type of machine to turn out the estimated weekly production. This process of course was gone through for each department.

Distributing the Existing Equipment

We were now in a position to distribute the existing equipment over the new departments. To do this we used a file having separate compartments, one compartment for each department. Into these compartments were sorted the cards for the individual machines. This showed us which machines would be in each department in accordance with Fig. 28, and removed the chance of assigning the same machine to more than one department.

We found before finishing this distribution of machines that we were going to be short of the equipment needed to come up to the estimated production. We figured the per cent increase in each type of machine needed and from these figures made another estimate as to the per cent which production would have to be reduced in order to make the possible and estimated productions equal.

We then went through the sheets and recopied them, with the weekly production reduced by the estimated percentage. The time required for this production was refigured and the machines redistributed. On this attempt the machine tools worked out very nearly correctly. A few shortages still existed for which additional machines were purchased to bring each department into the needed balance.

Another List Drawn Up

Another list, Fig. 29, was now drawn up for each department, showing the machines in that department in their correct order, how many of each type of machine was required, and actual machine hours available and the machine hours needed to reach the estimated production. Occasionally the same type of machine was required at two or more places in a depart-

MACHINE TOOL LIST DEPARTMENTAL 12

Shaft

TYPE OF MACHINE	MACHINE NO'S.	ACTUAL MACHINE HOURS	REQUIRED MACHINE HOURS
~~J & L Bar~~	0303-5-8-9-10-12	672	609.9
Warner & Swasey #6	373-379-0321	224	186.9
J & Chuck	0314-0318-393	336	241.3
Centering Mach.	278	112	74.2
14" Lathe	292-293-209	336	276.7
Norton Grinder 6" x 32"	0600	112	74.8
Reed Prentiss	306-307	448	
Lo-swing Lathe	315-333-342-366	336	337.6
Drill Press 22"	44	112	68.6
High Sp. Drill Press 2 sp.	73	112	118.7
Landis Threader	0323	112	73.5
Norton Grinder 10" x 36"	651	112	91.5
Warner Swazee	355	112	30.0
Chard Lathe 16"	285-289	224	233.2
Tapper	25	112	50.0
LoSwing Lathe	314-392	112	116.3
Fisher Oil Groover	276	112	63.5
J & L Bar			2.6
Barber Coleman	566	112	
Screw Feed Mill	420-428-429-435	448	424.6
Whitney Hand Mill	442	112	52.5
Bench			130
Speed Drill	33	112	110.0
O K			

FIG. 29. FORM SHOWING TOTAL WORK OF MACHINES IN DEPARTMENT

ment. If the total time required by both operations was less than that furnished by one machine, the requirements were combined, it being better to allow that part of the work to double back at some time in its course than to purchase an additional machine, a large part of whose time would be wasted. Where this was necessary, the machine which doubled up on operations was placed at a point most convenient for both.

Layout According to Floor Space

At this point we knew the number and type of machines needed to attain the given production and the order in which it was desirable that they be laid out.

We now obtained an accurate floor plan of the plant, on which we laid small pieces of cardboard cut to scale to represent the floor space taken by machines. They were arranged in the order already determined.

We called upon all foremen who were interested and who were in a position to give criticism to go over the layout, and after everybody was satisfied the prints were turned over to the millwright department to guide it in moving and placing the machines.

In making the final layout it is absolutely necessary that the floor plan be accurate and sufficiently in detail. It must show everything which could possibly affect in any way the placing of the machines. For instance, in one case we found that a ventilator operating device not shown on the plans was so located on a column that were the machine located as planned the operator would be inaccessible. This frequently happens with switches, panel boxes for the lighting systems and so on. Even a drain pipe may cause a machine to be set out a little farther than expected.

If these points are not known beforehand and the solution for the difficulties are left to the men who place the machines, they are more than apt to take liberties with other machines which should be placed absolutely as indicated. In this particular instance, this happened when the millwrights allowed a trifle too much space between the machines which resulted in our being unable to place the last machine in the row.

If changes in the layout are needed they should be dated and the attention of all concerned called to the changes. The layout blueprint should not only be to scale, but all possible dimensions should be shown. This facilitates the placing of the machines, as generally the men who do the moving are inexperienced in reading even the most simple blueprints. We have even found it well to go to the expense of laying out the exact location of each machine on the floor itself with paint or chalk. Even after doing this it is necessary to watch the millwright gangs closely to see that they place the machines properly.

Plans Seldom Go Smoothly

It would seem that so carefully worked out the plan would enable the placing of the machines in the new departments to go smoothly. It seldom does, however, for even though the foremen are called into conference in the first place there are a lot of things that they do not remember or visualize until the physical move is being made.

Although when we made up our index of machines we had placed against each one all of the special information concerning it, we would find the foremen later thought of lots of other tricks they had forgotten and which forced us to use different machines from the ones we had already picked out. Usually, however, this will not affect the layout at all, as the machine the foreman wants can usually be substituted for the machine reserved for the space. Such changes at a late hour, however, do cause considerable confusion. Great care in collecting information on all of the uses of each machine will well repay the effort.

It is my opinion that the plant equipped with more or less antiquated machines which are, however, carefully balanced and laid out, is more likely to get economical production than another plant equipped with the very latest in machine tools but whose units are hampered by "bottle necks."

In a single plant manufacturing gasoline motors, for which we installed a planning system, the goods in process inventory was reduced from \$3,000,000 to \$1,000,000 in spite of increased sales. This saving was at least 50 per cent due to balancing the machines. The high "goods in process" inventory had been caused by the large number of parts lying around the plant waiting for other needed parts which were being held up, due to a single machine restricting the capacity of a unit as a whole. What is the use of offering wage incentives to the workmen to increase their production and getting this increased production, when the parts which are made cannot be put into an assembly because it is physically impossible to turn out the required number of other parts on the existing equipment?

Finding the Length of a Common Tangent

By Henry R. Bowman

The following problem came up at the office and appeared difficult at first sight but the solution is very simple. Given the radii A, B, Fig. 1, the distance between their centers C, and their arc tangents D, to find the length of the connecting tangent x. As the radii are at right angles to the required tangent they will evidently be parallel to each other and by adding them we obtain the side of a right triangle, Fig. 2, of which the side y can be found by the equation:

$$y = \sqrt{(A - D + B)^2 + C^2} \quad \text{therefore}$$

$$x = \sqrt{[y + A + B][y - (A + B)]}$$

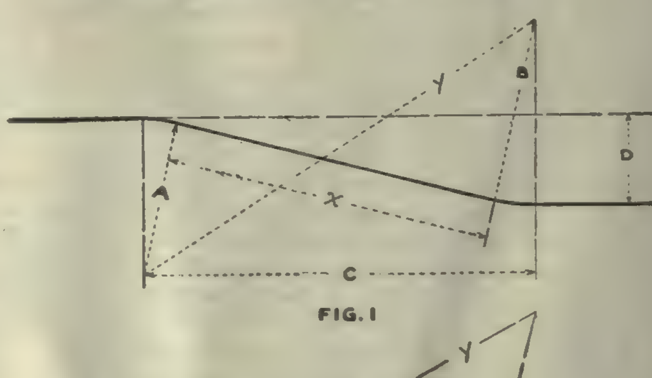
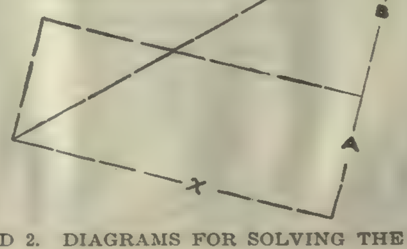


FIG. 1



FIGS. 1 AND 2. DIAGRAMS FOR SOLVING THE PROBLEM

A Glance at the Industrial Situation in Italy

By JOHN B. WOODS

This article on foreign conditions deals with the establishment of modern industry in Italy, especial attention being given to the development of Italy's waterpower for the generation of electricity. Conditions during the war just passed and the prospects for American trade in Italy are well covered.

ITALY is a land of electricity. Throughout the mountain regions and even down in the plains all the little hamlets boast of electric street lights and cheap current for house use. The almost limitless abundance of water power is the source of Italy's recent industrial development and her hope for a glorious future. The twentieth century had witnessed her appearance among the manufacturing nations after a rather long period of lethargy. She had made great strides in development of her power sources, at the same time showing a growing feeling of national solidarity. Then came the war, and this served to bind the men of the land in closer bonds. The problems of peace are now upon her, and when she at last emerges from the mixup of settling boundaries, her industrial needs will be greater than ever before. She will need to continue to broaden her production of electrical energy, and also she will require equipment for utilizing this power in the manufacture of goods for her own and foreign markets.

A RUINED FACTORY IN THE PIAVE VALLEY

The Beginning of Modern Industry in Italy

The industrial history of Italy is strangely interesting, and shows vividly how important the application of electricity to supplying human wants has become. After the discovery of the western hemisphere and the consequent swing of the flood of commerce from the Mediterranean to the Atlantic, the ancient trade centers of Italy were all but deserted. The countries of north Europe, with their iron and coal, grew into industrial giants and their importance increased as the application of steam to machinery increased. But Italy had almost no coal or iron at all. Thus, though protective tariffs might keep alive enough industry to supply part of the domestic needs with the use of imported coal and iron, she could not hope to compete for business in the markets of the world. Still, her land was densely peopled and agriculture alone could not suffice to support all of her families.

Then, two influences began to work, and strangely enough they operated in harmony. A flood of emigration commenced to the new lands of North and South America, and a movement in the direction of industrial development got under way. It has been said that Italy lacked the capital with which to finance manufacturing. This probably was true in a measure, but the emigrants earned much money in their new homes, and sent it back to the mother country in sums equal to one-fifth of the yearly production of wealth of the entire nation. At the same time the pressure of over-population was relieved. Thus, with additional capital to support it, the manufacturing movement grew by leaps and bounds, it being founded on the harnessing of the energy of the swift streams in the rocky fastnesses of the Alps and the Appenines.

The Adoption of Hydro-Electric Power

In 1892 the Anglo-Roman Society made the first installation of an electrical power plant, developing the possibilities of the Cascade Tivoli near the city of Rome. Before this time the country had few railroads and practically no industrial centers except at a few seaport cities, chiefly in the southern part. At present Italy ranks as the foremost nation of Europe in respect to the use made of her water-power resources. With the Alps at the northern end, and the ridge of mountains extending lengthwise through the peninsula as stream sources, her geographical conditions are

almost ideal for realizing the most from her generating stations with comparatively short transmission lines. Following the first installation came others in rapid succession, and in a short time the dizzy mountains were scaled by electric railroads. During the war the military engineers even built an electric trolley line, twelve miles long, to the top of Asiago, and operated trucks by electricity over a splendid rock highway for handling men and supplies to the heights.

Natural water courses often were made more productive by the construction of storage lakes, and pipe lines were laid to conduct the "liquid coal" to favorable generating station sites. In brief, power was obtained in great abundance for transportation, for lighting human habitations, and for turning the wheels of industry. And along with the power came factories for the production of many things. Textile and woolen mills sprang up. The old-time paper industry took on new life and regained much of its former prestige on a modern basis; mechanical, metallurgical and chemical enterprises were begun and carried on with success; sugar refineries and packing plants came in to take care of the soil products that formerly constituted practically the sole support of the nation except for the quarries—and with improved means of transportation the quarries became more productive of wealth.

Industrial Problems Before the War

There were disadvantages to confront the manufacturer in addition to the lack of iron and coal. Really the lack of iron did not cause so much hardship as the coal problem, for the cost of importing metals was not so great in relation to the quantities required and their values as was that of coal. However, the high tariff on iron did spell trouble, and this high import duty applied in even greater measure upon machinery from outside. Labor became a costly item, for the growth of unions and the departure of hundreds of thousands of young Italians each year for other lands worked together to raise wages.

There is some difference of opinion among those who are familiar with conditions in Italy with respect to the wage question. Some observers point to the fact that the capital of the country is concentrated in a relatively small body of people, and that they have been able to keep wage standards low in comparison with other lands. However, standards were low in all parts of Europe before the war, and evidently Italian proprietors did suffer to some extent from high labor expense. But they did possess cheap power, and this advantage increased with the exploitation of the water courses until it all but outweighed the counter consideration. And then came the series of international complications which resulted finally in a crystallization of national sentiment in favor of the Allies, and Italy came in to form a portion of the armed circle surrounding the Central Powers.

Industry During the War

Certain things she lacked and certain things she possessed to give to the struggle. Her sons came back from the Americas to fight, bringing with them increased respect for western ways, particularly with reference to the use of machinery. The Allies poured iron and coal into the southern ports, and the manufacturing facilities of the nation were directed into the production of war equipment. Being naturally of an inventive tendency, the Italian had progressed far in the field of automobile construction and in aëronautics, and the war served to quicken this activity. The motor-vehicle and airplane factories of the southern cities were brought to a high plane of productivity under pressure of military needs. A world-wide shipping crisis, together with the newly enlivened interest in the Italian Navy, speedily brought to unprecedented prosperity the shipbuilding yards of the coast towns. And the manufacture of munitions called for emergency development of ordnance and chemical-producing plants. In short, Italy went through the same feverish industrial growth as the other involved nations, with the main difference that she was in a great measure dependent upon her friends for some of the most important basic raw materials.

Her electrical accomplishments in the northern mountains and the new industrial region of the Piave stood her in good stead during the progress of the conflict, but she suffered severely from the destruction that came with the disastrous Austrian advances. It has been roughly estimated that 20 per cent of the manufacturing facilities, including power plants, suffered loss in varying degrees. Perhaps this figure is too high, but there were serious losses, which must be made good in the reconstruction period. The cost of war was heavy, naturally enough, and like the other nations, Italy must look to increased industrial activity in the next few years to rebuild her own devastated regions and to retire the debts of war. Thus her problem is to restore what has been lost and to go on from that point, broadening the productivity of the nation by strengthening the industries which were well advanced before the war and by developing, so far as may be possible in peacetime, the plants which were nourished on military orders. Motor vehicles, airplanes, marine construction, and the products of machine shops may rank ahead of her textiles and building stone in the future.

Equipping Italian Industry

The machinery used before the war was antiquated and slow when considered from the American point of view, hence new equipment is desirable. The cost barrier militates in favor of Austrian and German equipment as against American for two reasons: That of long freight haul is natural, but there has also been a tendency throughout Europe to buy general-purpose machinery from the near neighbors because it is lower in price than our own. Special machines for special purposes, produced by Yankee makers, have been in high favor over there, and the Continental manufacturers have been glad to get them even at higher prices. But Italy needs a great deal of new machinery and, with abundant power at fairly cheap cost, she should be able to use our general-purpose types to good advantage. The labor situation being what it is after the losses of war and the unrest of indefinite peace, our automatic devices should constitute powerful selling features.

With all their electrical stations the people of Italy are almost unacquainted with many of the mechanical aids which we consider essential to everyday living. Thus there is a field for education, which can be developed by the establishment of distribution facilities for many kinds of small machines which can be operated by electricity. These range from purely domestic contrivances to small wood- and metal-working equipment for artisans and merchants.

Commerce does not remember hostilities when prices are low. Even the Belgians, with their long-nursed hatred of all things German, were obliged to purchase great quantities of merchandise from the late enemy because their prices were too reasonable to be disregarded. Perhaps the people of Italy are divided in their attitude toward the United States at this time: They feel grieved about certain things, yet they entertain warm regard for this country as a result of the opinions of their returned sons and because of our coming into the war. However, they are in need of industrial equipment and they probably will buy it from the makers who offer the most for the money without regard to sentiment. The exchange situation still remains a handicap, to be offset by such factors as high quality and far-reaching service, with long-time payments almost a necessity. Then there is the nebulous belief that something will be done some time to stablize international finance.

But there is opportunity in Italy, and it may be well worth while for American firms to investigate the field from an engineering angle, by putting men over there to study requirements and possibilities of co-operation. We have much to give them in the way of industrial planning, with respect to co-ordination of methods and machines so as to obtain the biggest outputs with the least investments in costly equipment. Good advertising can do much to build up interest in the wonderfully efficient machines built in this country, if it is done in such a way as to appear entirely natural and credible. And without doubt there is a field for the power-plant engineer over there as a rebuilder of ruined stations and a pioneer along undeveloped waterways, especially if he is backed by a high type of generating equipment such as is made in this country. The industrial future of Italy appears to be founded upon electricity, and the engineers of America are particularly well equipped to help them go far, as our own experience during the past two decades has been largely that of generating current and perfecting machinery to be turned by it.

The Navy Yard at Charleston, S. C.

The Navy Yard at Charleston, S. C., in common with all the other yards, greatly increased its activity during the war. Handicapped in almost every way, from location to power equipment, it still managed to make a very fair showing. And the close of the war leaves it very well equipped for future operations, especially with regard to power plant and machine tools. There are also two marine railways and a fair-sized dry dock which enable several vessels to be handled at once, if they are not too large. At present, the memorable Olympia, which was Admiral Dewey's flagship at Manila, is in for repairs.

The principal drawback to the yard is its location. It is not only seven miles from a city, which has inadequate car service, but Charleston itself is far from ideal as a mechanical center. There is no manufacturing in Charleston, and it is almost safe to say that there are no mechanics except those employed in the navy yard.

Living conditions, especially housing, are very bad from the standpoint of the mechanic who is accustomed to the conveniences and the sanitation of manufacturing cities, and it was not easy to get good men to come to the city even during the war. The attitude of the city seems to be to resent either suggestions or criticisms and to be entirely self-satisfied with present conditions. This does not add to the joys of managing a yard at this place.

All these adverse conditions make it very difficult for any commandant or other manager to secure efficient operation of the shops. And this is made doubly hard by the present uncertainty as to navy yard activities. The lack of a definite policy—the lack of present funds and the uncertainty as to future activities, add to the problems of management. When it becomes necessary to lay men off for lack of money to pay them, they are practically lost forever, as it becomes necessary for them to go out of the state to find employment in mechanical lines. And present funds are running so low that it has become necessary to do many uneconomical things to save the expenditure of ready money.

Where $43,000 Went to Pot

To make matters worse, the yard has just been put to an unnecessary expense of $43,000 through the lack, not only of co-operation, but of common courtesy, on the part of the sister branch of the service. The Army had a huge warehouse near Charleston which was never fully utilized. A portion of this had been used for the storage of surplus material by the Navy, this material being that which is now to be sold to the highest bidder. As stored it could be readily seen by prospective customers and, on purchase, could be loaded directly on cars for shipment.

Before it could be sold, however, the Navy was ordered to remove all its stores within a given time. No extension of time or revocation of the order could be secured and the material had to be moved to the Charleston Navy Yard and stored in the hangars built for kite balloons. This took $43,000 out of the navy yard's budget and it will cost additional thousands before the material is finally sold and shipped. This $43,000 plus, would not only help the yard do a lot of necessary work, but means $43,000 of taxpayers' money worse than wasted. It emphasizes the need of the same kind of real co-operation between the Army and Navy that we expect, and get, in a well organized manufacturing plant. It also emphasizes the cost of war and war establishments, which it is always well to bear in mind.

The commandant at the Charleston Navy Yard, Rear Admiral Edwin A. Anderson, has some real problems, as already outlined. But he is apparently securing the co-operation of his shop force by frank and open methods, and this will go far toward offsetting other unfavorable conditions. Any man in the yard can see the Admiral personally with the minimum of formality and delay. This attitude, particularly at this time and with the undercurrent of unrest now abroad in the land, indicates a good grasp of the new industrial problems we are facing. It is interesting to note that evidences of co-operation are already apparent and really helpful suggestions are coming in from men in the shops.

This yard has handled repairs to former German ships, built mine sweepers, as well as destroyers and gun boats. The turbines were built complete, including reduction gearing, which gives some idea of the present machine equipment. Among Rear Admiral Anderson's assistants are: Commander John W. Woodruff, Constructor; Shop Superintendent Lieut. A. A. Smith and Master Machinist MacLaughlin. Together they are succeeding under conditions which would try the mettle of men in any line of work.

A Comparative Test of High-Speed Steels—IV

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In this installment the chemical composition, microstructure and manufacturing methods, which distinguish the really superior brands, are given. Having these data it is perfectly feasible for the metallurgist in the smaller shops to determine the steel best suited to his requirements.

(Part III was published in last week's issue.)

AFTER the test had been completed and the winners decided upon, there was still one point to be determined of fascinating interest from an industrial engineering standpoint.

Why did steels with an almost ideal chemical composition and good microstructure fail utterly? It was believed that an inspection tour of the various plants making tool steel would possibly shed some light on the matter. Happily, the writer was able to take this trip, and though it was impossible to visit all of the mills whose product was tested, due to limited time, yet a representative group was inspected. The principal points investigated were the organization, shop and laboratory equipment, personnel, plant layout, manufacturing methods, inspection methods and the raw materials used.

Good High-Speed Steel Is Strictly a Quality Product

Coming into the steel plants in this manner with a fresh viewpoint and having access to all departments, it was relatively easy to detect deficiencies or, better still, to ascertain why some brands simply *had to be* of superior quality. A well-balanced organization, modern, high-grade equipment, properly planned and executed work, experienced and careful workmen, together with the best only of raw materials and expert supervision, cannot help but be reflected in the product. Then, too, there are elements of refinement that some steel manufacturers do not incorporate in their product. As a matter of fact, whenever the policy was such that everything was sacrificed for quality and no product except such as met the established standard was shipped, an excellent steel was produced.

The above-stated general conditions are, of course, essential in the manufacture of a good steel. It is felt, however, that there are some additional important factors that will bear special mention, and for this reason they are listed below.

Raw Materials

A good iron as basic material is invaluable. Especially is this apparent where the refinement of the iron is controlled by the tool steel mill. The same is of course true of the other alloys, though in this case there are relatively few mills that control the production of the bulk of their raw metal. This latter feature is very desirable, especially when a market scarcity exists in the rarer elements. The chemical composition of the iron, both before and after refinement, should be held to close limits and frequent examinations made for the presence of slag and other inclusions.

Melting

Furnace construction and condition, grade of crucibles, correct mixture and temperature control are vital factors in melting practice. In pouring, the best practice is to eliminate the ladle and pour the ingot direct from individual crucibles. Each ingot, then, after annealing, should be analyzed and graded. If a steel mill makes various grades, it thereby effects quite a saving in costs over the "one-grade mill." Rigid inspection for surface defects should follow naturally.

Forging

Uniformly slow pre-heating and accurate temperature control for the forging operation are essential. Hammers of sufficient size or capacity should be used and in the same way the ingot must be of large enough cross-section to permit a sufficient reduction in area. When an ingot is worked in the rolling mills, the various factors must be controlled and a high standard set. Subsequent chipping or grinding is then followed by another inspection.

Miscellaneous

In the mixing of the alloy, especially where the electric furnace is used, there is an excellent opportunity for the introduction of "elixirs" (if that term may be used) such as uranium, and quite a bit of work is being done to this end. An advantage that few modern high-speed steels possess in any marked degree is that of being able to withstand the high heat in hardening without scaling. Needless to say, this is of prime importance in the manufacture of taps, hobs, form tools, etc., especially where the hardening is done in an open fire and not by packing.

Discussion of Results

Perhaps the most interesting data of the whole test are those presented on the two graph sheets, Figs. 5 and 6, reproduced herewith. Quite a few factors are brought out clearly, two of which appear of extreme importance, and which should be classed as essential requisites when a test of this nature is planned. They are the *number of specimen tools* used per brand and the *time limit in which failure should occur.* By an inspection of the graphs, it is at once obvious that no two tools of any one brand (of the same bar, heat treatment and subjected to identical working conditions) gave the same results. In most cases a wide variation is found, indicating that at least four and possibly six tools must be used if the results of a test are to be reliable. It is felt that this is a point of great importance, because conclusions are often based on the performance of one tool only and the above results indicate that such a test really means very little. When but one tool is used, the results may flatter a brand or do it great injustice with equal equanimity and in either case the consumer is the loser. The steel company, too, in such an instance does not have the proper opportunity to show the quality of its product.

The other point of importance brought out in the graphs is that apparently when a tool is not forced or

put to heavy duty, a mediocre steel may show up almost as well as a good brand. As the average plant probably does not exact a high duty from the high-speed tools in use, this fact explains why an inferior or even a poor brand may give fairly satisfactory results. Attention is invited to the fact that a superior steel will demonstrate its worth regardless of the duty exacted. For example, see steel B and D in both graphs. In the first run it will be remembered the cutting speed was 35 ft., the depth of cut $\frac{3}{32}$ in. and the feed 0.054 in., while in the second run the other factors remained the same except that the feed was increased to 0.090 in. A steel which is less excellent but still may be classed as "good" does not always fare so well, as is shown, for instance, by brand K. At this point it will probably be well to consider the exactly opposite performance of brand A, which finished as the leader in the first run, and in only the sixth position in the second run.

In the heat-treatment chart it will be noticed that this steel was treated with cyanide while at the high heat, the resulting "case" probably aiding the steel materially in the first run. After failing while cutting and then being reground (the case being removed in grinding) the beneficial effect of the case hardening was removed and the steel was graded as "good" steel only and not as a "superior" brand. While it appears that the cyanide treatment possibly aids a tool to some extent, its application should not be encouraged because it provides for non-uniformity, causes gasification and gives off dense, obnoxious fumes at the high heat, and distracts the attention of the tool hardener to a most undesirable extent. It is also to be noticed, from an examination of Table IV, that the nose of tool number 1 of brand B broke during the first run, thereby preventing this brand from finishing as the leader in this run also, to which position it unquestionably is entitled.

Check Runs

Attention is directed to the "check runs" indicated on both graphs. These additional runs were conducted to check the results of the leaders primarily, but as long as a check run was being made it was decided to include some of the other brands where the possibility of accidental performance such as broken tools indicated that they might be entitled to a higher standing. Steels of exceptionally promising analysis were also included in the check run. In every case a different bar of steel was procured from a standard supply; tools were then made up and put through the test like the first batch. It is to be noticed that the sequence as established by the original runs was not altered except in the case of brand M, which steel moved up to third position. This was to be expected because experience with brands C and J, previously occupying that position in the first and second runs respectively, had indicated that both steels were very non-uniform. Besides, they gave a lot of trouble in hardening. The rest of the check runs resulted in relatively unimportant changes in standing except that in nearly every case the "life" was greater than that of the original results. This fact seemed to indicate that brands D and B would at least duplicate the performance exhibited during the test at any time and probably would average even better. Brand M, on the other hand, showed a marked improvement in the check run, in which feature it far surpassed brands J and C and was awarded third place for this reason.

It is to be noted that one of these two "superior" steels, i.e., D and B, was in use at the Packard factory previous to the test. As a matter of fact the particular brand in question had been adopted as the factory standard for all Packard-made cutting tools. It should be further emphasized that unlike many large factories, tool steels are here specified by the mechanical department—which department is solely responsible for all machine and tool equipment used in the plant—rather than the purchasing department. This condition reflects credit on the head of the manufacturing department and his staff from the standpoint of industrial engineering.

Comparative Ratings by Other Large Consumers

It was thought expedient about this time to compare these results with those obtained by other large manufacturers. In Table VIII are given data collected with this end in view, the notation in each case being identical with the same symbols as were used in the test. The firms represented are composed of six large automotive manufacturers and three important tool companies. It will be noticed that three of the eight concerns represented buy their steel on the basis of results shown in actual test runs, one company on the basis of analysis only, and the four others on the basis of popular opinion. Note the fact that in the three cases where a cutting test was conducted, brand B was the winner. Further, in one of these instances brands M and D finished second and third respectively; in another, brand D was second and M fourth; while in the third case no mention is made of the other brands, besides B, that were in the test. These data were much appreciated because they verified the findings given in the Packard test to determine the correct choice of really superior steels and also presented some interesting facts about the brands as a whole.

Costs as Affected by a Superior Brand of Tool Steel

Automobile manufacturers usually make but a small percentage of the cutting tools required in their plant. Whenever possible, a standard tool is used, for example milling cutters, end mills, counterbores, hollow mills, reamers, taps, dies, twist drills, etc., and these are secured from companies which specialize in their manufacture. In the same way there are concerns which specialize in the manufacture of special cutting tools, and they in turn satisfy the requirements of the automobile manufacturer. This distribution then obviously effects the greatest economy that can be achieved and also tends to make a uniformly good product. However, some tools must always be made in an automobile manufacturer's own plant, and the annual cost of high-speed steel for this purpose (as it comes from the steel mills) in a factory employing 10,000 men is about \$125,000. A plant employing 20,000 men requires about \$250,000 worth of high-speed steel, and larger or smaller factories are affected in the same proportion. The cost of the finished tools made from the first amount of steel (\$125,000 worth) would be approximately \$375,000.

So far, though, these figures show only relative values of the tools. As pointed out in a foregoing paragraph, the tool made from a poor steel may break during hardening, or if it gets into the machine shop it will then give extremely poor results in performance. During rush periods, assuming no excess finished goods in stock, such tool trouble, when occurring on major units

like cylinders, crankcases or crankshafts, means that just so many less motors or finished cars can be shipped on that day and production cost is increased accordingly. All of these costs, however, are chargeable to the poor quality of high-speed steel that has been used. It is difficult to say to just what extent manufacturing costs will be affected, but aside entirely from the losses in indirect labor, material and burden that occur when a finished tool of poor steel breaks in hardening, the writer feels that a superior high-speed steel will easily decrease the direct labor cost from 5 to 10 per cent.

TABLE VIII.

Brands of high-speed steel being used by six large automotive manufacturers and three tool companies, and the sequence of their rating in each case.

Name of Co. or Manufacturer	Brands Being Used	Brands "Tried"	First Choice	Brands in Sequence of Desirability	Undesirable	Remarks
a	B H A J R D M	B C H N A O R D M	B	B D H M A J R	None	These classifications are the results of an actual cutting test.
b	R G B C	R,O G B C,N	R	Non-committal	N O	No test had been conducted in years.
d	B C	B C	B	B	None	In a test recently completed, B proved superior to all others and will be used exclusively.
e	J L C W	J L C W	J, W & L	Non-committal	None	All high speed steel is bought on the basis of analysis.
f	F J L B C	F J,H L,X B,H C	Non-committal	Non-committal	H N X*	Analysis is specified but used as an indicator only.
g	D B H M R Y*	D,Y B,J H M,C R,O N	B	B M D H Y* R	C O N J	Standard analysis as specified by the steel maker is required. Classification is made on the basis of actual cutting tests.
h	C N D A	C N D H	A and H	Non-committal	None	Classification based on opinion only.
	F O N M	F N O M	Non-committal	Non-committal	None	No test had been conducted for five years.
m	C N O R	C N O R	C and N	C N O R	None	Classification based on what the men of the manufacturing department "thought" about the brand.

*X and Y are brands of steel that were not represented in the test; they are obviously of inferior quality.

To give a better perspective of the cost and number of tools required to carry out a gasoline motor manufacturing program, the following figures are quoted from the text book of lectures used in the "Advanced Training School"[1] of the Packard Motor Car Co.:

"The total number of tools made by the Packard Motor Car Co. for the Liberty '12' airplane motor was 1,796,910. The cost of the perishable tools only was $1,466,540. Standard tools, such as drills, reamers, counterbores, taps and dies, cost approximately $500,000.

"We used 48,000 special tools for machining the connecting rods, 42,862 of which were perishable tools. For the large cutters which were used for straddle milling the large ends of the connecting rods, there were 25,000 cutter blades costing $4 each. Eighteen hundred end mills were used for milling out the channel of the rod, and 4,100 doming tools for the cylinder."

It will be observed that the total cost of special and standard cutting tools required for producing the Liberty motor at the Packard Motor Car Co. was $2,000,000 in round figures. One item alone, that of the cutter blades for straddle milling the large ends of the connecting rods, cost $100,000. The tremendous importance of using only the cream of superior grades of high-speed steel is, then, readily perceived, but we must not forget that these figures involve only indirect factory costs. As was pointed out repeatedly, the real inefficiency is not reflected in the tool costs but in the direct labor costs and in a degree far in excess of that indicated by the above figures.

Preferred Chemical Analysis

About the first factor usually determined when a test is to be conducted on a large scale is that of the chemical composition of the different brands. By an inspection of Table II an astonishing and entirely unwarranted variation of the proportion of the elements well known today as requisite is disclosed. The carbon content varies from 0.38 to 0.79, tungsten from 12.8 to 21.92, vanadium from 0.05 to 2.20, chromium from 2.72 to 5.27. Phosphorus and sulphur were below 0.04 in all cases, while other elements were present in practically a "trace" only. Uranium was probably present in an appreciable quantity in brand D only, the other traces being due to difficultly separated impurities. It is to be noticed that no cobalt or molybdenum was used by any of the steel makers whose brand was represented in the test.

Quite a variation will be observed in the heat treatment of these tools. Table II also contains the details of the heat treatment and such notes on observations as were made. It will be observed that some of the tools of the same brand were treated differently, though this applied only to the kind of quenching medium used and variations in the drawing temperature. On the whole, however, such practice indicates an apparent uncertainty on the part of the steel makers as to which treatment is the best for general purposes or even for a specific requirement.

Regarding the desired chemical composition, the writer feels that the analysis below is probably the most desirable for modern high-speed steel. Alongside is also affixed the analysis of the best high-speed steel tested by Frederick W. Taylor when he wrote his classical monograph "On the Art of Cutting Metals." It shows that this master had apparently plumbed the depth of the art, so that the last fifteen years show little progress in new compositions. As a matter of fact, Taylor recommended an ideal composition, slightly different from the one listed as giving him the best results.

Of course, were a substituting element such as molybdenum, uranium or cobalt used, the composition would be varied accordingly.

In order to determine the variation that might exist in the microstructure of the various brands of high-speed steel used in the test, specimens were examined

	Minimum	Maximum	Taylor's Best Steel
Carbon	0.62	0.68	0.67
Tungsten	17.00	18.20	18.0
Vanadium	0.85	1.05	0.29
Chromium	3.00	4.50	5.5
Silicon	0.20	0.30	0.04
Phosphorus	0.00	0.04	Low
Sulphur	0.00	0.04	Low
Other impurities	0.00	0.10	.....
Manganese	0.00	0.00	0.11

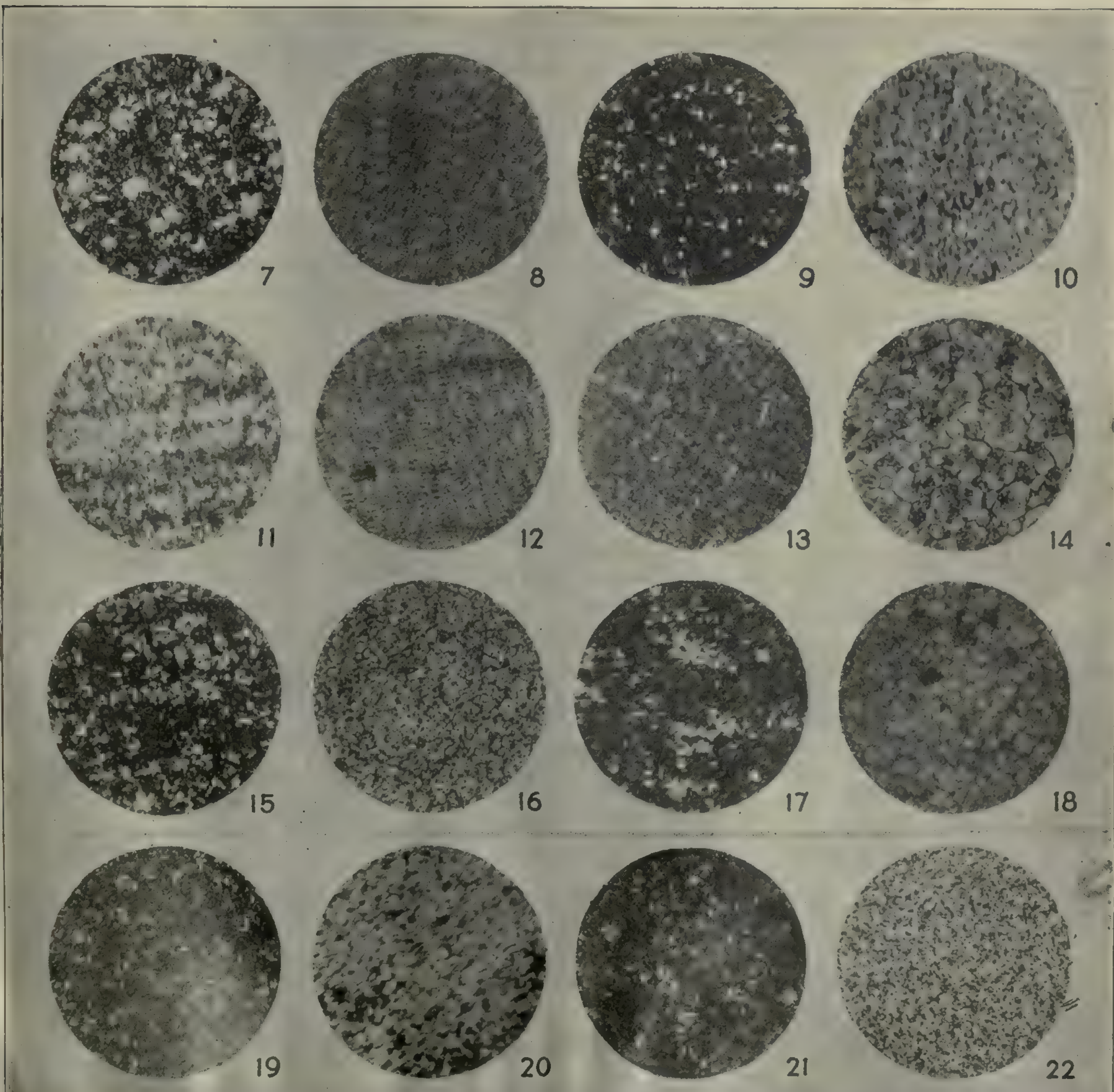
[1]Edited by D. G. Stanbrough, general superintendent, Packard Motor Car Co.

both in the condition in which they were received and also after hardening. It is understood, of course, that these specimens were made from the same section of the bar as were the test tools proper. The hardening of the samples used for microscopic examination was performed by an expert workman of wide experience in the hardening of high-speed steel. In every case the hardening specifications as quoted by the steel manufacturer were used. None of the samples was drawn, because it was desired only to investigate the structure resulting from the prescribed treatment at the high temperature.

Photomicrographs depicting the structure of seven different brands (both in the annealed state as received from the mills and after hardening) are shown in Figs. 7 to 22, all at 100 diameters.

In the case of brand F four exposures, 7 to 10, include a second pair made from a short piece cut from a bar secured from a different source. The set of pictures, as well as the analysis, Table II, shows clearly the wide variations that may be met in this brand.

An inspection of the odd-numbered microphotographs, showing the steel as it came from the mills, indicates that it was all in an annealed state; no trace is exhibited in any of the specimens of the original cellular ingot structure found in the newer cast high-speed steel. The microstructure therefore shows the presence of free carbides bedded in a sorbitic matrix. However, the quantity and the distribution of the carbides differ greatly in the various brands. The amount of free carbides, of course, depends on the composition and the rate of cooling. In the following brief discussion only the general characteristics exhibited in the different microphotographs will be noted.



FIGS. 7 TO 22

Microstructure at 100 diameters after nitric acid etching of some typical high-speed steels. Odd numbers are steels as received; even numbers the corresponding steels after hardening. Figs. 7, 8, 9 and 10 are of brand F; Figs. 11 and 12, brand L; Figs. 13 and 14, brand O, low W; Figs. 15 and 16, brand O; Figs. 17 and 18, brand B; Figs. 19 and 20, brand N, Figs. 21 and 22, brand H

Figs. 7 and 9, as remarked above, are of one brand (F) and therefore probably underwent the same cooling. However, the quantity of free carbides shown in Fig. 7 is much higher than that in Fig. 9. This difference is explained by the higher percentage of tungsten in the former case. In Fig. 11 it will be seen that the carbides are most conspicuous and the chemical analysis (brand L) shows the tungsten in this instance to be the highest of all steels tested. Again in Fig. 13, a bar of brand O in which the tungsten dropped to 11.12 per cent, little free carbide is found. Several of the specimens having good percentages of carbon and tungsten do not reveal corresponding amounts of the free carbides. Probably in such instances the rate of cooling was faster or perhaps the time at the annealing temperature was shorter.

In several instances the distribution of carbides is found to be quite non-uniform. This is brought out exceptionally well in Fig. 11 and Fig. 15. The carbides as depicted in these two cases are obviously more or less segregated into striations, whch indicates that the annealing was not sufficiently prolonged. An inspection of Fig. 12 discloses that even after hardening at the high temperature, this marked segregation of carbides still persists.

Microstructure of Hardened Steels

The exact nature of the physicochemical changes which take place in the hardening of high-speed steel are not yet fully known. Up to the present time no theory has been advanced which satisfactorily explains all the phenomena exhibited by the heating and cooling curves of this steel.[2]

However, it is known that for the best results in hardening, two requirements should be fulfilled. One of the requisites is that the carbides must first be taken into solution and then held in that state by a proper rate of cooling. The second requirement is that the solution of the carbides should be effected in such a manner that the resulting grain size is held to a minimum.

In carbon steel and in most alloy steels the preceding requirements are fulfilled at nearly the same temperatures. In other words, the carbides go into solution at about the same temperature, which also gives maximum grain refinement. This, however, is not true in high-speed steel. Here the temperature at which the carbides go into solution is far above the grain-refining temperature. Since both temperature and time are functions of the grain size, it is imperative that the tool, after thorough pre-heating, be brought rapidly to the high heat and held there for a minimum of time. Otherwise the grain structure will become too coarse and brittle, with consequent fragility. Some of the alloying elements in high-speed steel, tungsten in particular, tend to make grain growth more difficult, an influence on the grain size very beneficial to steel requiring high hardening temperature. On considering the variables which enter into the hardening process, and the difficulty with which they are controlled, the folly of drawing conclusions from tests made with a single tool is evident.

Examination of the photomicrographs of the hardened specimen shows quite a variation in the grain size. In most instances the nitric acid etching after hardening reveals polyhedral structure, part austenitic, part martensitic. The specimen shown in Fig. 14 shows the largest grain structure. Although the granulation in this instance is large as compared to some of the other specimens shown, still it is not uncommonly met with in commercial hardening. Perhaps in this case the large grain size was occasioned more by the high carbon and the low tungsten than by the temperature and time.

The microstructure of the hardened samples shows that little of the free carbides remained undissolved. Only in Figs. 10 and 14 are appreciable quantities of the carbides to be seen. Moderate amounts of undissolved carbide are believed not to have a detrimental effect on the cutting properties providing the tungsten and chromium contents are normal. Still, when the amount of the carbides is too great, as in Fig. 14, the solution will not be sufficiently complete to give good results.

Facts Brought Out in the Test

1. The chemical analysis of a high-speed steel may be used only as an indicator of its possible qualities.
2. Tools made of a medium grade of steel will work fairly satisfactorily when subjected to a relatively light duty.
3. No two tools of the same brand give exactly the same results, in a cutting test.
4. In conducting a test, no less than four specimen tools should be used.
5. To get the most efficient results from high-speed steel tools they must be operated under heavy duty, and no tests are reliable unless made with heavy cuts.
6. Test tools must be reground once, at least, and then again put through another run.
7. High-speed steel should be purchased only on the basis of performance.
8. A wide variation exists in the cutting qualities of the various brands of high-speed steel that are on the market today, and both indirect (material, labor and burden) and direct (labor and burden) costs are affected adversely when inferior steels are used.
9. Heat-treating practices of today leave wide room for improvement.
10. In hardening, the time factor is probably the important item needing investigation.
11. It is expected that a method of determining the efficiency of high-speed steel by means other than the service cutting test will be developed. Work with the X-ray and magnetic properties is quite hopeful in this direction.
12. It is believed that today the American manufacturers can produce a high-speed steel that is at least equal to the best European brands.

Application to the Small Shop

As was pointed out in the opening paragraph of this article, the proper choice of high-speed steel brands is of equal importance to the large manufacturer and the small shop. The writer is convinced that the time is not far distant when even the largest machine-tool manufacturers will not only use a superior brand for the tools they make themselves but they will, in addition, prescribe the particular brand or a series of brands to "tool shops" that must be used in all the tools manufactured for them. This would apply to standard tools such as milling cutters, counterbores and twist drills, as well as for cutting tools of special design.

All tool steel will be specified by the mechanical

[2]See Sauveur, "Metallography and Heat Treatment."

superintendent, and the purchasing department will work in close co-ordination with that office. It naturally follows that a steel salesman with mechanical training and wide practical experience in manufacturing and steel making will be the successful salesman of the immediate future.

Now, then, what about the small machine shop? Obviously, such an institution cannot conduct a test in the elaborate manner described above. It can, however, conduct a thorough test in a small way, and the following suggestions may be helpful:

Some investigators have apparently concluded that a cutting test consisting of running a tool to destruction by "turning off the face" (that is to say, using the cross-feed and not longitudinal feed) of a bar yields accurate results. This, in my opinion, is erroneous. In the first place, at least two variables are introduced—cutting speed and material cut. It will easily be appreciated that under the proposed conditions the cutting speed varies so that at the center of the bar the duty is very low; as the periphery is approached it increases rapidly to an abnormal value. Now, if a tool approaches its breaking-down point while cutting anywhere near the periphery, failure occurs at once. If, on the other hand, a "weary" tool escapes failure at the periphery, it will continue to cut on its next travel out from the center until a high cutting speed is reached, when it will fail suddenly. However, had the previous cut been continued for a short time longer, possibly seconds only, failure would have inevitably occurred. The total life in such a case will vary widely, giving results entirely out of proportion to the facts. Variations in the material cut will also be encountered, as absolute homogeneity cannot be obtained for any great depth. There are other objections of a practical nature, but it is felt the above are sufficient to establish my positions.

The brands used in the small test can be of a limited number, therefore time spent in investigating a product before it is granted entry to the group to be tested is well spent indeed. Usually, two letters of inquiry per brand will be sufficient to classify it definitely. These letters would naturally be addressed to prominent users of high-speed steel who base their choice of brands on the results of actual cutting tests.

A thorough understanding of Taylor's thirteen fundamental variables and important factors brought out in this work, together with proper safeguarding of the human element, is, of course, essential. Stringent means must be employed to insure the correct heat treatment, and to avoid possible damage in hardening. As far as the material is concerned, a straight production job will give entire satisfaction so long as the necessary precautions are taken. A feed of $\frac{1}{16}$ in. or more, depth of cut $\frac{1}{8}$ in. or greater, time for failure of tool to occur twenty minutes to one-half hour, four test tools per brand, provision for at least one regrind, and a reliable record of all the data will round out the requirements. Finally, as much information as possible should be secured from reliable disinterested parties concerning the various brands of high-speed steel on the market.

Appreciation

It affords the writer particular pleasure to acknowledge his appreciation of the great assistance of his present and former associates, R. N. Brown, J. J. Long, E. P. Stenger, F. R. Weaver and M. Y. Kaptansky, who have contributed so much of value to this work.

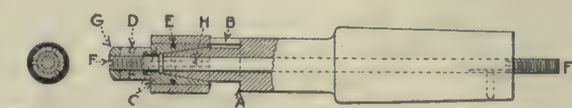
A Special Expanding Chuck

By R. Gustafson

The chuck shown in the illustrations is made to handle small bushings in quantities. It can be adapted to various sizes by making a set of jaws for each size.

The shank is made to fit the lathe upon which it is to be used. A shoulder at *A* serves as a gaging point from which the bushings can be located if desired by a loose gaging piece *B*.

The outer end of the arbor is tapered 10 to 15 deg. (depending somewhat upon the size of bushing the tool is made to hold) and the jaws *C* are fitted to it. The jaws are first made as a single piece and then slit in three parts. A projection from the front of the jaws is covered by the recessed nut *D* which, with the annular spring *E*, holds the jaws from falling out when no work is on them.



A SMALL EXPANDING CHUCK

The recessed nut *D* is threaded to the draw pin *F* and held by the lock nut *G*. The draw pin has a shoulder just inside the bore of the jaws to force the latter down the incline, in case they tend to stick when releasing the work.

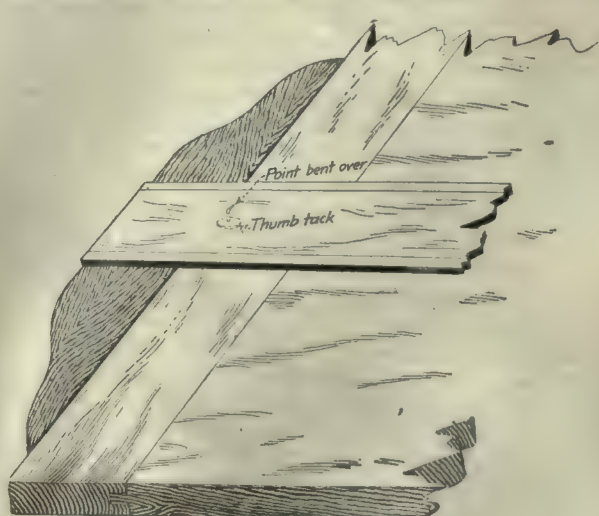
The draw pin may extend clear through the lathe spindle and be fitted at the end with a small knurled wheel for operating.

A small pin *H* in the tapered part of the arbor between each jaw keeps the latter evenly spaced, preventing them from slipping on the taper and refusing to drive.

Kink for Draftsmen

By S. Jones Nelson

Some draftsmen have a habit of wrapping a layer or two of drawing paper around the blade of a T-square near the head so that the square can be moved more easily over the board. A better way is to push a thumbtack through the blade from the under side as shown in the cut, and clinch the point on the top.



T-SQUARE KINK

Some Experience with the Metric System

By FREDERICK A. POPE
Assistant to General Superintendent, Blake-Knowles Works,
Worthington Pump and Machinery Corporation

Some practical objections to the use of the metric system of units are given here, the information being derived from an actual attempt to use the metric system in an American plant. The article sums up in a convincing manner much that has already been written upon this matter.

IN VIEW of the renewed discussion of the metric system and its proposed compulsory adoption as a legal standard in this country to supersede our present system, the comments of one who has been "through the mill" during an attempt to use the metric system in an American shop, may be of interest.

For more than seven years prior to my present connection, my work included the development or standardization of product, which, in turn, naturally included as a vital consideration, shop standards and manufacturing practice in the production of a line of power machinery by a well-known manufacturer. The line being an entirely new one with this company, a separate engineering division was established with its own records, etc., though manufacturing was carried on in an existing shop already equipped and making other products in the inch system. On the recommendation of a German chief engineer the metric system was adopted for this new product.

To begin with it is pretty generally conceded that the metric system, as a system, is simpler and superior in some respects to our English inch system, and it was just this consideration of the system alone, without serious practical thought as to its applicability, that resulted in tremendous useless expense without gaining a single advantage.

Work on the new product was started, drawings and patterns being made, and no serious difficulties arose at the very beginning. It may be remarked here, that for the actual work of making a drawing or a pattern, where probably the smallest unit used is the millimeter, the metric system is really very convenient for both designer and pattern maker.

Troubles Encountered in Cutting Threads

Soon after the start the first concession to the inch system was in the matter of standard taps up to 2 in., as the first stumbling blocks were the commercial stud, bolt and nut, all of which are in inches.

Consequently, it was agreed that tapped holes and die-cut threads would have to be in inches, although machine-cut threads of fairly large diameter were cut on a metric dimension for the diameter with a U.S.S. form of tool and the number of threads were specified as so many per inch. Of course this was ridiculous, but so far things were not so very bad, it still being maintained by those "higher up" that no further obstacles would be encountered.

The taps had been the first to go back to inches, but immediately the question of tap drills arose. Although it seemed of course extremely simple to purchase metric drills, the cost of equipping the shop with tap drills alone in metric sizes was found to be somewhere in the neighborhood of $5,000. That cost would be around $10,000 at present prices. Remember, that was only for this one really small item of tap drills, and if metric drills were to be used for tap drills, of course all other drills must be in the same system. Right here our real troubles began. The shop being already fully equipped under the English system, it became immediately apparent that double drill equipment would be necessary. Consequently, it was decided to give in again to the inch system as far as the drills were concerned, but (worse and more of it) to continue to specify metric dimensions on the drawings—the shop to select the nearest inch drill for holes that could be drilled. This was lone, and very soon it developed that on some repair jobs there was no way of knowing whether, for instance, a hole which was specified on the drawing as 25 mm. had been actually bored to that dimension or drilled and reamed 1-in. (equivalent to 25.4 mm.). Of course the part that fitted the hole was also affected.

In all cases where accurate dimensions and careful fits were absolutely essential and cylindrical parts were fitted to reamed holes we were in trouble again on the reamer sizes. For instance, if the hole were specified as 25.00 mm. exact, a 1-in. reamer (equal to 25.4 mm.) might be used, or a 63/64-in. reamer (equal to 25.003 mm.), either of which would meet all requirements of design; but, it was asked, how would everyone know which to use unless the drawing definitely specifies it, and, if it does specify the inch equivalent, then why the metric dimension. That is, why should not the inch dimension be used to begin with? Of course before long it was.

Further Illustrations

Further illustrations of the difficulties and complications encountered may be suggested by the following examples: Trying to use commercial sizes in inches of cold-drawn round bars and wires in conjunction with metric holes; trying to use commercial sizes in inches of rectangular and square keystock with keyways expressed in millimeters (either the keystock must be altered or the keyways actually made in inches); trying to use commercial sizes of tubing in inches in conjunction with parts of metric dimensions. All commercial standard tapered parts used were in inches-per-foot taper, as were the reamers for making the holes; in all cases where hexagon stock was required, of course commercial inch sizes were used; all final flanged connections were of necessity made up in inch dimensions to meet customers' piping, which was in American standard inch dimension; and all sheet metal used was of course in the inch system, and therefore difficult to tie into the metric system.

In addition to the cases described above there were those of the many accessories which were made either completely or in part by outside firms to our drawings. All dimensions were in millimeters for our shops. but inch equivalents were necessary for the outsiders, thus causing more mixed dimensions and. of course, more confusion.

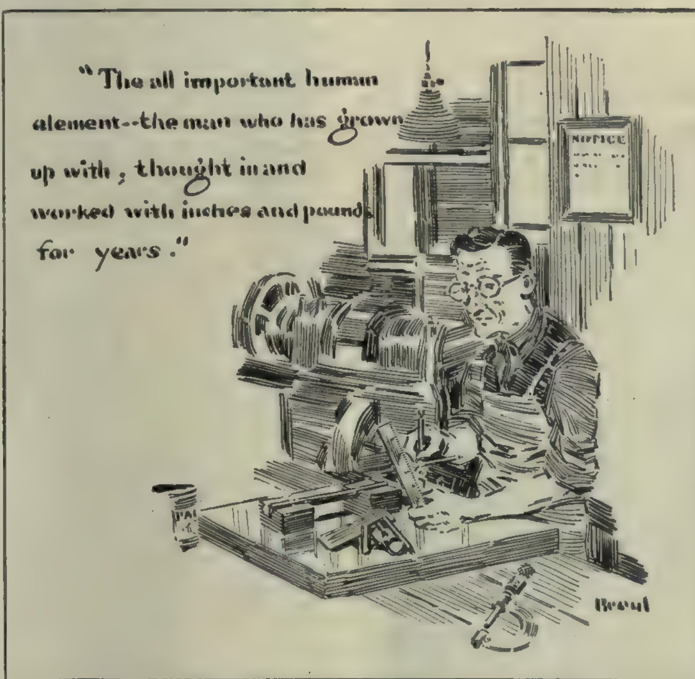
The foregoing examples were only a few of innumer-

able cases and, while not of themselves so tremendously consequential, are nevertheless indicative of the nature of the difficulties encountered all along the line. As time went on the complications spread, and increased with the increase of business and the number of machines shipped.

Difficulties of Changing System

Of course the conditions described are those resulting from a mixed system and exponents of the metric system will contend that these difficulties would not exist if the metric system were a universal standard. Of course they would not, if it were a universal standard, but how to get to that ideal state is another story and the only one that counts.

If the transition from the present inch system to the metric could be accomplished overnight (as by magic) everything would be all right, but we know that it cannot be done.



We have our drills, taps, dies, reamers, tapers, cutters and other sized tools of every kind; bar stock and tubing, and dies for their drawing or rolling; piping and all that goes with it; sheet metal; measuring instruments; tools and gages of all types; lead screws and feed dials on machine tools; and many thousands of other things which would become entirely apart from the stupendous task of changing over, a complete loss, and these items represent, principally, only "short life" goods and are, comparatively, of far less importance than the billions of dollars worth of permanent equipment of all kinds now existing in the inch system. The various combinations and complications represented here are infinite and difficult of conception.

The consideration of repairs to this existing permanent equipment is another consideration of tremendous importance. Just to cite a good example, consider the pump manufacturing business. Repairs are being made on pumping machinery built thirty or more years ago, much of which work obviously requires standard-sized tools for interchangeability, so it is evident that many years must elapse before the old product disappears and the new takes its place. In the meantime practically double equipment and two systems will be in use.

As another good example of permanent equipment can be mentioned the case of repairs and replacements to millions of dollars worth of government ordnance and naval machinery made under the inch system, for which thousands of special gages have been made at tremendous cost. Also, complete files of elaborately dimensioned drawings in inches exist, not only with the maker but several sets are in the government's possession. Those records will be practically useless without the tools to execute much of the work required—so, double equipment and two systems again.

Further, there are the millions of dollars worth of manufactured parts carried as stock by thousands of manufacturers whose entire business structure is based on the principle of large-volume production into stock. Setting a date for the changeover from one system to the other would be of no avail here, as either the unassembled parts or completely assembled machines would be obsolete, and there would in any event be useless stock on hand. In the automobile industry where several specialty concerns make the various elements of an automobile, to be assembled by still another concern, another example is offered. The assembler would have perhaps a metric motor and an English-inch rear axle, or he could wait until he gets all metric parts—in the meantime his business is stopped and the makers of the various parts are loaded with useless old stock on hand. Imagine business on this basis!

We have, further, the all-important human element to consider—the man who has grown up with, thought in and worked with inches and pounds for years and who possesses all his own English instruments. To change over to the new system he must "feel" his work in hundredths of a millimeter instead of thousandths of an inch, think in kilograms instead of pounds, he must develop the sense of pressures in kilograms per square centimeter instead of the old pounds per square inch.

He must learn to forget his old inch system in addition to learning the new (a double effort), and I know from my own actual experience and observations that it is impossible for one who has been brought up, so to speak, on inches not to be continually, when metric units are used, converting back to inches to get a real natural conception of what is being dealt with. The results of this process may be easily imagined.

The nothing-less-than-chaotic conditions suggested would hold true all the way through the mechanical industries, and other branches as well, as it is an absolutely incontrovertible fact that for generations any attempt to adopt the metric system would necessitate the use of *both* systems—because otherwise a change from one to the other would require all branches of industry. and all divisions of each single branch to be in absolute synchronism—a ridiculous impossibility.

Suicidal to Abandon Present System

Whatever may be the real origin and object of some of the efforts and propaganda in behalf of the compulsory adoption of the metric system, I can not say, but there should not be the slightest shadow of a doubt in the mind of any practical thinking man that to attempt to abandon our present system for the metric would inflict much harm and would be nothing short of industrial suicide.

The Manufacture of Household Appliances—II

By J. V. HUNTER
Western Editor, *American Machinist*

A great deal of small machinery for household and agriculture use requires little machining other than the drilling of numerous holes. While this does not apply to all the parts mentioned in this article, still the drilling operations make up a large portion of the total machine work, and an endeavor has been made to handle it as expeditiously as possible.

(Part I was published in our June 3 issue.)

THE parts requiring machining in the plant of the Hurley Machine Co., Chicago, all go through the same general machine shop, and little or no classification of the work into different sections is made in this department. They are later classified into distinct departments where unit assembly is conducted and the machines are finished.

In considering the drilling operations, it will be found that nearly all of the common types of drill jigs are represented among those in use in this plant. One of the simplest is the small box jig *A*, Fig. 6, which is used for drilling the hole *B* and counterboring as at *C* the small part shown on the drilling-machine table. The piece is slipped on the pin *D* and aligned by two smaller pins which fit in holes already drilled. The counterboring operation is performed first, using drill *E*, and this centers the hole sufficiently so that no bushing is required to guide the smaller drill *F*. In holding the piece, the operator closes the leaf with the hand lever G, pressing the four pins on the leaf against the back of the piece to hold it firmly in position.

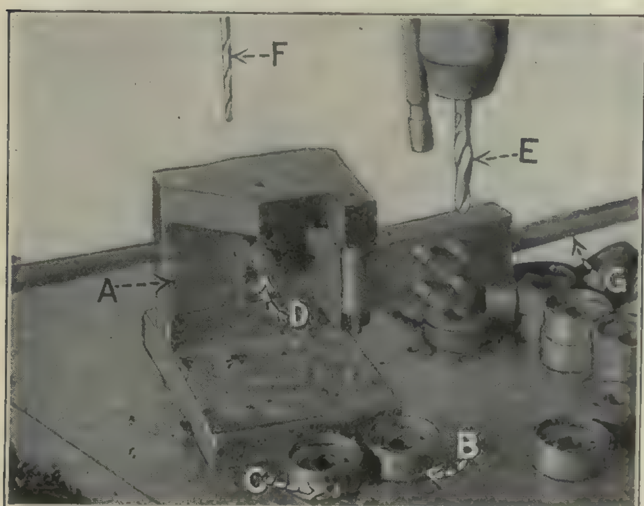


FIG. 6. HAND HELD JIG FOR SIMPLE PARTS

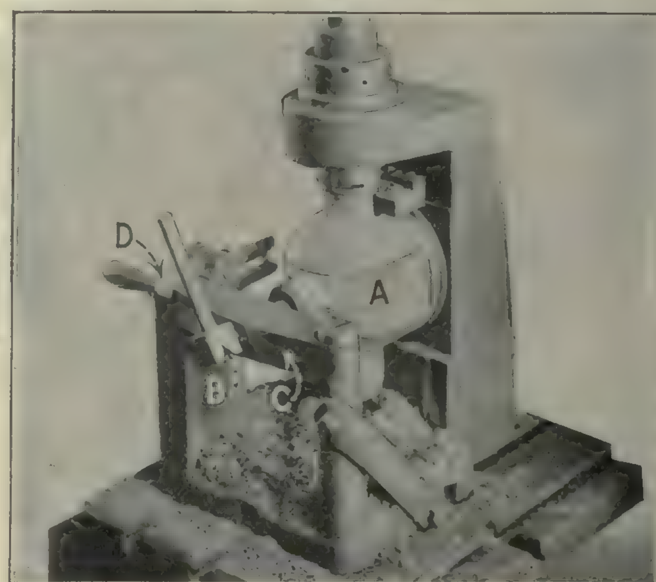


FIG. 8. JIG WITH TRIGGER RELEASE OF CLAMPING ARM

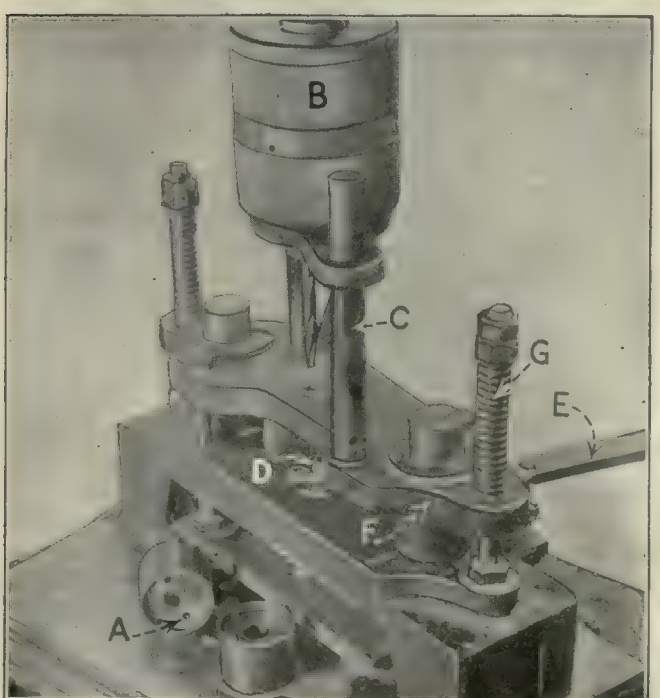


FIG. 7. PUMP TYPE OF JIG RELEASED BY FOOT LEVER

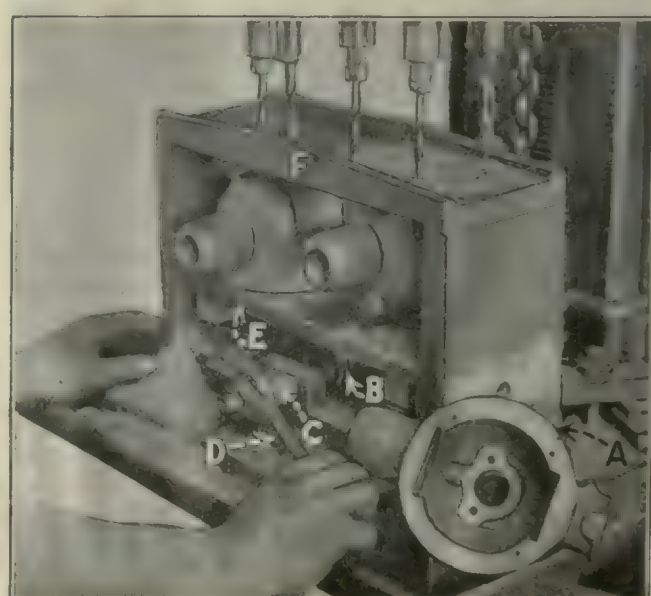


FIG. 9. DOUBLE JIG CLAMPING BY CAM

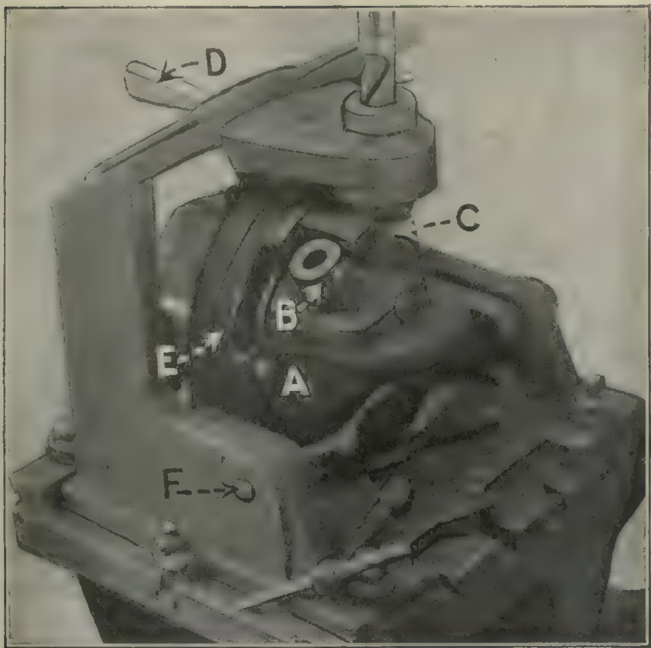


FIG. 10. COMPOUND TILTING AND REVOLVING JIG

An adjoining machine is employed to drill the two small holes *A*, Fig. 7, and uses a geared head *B* to drive two small drill spindles. This head is held in correct position by the arm of an auxiliary stud *C* extending up from the face of the jig plate. After being slipped in place over a stud *D* fitting in its center hole, the work is firmly held down by releasing the lever *E*, so that the jig plate *F* is closed down on the part by means of the springs *G*. This jig is one of the type commonly called a pump jig, in which the lever *E* is worked in the manner of a pump handle by means of a pedal beneath the machine table, the two being connected together by a rod.

The jig for drilling, reaming and facing operations on the bearing hubs of the small bevel-gear housing *A*, Fig. 8, is used to complete these three operations at a single setting of the piece. As shown in the illustration, the facing tool is in position for finishing the outer end of the hub. The casting is held against the vertical face of the jig frame by means of the screw *B*, which is tightened against the boss on the housing. The cross-piece *C* is provided with a latch *D*, so that it may be instantly released and quickly swung out of the way for removal of the work. By this arrangement only half a turn or so is required in order to put the necessary pressure on the castings.

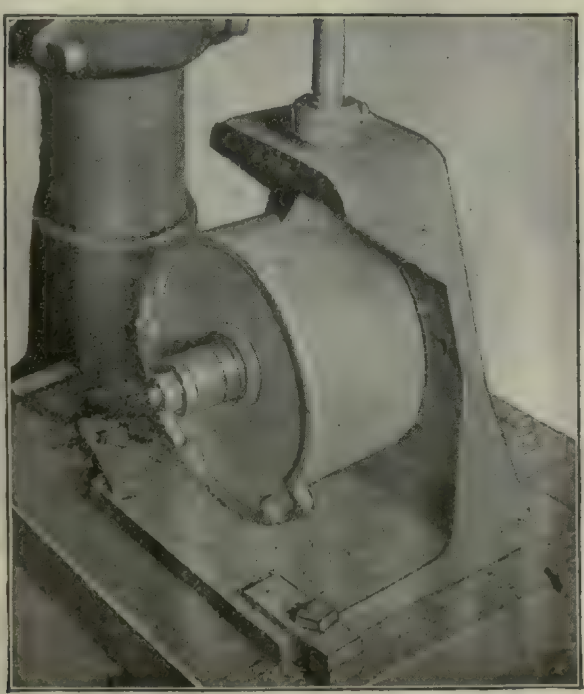


FIG. 11. SIMPLE JIG FOR HEAVY CASTINGS

Two further drilling operations on this casting are carried out on a Natco drilling machine in an adjoining station. The six holes that are drilled in these operations will be seen in the face of the casting lying at *A*, Fig. 9, and of these, two holes are produced at one setting and the other four at a subsequent setting. A double jig is used and the castings are transferred from the left position to the right after the first pair of holes has been drilled. The clamping arrangement on this jig is by means of a small cam *B*, mounted on the shaft *C*, to which the hand lever *D* is connected. This cam raises the plate *E*, upon which the castings have been previously placed and clamps them firmly against the top plate *F*.

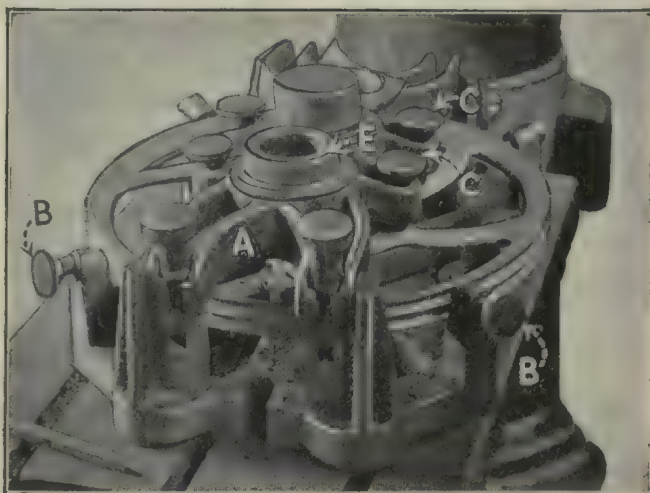


FIG. 12. JIG FOR DRILLING GROOVED BELT PULLEY

The casting *A*, Fig. 10, is shown bolted against the right side of the jig, which is used for finishing the holes in the two hubs *B* and *C*. After boring and reaming the first of these hubs, the lever *D* is released at the back of the jig and the plate *E* may be revolved until it reaches a stop which brings the other hub in line with the drill spindle. A drilling operation on the inside of this housing is performed at a subsequent time by tilting out the inside frame of the jig which, it can be seen, is hinged at the point *F*.

A simple form of drill jig is used for operations on the large gear housing, Fig. 11, and is illustrative of the type of jigs used on some of the larger laundry machines built in these shops. Another large jig, Fig. 12, is used for certain drilling operations on the sides of a grooved pulley. This jig is equipped with a hinged top plate *A* which carries the drill bushing and must be swung out of the way for removal of the work. The thumbscrews *B* serve for centering the pulley and keeping it from side-slipping during the drilling operation. In addition to these the four clamping screws *C* are provided for holding the pulley firmly to the bottom bearing on the jig and supports are provided to furnish a

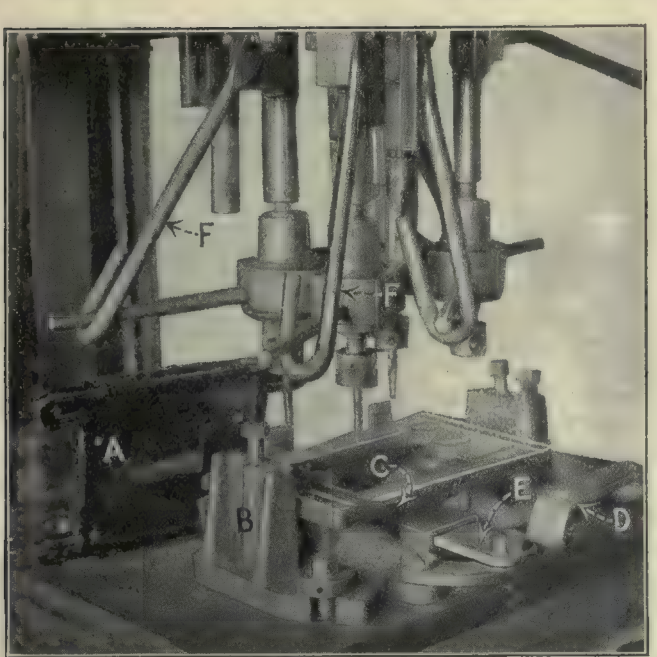


FIG. 13. JIG FOR BOTH DRILLING AND TAPPING OPERATIONS

bearing for the underside of the hub so that there will be no danger of breakage from the pressure of the drill. The drill bushing E does not indicate the true size of the drill, as it is cup-shaped and the lower face has a much smaller hole of the proper size for locating the drill. The peculiar shape provides for the reamers and counterboring tools which are used.

An unusual tapping job is shown set up under a Natco drilling machine, Fig. 13, for tapping the four small corner holes in the casting A. The jig B, which is in use during the tapping operation, is the same that is employed for drilling the holes; but the bushing plate has been removed to permit the use of the taps. The arrangement shows how this casting was held for the drilling operation, it being then placed on the plate C and clamped up against the bushing plate by pulling the lever D forward, which, by a wedge arrangement through the arm E, raises the baseplate vertically. The peculiar arms F, bolted to the under face of the drill-spindle head, should be noted. They are used to prevent twisting of the tapping fixtures.

Should a Man's Pay Equal the Value of His Production

By Francis W. Shaw

Is it fair that a man should consume or reserve for his own use all that he produces, or its equivalent? John S. Watts says, on page 43 of the *American Machinist*, that it is fair. Setting aside one little omission—the fact that some people are unable to produce by reason of incapability of some kind—I do not see how this gentleman's suggestions or recommendations are going to put an end to strife in the labor world.

Suppose, for instance, that Smith, a man of inventive ability, so improves a process that one man in a lifetime can do the work of a hundred working under the old conditions. Then Smith, having saved the labor of ninety-nine men out of one hundred, is entitled to 99 per cent of the products of all the machines that are put in operation. Many Smiths have passed, many Smiths are living and many Smiths are to come. Indeed, had no such Smith ever lived, people would have remained cave and forest dwellers, or died of starvation. If Mr. Watts' proposition be carried out, the living Smiths and the Smiths to come will be entitled to accumulate more than ever did the Smiths of the past. I fancy that most of those who hold positions of responsibility would be entitled, according to this theory, to quit their work and live out their lives on the value of the labor they have saved others.

Is it not reasonable to suppose, after all, that every man who does his best is entitled to share equally with the others in the category of "best-doers!" What, really, is the measure of value of output in these days of the fine sub-division of labor? There are certain classes of undesirable and unpleasant work at which I should consider one hour spent—if I had to spend it there—worth as much as twenty hours of ordinary work, such as at a lathe; and I am duly thankful that the Lord has endowed me with sufficient talents to enable me to rise above such menial labor.

What is wanted is a means of measuring a man's output in relation to his material gifts, his opportunities, his environment. When regard is had to the sort of start some poor devils get in life, it is not what they don't do that should surprise us, but rather what they do. If these unfortunates are going to receive just what they produce, God help them, as it would not suffice for a bare existence.

A Self-Contained Tool Rack

By Frank C. Hudson

Here is an unusual tool rack for a tool crib. It is a sort of wooden tunnel with sides on a gentle slope and plenty of room inside for a man to walk through and pick off the milling cutter or other tool he wants.

This form of rack gives four good sides for tools in a comparatively small space and it also braces itself rigidly against movement or swaying. In this case it is about 6 ft. long and provided with a powerful electric light inside so tht every tool can be readily seen at a glance. It is in use in the shops of the Fergus Motors Co. of America, in Newark, N. J.

A SELF-CONTAINED TOOL RACK

A Simple and Effective Press Guard

BY LEROY W. ALLISON

The value of safety devices or equipment for operating presses of all kinds has been demonstrated effectively in many ways during the past few years, and the simpler the contrivance, the more efficient it becomes in actual service. This simplicity is to be desired not only in the device itself, but in the method of application, with elimination of any interference or disturbance in regular operation.

OPERATORS become accustomed to working at a machine in a certain way, and the addition of a safety appliance, unless of the right character, is likely to result in confusion and to upset operating calculations to such an extent that will make the workman rather "take a chance" than allow its regular use in the daily work. This attitude has cost many fingers and hands, as well as other injuries, and reflects in a measure on the judgment of the designer of the device, as well as on that of the employee.

The use of a certain type of guard to a particular type of press does not mean that this, necessarily, is the limit of possibilities. On the contrary, the appliance may be readily applicable to presses of other styles, being modified or extended in a way to suit the exact conditions of the machine and character of production. For this reason, practically all safety devices for presses and heavy machinery are interesting, and the effective Sheridan press guard, described in this article, seems no exception to the rule.

The Sheridan press is one of the most popular and efficient embossing and plating presses used in the leather industry, being particularly adapted to the finishing of upholstery leather of all kinds. In spite of its wide use, however, the machine has unprotected working parts that have caused many hand and finger amputations. While numerous attempts have been made to develop a satisfactory guard, it is only quite recently that such a device has been perfected, and marked simplicity is evidenced in this accomplishment.

As a basis for proper protection to the operators, it is necessary that fixed guards should be provided both on the "operating" and "take-away" sides, enabling the operator who feeds the machine to insert the leather, but preventing him from getting his hands between the plates; and, on the other side of the machine, permitting the workman to catch the emerging leather without danger to himself.

Extended study has been given to this matter by the Industrial Bureau of the Tanners' Council, under the direction of R. S. Bonsib, in co-operation with the United States Department of Labor and prominent leather manufacturers, with the result that a type of guard is now being used successfully on these presses at a number of well-known plants in this industry. The writer is indebted to the first-mentioned organization for the following information regarding this device, and the accompanying illustration is reproduced through the courtesy of the Department of Labor.

Perforated or expanded metal sheets are attached to the machine both on the "operating" and "take-away" sides; this is shown clearly in the accompanying illustration, setting forth an installation as developed at the plant of the W. H. McElwain Co., of Boston, Mass. The perforated sheet on the front permits the operator feeding the press to insert the leather under the guard, and there is no opportunity nor likelihood of his hands getting between the plates. The perforations also enable him to look through the guard to guide the leather properly into the press. The guard on the other, or "take-away" side, of the machine prevents the attendant from removing the leather until it protrudes from under the guard.

The construction of this guard is very simple. Iron flats, 1 x ¼ in. and 1 x ⅛ in., bent to shape, are used for the frame work. The front guard is 35 in. wide and about 19 in. high; the opening for the leather is 1¼ in. The frame protrudes for a distance of about 10 in. in front of the machine. The grill work is formed of No. 20 expanded metal. The back guard is 34 in. wide, 15¾ in. high, and has a protruding depth of 11½ in. This, likewise, is provided with No. 20 expanded metal, as are the two side guards, each measuring 11¾ x 8¾ in. The frame is secured to the machine by means of angle-iron clips and No. 6 rivets.

While the material used in this instance is expanded metal, as noted, heavy 1-in. wire mesh may also be employed, but the former is preferable. The guard,

THE FRONT OF THE PRESS SHOWING THE GUARD IN PLACE

while securely fastened to the machine, is arranged so that it can be opened readily when necessary for repairs to the press or other important purpose. Recommendations in this connection are that the master mechanic be the only one authorized to open or remove the guard.

In passing, it is interesting to note that two or three other types of guards have been developed for the Sheridan press. These either force the arms away from the machine through the raising of a table or bar, or require the operator to pull down a lever so arranged that both hands must be used. These devices have not proved entirely satisfactory; in the first type, the table or bar "gets broke"—in other words, the workmen do not like the contrivance and prefer the danger of operating without it; in the other type, it is frequently found that both handles are tied together and operated by one hand, rather than used with two hands, leaving one hand of the operator exposed to injury.

The guard as described above is not subject to these alterations, or in fact a change of any kind. It becomes, in reality, a part of the machine, and the operator readily grows accustomed to its presence.

Carriers by Water Under New Transportation Act

The traffic bureau of the Merchants' Association calls the attention of shippers to some important provisions of the new railroad law which affect steamships. This digest of the new law has been prepared by the Merchants' Association for the guidance of American exporters.

The Transportation Act of 1920 prescribes important regulations with respect to water carriers engaged in foreign commerce, requiring them to file with the Commission schedules of sailing dates, ports of loading, routes and destination. Provision is also made for furnishing rates, reservatons of space and the issuance of through bills of lading under rules to be prescribed by the Commission. These provisions read as follows:

(1) "That every common carrier by water in foreign commerce, whose vessels are registered under the laws of the United States, shall file with the Commission, within thirty days after this section becomes effective and regularly thereafter as changes are made, a schedule or schedules showing for each of its steam vessels intended to load general cargo at ports in the United States for foreign destinations (a) the ports of loading, (b) the dates upon which such vessels will commence to receive freight and dates of sailing, (c) the route and itinerary such vessels will follow and the ports of call for which cargo will be carried.

(2) "Upon application of any shipper a carrier by railroad shall make request for, and the carrier by water shall upon receipt of such request name, a specific rate applying for such sailing, and upon such commodity as shall be embraced in the inquiry and shall name in connection with such rate, port charges, if any, which accrue in addition to the vessel's rates and are not otherwise published by the railroad as in addition to or absorbed in the railway rate. Vessel rates, if conditioned upon quantity of shipment, must be so stated and separate rates may be provided for carload and less-than-carload shipments. The carrier by water, upon advices from a carrier by railroad, stating that the quoted rate is firmly accepted as applying upon a specifically named quantity of any commodity, shall, subject to such conditions as the Commission by regulation may prescribe, make firm reservation from unsold space in such steam vessel as shall be required for its transportation and shall so advise the carrier by railroad, in which advices shall be included the latest available information as to prospective sailing date of such vessel.

(3) "As the matters so required to be stated in such schedule or schedules are changed or modified from time to time, the carrier shall file with the Commission such changes or modifications as early as practicable after such modification is ascertained. The Commission is authorized to make and publish regulations not inconsistent herewith, governing the manner and form in which such carriers are to comply with the foregoing provisions. The Commission shall cause to be published in compact form, for the information of shippers of commodities throughout the country, the substance of such schedules, and furnish such publications to all railway carriers subject to this Act, in such quantities that railway carriers may supply to each of their agents who receive commodities for shipment in such cities and towns as may be specified by the Commission, a copy of said publication; the intent being that each shipping community sufficiently important, from the standpoint of the export trade, to be so specified by the Commission shall have opportunity to know the sailings and routes, and to ascertain the transportation charges of such vessels engaged in foreign commerce. Each railway carrier to which such publication is furnished by the Commission is hereby required to distribute the same as aforesaid and to maintain such publication as it is issued from time to time, in the hands of its agents. The Commission is authorized to make such rules and regulations not inconsistent herewith respecting the distribution and maintenance of such publications in the several communities so specified as will further the intent and purpose of this section.

(4) "When any consignor delivers a shipment of property to any of the places so specified by the Commission, to be delivered by a railway carrier to one of the vessels upon which space has been reserved at a specified rate previously ascertained, as provided herein, for the transportation by water from and for a port named in the aforesaid schedule, the railway carrier shall issue a through bill of lading to the point of destination. Such bill of lading shall name separately the charge to be paid for the railway transportation, water transportation, and port charges, if any, not included in the rail or water transportation charge; but the carrier by railroad shall not be liable to the consignor, consignee, or other person interested in the shipment after its delivery to the vessel. The Commission shall, in such manner as will preserve for the carrier by water the protection of limited liability provided by law, make such rules and regulations not inconsistent herewith as will prescribe the form of such through bill of lading. In all such cases it shall be the duty of the carrier by railroad to deliver such shipment to the vessel as a part of its undertaking as a common carrier.

(5) "The issuance of a through bill of lading covering shipments provided for herein shall not be held to constitute 'an arrangement for continuous carriage or shipment' within the meaning of this act."—*Greater New York.*

Producing 17,000 Connecting Rods a Day—II

BY FRED H. COLVIN
Editor, *American Machinist*

This article describes the boring of the half hole, the die-casting of the bearings, the assembling of the rods and caps and the final boring and broaching which brings the center distance to length and makes the rod ready for the assembly department. The operations, thirty-seven in number, are all of interest, but not all are illustrated.

(Part I was published in our June 3 issue.)

THE transformations which take place during the operations described in this article are shown in Fig. 14. One of the most striking departures from the usual method is the boring of the large end of the connecting-rod. The extra draft is drilled out in a previous operation to reduce the work of the boring tool at this point. Unlike most other methods, the rod and cap are forged separately and do not come together until after each has been babbitted and is ready for the broaching and other final operations. This method means that the boring tool only cuts a half hole in both rod and cap, and, while mechanics generally endeavor to avoid operations of this kind, the Ford engineers have proved that it can be done very successfully and economically, if suitable means are provided for the work.

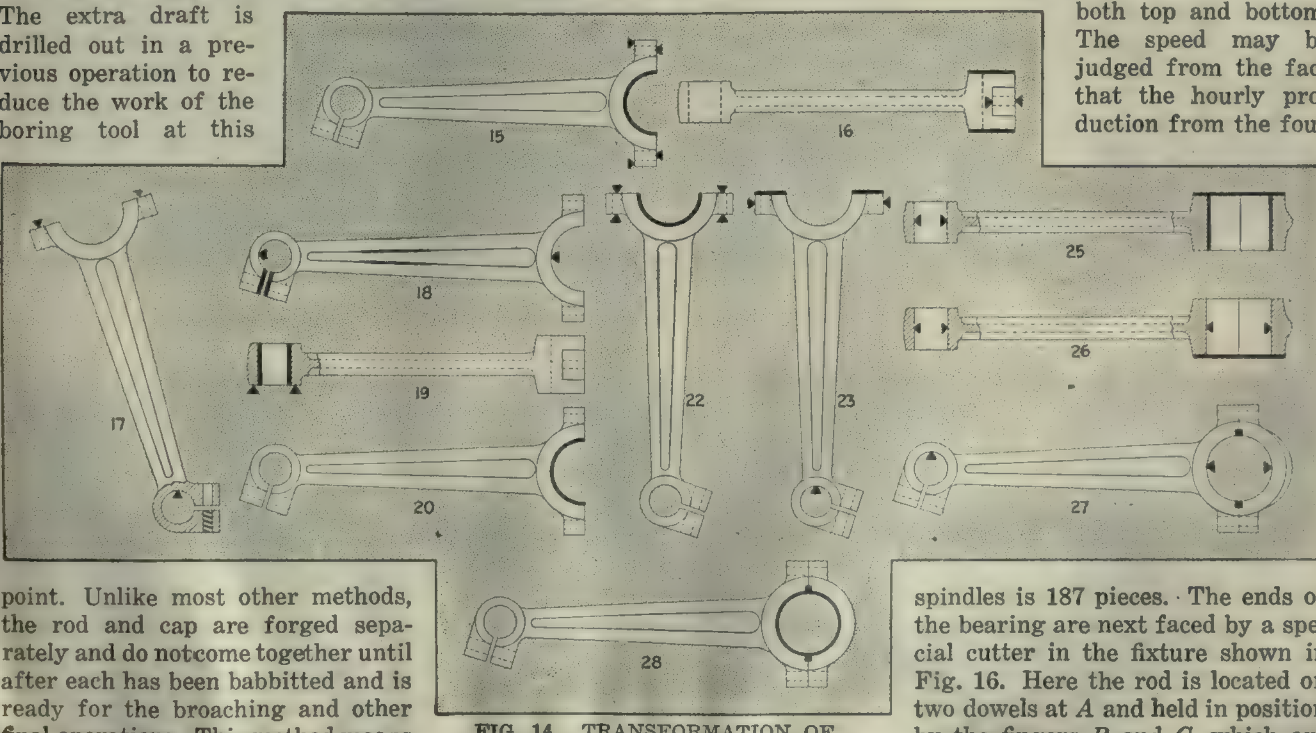


FIG. 14. TRANSFORMATION OF OPERATIONS

The first requirement is to locate the rods correctly and hold them firmly in place during the operation. The next is to support the boring tool by ample bearings and guide it steadily while the operation is being performed.

The rod is positioned on the two dowel pins *A* and *B*, Fig. 15, and held firmly in position against the supporting plate by means of the ears *C* and *D*, which bear against the ends of the bolt bosses. These clamps are actuated by the cam *E* controlled by the handle *F*.

The boring tools are supported in large bearings in the heavy bracket *G*, being driven by universal joints from the drilling-machine spindle above. The boring cutter has a pilot *H* which fits a guide beneath, so that it is firmly supported both top and bottom. The speed may be judged from the fact that the hourly production from the four spindles is 187 pieces. The ends of the bearing are next faced by a special cutter in the fixture shown in Fig. 16. Here the rod is located on two dowels at *A* and held in position by the fingers *B* and *C*, which are operated by hand under control of the handle *D*. The action of these fingers is to draw the connecting rod firmly against the base of the fixture. The cutter faces the end at an angle of 20 deg., both sides being faced in the same fixture. The die-cast bearing fits over this level which helps to lock it in place.

AUTOMOTIVE CONSTRUCTION

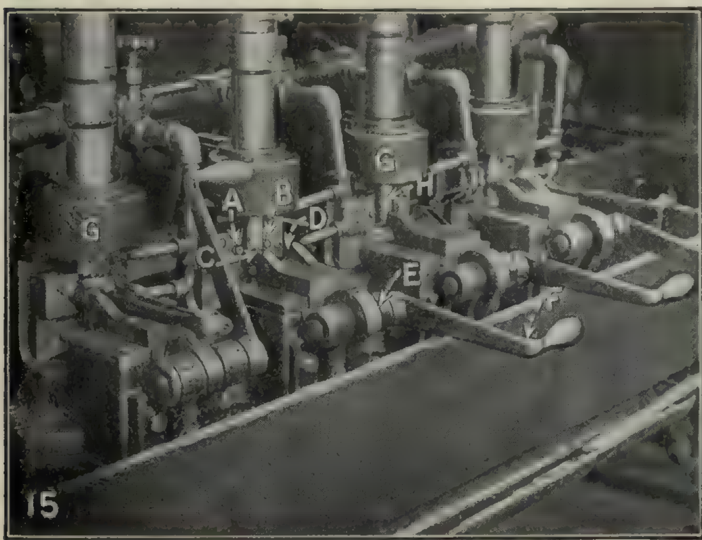


FIG. 15. BORING LARGE END OF ROD

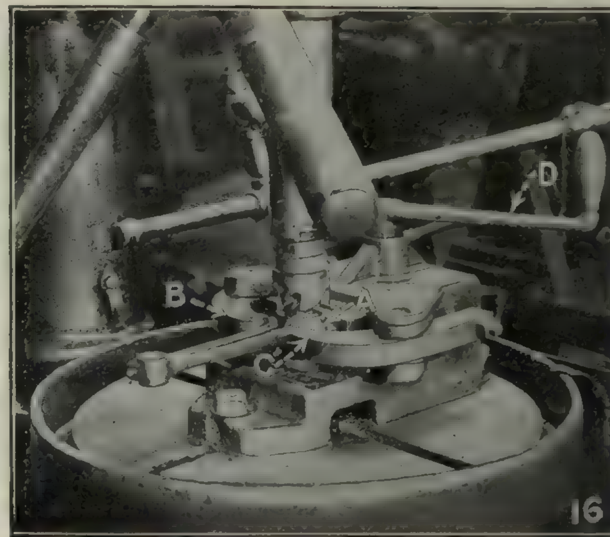


FIG. 16. FACING LARGE END OF ROD

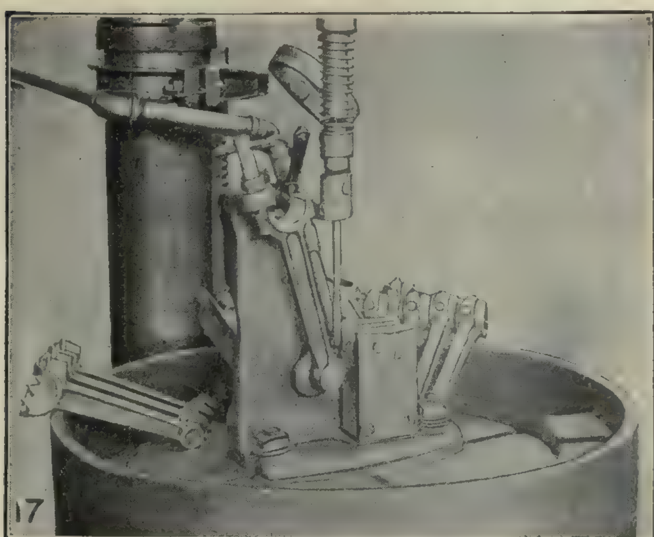


FIG. 17. TAPPING FOR BINDING BOLT

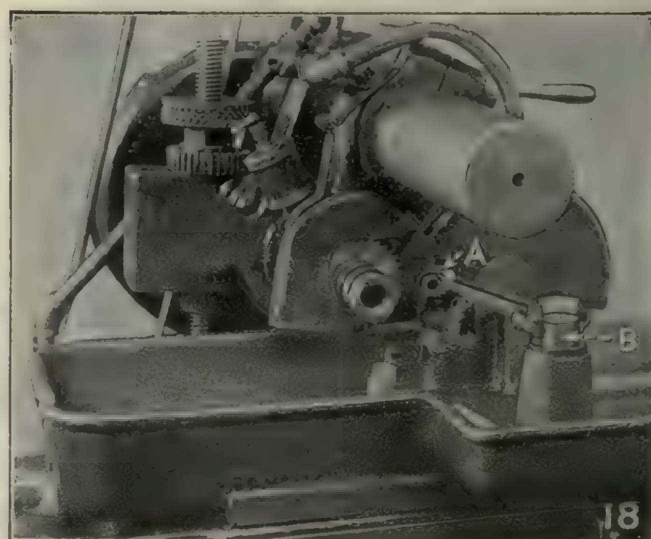


FIG. 18. SLITTING SMALL END OF ROD

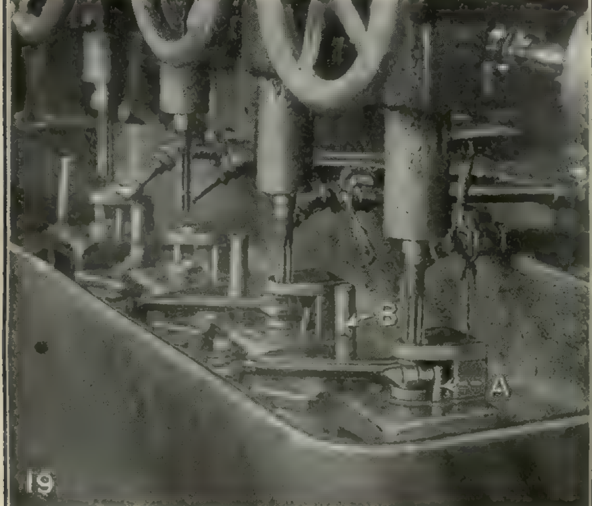


FIG. 19. FINISH-REAMING PISTON-PIN HOLE

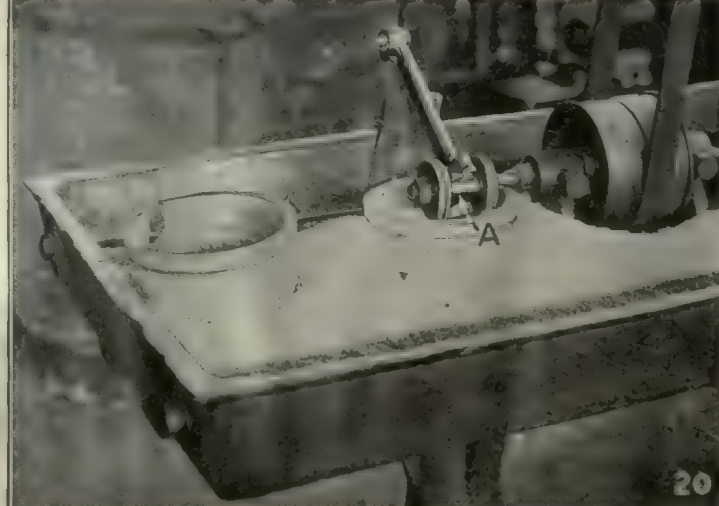


FIG. 20. CLEANING LARGE END WITH ACID

AUTOMOTIVE CONSTRUCTION

FIG. 21. TINNING FOR BABBITTING

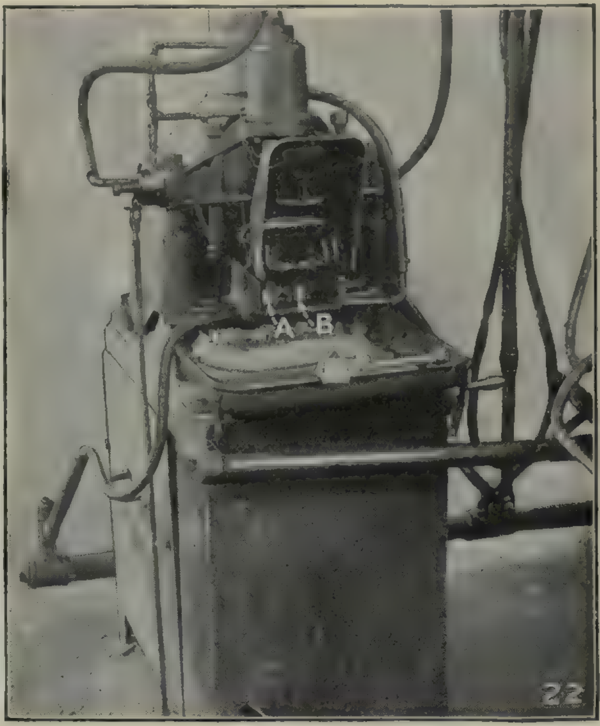


FIG. 22. DIE-CASTING THE BEARING

Tapping the small end of the connecting rod for the piston-pin binding bolt is done in the machine shown in Fig. 17. This is a special machine built for this purpose. It has a readily operated reverse for backing out the tap. The method of holding the rod is the same as that shown in Fig. 13. Each machine handles approximately 300 rods per hour.

The binding slot is sawed or milled in the simple fixture shown in Fig. 18. It will be noted that this fixture is cast solid with the pan and that the whole thing is readily mounted on the milling-machine table. The small end of the rod slips over a slotted pin at *A*, the proper angle of the saw slot being determined by the pin *B*, which positions the large end of the rod. These handle the work very rapidly, the saw slot dividing the tapped hole and the body-bolt hole in the small end of the rod.

The piston-pin hole is next reamed as in Fig. 19, both to secure size and to remove the burr from the inside. It is positioned by the pin *A*, while the stop *B* prevents it from turning under the action of the reamer. The body-bolt hole is next reamed to the saw slot, and the binding-screw hole retapped, after which all burrs are removed from around the slot and the rod cleaned in a Niagara washing machine.

The large ends of the rods are now ready for babbitting, and before tinning they are cleaned with acid by the fixture shown in Fig. 20. The revolving spool *A* is of felt and is kept saturated with acid. By holding the rod bearing against the felt spool it is thoroughly coated and ready for tinning, this being accomplished in the furnace shown in Fig. 21. The melted tin is in a suitable pot inside the furnace, this being kept hot by an oil or gas flame.

After tinning, the rods go to the die-casting machine shown in Fig. 22, the rods being held in position against

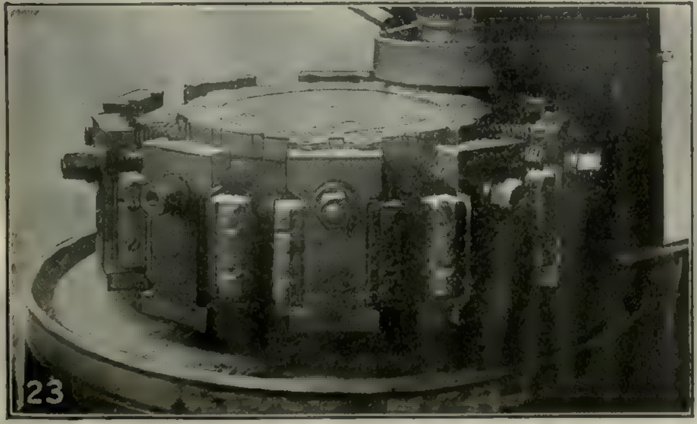


FIG. 23. MILLING THE BABBITT

FIG. 24. ASSEMBLING ROD AND CAP

AUTOMOTIVE CONSTRUCTION

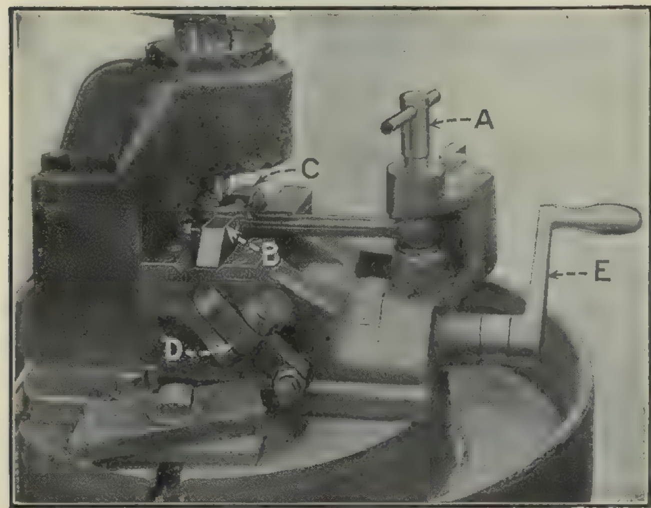


FIG. 25. FINISH-BORING LARGE END AND FACING ONE SIDE

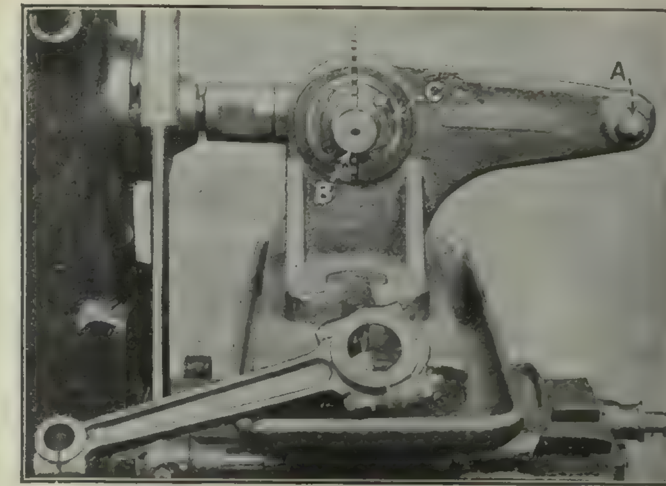


FIG. 27. SLOTTING FOR OIL GROOVE

the mandrels *A* and *B*, and the bearings are die cast, the previous tinning operation insuring proper adhesion to the rod.

After cutting off the gates the babbitt is milled in the continuous milling machine shown in Fig. 23, which is almost identical with that shown in Fig. 7. This machine runs at a rapid rate, requiring only two machines to handle the entire output with a good margin. Then the $\frac{3}{8}$-in. bolt holes are finish-reamed and the rods are ready for assembling.

The Connecting-Rod Caps

In the meantime, the connecting-rod caps have been machined by methods very similar to those used on the large end of the connecting rod, and they have also been tinned and babbitted in the same way. They are now ready to be assembled to the connecting rods, and from this point the completed job travels as a single unit. The rods and caps are bolted together with several shims between them, the friction-head device, shown in Fig. 24, being used for this purpose. This contains a friction which slips when a safe tension has been secured, after which the finishing touches are given with a hand wrench.

The babbitt bearing is bored and faced on one side in the fixture shown in Fig. 25, the rod being located by the pin *A*, which fits through the piston-pin hole. This fixes the center distance of the rod, and the complete bearing is bored in the substantial support shown. The large end of the rod is centered by the jaws *B* and *C*, these being controlled by two arms (one being shown at *D*) and operated by a cam controlled by the handle *E*.

The other side of the large bearing is faced in the fixture shown in Fig. 26. The rod is located on the small pin at *A* and a large pin at the other end. This large pin is of such length that when the pilot *B* on the facing cutter contacts with it, the bearing has been faced to the proper length. This is the same method as that used in facing the sides of the piston-pin hole, and makes a simple yet positive method of securing duplication. It is, of course, necessary to keep the surfaces which come into contact clean and free from chips,

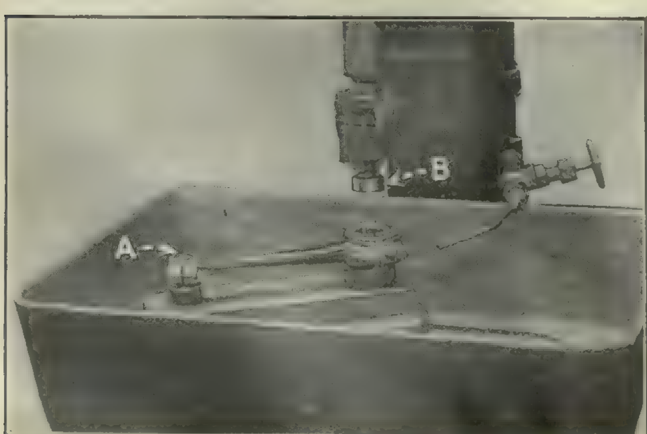


FIG. 26. FACING THE OTHER SIDE

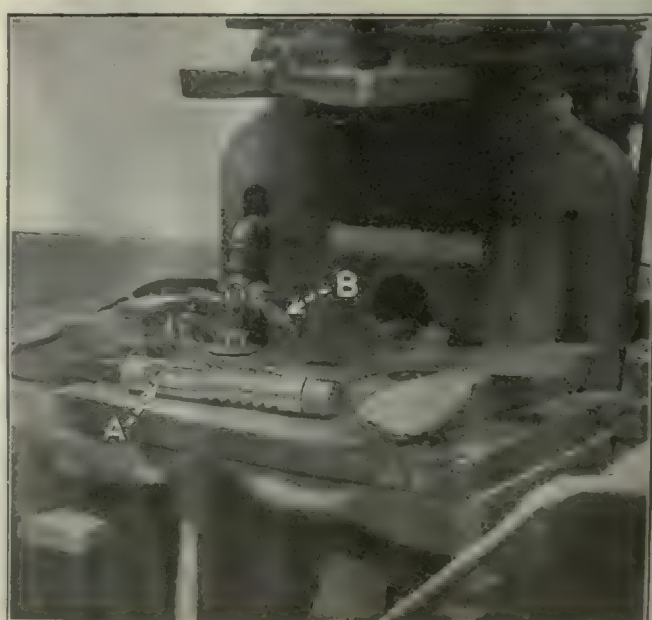


FIG. 28. BROACHING BEARING TO SIZE

AUTOMOTIVE CONSTRUCTION

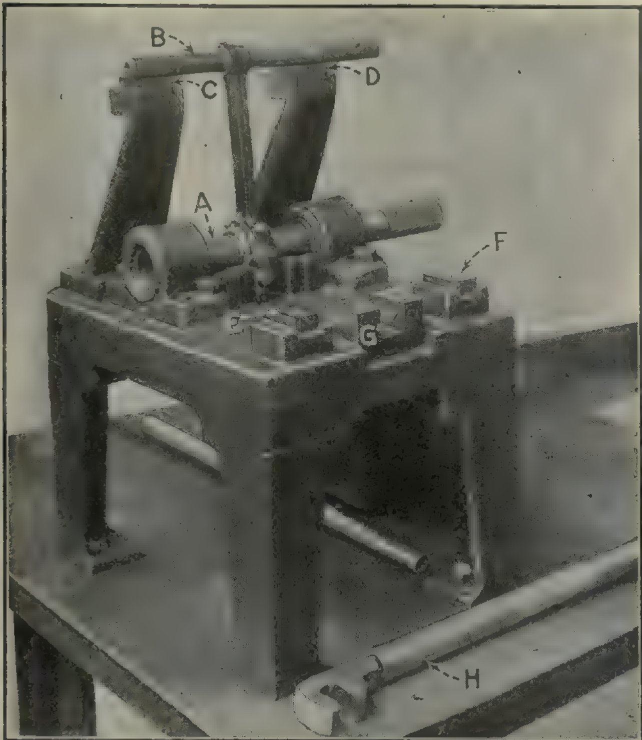


FIG. 29. THE FINAL INSPECTION

and also to watch for wear. This, however, can be readily done, as this practice indicates.

Oil-groove slots are then milled in the end of the bearing, where the rod and cap meet. This is very neatly done in the device shown in Fig. 27. The rod is placed over the pins *A* and *B* and simply pushed against the rapidly running saw. This saw projects through the opening in the fixture the correct amount, so as to cut the desired depth without gaging of any kind. The rod is simply pushed over both pins by hand until the large end touches *C*.

The Final Finish of the Bearing With "Short-Push" Broach

The final finish of the bearing is secured with the broach shown in Fig. 28. This, as will be seen, is a short-push broach, with sides slotted at the top so as to position correctly to bring the grooving cutters *A* at the parting line of the bearing. This finishes the rod, which is then ready for final inspection before going to the motor-assembly department. The pipe *B* supplies the necessary lubricant.

The inspection stand is shown in Fig. 29 with a rod in position. The bar *A* goes through the large end and into the substantial bearing shown. The small rod *B* fits the piston-pin hole, and when swung up into the position shown must bear evenly on the test pieces *C* and *D*.

When swung down it must rest evenly on blocks *E* and *F*, while the piston-pin boss fits the slot *G*. This makes a very substantial fixture and one which allows rapid inspection. It is sufficiently rigid so that should any bending or twisting be necessary it can be done in the usual way by the wrench *H*. without affecting the fixture itself.

Grinding the Inner Flanges of Spools

By J. H. Vincent

A peculiar job of grinding necessitated the construction of the machine shown in Fig. 1 which is a special form of the standard toolroom grinding machine built by the Oakley Machine Tool Co., Cincinnati, Ohio. The job required the grinding of the inner faces of the flanges of the spool *A*, Fig. 2.

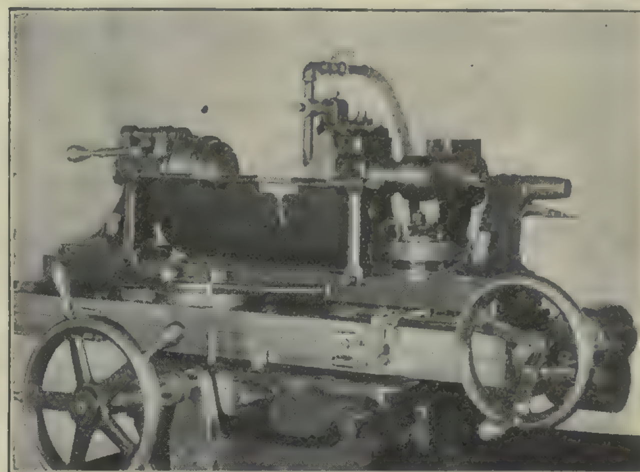


FIG. 1. MACHINE FOR GRINDING FLANGES OF SPOOL

As a chuck could not be relied on for this work the spools were mounted on an arbor *B*, and driven between centers. The machine has a special cross-feed screw for rapid traverse so that the wheel can be brought rapidly into the work between the flanges. An adjustable stop is provided so that the wheel will be stopped just before reaching the bottom of the groove, which is not to be touched in grinding. The grinding wheel is dished on both faces, so that it will grind on either side near the periphery.

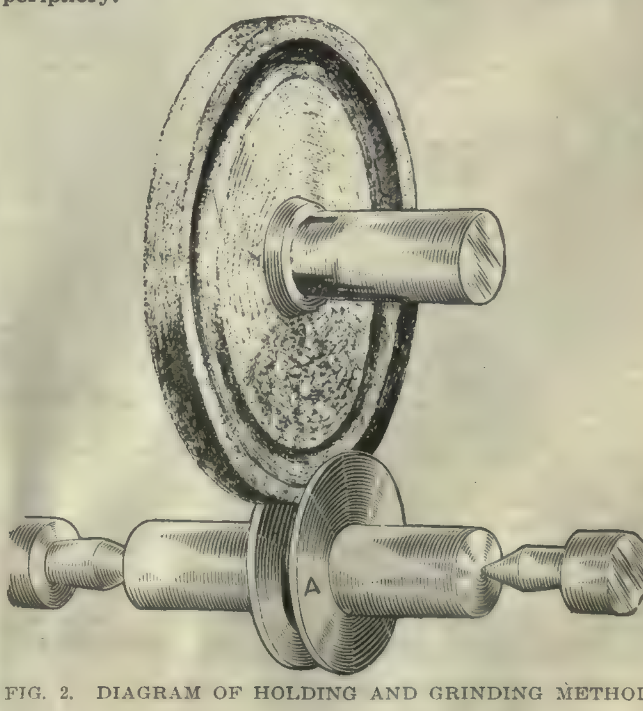


FIG. 2. DIAGRAM OF HOLDING AND GRINDING METHOD

EDITORIALS

Look at This!

THE following petition, signed by Factory Superintendent Oscar Grothe and twenty-one department foremen of the White Sewing Machine Co., Cleveland, Ohio, has been sent to Washington. It shows what practically every man acquainted with manufacturing conditions thinks of a compulsory metric law.

Washington, D. C., May 8, 1920.

The Chairman of Committee on Coinage, Weights and Measures, House of Representatives.

Sir—We the undersigned foremen of the White Sewing Machine Co., St. Clair at 79th St., Cleveland, Ohio, do hereby petition you concerning the coming legislation regarding the adoption of the metric system for use in the United States of America and its possessions.

Whereas, after careful consideration of the arguments advanced by the pro-metric party, be it resolved that you be petitioned to vote against any legislation making the use of the metric system of measures legal, optional or compulsory in the United States of America and its possessions and, furthermore, that you be urged to use your influence and untiring effort to defeat any such legislation.

We feel that, under the conditions existing at the present time and which may exist for an indefinite period, to change the basis of our system of measurement will completely paralyze the industry. We have all the confusion we can handle now, due to new and inexperienced help, without adding an additional burden.

The majority of the arguments as to the advantages of the metric system apply with equal force to the English standard of measurement. Many cases which seem to be exceptions, when carefully analyzed, are found to be of no practical value and, therefore, negative.

The financial loss to our company caused by changing to the metric standard would be enormous. This would be indirectly, our loss. The argument that this would be spread over a period of time does not change the fact that it would be a loss.

A change of standard would be a serious handicap to all our engineers and highly trained specialists who have spent years in the use of the English system of measurements.

We have difficulty in getting all the new tools we want, without making over the old ones.

We could not be partly on one system and partly on the other. We would have to change over entirely at one time. This would mean that many of us would be without work for a long period of time or would have to seek work elsewhere.

Other plants would be in the same condition, so we would be seriously inconvenienced by any such arrangement.

Our machine could not function any more perfectly if it were made under the metric system. We make all the repair parts used on our machine and so there would be no advantage gained by using the metric system, even if the machine were used in a foreign country.

Members of this committee, who have worked in foreign countries where the metric system is in use, report that even there the metric system has caused enormous amounts of confusion.

To conclude, the arguments for the adoption of the metric system were obviously written by people not familiar with the practical problem confronting the manufacturer and, therefore, are largely erroneous.

* * *

Over 100,000 of our cards of protest have been sent in—GET YOURS NOW—THEY ARE ABSOLUTELY FREE.

Keeping Tabs on the Pacific Coast

THOSE who have not visited the Pacific Coast since the beginning of the war hardly realize to what an extent the machine shops have developed during the past five years. This is particularly noticeable in the kind of machine equipment, rather than its quality. For while manufacturing in large quantities does not exist, except in a few instances, we find goodly installations of heavy duty turret lathes, of gear cutters of various kinds and other machines which were not at all plentiful a few years ago.

There are also a goodly number of shops which specialize on such machine parts as gears, pistons and piston pins as well as what may be called semi-manufacturing on as large a scale as conditions warrant. Perhaps the extent of this may best be judged by remembering that the California and the districts which secure machinery through either San Francisco or Los Angeles, absorb about two and one-half million dollars worth of machine tools annually. This is steadily growing and is likely to result in more machine tools of the standard types being manufactured on the Pacific Coast.

Shipbuilding has also increased greatly, one yard which was hardly known more than locally recently launched six merchant vessels on a single tide. Internal combustion engines are also being built to a considerable extent, more than one firm building Diesel type engines up to if not exceeding 1,000-horsepower units. Water-power development is also going steadily forward and, as with all other advances in civilization, means an increased use of machinery.

With a knowledge of what changes have taken place, it behooves all who wish to keep pace with the growing and changing fields in the Far West to take the time for regular and fairly frequent visits to the Pacific Coast. In no other way can one realize the advances which are being made or the changes in the machine requirements of a large and growing market.

The Importance of the Cutting Tool

WITH all our advances in machine production, we are still far from the goal of real efficiency, either as to men or machines. And most of this comes from not getting a proper viewpoint of the factors which go to make up production.

The case of milling machines makes a good example, and shows how a weak link may spoil the whole chain of efficiency. It too often happens that we spend much thought and energy in selecting the proper milling machine for the work in hand. We go carefully into its design, construction and the motor which is to drive it. We install it carefully on a substantial foundation and point with pride to it as a new machine equipment. And then too often we think our job is done, forgetting that without suitable cutters it is impossible to secure anything like adequate production.

It often happens, moreover, that the cutters are so little considered that they do not receive engineering attention of any kind. Cutters are considered in the same class of small tools as files, and they are ordered without regard to their fitness for the work. This seems almost unbelievable when we consider their importance in securing production, but it is nevertheless true in too many cases. The output of a ten-thousand dollar machine is often curtailed by lack of a cutter.

Milling cutters that will remove the most metal in a given time, that will run the longest between grindings and set up, are almost as important as the milling machine itself. The time lost in changing cutters on an expensive machine will pay for considerable engineering attention and outlay in the cutter itself.

In order to secure the best results, milling cutters should be designed by experts just as much as the machine itself. The selection of material for the body in an inserted-tooth cutter, or the blades themselves, is an engineering problem.

Sufficient support to the cutting edge, so as to eliminate or at least reduce the vibration which causes chatter and breakage, is a serious point and one that requires careful study. Chip clearance is also vital, the tooth shape being a compromise between these two factors. Ease of sharpening and its effect on the life of the cutter is a third point to be considered.

The whole question of cutting tools is so tied up with the output of the machine itself that it requires more attention than it usually receives. Cutter makers should really be cutter engineers, if best results are to be obtained. It is obviously poor management to put a cutter which can stand but two-horsepower on a ten-horsepower machine. More careful attention to the cutting tools will usually prove a paying investment.

Publicity for Engineers*

Publicity and engineers do not mix. Most engineers are self-conscious and do not like to talk about themselves, although the engineer and engineering are faced today with perhaps the greatest opportunity for publicity that has ever been given to a profession or to an industry. The growth of engineering, which underlies our industrial development, has been remarkable, as has the growth of the technical societies. With the big increase in size and scope of engineering activities came specialization and the formation of separate societies in the different fields of engineering. It is the purpose of this conference to effect a combination of organizations for the purpose of dealing with technical problems in the whole. Such an organization may serve for the protection and for the welfare of the engineering profession, and it will be to the advantage of the people and the nation as a whole in dealing with the problems of engineering which are encountered in all phases of our modern life. This organization would serve the same purpose for engineers that a union serves for labor and a chamber of commerce for merchants.

One of the most constructive things the proposed organization can do is to visualize the opportunities for publicity for the engineer and perfect some method of securing this publicity. The engineer is the man who faces facts as facts, and who solves economic problems by the consideration of all factors and not from one particular viewpoint, as does the banker, the business man or the politician. Probably because the engineer works with the viewpoint of service, the public is conscious of him as a good servant and not as a leader. Now, in order that the engineer may be recognized as the man who makes our present life possible, he must advertise, become a better business man, and make the public conscious of his importance.

The chief means of obtaining publicity for engineers are the newspapers, the general magazines and weeklies, the technical and industrial press, the papers of associations and societies, and the public platform. The newspapers and general periodicals will not present the technical side of engineering as much as the human interest phase, but by this means the work of the engineer can well be shown to the general public. The public platform could provide a means of publicity by presenting the engineering viewpoint to chambers of commerce and business organizations.

As regards the technical press, it serves both as a medium of publicity (probably the biggest one of those mentioned) and as a means of interpreting the viewpoints of engineers to other groups and other industries. The technical press and the engineering societies are natural partners, the growth of each being dependent upon the other. It follows that there should exist no antagonism between the society journals and the independent technical press, as both are really working toward the same end. Editors may differ at times, but this fact, provided their differences are based on fundamental considerations, makes even sounder the relation of the press to the engineer.

I should like to see grow out of this conference a thorough understanding of the opportunities for the engineer and the opportunities for the independent technical and engineering press to forward the broad conceptions of engineering. Every branch of engineering must give freely of its best in exchange for the best of others; must recognize the value of gaining by giving and also the fact that what injures one, injures all.

*Extracts from an address by James H. McGraw, President, McGraw-Hill Co., Inc., delivered June 3, 1920, at the Organizing Conference of Technical Societies, Washington, D. C.

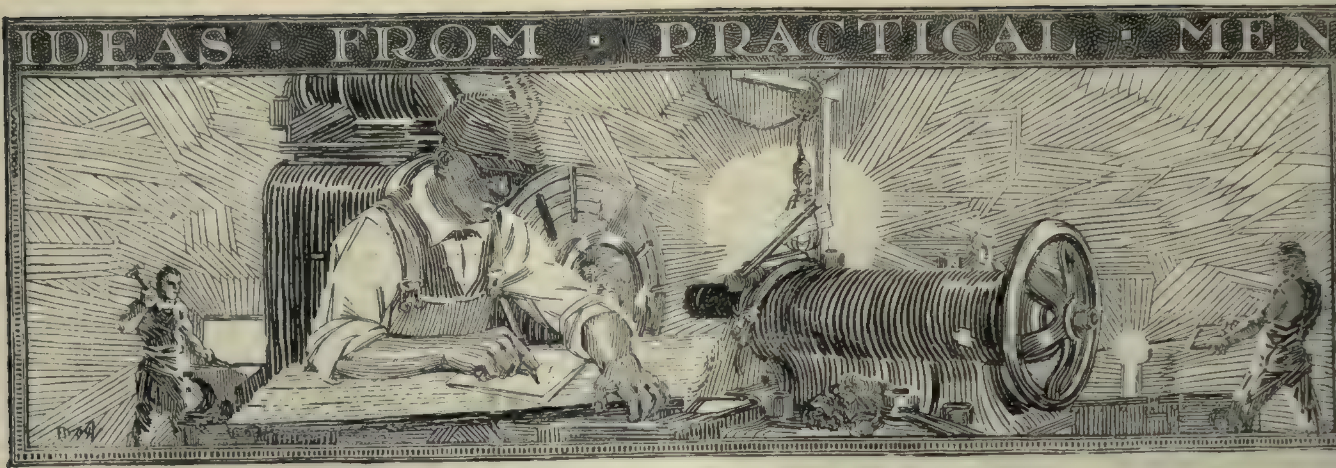
An Experience with Iron Molds

By A. W. Forbes

In the May 6 issue of the *American Machinist* appeared an article "Iron Castings in Iron Molds." It has long been a puzzle to me to understand why this method was not commercially satisfactory, and I should like to ask if anyone knows any other reason for not adopting it except the matter of the hard shell next to the mold. I have had enough experience with castings made this way to show that this hard shell is not necessary.

A few months ago when foundry work was held up so badly, we needed a few small castings in the worst way. Not having any other facilities, I melted iron in a fire-clay ladle, by turning the oxy-acetylene torch directly onto some pieces of cast iron in the ladle. The effect of the flame on the iron I cannot state, but when poured into cold iron molds there was but slight hardening of the surface, which was completely removed by slight reheating. The quality of the iron appeared to be better than the scrap which was melted.

The use of acetylene is of course out of the question for melting iron commercially, but if the same quality castings could be produced in a commercial way, I should be ready to pay considerably higher prices for them than for ordinary sand-molded castings.



Producing Core-Hole Plugs in a Locomotive Shop

By H. L. Ruark

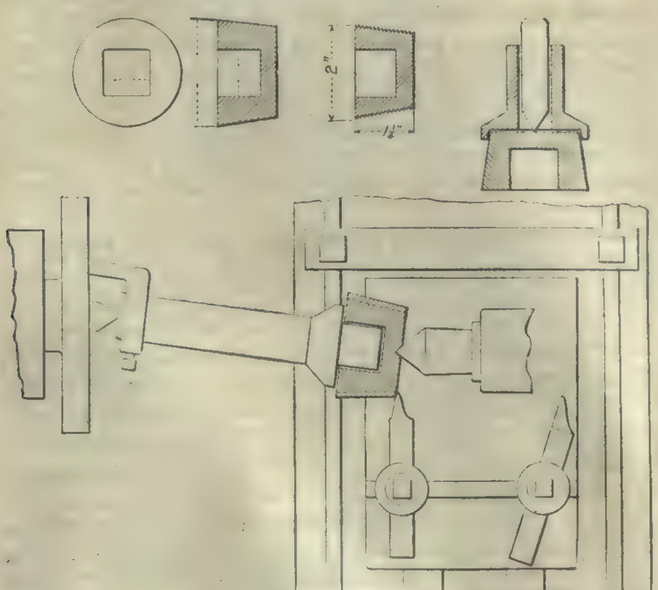
The drawings show a method of attaining rapid production in the machining of locomotive piston core-hole plugs or work of a similar nature, with an ordinary screw cutting lathe. By the use of this method I have found it possible to center, turn, and thread to a standard size an average of one plug every two minutes.

First a quantity of plugs are centered with the centering device shown at *A*, a heavy punch mark being sufficient for this job, as absolute precision is not necessary. Two toolposts are set in position, the first holding a turning tool and the second a threading tool. The turning tool is set about ¼ in. closer to the work than the threading tool, with the tools about three inches apart.

After the first plug has been turned to size, note the position of the cross feed handle which will enable the second and succeeding plugs to be turned to size with one cut and without using the calipers. When the plug has been turned the threading tool is brought into use.

After threading the first one to size, a stop clamp placed on the cross-slide ways will enable the operator to cut all following threads to the correct depth without the use of calipers or gage.

The end of the driver is squared to fit the cored recess in the plug. The tail center is offset to give the required taper. When the threading tool is in use the turning tool travels in the space forward of the plug.



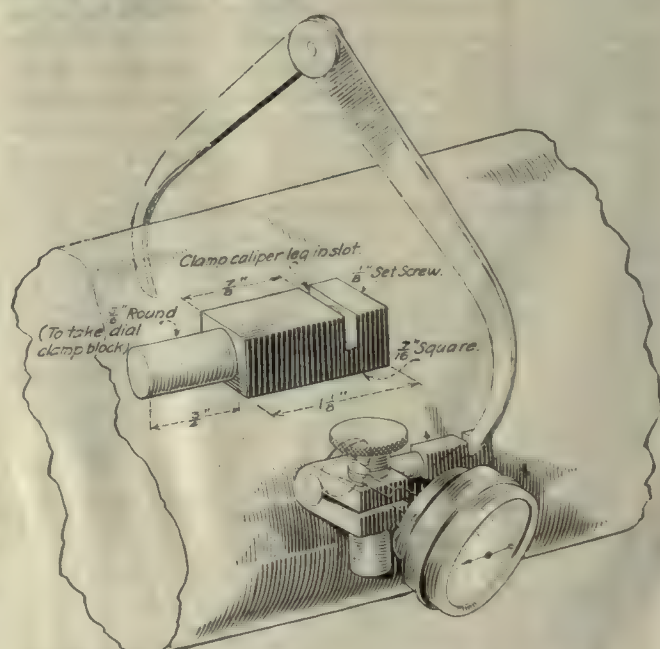
QUANTITY PRODUCTION OF CORE-HOLE PLUGS

Dial Test Indicator Attached to Calipers

By H. H. Parker

When it is necessary to reduce work in the lathe by a known number of thousandths or if it is desired to test the work for eccentricity or unevenness, a dial test indicator attached to one leg of a medium sized pair of calipers is sometimes more quickly read and will show up the amount of eccentricity better than a micrometer. The sketch shows an adapter clamp for fitting a dial indicator to the caliper leg. It is made of a piece of square stock about seven sixteenths on a side with a portion turned down to fit into the indicator clamp block. A slot is cut halfway through the square portion and a setscrew provided to clamp the caliper leg.

The actual diameter of the work cannot be determined in this way, but the reduction caused by subsequent cuts is quickly read if the dial is set at zero when the calipers are passed over the work. Work of any size within the limits of the calipers may be tested by merely spreading the legs.



DIAL INDICATOR ATTACHED TO CALIPER

The Federated American Engineering Societies

AN EVENT of immense importance to the engineering world took place in Washington, June 3 and 4. The large number of great engineering organizations represented would alone stamp this meeting as of tremendous import, but the object sought places it above that of any engineering gathering ever held.

If the plan projected becomes workable, the engineer will at last be given the recognition due him for his public-spirited, though hitherto too modest, service.

The president of the American Institute of Mining and Metallurgical Engineers said in his inaugural address a short time ago: "We have in this country probably one hundred thousand professional engineers. The events of the past few years have greatly stirred their interest in national problems."

L. K. Sherman, the head of the United States Housing Corporation, said: "It is estimated that more than 25 per cent of all the engineers are engaged in some sort of public service work. It is natural that it should be so. The engineers' field embraces the activities which must be entered into by large corporations either public or private.

"There are more engineers as employees of the public—municipal, state or national—than employees from all the other professions. The number of the engineering profession in public service who may be classed as officials, representative or executives is, however, disproportionately small, not only to the number of engineer employees, but also in comparison with the number of public officials from the ranks of law, medicine or business.

"Obviously, this is not right for either the interests of the engineer employees, the engineering profession, or the public.

"Why are there not more engineers as public officials? The engineer to-day has the esteem, respect, and good will of the public. That is one of the points secured by technical societies and engineering colleges.

"The fault is with the engineers themselves, that they are subordinates, as a rule, in the management of public affairs. First, it is due to the engineers' training, which deals with things and not with men. Second, it is due to the engineer's conservatism or reluctance in matters which he deems outside of the strictly technical field of engineering."

The American people *need* successful engineers in public office, along with successful business men and manufacturers, as we called to your attention in our recent editorial: "Not Politics—But Common Sense."

The American people need engineers to take active interest in the great national problems.

The Engineers need the American people to take an interest in THEM—a human, urging interest.

It was to bring about the satisfying of this mutual need that the Federation was first proposed.

It is with great pride that the *American Machinist* can point to the fact that the first meeting of the American Society of Mechanical Engineers was held in our office, and we are proud to point to the fact that the American Society of Mechanical Engineers was farsighted enough to send delegates to the great Federation Conference, who were instructed for it and empowered to act.

We are for the Federation and shall push for its success with all the force and energy of the "American Machinist," and with us is the tremendous power of the entire McGraw-Hill organization.

Ethan Viall
Editor

The Federated American Engineering Societies

THE Organizing Conference of delegates representing some sixty engineering societies of the United States, met in Washington, D. C., June 3 and 4, 1920, and adopted the following resolutions:

Resolved, That it is the sense of this conference that an organization be created to further the public welfare where technical knowledge and engineering experience are involved, and to consider and act upon matters of common concern to the engineering and allied technical professions and

Resolved, That it is the sense of the conference that the proper organization should be an organization of societies and affiliations and not of individuals.

As a starter these resolutions were adopted by 119 affirmative votes, representing 52 societies out of the 57 present, five not voting and no negative votes being cast.

The significance of this great conference of engineering societies is, of course, that extremely valuable potential forces for public good, which have been functioning separately as engineering forces have begun to be organized into one powerful body, which, by the nature of its existence, is pledged to be an active force for the public good. There is intended to be, then, one federation of societies whose prestige, qualifications and records are beyond question, the societies themselves composed of men belonging to a profession, the activities of which demand as a prerequisite, honesty of purpose and of fact. These forces, added to those of existent constructive bodies should react forcefully to the benefit of the public and themselves.

The motive of the organization is best shown by quoting from the opening address of Richard L. Humphrey, the spirit of which prevailed throughout the session: "I believe that the keynote of this conference could be properly expressed by the word 'service'; we desire, first, to serve the country, and second, to serve the societies and organizations of which we are the representatives. One cannot contemplate service, which means giving—not receiving—with any feeling that it is actuated by selfish motives, but rather is it the giving of our best. . . . I am supremely confident that a body of men of the high order of intelligence that is here represented, cannot fail. I am confident that there will be laid at this conference the cornerstone of the united engineering and allied technical professions that will deal with public affairs of the city, state and nation, where engineering experience and technical knowledge are involved, and that will take action on other matters of a non-technical character which are of common concern."

A brief history of affairs which have led up to the present conference will show that the idea of one representative organization of engineering bodies is not new and that they were natural and logical steps by which the leaders in what will be the member-societies, become convinced that such an organization is not only desirable, but extremely advisable for the good of the country.

The American Society of Civil Engineers, the first of the so-called founder-societies, was organized in 1852. Later the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials, the American Railway Engineering Association and other national societies were founded, their activities being briefly technical. There still later developed, over the country, engineering clubs and societies and state and regional organizations, concerned with strictly engineering work, and each society, as a rule, acting independently of any other.

The need for a combination of the forces of the societies to present a solid front became self-evident and resulted in the formation of Engineering Council, representative of the four founder-societies. A step further was the appointment by the American Society of Chemical Engineers in 1918, of a Committee on Development to make a survey of the scope of the society and its relations to other societies. Similar Committees were appointed by the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining and Metallurgical Engineers. These Committees met in joint conference and organized the Joint Conference Committee, with the object of determining in what manner these four societies could co-operate on non-technical or welfare work affecting the relations of the engineer to, and his service in, public affairs.

The result of the investigations of this Committee and of its reports to its societies was the call for a conference of representatives of national, local, state and regional engineering organizations of this country, for the purpose of bringing into existence a comprehensive organization such as has been developed in the Federated American Engineering Societies.

The work of fostering the Federation, until it can be made an active organization was intrusted to the Engineering Council, upon their request.

The Conference adopted resolutions covering the following subjects:

1. Urging the payment of adequate salaries for the teachers of engineering in our technical institutions in order that adequately trained young engineering talent may be made regularly available.

2. Advocating the immediate adoption of appropriate measures to give effect to the recommendations made to Congress by the Commission which recently reported upon a more adequate salary schedule for the engineering and other technical services of the Federal Government.

3. Indorsing the bill which has for some time been under consideration by Congress for the creation of a Department of Public Works.

4. Expressing the appreciation of the Organization Conference for the valuable work of the Engineering Council, especially its offers of assistance in making effective and operative the newly devised plan of organization; and expressing thanks to the Washington Society of Engineers and the Cosmos Club for their courtesy and assistance afforded during the sessions of the Conference.

The constitution and by-laws which follow, are still to be ratified by the societies expecting to become members, except for the A. S. M. E. and the A. I. E. E. The former society sent delegates empowered to ratify

Organization Chart of the Federated American Engineering Societies

The representatives of the group of National Societies on the Executive Board are to be elected or appointed or designated by the National Societies in any way upon which these societies may agree among themselves.

*Representation in the National Council is on the basis of one delegate for 100 to 1000 members and one additional delegate for each additional 1000 or major fraction thereof for national and other societies alike; no society to have more than 20 delegates.

†Representation on the Executive Board is so divided that the representation of the group of national societies (b) bears the same ratio to the representation of the group of state, regional and local societies (c) that the combined representation of the national societies in the Council bears to that of the other societies.

The representatives of the group of state, regional and local societies on the Executive Board to be elected by districts, the boundaries of which are so prescribed as to take account of both membership and area.

State, regional or local societies may be composed of a number of affiliated societies, sections, clubs, etc., but in the determination of their representation no count shall be taken of any organization which is represented individually or through another local, state or regional organization or affiliation.

The societies diagrammed are simply chosen as typical. Not all of those shown have indicated their intentions of joining the federation, and not all of those taking part in the organizing conference are included in the diagram.

and they went on record with their approval before the conference. This was followed later by the A. I. E. E., acting through Calvert Townley. Forty-nine societies voted in favor of the constitution and by-laws and eight societies with representatives present, did not vote. Ten societies were absent.

THE CONSTITUTION

Art. I. Name

The name of this organization shall be The Federated American Engineering Societies.

Art. II. Object

Service to others is the expression of the highest motive to which men can respond, and duty to contribute to the public welfare demands the best efforts that men can put forth, therefore, it shall be the object of this organization to further the interests of the public through the use of technical knowledge and engineering experience, and to consider and act upon matters common to the engineering and allied technical professions.

Art. III. Membership

Sec. 1. *Scope.* The membership shall consist of national, local, state and regional engineering and allied technical organizations and affiliations, classified as follows:

(1) National engineering and allied technical organizations.

(2) Local, state, or regional engineering or allied technical organizations other than local associations, sections, branches or chapters of national organizations.

(3) Affiliations consisting of any one, or a combination, of the following constituents:

(a) Local sections or associations of members of national organizations included under (1).

(b) Local engineering or allied technical societies or clubs, not of national scope.

(c) Local engineers and members of allied technical professions and their associates.

Sec. 2. *Qualifications:* The qualifications for membership shall be as provided in the By-Laws.

Sec. 3. *Application for Membership:* Application for membership shall be made in the form and manner prescribed in the By-Laws.

Sec. 4. *Termination of Membership:* The membership of any constituent organization may be terminated by it or by the Council in the manner provided in the By-Laws.

Art IV. Management

Sec. 1. *American Engineering Council.* The management of this organization shall be vested in a body to be known as the "American Engineering Council," and its Executive Board.

Sec. 2. *Functions.* The American Engineering Council shall consist of representatives of Member-Societies selected as hereinafter provided. This Council shall co-ordinate the activities of state councils and of local affiliations whenever these activities are of national or general importance or may affect the general interests of engineers.

Sec. 3. *Representation.* Each National, local, state or regional organization, or affiliation shall be entitled to one representative on the Council for a membership of from 100 to 1,000 inclusive, and one additional representative for every additional 1,000 members or major fraction thereof; provided that in the determination of the representation of local, state or regional organizations or affiliations no count shall be taken of any organization which is represented individually or through another local, state or regional organization or affiliation; and, provided further, that no organization shall have more than 20 representatives on the Council.

Sec. 4. *Selection of Representatives.* Representatives on the Council shall be selected as stipulated in the By-Laws.

Sec. 5. *Meetings.* The Council shall hold an annual meeting. Other meetings may be called by the Executive Board and shall be called by it upon the written request of 25 representatives on the Council.

Sec. 6. *Officers.* The elected officers of the Council shall consist of a President, to hold office for two years, and who shall be ineligible to re-election, four Vice-Presidents, to hold office for two years, two to be elected every year, and a Treasurer, to hold office for one year. These officers shall be elected by a letter ballot of the Representatives on the Council as provided in the By-Laws. There shall be an Executive Officer who shall also be Secretary appointed by and holding office during the pleasure of the Executive Board. He shall not be a member of the Executive Board but may be a representative on the Council.

Sec. 7. *Executive Board; Functions.* There shall be an Executive Board of thirty members of the Council constituted as hereinafter provided and charged with conducting the business of the organization under the direction of the Council.

Sec. 8. *Membership.* The Executive Board shall consist of thirty members, of whom six shall be the officers elected by the Council and twenty-four shall be selected, a part by the national societies, and the remainder by the local, state or regional organizations or affiliations according to districts, as provided in the By-Laws; provided, that the number of representatives of the national societies shall bear as nearly as may be the same ratio to the number of representatives of local, state and regional organizations or affiliations as the number of representatives of the national societies bears to the number of representatives of the local, state and regional organizations or affiliations.

Sec. 9. *Electoral Districts.* For the purpose of facilitating the selection of the district members on the Executive Board, the Council shall divide the country into districts as provided in the By-Laws, based upon an equitable representation, having regard to both its membership and area.

Sec. 10. *Officers.* The President and Secretary of the American Engineering Council shall be respectively the Chairman, and the Secretary of the Executive Board. There shall be two Vice-Chairmen elected by the Board from its members.

Art. V. Unexpired Terms

Vacancies in the offices of the President, the Vice-Presidents, the Treasurer and in the Executive Board and among the representatives on the Council, shall be filled as soon as feasible, by the agencies originally selecting the incumbents. Officers and delegates thus chosen shall serve for the unexpired terms.

Art. VI. Funds

Sec. 1. Funds for the use of the organization shall be contributed as follows:

(a) Each national society represented on the American Engineering Council shall contribute annually one dollar and fifty cents ($1.50) per member.

(b) Each local, state or regional organization or affiliation represented on the Council shall contribute annually one dollar ($1.00) per member.

No portion of such funds shall be applied to the use of local affiliations or state councils.

Sec. 2. The American Engineering Council may receive and administer gifts, bequests or other contributions for carrying out the purposes of the organization.

Art. VII. Local Affiliations

Sec. 1. *Object.* The American Engineering Council shall encourage the formation of local affiliations, to consider matters of local public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that there may be united action and that suggestions and advice may be offered to the Council.

Sec. 2. *Constitution.* Each local affiliation desiring membership in this organization shall submit its Constitution and By-Laws and all subsequent amendments thereto to the Executive Board of the Council for approval of such portion thereof as may affect its eligibility, or its relation to the work of the Council.

Art. VIII. State Councils

Sec. 1. *Object.* State Councils, consisting of representatives of local affiliations within the state or otherwise representative of the majority of engineers and members of allied technical professions in the state, if members of

this organization shall consider state matters of public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions in order that there may be united action in state affairs.

Sec. 2. *Constitution.* Each state council desiring membership in this organization shall submit its Constitution and By-Laws and all subsequent modifications thereto to the Executive Board of the Council for approval of such portion thereof as may affect its eligibility, or its relation to the work of the Council.

Art. IX. Delimitation of Authority

Local affiliations, state councils and the American Engineering Council, shall deal with local, state and national matters respectively, and they shall be autonomous with respect thereto. It shall, however, be the duty of the American Engineering Council to interest itself in the activities of local affiliations and state councils if such activities are of national scope, or affect the general interest of the engineering and allied technical professions; provided, that nothing herein stated shall be construed as preventing the discussion by any local affiliation or state council or by the American Engineering Council of any matters of interest to engineers and members of allied technical professions, or action by the said Council on local or state matters where no local affiliation or state council exists.

Art. X. Publicity

This organization shall stand for the principle of publicity and open meetings under such regulations as may be provided for in the By-Laws.

Art. XI. Amendments

Sec. 1. An amendment to this constitution may be proposed by the Executive Board.

Sec. 2. An amendment may be proposed in writing, by at least 25 representatives on the American Engineering Council; such amendment shall be considered first by the Executive Board, which may approve, disapprove or formulate a modified or alternative amendment, report of which action shall accompany the original proposal to this organization.

Sec. 3. Any amendment proposed as provided in Sections 1 and 2 shall be considered at a meeting of the American Engineering Council and shall be submitted to its members at least 90 days in advance of such meeting. At this meeting, provided a majority of the representatives are present, the amendment may be rejected, or ordered submitted to the members of the Council for letter ballot within 30 days thereafter, with such modifications as may be adopted by a majority of those present. The amendment shall fail of adoption if one-third of the votes cast are in the negative.

THE BY-LAWS

Chap. I. Membership

Sec. 1. *Qualifications.* Any society or organization of the engineering or allied technical professions, is eligible for membership, the chief object of which is the advancement of the knowledge and practice of engineering or the application of allied sciences, and which is not organized for commercial purposes.

Sec. 2. *Admission.* The Executive Board shall submit each application made to it on its prescribed form, to a letter ballot of the American Engineering Council, accompanied by a statement of its findings as to eligibility and the number of representatives to which the applicant would be entitled. The applicant shall be admitted by a majority vote of the Council provided that not more than 25 per cent of the members of the Council shall vote in the negative.

Sec. 3. *Termination of Membership.* Any member society may terminate its membership on June 30 or December 31 or any year by at least three months' written notice to the Secretary; and, provided, the financial obligations of such organization are discharged to the said June 30 or December 31, respectively.

On complaint brought by any three members of the Council, and transmitted in writing to the Secretary of the Executive Board, alleging reasons why the membership of any member society should be terminated, the Committee on Membership and Representatives of the Executive Board shall investigate said charges, inform itself of all matters pertaining thereto, and report its findings to the Executive Board. The latter may dismiss the proceedings or make recommendations to the Council. The Council, by a two-thirds vote of those present at a meeting, may dismiss the proceedings or order a letter ballot; when the latter is taken, a two-thirds vote of the Council shall be necessary to terminate the membership.

Chap. II. Management

Sec. 1. *Terms of Representatives.* Representatives on the American Engineering Council shall serve for two years; provided, that after the first election, where there is more than one representative from one organization, approximately half shall be elected each year.

Sec. 2. *Announcement of Representatives.* Each organization represented shall send to the Secretary of the Council on or before August 15th of each year the names of its Representatives who are to serve for the term beginning January first following.

Sec. 3. *Votes of Representatives.* Representatives on the Council and on the Executive Board shall each have one vote on these bodies.

Sec. 4. *Meetings.* 1. At all meetings of the National Council the order of business shall be as follows:

a. Roll call of Representatives
b. Approval of minutes of last meeting
c. Report of Secretary
d Report of Treasurer
e. Report of President
f. Report of Executive Committee
g. Report of other committees
h. Unfinished business
i. Special business
j. New business

2. *Rules of Order.* Unless otherwise provided, Robert's Rules of Order shall govern the procedure of all meetings of the Council.
3. *Quorum.* A majority of all of the representatives of the Council shall constitute a quorum for all of its meetings.

Sec. 5. *Nomination and Election of Officers.* 1. The Secretary shall send to each member of the Council at least 90 days in advance of the Annual Meeting nomination blanks for offices to be filled at that meeting. Nominations received within 30 days shall be canvassed by the tellers appointed by the Executive Board and reported to them to the Board. The Board shall place upon the ballot the names of the three candidates receiving the highest number of votes.

2. The Secretary shall mail to each member of the Council, at least 30 days before the Annual Meeting a ballot containing the names of the nominees for each office.

3. Ballots received before 7 a.m. of the first day of the Annual Meeting shall be canvassed by tellers appointed by the Executive Board, and the result certified to the President of the Council, who shall announce the result of the election at the Annual Meeting. A plurality of votes shall elect; in case of a tie vote the Annual Meeting shall select immediately between the tied candidates by ballot.

Sec. 6. *Duties of Officers.* 1. The terms of all officers elected at an Annual Meeting of the Council shall commence on the adjournment of such meeting.

2. The officers shall have the usual duties pertaining to their respective offices, except as may be otherwise provided in the Constitution and By-Laws.

3. It shall be the duty of the President to represent the Council on any formal occasion.

4. The Vice-President, in the order of seniority of election and age, shall, in the absence or disability of the President, discharge his duties.

5. The Treasurer shall receive all moneys and deposit same in the name of the Council, with a bank or trust company approved by it. He shall invest all funds not needed for current disbursements as ordered

by the Executive Board. He shall pay all bills covering expenditures authorized by the budget or the Executive Board, by checks countersigned by the Chairman of the Finance Committee or some other member thereof. He shall make an annual report and such other reports as may be prescribed by the Executive Board. He shall give a bond at the expense of the Council, in amount and with surety satisfactory to the Executive Board.

6. The Executive Officer shall be appointed and his compensation fixed annually by the Executive Board and shall hold office during its pleasure. He shall be the Secretary of the Council and of its Executive Board. He shall manage the busineess of the Council under the direction of the Executive Board, and perform such duties as may be assigned to him by the Council or the Executive Board. He shall be the custodian of the property of the Council. He shall collect all moneys due the Council and transfer them to the custody of the Treasurer. He shall scrutinize all expenditures and use his best endeavors to secure economy in the administration of the business of the Council. He shall certify to the accuracy of all bills or vouchers on which money is to be paid. He shall give a bond at the expense of the council in amount and with surety satisfactory to the Board. He shall pay the current expenses of the office and for this purpose shall have at his disposal a suitable sum of money to be fixed by the Board, which amount shall be periodically replenished under the authority of the Finance Committee upon the representation of an account of disbursements in the form required by it. He shall mail to the member-societies bills for their annual contribution 30 days prior to the beginning of the fiscal year. He shall perform such other duties as may from time to time be assigned to him by the Council or the Executive Board.

Sec. 7. *Selection of Executive Board.* 1. The Secretary shall submit to the Executive Board, at its September meeting, a list of Member-Societies in good standing with their respective memberships.

2. The Executive Board shall thereupon determine the number of its members for the next ensuing administration year to be selected by national societies, and by the Representatives of the local, state or regional organizations or affiliations, such members to be proportioned as near as may be, to their respective memberships in good standing, and it shall prescribe the boundaries of each district.

3. The Secretary, within two weeks after the September meeting of the Executive Board, shall mail to the proper officer of each member-society a copy of his report on membership and the Board's action with respect to membership of the Board and its delimitation of districts.

Sec. 8. *Duties of Executive Board.* 1. The Executive Board shall organize within 30 days after the adjournment of the annual meeting of the Council.

2. It shall hold regular monthly meetings except during July and August. The regular meeting shall be held on the second Monday of each month except that a regular monthly meeting shall be held in connection with the meeting of the Council.

3. Special meetings may be called at the discretion of the President and shall be called at the written request of five members of the Executive Board.

4. The Secretary shall mail the notices of each regular meeting at least 15 days in advance thereof, and shall mail notices of each special meeting, stating its purpose at least ten days or telegraph six days in advance of the date. No business, other than that for which it has been called, shall be transacted at a special meeting.

5. A quorum for all meetings of the Executive Board shall be fifteen members.

6. The Executive Board, unless otherwise provided, shall appoint all special committees of the Council and of the Executive Board. The membership of such committees may be drawn from the membership of the Council or of the member societies.

7. The Executive Board shall, whenever practicable, provide for the whole or a part of the expenses of representatives attending meetings of the Council and of the Executive Board.

Sec. 9. *Appointment of Committees.* 1. The following Committees shall be appointed for the membership of the Board annually by the incoming president with the approval of the Executive Board, each member to serve one year, or until his successor is appointed:

a. On procedure.
b. On Constitution and By-Laws.
c. On Publicity and Publications.
d. On Membership and Representation.
e. On Finance.
f. On Public Affairs.

Sec. 10. *Duties of Committees.* 1. The Committee on Procedure shall act for the Executive Board in the interim between its meetings, and shall perform such other duties as may be assigned to it.

2. The Committee on Constitution and By-Laws shall report on all proposed amendments referred to it by the Executive Board, together with any modifications it may deem desirable.

3. The Committee on Publicity and Publications shall, when so requested, prepare all public statements and shall have the direction of publications of the Council.

4. The Committee on Membership and Representation shall report to the Executive Board on eligibility of each applicant for membership and the number of representatives to which it would be entitled. It shall review and report at least 90 days before each regular meeting of the Council, the number of representatives to which each member-society is entitled. It shall review the existing electoral districts and report thereon to the Executive Board, at least once every two years. It shall report on all questions regarding registration and credentials of representatives on the Council.

5. The Finance Committee shall have supervision of the finances of the organization. It shall report an annual budget to the Executive Chairman or some other member of the committee shall countersign all checks for the payment of money.

6. The Committee on Public Affairs shall report tc the Executive Board on all public affairs with which the Engineer is concerned or which affect the relation of the Engineer to the Public.

7. Special Committees shall report to the Executive Board.

Chap. III. Funds

Sec. 1. *Fiscal Year.* 1. The fiscal year shall begin on the first day of January of each year.

2. The contributions of each member-society shall be payable in advance in semi-annual payments, on the first day of January and July of each year, and shall be based upon a certified statement of its membership as of January first.

3. A member-society failing to pay its semi-annual contribution within six months after it is due shall be suspended or dropped from membership at the discretion of the Executive Board.

4. Funds shall be disbursed, as authorized by the budget or the Executive Board, by checks signed by the Treasurer and countersigned by the Chairman or some member of the Finance Committee.

Chap. IV.

Sec. 1. *Publicity.* The privilege of attendance of all meetings of the American Engineering Council, of the Executive Board and committees, when not in executive session, shall be extended to any proper person, but this privilege does not extend the right to speak or vote. Any proper person shall have the right to inspect and make true copies of the record of all meetings of the Council, executive board and committees.

Sec. 2. The committee on publicity and publications may employ a publicity secretary whose duty under the direction

of the executive board shall be to prepare and supply to the engineering, technical and general press news from the Federated American Engineering Societies, and of the engineering world, and to co-operate with the editors of engineering and technical publications in disseminating information in regard to this organization and its activities. The committee on publicity and publications may appoint a co-operating board of engineering editors to counsel or assist in any or all of its activities.

CHAP. V. AMENDMENTS

Sec. 1. An amendment to these By-Laws may be proposed by any representative of the American Engineering Council or of the Executive Board. The latter shall consider all proposed amendments and mail a copy of such amendments together with its report thereon to each representative on the Council at least 60 days prior to the date of a regular meeting.

Sec. 2. These By-Laws may be amended by an affirmative two-thirds vote of all representatives on the Council present at a regular meeting thereof, provided that the proposed amendment shall have been mailed to each representative at least 30 days in advance of such meeting.

Sec. 3. Sections 2, 4 (paragraph 1), 5, 6 (paragraphs 3, 4, 5 and 6), 7 and 10, of Chapter II, of these By-Laws, and any By-Laws adopted subsequent to ——— —— ——— may be amended by a vote of three-fourths of the members of the Executive Board at any regular meeting; provided that the proposed amendment shall have been presented in writing at a previous regular meeting of the Board.

LIST OF ORGANIZATIONS PRESENT

American Association of Engineers, Chicago, Ill.
American Association of Petroleum Geologists, Norma, Okla.
American Ceramic Society, Alfred, N. Y.
American Electric Railway Engineering Association, New York City.
American Electrochemical Society, South Bethlehem, Pa.
American Institute of Electrical Engineers, New York City.
American Institute of Mining and Metallurgical Engineers, New York City.
American Railway Engineering Association, Chicago, Ill.
American Society of Agricultural Engineers, Columbus, Ohio.
American Society of Civil Engineers, New York City.
American Society of Mechanical Engineers, New York.
American Society of Naval Architects and Marine Engineers, Washington, D. C.
American Society of Refrigerating Engineers, New York City.
American Society for Testing Materials, Philadelphia, Pa.
American Society of Heating and Ventilating Engineers, New York City.
American Waterworks Association, New York City.
Associated Engineering Societies of St. Louis, St. Louis, Mo.
Association of Railroad Engineers, Chicago, Ill.
Boston Society of Civil Engineers, Boston, Mass.
Brooklyn Engineers Club, Brooklyn, N. Y.
Cleveland Engineering Society, Cleveland, Ohio.
Colorado Society of Engineers, Denver, Colo.
Duluth Engineers Club, Duluth, Minn.
Engineers Club of Baltimore, Baltimore, Md.
Engineers' and Architects' Club of Louisville, Louisville, Ky.
Engineers' Club of Philadelphia, Philadelphia, Pa.
Engineering Society of Eastern New York, Troy, N. Y.
Engineering Society of Buffalo, Buffalo, N. Y.
Engineers' Society of Pennsylvania, Harrisburg, Pa.
Engineers' Society of Western Pennsylvania, Pittsburgh, Pa.
Florida Engineering Society, Gainsville, Fla.
Grand Rapids Engineering Society, Grand Rapids, Mich.
Illuminating Engineering Society, New York City.
Indiana Engineering Society, Indianapolis, Ind.
Institute of Radio Engineers, College of the City of New York.
Iowa Engineering Society, Iowa City, Ia.
Kansas Engineering Society, Topeka, Kan.
Los Angeles Joint Technical Society, Los Angeles, Cal.
Mohawk Valley Engineers' Club, Utica, N. Y.
National Fire Protection Association, Boston, Mass.
Nashville Engineering Association, Nashville, Tenn.
Northeastern Water Works Association, Boston, Mass.
Oregon Technical Council, Portland, Oregon.
Providence Engineering Society, Providence, R. I.
San Francisco Joint Council of Engineering Societies, San Francisco, Cal.
Scientific Club, Indianapolis, Ind.
Society of Automotive Engineers, New York City.
Society of Industrial Engineers, Chicago, Ill.
Society for Promotion of Engineering Education, Pittsburgh, Pa.
Society of American Military Engineers, Washington, D. C.
Taylor Society of New York City.
Technical Club of Dallas, Dallas, Tex.
Topeka Engineers' Club, Topeka, Kan.
Vermont Society of Engineers, Montpelier, Vt.
Washington Society of Engineers, Washington, D. C.
Engineers' Club of St. Louis, St. Louis, Mo.
Engineers' Club of Trenton, Trenton, N. J.
Engineering Council, New York City.
Illinois Society of Engineers, Wheaton, Ill.
Engineering Society of Akron, Akron, Ohio.
Detroit Engineering Society, Detroit, Mich.

Opening Address at the Organizing Conference

BY RICHARD L. HUMPHREY

I ESTEEM it a high honor, as well as a privilege, as chairman of the Joint Conference Committee, to call this Organizing Conference to order.

We are met to consider some of the most important questions that have ever confronted the engineering and allied technical professions in this country; the results of our deliberations will have a far-reaching effect. We must decide whether there shall be formed a comprehensive organization that can speak for these professions in public affairs where technical knowledge and engineering experience are involved, as well as on other matters that are also of common interest—or, whether our respective societies shall, as heretofore, pursue their separate ways and only occasionally co-operate in matters of common concern.

The problem is of national as well as of local importance, and because of this importance, any decision reached should reflect the judgment of all here represented.

The American Society of Civil Engineers was founded in 1852 for "the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members." Subsequently, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers and later the American Society for Testing Materials and the American Railway Engineering Association and other national engineering societies were formed. The activities of these societies are

almost entirely technical. In addition to the numerous national societies that have organized to care for social lines of engineering and allied sciences, local engineering societies and clubs, as well as state and regional engineering and allied technical organizations have been formed. These organizations carry on their activities, generally, independently of each other.

As these organizations increased in number, it became evident that it was desirable to so federate them that there would be a representative body that could speak for these professions. The matter was under consideration prior to the war, and with its advent the desirability of this federation became more apparent.

The Service of Engineering

Engineering is defined "as the art of organizing and directing men and of controlling the forces and materials of nature for the benefit of the human race." The growth and development of this country has been largely a matter of engineering. The European war, because of the brilliant work of the engineer, brought the universal recognition of his importance in its successful prosecution; it awakened the public to a keener realization of the service of the engineer and awakened in the engineer a desire for greater service to the public —a desire to do his part in the successful administration of the affairs of the nation. The engineer has, therefore, changed his view point from the somewhat narrow one of following his profession exclusively, to the broader one of unselfish devotion to the common cause.

This meeting marks the culmination of many years of efforts that have been made to bring about the formation of an all-inclusive organization, and these efforts have been crystallized during the last two years by the work of the Joint Conference Committee, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

An all-inclusive organization of the engineering and allied technical professions has been advocated for a long time; the need for such a comprehensive organization in which all the engineering and allied technical societies of this country could be represented has been apparent for many years.

Organization Movement

The first step toward meeting this need was taken June 27, 1917, when the representatives of the four above-named societies organized Engineering Council "to provide for consideration of matters of common concern to engineers, as well as those of public welfare in which the profession is interested, in order that united action may be possible."

The American Society of Civil Engineers, June 18, 1918, adopted a resolution which stated: "Sociological and economic conditions are in a state of flux and are leading to new alignments of the elements of society." These new conditions are affecting deeply the profession of engineering in its service to society, in its varied relationships to communities and nations and in its internal organizations,"—and authorized the appointment of a committee on development to make a broad survey of the functions and purposes of the society in order that an intelligent and effective readjustment may be accomplished so that the society may take its proper place in the larger sphere of influence and usefulness now opening to the profession." The relations of the society to other societies and to the profession generally was also included.

This action was followed by the appointment of similar committees by the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers. These committees appointed conferees who met and organized the Joint Conference Committee; its purpose was to determine in what manner these four societies could co-operate on non-technical or welfare work affecting the relations of the engineer to, and his service in, public affairs. This committee presented a report to these societies in September, 1919; at the meeting held in New York, Jan. 23, 1920, the governing boards of these societies, the American Society for Testing Materials and the trustees of the United Engineering Society, unanimously requested the Joint Conference Committee to call, without delay, a conference of representatives of national, local, state and regional engineering organizations of this country, for the purpose of bringing into existence the comprehensive organization recommended by the Joint Conference Committee.

In compliance with this request the Joint Conference Committee issued an invitation to 110 engineering and allied technical organizations and societies; these represented an aggregated membership of over 120,000, who, under conditions of the call, were entitled to send 184 delegates to this organizing conference. The list included all societies, organizations or affiliations, not associations, sections, chapters or branches of national societies, whose chief object is the advancement of the knowledge and practice of engineering and the application of allied sciences and who are not organized for commercial purposes.

Conference Thoroughly Representative

This conference is thoroughly representative. There are in attendance delegates representing over 60 per cent of the organizations invited. These delegates, over 70 per cent of those who could attend under the conditions of the call, represent organizations having an aggregated membership of over 100,000, or 83 per cent of the membership of all the organizations and societies invited.

This splendid response from the engineering and allied technical organizations of this country to the invitation to attend this conference, to consider the desirability of welding the engineers of this country, through their representative societies or organizations, into a comprehensive body for united action in non-technical or welfare work, is evidence that there is a general desire on the part of the engineers and allied technologists in this direction.

It is believed that this is the first attempt that has been made to hold a conference for the purpose of discussing the possibilities of such an organization; I think you will agree with me that on the evidence of this representative attendance the organizations represented look with favor on the fundamental principles involved.

On behalf of the Joint Conference Committee and of the Societies which it represents I desire to thank you and through you the societies and organizations that you represent, for your co-operation in making this conference so successful.

This is an auspicious occasion and is fraught with great potentialities for strengthening and advancing the engineering and allied technical professions in this country. It is one of the most important gatherings that has ever been planned; it can be considered a success if harmony is its outstanding characteristic—for it is only through harmony that we may achieve the results that will ultimate in the greatest success of our organization.

We are met not to discuss details but to use our best endeavors to reach an harmonious agreement as to fundamental principles. This occasion, to be properly utilized, must deal with the fundamental principles involved and leave the working out of the details of whatever plan that may be agreed upon to the governing board of the new organization.

I would suggest that this problem be approached with an open mind and that the discussion be on a broad, unselfish plane, having one object, namely, the good of the engineering and allied technical professions.

The Joint Conference Committee may perhaps be criticized for having unduly usurped authority or taken action that may not be approved by this conference, but I think you will agree with me that it was necessary for somebody to undertake to complete the arrangements if the conference was to be a success and in making these arrangements the committee had, of necessity, to decide the many questions that arose in connection therewith. There was no desire on the part of any member of the committee, of which I have the honor to be the chairman, to take any action or to be actuated by any other motives than those that were for the best interests of the cause. Action has always been taken by the committee with the understanding that it would be subject to the approval of the conference when it shall have organized. I bespeak for my colleagues, your consideration and trust that you will realize that they have worked zealously for the success of the conference, and be lenient with any sins, either of omission or of commission.

It is not to be expected that a conference of this character, composed of delegates representing organizations and societies of widely different activities, could be brought together without the expression of a very considerable difference of opinion as to the best means of accomplishing the object sought.

"Service"—the Slogan

I believe that the keynote of this conference could be properly expressed by the word "service"; we desire first to serve the country, and, second, to serve the societies and organizations of which we are the repsentatives. One cannot contemplate service, which means giving—not receiving—with any feeling that it is actuated by selfish motives, but, rather is it the giving of our best.

In our endeavors to work out a plan involving fundamentals to which we may all subscribe, let us be lenient in our dealings with one another and let us discuss questions before us in a broad way, realizing that this conference of itself cannot put the organization we are contemplating in operation—that some of those present must refer the matter back to those they represent for ratification; let us agree on a tentative plan which may serve as a basis of discussion and leave the working out of a complete plan, as to details, to the delegates from those societies which agree to participate in the new organization.

It is one of the outstanding characteristics of the engineer that he gets results. Let us, therefore, determine that this gathering, unparalleled in this country, shall not adjourn without having taken a forward step in the formulation of a plan which will ultimate in some form of comprehensive organization that will represent the solidarity of these professions. If each one of us will keep this object firmly before him we shall attain the end desired.

Forbearance, a desire to give and take, must characterize our deliberations, because it is not otherwise possible to reach an harmonious agreement. The results of all deliberations of this character, if success, must be a compromise. I would commend to your most earnest consideration the desirability of approaching the matters that will come before you along these lines in order that the results may be eminently successful.

I am supremely confident that a body of men of the high order of intelligence that is here represented, can not fail. I am confident that there will be laid at this conference, the corner-stone of the united engineering and allied technical professions that will deal with public affairs of the city, state and nation, where engineering experience and technical knowledge are involved, and that will take action on other matters of a non-technical character which are of common concern.

Industry's Need of Oil

In an address before the general meeting of the American Iron and Steel Institute, held at the Hotel Commodore, New York, on May 28, 1920, George Otis Smith had the following to say regarding the petroleum situation in America today. Mr. Smith is director of the United States Geological Survey and has made an intensive study of this subject and its relation to the future of American industry.

The last ten years might be called the petroleum decade. The world war depended upon American oil wells for motive power. Gushers and oil booms increased popular faith in an inexhaustible supply of petroleum. Domestic production doubled and consumption more than doubled, so that Mexican oil has become an absolutely necessary part of our supply. These ten years mark a transition from oversupply to overdemand.

The ever-increasing demand for gasoline and fuel oil are the outstanding oil needs, so that the question of priority must soon arise. With an estimate of 7 billion barrels in the ground and the 1920 consumption closely approaching a half billion barrels, this rapid pace cannot long be maintained. Benzol and alcohol from the coke ovens promise only enough motor fuel to meet part of the present increase in demand; oil from oil shales will not be labor-cheap like the petroleum now flowing from the wells. Regard for the future forces us both to plan to use less oil and to import more.

Some restriction in gasoline consumption must soon come; fuel oil in locomotives and stationary steam plants must give way to the demand for this fuel by the Navy and United States merchant marine, which alone this year require one-third of the output of fuel oil. Oil as a power-saver has a unique function and the demand for lubricating oil must continue to increase as the use of machinery increases.

Pioneering for oil in foreign countries by American capital will not only help secure the needed oil but will also furnish markets for American manufacturers, especially of steel products. Planning for the future needs to include more attention to supplies of raw materials to insure the country's industrial life.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT · NEWS ·
A weekly review of modern designs and · equipment ·

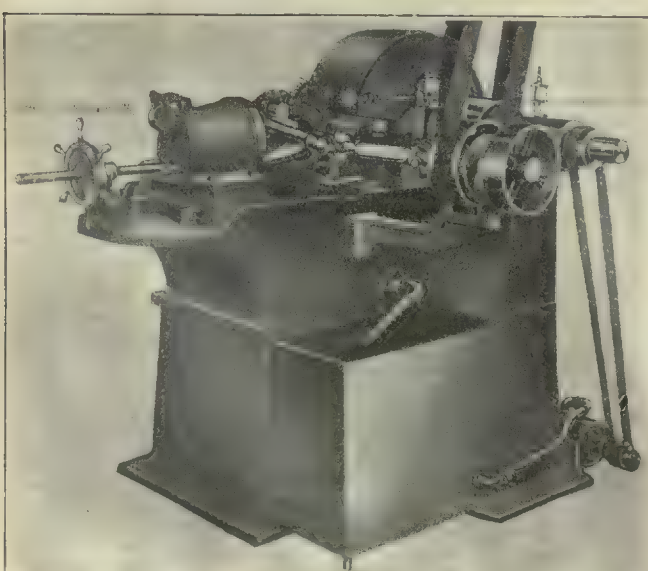
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

· CONDENSED · CLIPPING INDEX
A continuous record of modern designs · and equipment ·

Sanford Centerless Grinding Machine

The Model B centerless grinding machine illustrated is manufactured by the F. C. Sanford Manufacturing Co., Bridgeport, Conn., and sold by Russell, Holbrook & Henderson, Inc., 30 Church St., New York. The B model is of improved design and much heavier than the machine described in Vol. 52, No. 13 of the *American Machinist*. The bearings located at both sides of the driving pulley are of manganese bronze, tapered and fitted into cast-iron sleeves, and have provision for quick adjustment for wear. The grinding wheel is 20 x 4 in. in size and is carried on a high-carbon heat-treated steel shaft 3¼ in. in diameter. The feed wheel runs at 48 r.p.m., is 10 x 4 in. in size and is supported at both sides.

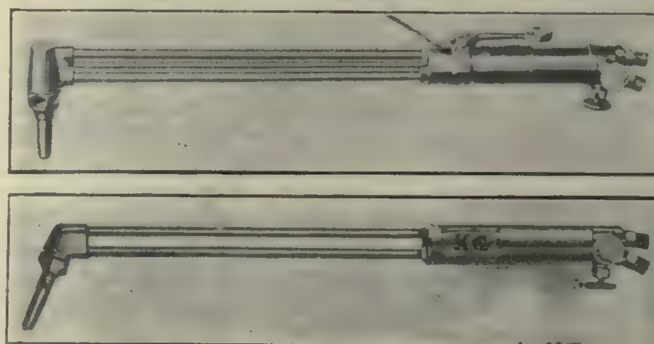
The machine shown is intended for straight cylindrical work only and has a capacity for work ranging from 3/16 to 6 in. in diameter, and lengths up to 20 in. Where work is to be handled in large quantities the best results are said to be obtained by using a series of two or more machines connected by automatic feeds or gravity chutes. With such an arrangement the work is successively reduced by each machine and finally finished without changing the wheel adjustment. Where one machine only is used it is necessary to pass the work through two or more times according to the amount of stock to be removed. Floor space, 48 x 68 in.; net weight, 2,200 lb.; crated, 2,500 lb.



SANFORD MODEL "B" CENTERLESS GRINDING MACHINE

K-G Model M Welding and Cutting Torches

The oxy-acetylene torches illustrated are a recent development of the K-G Welding & Cutting Co., 556 West 34th St., New York City. The heads, tips and nuts that are exposed to the heat are made of Monel metal. The claims made for the torches are low upkeep and long life due to the high melting point and heat conductivity of the metal. The heat-resisting qualities of the tip are said to permit continuous work in certain cases without stopping to cool the torch before the weld is completed; also that the joints are not likely to loosen from overheat and cause a flash back when working in corners and pockets.



K-G MODEL M WELDING AND CUTTING TORCHES

Coulter Automatic Multiple-Spindle Profiling Machine

A machine possessing unusual possibilities for the rapid production of irregular contours, and especially adaptable to the manufacture of automobile engines and parts, is the multiple-spindle profiling machine illustrated in Figs. 1 and 2. It is made by the Automatic Machine Co., Bridgeport, Conn.

Though the machine shown has six spindles, it may have any number (less than six) that may be best adapted to the work in hand, and the distance between centers of the spindles may be anything within the limits of the head casting; this piece only being changed to accomodate two, three, four or six spindles.

The spindles are driven through the medium of bronze helical gears meshing into a single helical gear of steel, keyed to the driving shaft and long enough to cover the full width of the head, including its extreme travel in both directions.

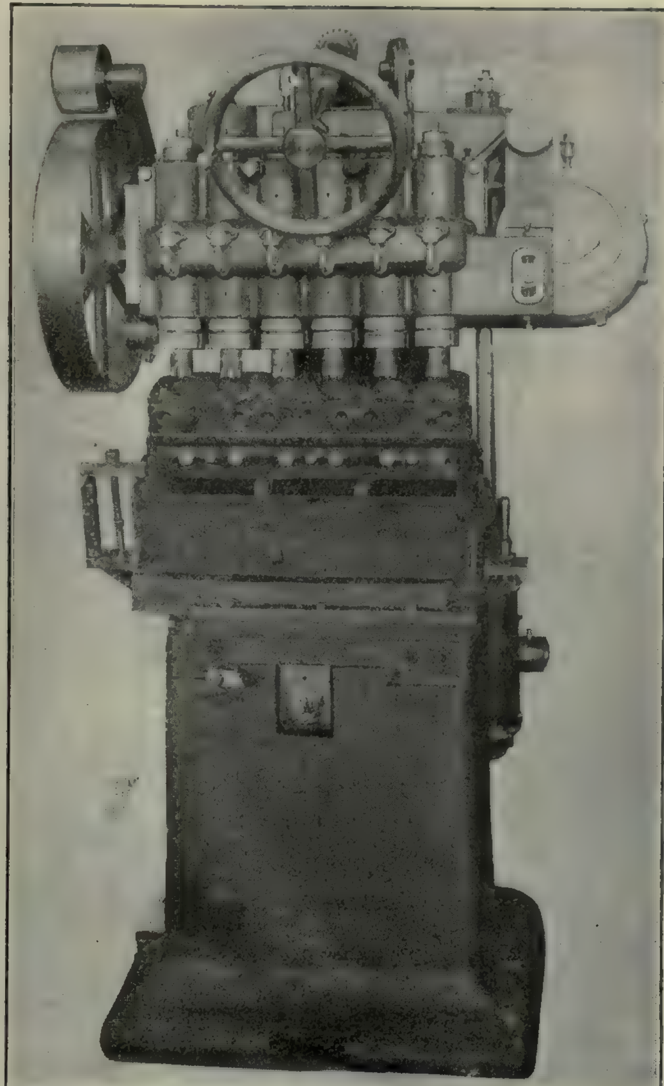


FIG. 1. SIX-SPINDLE AUTOMATIC PROFILING MACHINE

The movement of the head is obtained from the cam seen to the right; the cam roller being attached to the swinging arm, and the movement transmitted through the adjustable block and yoke. This adjustment provides compensation for wear and for grinding of cutters. A movement, similar in every respect, is located in the lower part of the column, and moves the table of the machine in and out from the column, or at a right angle from the direction of movement of the head. By designing suitable cams for these two movements the work may be caused to travel in relation to the cutter through any desired contour.

The two camshafts are driven by worm gearing and timed to rotate in unison, the drive is taken from the shaft that drives the spindles, so that in event of the machine stalling from overload, the feed does not continue. The feed drive is through a timed clutch, and once engaged by depressing the treadle, the movement continues throughout the complete cycle, stopping automatically at the point from which it started.

The head may be raised and lowered by means of the large handwheel, and its downward movement is limited by a micrometer stop so that the cutters may be raised for examination or for changing the work and returned with certainty to their correct position.

The spindles run in tapered bronze bearings and the cutters are held in split chucks gripped by the ring nuts which may be seen at the lower end of the spindles. Endwise adjustment for the cutters is provided by a rod threaded into the shank of the cutter, and terminating at the upper end of the spindle in a collar that is held by a locknut.

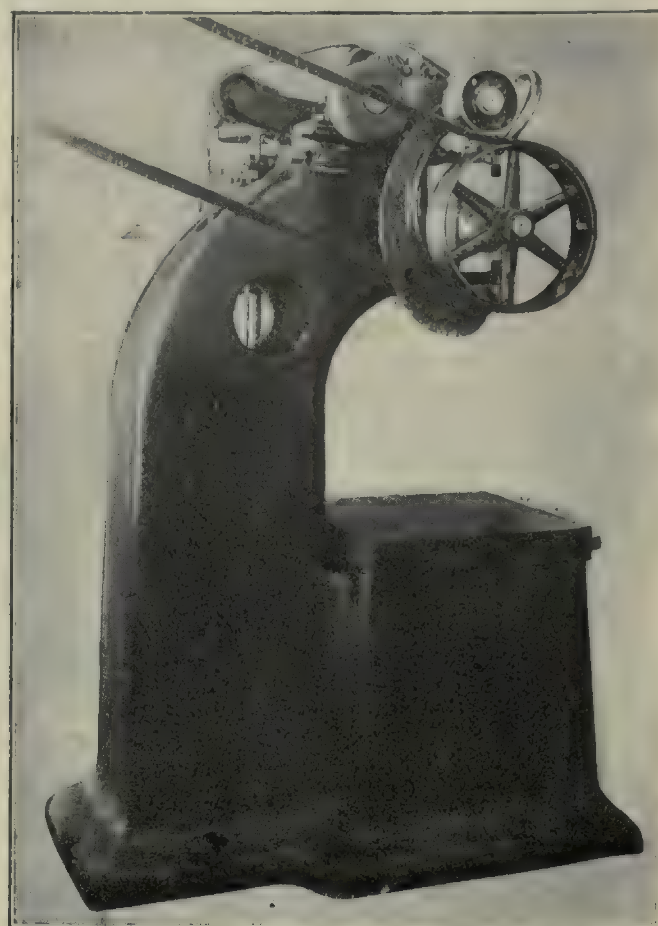


FIG. 2. SIDE VIEW OF MACHINE SHOWING TABLE

The spindle construction and this adjustment is plainly shown in the drawing, Fig. 3, which also shows the provision for taking up wear of the spindle bearings.

The lower bearing is tapered, and immediately above it is the bronze gear keyed to the spindle. Upon this rests a split nut threaded to the spindle and clamped by means of a fillister-head screw. By removing the cover plate (which in Fig. 1 carries the sight-feed oiler) this split nut may be loosened with a screw driver and turned down by means of a piece of drill rod until any lost motion in the lower bearing is taken up.

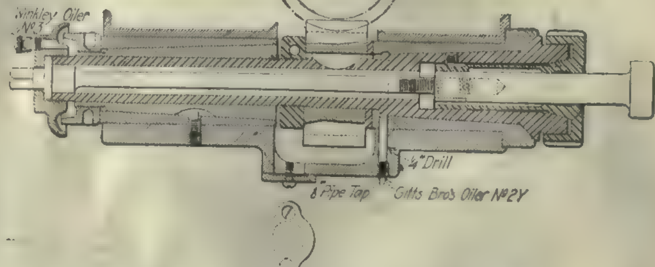


FIG. 3. DETAIL OF SPINDLE BEARING

Fixtures may be provided to suit work in hand. The one shown here is arranged to hold the cylinder block of a well-known automobile engine while profiling the compression spaces. For single pieces the fixtures may be made reciprocating, that is, adapted to hold twice as many pieces as there are spindles, and moving from one position to another so that the operator may be unloading and reloading one half of the fixture while the cutters are at work on the other half.

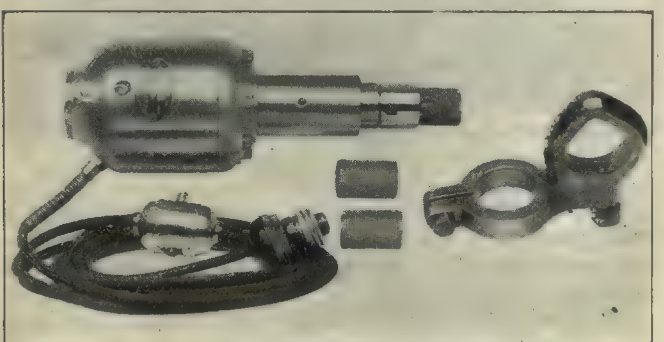
In and out adjustment of the table in addition to the automatic movement is provided by the screw which may be seen projecting below the table in Fig. 1. A taper gib provides adjustment for wear in the table slide.

This machine is strictly a production machine and is expected to make long continuous runs on one particular piece. For this reason there is no provision for varying the spindle speed. This will be determined upon with respect to nature of material and size of cutter, and the driving pulley selected accordingly. All drive and feed shafts run on ball bearings.

The shipping weight of the machine is approximately 6,000 lb. and the floor space occupied is about 5 x 6 ft. It is provided with a bracket on the rear of the column if independent motor drive is desired, or it may be driven direct from the line shaft.

Precision Truing Machine

The truing machine illustrated herewith, has been placed on the market by The Precision Truing Machine and Tool Co., Cincinnati, Ohio, and is intended for use in place of a diamond in truing abrasive wheels. The device consists of a motor, abradent nib and a holder and can be operated from a lamp socket. The



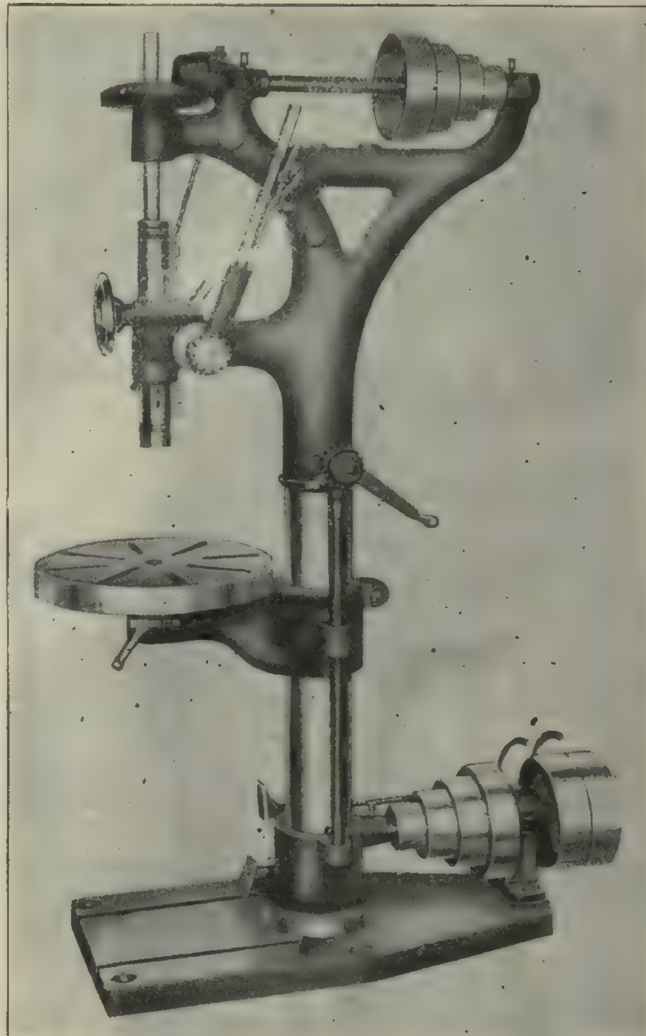
PRECISION TRUING MACHINE

holder shown is for attaching the device to the tailstock center of a grinding machine, but holders for special or unusual applications can be furnished. In operation the revolving nib should approach the wheel at an angle and then be fed across the face of the wheel the same as when using a diamond. It is claimed that the wheel can be more quickly trued than with a diamond and that one nib will keep a wheel in condition during 100 hours of grinding. Three general purpose nibs 1 in. in diameter and 1½ in. long are furnished with the machine. Nibs for special purposes can be supplied.

Holt 20-In. Vertical Drilling Machine

The illustration shows a 20-in. vertical drilling machine which is built by the Holt Electric Co., 377 South Pierce St., Milwaukee, Wis.

This machine is built with the standard form of column having a 5½-in. diameter finished portion for the table arm. The base is square with T-slots for clamping



HOLT 20-IN. VERTICAL DRILLING MACHINE

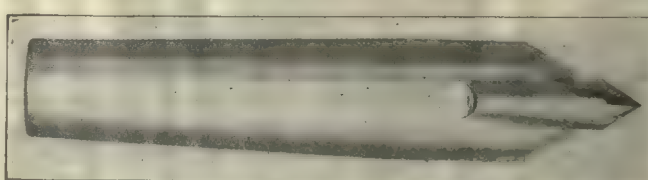
Specifications: Spindle; dia., 1⅜ in.; vertical travel, 11⅜ in.; hole, No. 3 Morse taper. Maximum distance; spindle to table, 25½ in.; spindle to base, 41¾ in. Table dia., 18 in. Four-step cone pulleys for 2-in. belt; dia. large step, 8½ in.; small step, 3½ in. Countershaft pulley; speed, 350 r.p.m., dia. 9 in. for 2½-in. belt. Height, 73 in. Floor space, 41 x 16½ in. Weight, 750 lb.

up work. The spindle is provided with bronze bearings, double locknuts and ball-end-thrust bearings. It is counterbalanced by a weight hung inside of the column. A combined lever and wheel feed is provided.

Tight and loose pulleys are provided for 2½-in. belt. The speed changes are arranged through four-step cone pulleys.

Federal Inserted Center

The Federal Steel Co., Detroit, Mich., is marketing a machine center of the type illustrated. The inserted point is made of high-speed steel and both the point and the hole in which it fits are ground to Morse taper. The shank is made of carbon steel, hardened and ground, and is furnished in all standard sizes to fit Morse, Brown & Sharpe or Jarno taper holes.



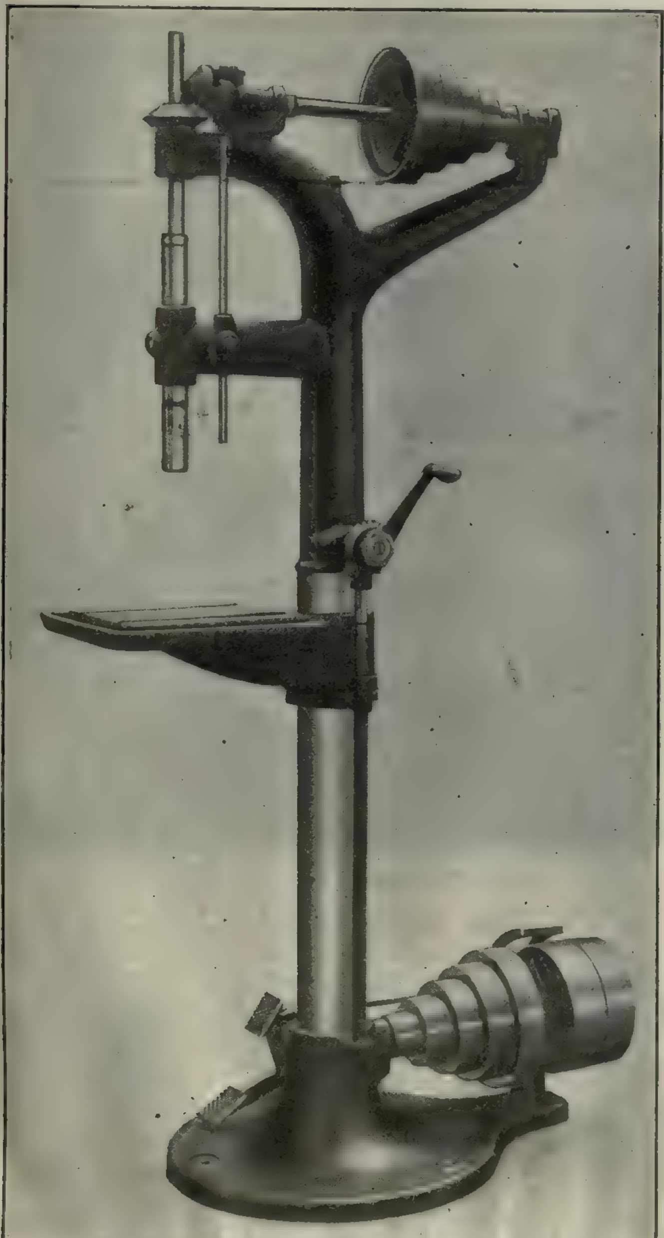
FEDERAL INSERTED CENTER

Hoosier 16-In. Vertical Drilling Machine

The Hoosier Drilling Machine Co., of Goshen, Ind., has brought out the 16-in. vertical plain-drive drilling machine shown in the illustration herewith. This machine was designed for light and medium work. Care has been used in designing and building this machine in order to insure careful fitting of the gears, alignment of the spindle, lubrication of all bearing surfaces, etc.

The machine is only furnished with leverfeed and the feed handle is made adjustable to suit the convenience of the operator.

The machine is furnished either with the round table or with a square table having T-slots and an oil rim.



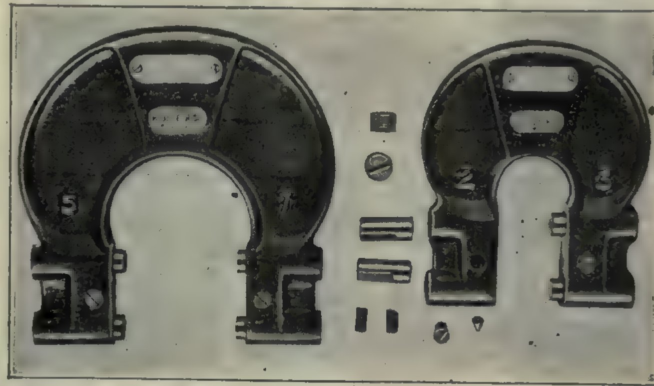
HOOSIER 16-IN. VERTICAL DRILLING MACHINE WITH SQUARE TABLE

Specifications: Column to center of spindle, 8 in. Maximum distance, spindle to table, $28\frac{3}{4}$ in.; spindle to base, $44\frac{3}{4}$ in. Travel of spindle, $8\frac{1}{2}$ in. Hole in spindle, No. 2 Morse taper. Diameter of round table, 12 in. Travel of table on column, $19\frac{3}{4}$ in. Spindle speeds, 46, 172, 300, 521 and 971 r.p.m. Floor space, $19\frac{3}{4}$ x $26\frac{1}{2}$ in. Weight; net, 300 lb.; crated for domestic shipment, 380 lb.; boxed for export shipment, 500 lb. Cu.ft. boxed for export, 15.

Rogers Adjustable Limit Gage

One of the late products of the John M. Rogers Works, Inc., Gloucester City, N. J., is the adjustable limit snap-gage which is here illustrated. Gages of this type are made in twenty-two different sizes, the smallest of which has a range of from 0 to $\frac{1}{4}$ in. while the largest has a range of from 8 to $8\frac{1}{2}$ in. The frame of the gage is double-ribbed to afford extreme rigidity, and the anvils are made of alloy steel, hardened, ground, and lapped to afford durability and accuracy. Marking tags showing the sizes are made in the form of separate brass plates screwed to the frames of the gages, and extra tags may be furnished when they are required.

Before being machined, the malleable-iron castings are well seasoned to guard against danger of warping



ROGERS ADJUSTABLE LIMIT GAGE

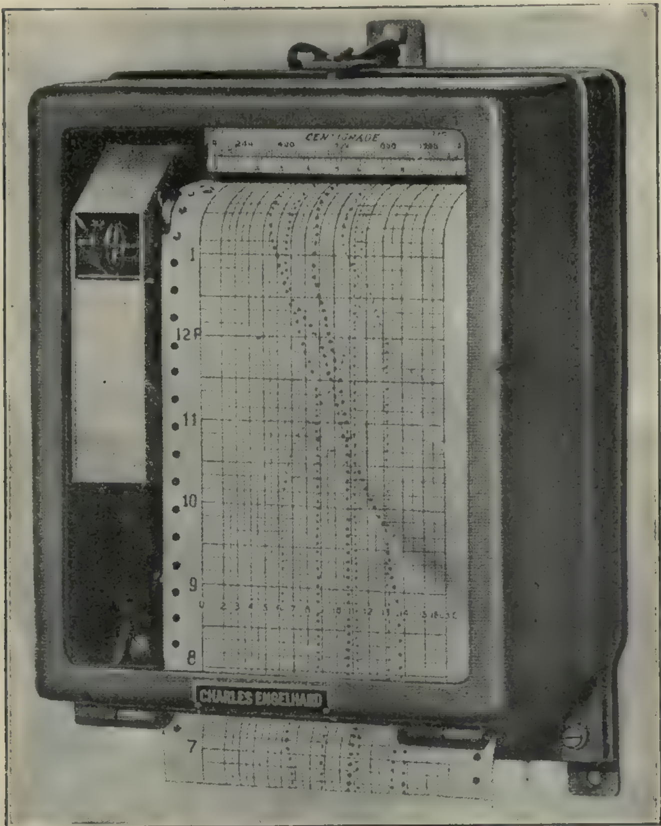
after the gages have been finished. All of the gage plugs are carefully lapped, both on their diameters and gaging surfaces. This accuracy in sizing the diameters of the plugs enables them to fit snugly into the holes in the frame which are line-reamed to assure parallelism. The plugs are so designed that they cannot turn in the frame. The adjusting screws have a fine-pitch thread, which permits of making accurate adjustments. The Rogers master locking device, in addition to firmly setting both anvils with one master screw, can also be set to hold a slight tension equally on the anvils while adjustments are being made. When the master locking screw is firmly set, the space provided over the head may be sealed, making the gage proof against tampering.

The plugs may be easily set to any dimension within the range of the gage by using a standard measuring plug, block, or disk. Either standard reference disks of nominal size or disks of specified accuracy can be furnished for setting the gages. When the plugs become worn and require repairing, it is only necessary to grind the ends on a wheel and lap the surfaces square.

Engelhard Pyrometer Recording Instrument

Charles Engelhard, 30 Church St., New York City, has placed on the market the pyrometer recording instrument illustrated herewith.

In order to make this instrument as nearly "fool proof" as possible, the interior has been divided into two compartments. In one compartment is mounted the moving system, so protected that it is not liable to injury either from accident or from carelessness in

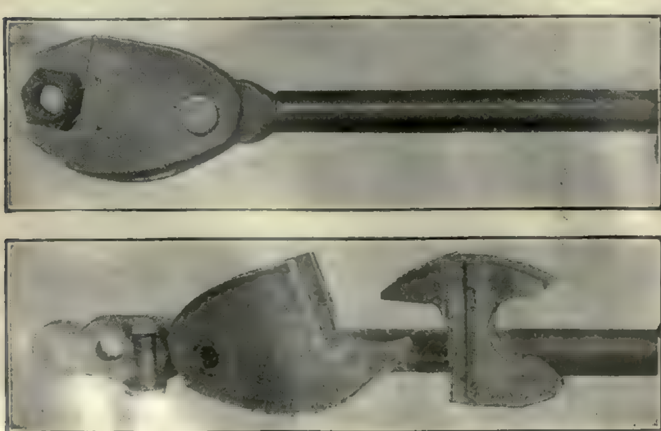


ENGELHARD PYROMETER RECORDING INSTRUMENT

removing or replacing the recording charts. The clock, depressor-bar mechanism and the direct-reading scale are mounted in the front compartment. The entire front of the instrument is of glass, completely exposing the chart. The front of the case is hinged at the bottom so that the interior is accessible. The 5½-in. scale is calibrated both in temperature and corresponding millivolt range. The charts are of the continuous roll type, approximately 100 ft. in length. The time-temperature lines are at right angles to one another. The instrument is made in two types, type R1 being a single record while type RM is a multiple record instrument. The case is of cast aluminum with black finish. The dimensions of the instrument are height, 11 in.; width, 8½ in.; depth, 8½ in.

Allan-Diffenbaugh Wrench

The wrench shown is made by the Allan-Diffenbaugh Wrench and Tool Co., Baraboo, Wis. It is adjustable to various size nuts and automatically grips the nut when the handle is pulled, the grip increasing with the pull. The wrench may be used in a similar manner to a ratchet wrench as the grip releases instantly when the pull is released. It is made in several sizes from drop-forged steel, the jaws being machined and hardened.



ALLAN-DIFFENBAUGH WRENCH

Wiesman Safety Press Guard

William A. Wiesman, 14 N. Canal St., Dayton, Ohio, has placed on the market the press guard illustrated herewith.

The following claims are made for this guard: That it can be attached to the press without boring any holes; that it has only two moving parts and that it never touches the operator's hands unless they are on the die when the punch comes down.

WIESMAN SAFETY PRESS GUARD

Should the operator's hands remain on the die when the punch descends the guard will swiftly brush them aside and out of danger.

DIVISION OF LABOR. The editor, in his travels, was passing along the shoulder of a railroad embankment the other day when he came upon two small boys, aged, perhaps, six or seven years, industriously digging around the end of a discarded tie, bent upon some great engineering project known only to themselves; at least, *one* of them was industriously digging, while the other seemed inclined to "soldier" on the job, whereat the more industrious one complained loudly.

"—— ——!" responded the other little chap; "ain't I doin' all the swearin'?"

The A. S. M. E. Spring Meeting

BEGINNING with the departure from New York on special cars the Spring Meeting of the American Society of Mechanical Engineers was a peripatetic reception and general good time. From the point of view of shop men the papers presented at the professional sessions had but little interest as C. B. Lord's paper on "Tight-Fitting Threads for Bolts and Nuts," was the only strictly shop paper presented. The power engineers had a veritable feast, however, as there were many papers on the generation and handling of steam, gas and electric power.

The members from New York and vicinity left the Pennsylvania Station at 5:30 p.m., on Friday, May 21, and reached Chicago in time to dine at the Engineers' Club on Saturday evening. Here the Chicago members joined the party which left for Keokuk, Iowa, later in the evening. Sunday morning was devoted to an inspection of the dam and power house of the Mississippi River Power Co., the largest low-head water-power development in the world. Three views of different parts of the plant appear on this page and show the dam itself with the gate-opening traveler, the Government drydock and the power house and bridge over the river. The party moved on to St. Louis Sunday night, arriving in the morning to find that something had gone wrong with the reservations at the Statler Hotel, which was the official headquarters, and that most of them could not obtain accommodations. This was the only serious inconvenience of the trip, although there were minor ones due to delays on the road.

THE FIRST SESSION

Registration having been accomplished, the council got down to business and approved the applications for local sections in Akron and Columbus, Ohio, and the organization committees of several of the new professional sections met and prepared their reports. Of interest to machine-shop men will be the formation of a machine-shop section which has been authorized and about which we hope to have more definite information at a later date. Monday afternoon the Appraisal and Valuation Session discussed the following papers:

"Appraisal and Valuation Methods," David H. Ray.

"Rational Valuation—A Comparative Study," James Rowland Bibbins.

"Data on the Cost of Organizing and Financing a Public Utility Project," by the late F. B. H. Paine (contributed by Dean M. E. Cooley).

"The Construction Period," H. C. Anderson.

"Price Levels in Relation to Value," Cecil F. Elmes.

Monday evening everyone assembled to hear speeches of welcome by Governor Gardner of Missouri and Mayor Kiel of St. Louis and to see the moving pictures of the first transcontinental motor convoy, shown by E. R. Jackson, formerly of the Ordnance Department, U. S. A.

A double bill was on the boards for Tuesday morning, the new elevator code being discussed at one meeting while papers contributed by St. Louis engineers were presented at another. They were as follows:

"The Housing Problem in St. Louis," Nelson Cunliff.

"Industrial Housing—A Financial Problem," Leslie H. Allen, of Springfield, Mass. (paper presented by special request).

"Design of an Ore Fleet for the Upper Mississippi River," William S. Mitchell.

"Mississippi Valley Rivers' Transportation Activities," E. W. Schadek.

"Burning Eastern Coals Successfully on a Conveyor-Feed Type of Stoker," Lloyd R. Stowe.

"Tight-Fitting Threads for Bolts and Nuts," Chester B. Lord.

At noon everybody embarked in special electric cars supplied by the hosts and went over to the plant of the

Commonwealth Steel Co., at Granite City, to see how large steel castings are handled. The visitors saw the various processes in the production of cast-steel locomotive and tender frames, car platforms, etc. Some of them were very intricate. In fact, when Eugene Schneider and his French engineers visited the plant they said that such castings could not be made. The Commonwealth Co. opened its employees' cafeteria to the guests and fed them all in quick order.

The party adjourned to the Ashley Street Power Plant of the Union Electric Light and Power Co., where, after they had examined the plant, they were fed once more. A few had enough energy left to visit the adjacent shipyard of the St. Louis Boat and Engineering Co., where the first two of the fleet of self-propelled steel barges, mentioned in one of the papers of the morning, were on the ways and nearing completion.

A banquet was given at the Missouri Athletic Club in the evening and was followed by an illustrated address by Lieutenant-Colonel Miller, of the Ordnance Department, on "The German Defences on the Coast of Belgium."

Wednesday morning was devoted to the Aëronautical and Castings Sessions, at which the following papers were discussed:

Aëronautic Session

"Physical Basis of Air Propeller Design," F. W. Caldwell and E. N. Fales (illustrated by moving pictures).

"Analytical Theory of Airplanes in Rectilinear Flight and Calculation of Maximum Cruising Radius," A. Rateau, Hon. Mem. A. S. M. E.

"Aëronautic Instruments—General Principles of Construction, Testing and Use," Mayo D. Hersey.

"Flow of Air Through Small Brass Tubes," T. S. Taylor.

Castings Session

(Under Auspices of Sub-Committee on Foundry Practice)

"Malleable Castings," Enrique Touceda.

"Die Castings," Charles Pack.

"Aluminum Castings," Zay Jeffries.

"Steel Castings," John H. Hall.

"Gray Iron Castings," Richard Moldenke.

"Brass and Bronze Castings," C. H. Bierbaum.

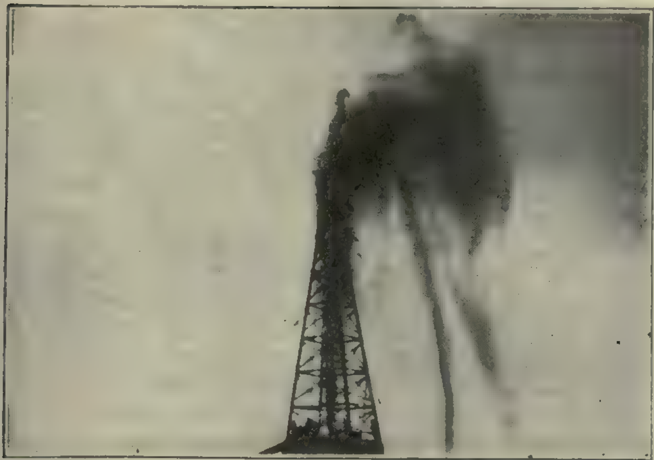
At the same time, many of the members left by automobile to visit the plants of the Heine Safety Boiler Co., Wagner Electric Co., and Ever Tite Piston Ring Co. All gathered at the Bevo Plant of the Anheuser-Busch Association for lunch and real Budweiser, plenty of it! After recovering from lunch the party broke up to visit the Busch-Sulzer Bros. Diesel Engine Co., the Mississippi Valley Iron Co. and the Coke plant of the Laclede Gas Co. In the evening a special entertainment was given at St. Louis' magnificent open-air theater.

On Thursday, joint sessions were held with the American Society of Refrigerating Engineers and the American Society of Heating and Ventilating Engineers, at which these papers were given:

"An Improved Form of Weir for Gaging in Open Channels," Clemens Herschel.

"Simplification of Venturi-Meter Calculations," Glenn B. Warren.

"Dissipation of Heat by Various Surfaces," T. S. Taylor.



"The Thermal Conductivity of Heat Insulators," M. S. Van Dusen.

(Contributed by A. S. R. E.)

"Ship Ventilation," F. R. Still.

Power and Combustion Session:

(Contributed by A. S. H. and V. E.)

"Pulverized Coal in Metallurgical Furnaces at High Altitudes," Otis L. McIntyre.

"Efficiency of Natural Gas Used in Domestic Service," Robert F. Earhart.

"The Separation of Dissolved Gases from Water," J. R. McDermet.

"Locomotive Feedwater Heating," Thos. C. McBride.

In the afternoon all hands boarded the excursion steamer "Saint Paul," which appears in one of the photographs on this page, and ploughed ten miles up the muddy river to the St. Louis Water Works at Chain Rocks. The new municipal docks, from which freight can be unloaded from cars directly into barges, were passed on the way up and are here illustrated. The cases shown on the docks are automobiles packed for overseas shipment. The untiring St. Louis members put on what amounted almost to a three-ring circus as a grand finale to their efforts in the way of entertainment. The Society voted the result an overwhelming success and decided that St. Louis must be the place where Southern and Western hospitality meet and combine to attain a maximum.

The Oklahoma Oil Fields

About seventy survivors met at the Union station at 6:30 and started for Tulsa, Oklahoma, and the oil fields. Here a train was finally discovered that had a bowing acquaintance with the time-table for it was only five minutes late at Tulsa, instead of the hours to which the Engineers had become accustomed. At Tulsa the local sections of the A. S. M. E. and of the American Chemical Society joined to insure the success of the meeting.

Tulsa had evidently heard of the ability of St. Louis at entertainment and decided not to be outdone for it was impossible for the visitors to spend any money on Friday and almost equally difficult on Saturday.

After breakfast and an address of welcome by the mayor automobiles appeared to take the guests around the town and out to the refineries. The first refinery visited was the Cosden, the largest of the independents. The refinery and some of the guests and their transportation are illustrated. The cars took the party to the Texas Refinery for luncheon at the cafeteria run by the company and after a short tour of the plant carried them back to the City Hall for a professional session which included the following papers.

1. "The Preparation of Motor Gasoline from Heavier Hydrocarbons," Prof. Fred W. Padgett, associate professor of chemistry, University of Oklahoma, Norman, Okla.
2. "Modern Water Purification," W. R. Holway, consulting engineer and former engineer in charge of Filter Plant, Tulsa, Okla.
3. "Refining of Crude Mineral Oils and the Action of Absorptive Clays on Same," F. C. Thiele, consulting chemist, Oklahoma City, Okla.
4. "Flow of Fluids Through Pipe Lines and the Effect

of Pipe Line Fittings," D. E. Foster, secretary, Mid-Continent Section A. S. M. E., of Foster and Gilmore, Consulting Engineers, Tulsa, Okla.

5. "Some Investigations in Briquetting of Oklahoma Bituminous Coal," Prof. James C. Davis, Dept. of Mechanics, College of Engineering, University of Oklahoma, Norman, Okla.
6. "Meta-Nitrophenyl Ether," Dr. Hilton I. Jones, secretary Oklahoma Section, American Chemical Society and professor of chemistry, Oklahoma A. and M., Stillwater, Okla.
7. "Mid-Continent Gasoline," Dr. Chas. K. Francis, chief chemist, Cosden Oil and Gas Co., Tulsa, Okla.
8. "Coal vs. Oil Cost Performance Chart," L. C. Lichty, Dept. of Mechanical Engineering, University of Oklahoma, Norman, Okla.

A banquet was given at the Hotel Tulsa in the evening at which addresses were made by Mr. Greer, of the Tulsa Chamber of Commerce, in which the great superiority of Tulsa to any other spot in the universe was very convincingly proved, and also by Dean Walker of the University of Kansas.

On Saturday the visitors were taken on a tour of the oil fields about Tulsa, where they saw the actual details of getting the oil from the ground and into the pipe lines. A few of the members missed the train to St. Louis by reason of waiting to see a well "shot," as they call it in the oil region. They were well repaid for the well turned out to be a good one, as will be seen from the illustration on the top of the previous page.

The other snapshots show President Miller and Secretary Rice in earnest conversation, the three hard-working assistant secretaries, Hartford, Bullock and Davies, and the group of engineers waiting for the well to produce. Local color was supplied by Barney Meyer, Deputy Sheriff and leading citizen of Tulsa. The illustration shows him hard at work.

Training is everything. The peach was once a bitter almond; cauliflower is "cabbage with a college education." Safety is only self-preservation, says the National Safety Council.

An Ingenious Die

By R. H. Kasper

This die was designed to form the leaves of hinges in such a way that, on curling the ends, the hole thus formed would be as nearly round as possible, as shown at *A* by the edge view of the finished spring leaf in Fig. 1. An edge view of the blanks, as produced by this die, is shown in Figs. 2 and 3. In a previous operation, the stock is punched out as shown at *B* and *C*, in Fig. 1, to produce the opposite leaves of the hinge. The round holes are for the attaching screws in the hinge, and the dotted lines show where the stock is pinched off. It will be seen that the end is formed to a quarter-circle and drawn out to a feather edge.

Fig. 2 shows the details of the die as it appears before the upper die descends, the stock being located by slipping the screw holes over the locating pins. Strong springs are placed under the pressure pads to keep the stock from moving while being formed. The upper pressure pad is set lower than the upper cutting edge so that it will tighten on the stock before it is cut. The upper cutting edge is made lower than the upper forming edge so that the stock will be cut before the forming begins.

In Fig. 3, the upper die has almost reached the bottom of its stroke. Blank *A* has been cut off and the stock is being formed by the forming edges. These forming edges are aligned so that, as the upper die descends, the stock is pinched off, drawing it out to a very fine edge. The forming edges are highly polished and are kept well oiled. It will be seen that this die produces two pieces on each stroke, one blank being cut off, while the other is pinched off. The blanks are then bent to the form shown at *A*, Fig. 1.

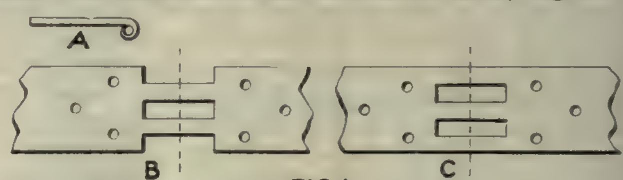


FIG 1

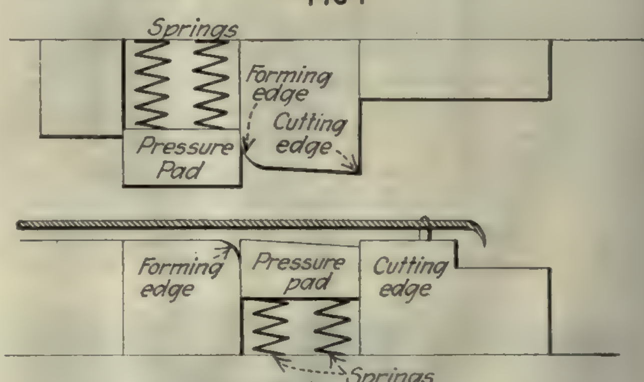


FIG 2

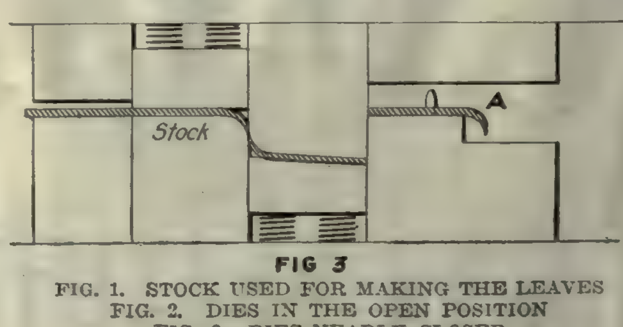


FIG 3

FIG. 1. STOCK USED FOR MAKING THE LEAVES
FIG. 2. DIES IN THE OPEN POSITION
FIG. 3. DIES NEARLY CLOSED

WHAT *to* READ
—*for the man in a hurry*

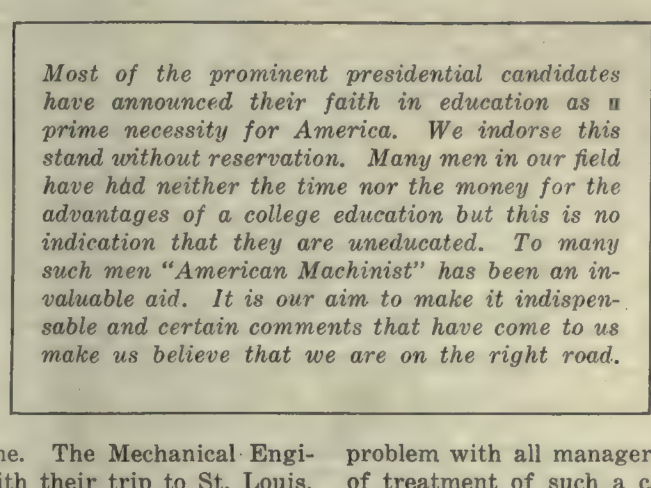
Suggested by the Managing Editor

> *Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.*

WE ARE still in the midst of the convention season. The Machine-tool Builders, the Dealers and Supply Men, the Chamber of Commerce of the United States, the Foreign Trade Association, the National Metal Trades Association, the American Gear Manufacturers and others have held their get-together sessions and gone back home to think over what they have learned.

But there are more to come. The Mechanical Engineers appear in this issue with their trip to St. Louis, the Keokuk dam and the Oklahoma oil fields, page 1327. There is also an account of the organization meeting in Washington of the Federated American Engineering Societies, on page 1314. We have given particular attention to this session because its results promise to be so far-reaching. The extracts from Mr. McGraw's speech on page 1311 indicate the part that the trade press can play in furthering the ends of this new federation. Our own feeling in the matter is set forth in the editorial on page 1313.

The first article deals with the manufacture of piston rings for internal-combustion engines, "the production of which reaches literally into millions." It is by Ellsworth Sheldon, who has been on the *Machinist* staff for nearly three years and has been writing articles for many more than that. Here he is at his desk as seen by one of the artists from our illustration department. Sheldon is one of the real dyed-in-wool New England mechanics and naturally has to be shown before he will pass the many practical letters that go through his hands. Any contributor who has tried to get away with a purely imaginary method of doing a shop job will probably appreciate the truth of this statement.



"A group of machines comprising a unit is able to produce quantitatively in accordance with the capacity of some one machine or group of machines of a type, either of which may form the minimum or restricting point in manufacture of the unit. This point is best known in shop practice as the neck of the bottle." Bottle necks are not confined to machine shops by any means and their elimination or expansion is an ever-present problem with all managers. Read Mr. Basset's method of treatment of such a case in the current instalment of "Modern Production Methods," page 1285.

The potentialities along industrial lines in connection with Italy were brought out rather strikingly by the war and our attention has been attracted in that direction of late. On page 1289 is an account of present conditions in Italy which is well worth consideration.

Mr. Langhammer's article on the testing of high-speed steels is concluded in this issue. His tests showed among other things the wide variation in the performance of commercial high-speed steels, the need for improvement in heat-treating methods and the necessity for heavy cuts to make the use of high-speed steel economical.

On page 1305 is the concluding installment of Colvin's "Producing 17,000 Connecting Rods a Day." The transformation sheet is reproduced and most of the operations illustrated.

Just a word as to future automotive articles may not be out of place at this time. The second part of Carhart's article on Liberty crankcases is still to come and Colvin has one on the Fordson Tractor connecting rods and another on the methods used in the shops of the Pierce-Arrow Co. Following them will come articles on gears, axles and bodies from leading manufacturers.

SPARKS FROM THE WOR

Valentine Francis

Annual Conference of U. S. Weights and Measures at Washington

The thirteenth annual conference of the Weights and Measures of the United States was held at the National Bureau of Standards, Washington, D. C., on May 24 to 27, 1920. Several hundred delegates attended, nearly every State being represented.

The convention opened Monday, the twenty-fourth, with an address from the president, Hon. S. W. Stratton, who is director of the Bureau of Standards. Following this came the report of the secretary, L. A. Fischer, chief, division of Weights and Measures, Bureau of Standards, and the various reports of the State delegates. A display and demonstration of manufacturers of liquid-measuring devices was provided for the inspection of the members of the conference.

The conference dealt largely with safety devices for gasoline pumps and apparatus for weighing bread. One of the most important addresses was delivered on Tuesday by the Hon. J. W. Alexander, Secretary of Commerce, and on Wednesday the conferees listened to another instructive talk from the Hon. Albert H. Vestal, chairman, Committee on Coinage, Weights and Measures, House of Representatives. Among the other addresses were: "The Effect on Commerce of Uniform Weights and Measures Legislation and Methods of Inspection by the States," by D. A. Gregg, Deputy State Superintendent of Weights and Measures of Texas; "Gasoline Pumps from the Standpoint of Safety," by A. R. Small, vice president, Underwriters' Laboratories; "Weight Standardization of Bread," by Charles C. Neale, State Commissioner of Weights and Measures of Minnesota; "Net Weight," by Charles G. Johnson, State Superintendent of Weights and Measures of California; "Standardization of Package Goods," by A. W. Schwartz, Assistant State Superintendent of Weights and Measures of New Jersey; "Weights and Measures Education in the Schools," by Joseph J. Holwell, Commissioner of Weights and Measures of New York City; "Machine Measurements in Retail Dry Goods Stores," by Dr. F. Reichmann, Former State Superintendent of Weights and Measures of New York City.

Safety Campaign

The Buffalo Safety Council has selected Sydney H. Coleman as manager. Mr. Coleman is starting a safety campaign in all factories here with a view of curtailing shop accidents.

Machine-Tool Combine Opens Office at Grand Central Palace

The Reed-Prentice Co., the Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co., opened on June 1, at Grand Central Palace, 5th Floor, in the International Machinery Exhibition, a direct sales office for handling their sales in New York.

The office is under the management of P. K. Dayton, who is well known in the machinery trade, having been connected with Niles, Bement, Pond Co. and Manning, Maxwell & Moore.

Their Cleveland store has already been opened at 408 Frankfort Ave., in charge of C. A. Severin, formerly of the Cleveland Tool and Supply Co., assisted by Charles Brandhill.

These three companies, which are controlled by the same financial interests, have adopted the policy of selling direct to the trade, thus insuring their customers prompt and efficient service.

Engineering Council Endorses National Public Works Dept.

The Engineering Council, 29 West 39th St., New York City,—a national organization, embracing the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Institute of Electrical Engineers, American Society for Testing Materials, and American Railway Engineering Association—has by a referendum endorsed the project to establish a Department of Public Works by the National Government.

Auburn Men Buy Malleable Iron Works

The Malleable Iron Works, New Britain, Conn., one of the oldest foundries in New England, has been sold to a company of capitalists from Auburn, N. Y., headed by George W. Bowen who is president of the Bowen Products Corporation of Auburn, Detroit, Minneapolis and Cleveland. Herbert Swift, secretary of the concern will remain with the company under its new management.

At the business meeting at which the transfer of the controlling interest took place, the following officers were elected: president, George W. Bowen; secretary, Walter H. Beck; treasurer, George W. Benham; assistant treasurer and general manager, Harold Putnam.

Malleable iron and gray-iron castings of a high-grade quality have been the output at the Malleable Iron Works, and this same grade of products will continue, but in a greatly increased volume, under the new management.

Convention of National Association for Corporation Schools

The National Association for Corporation Schools held its eighth annual convention at the Waldorf Astoria hotel from May 31 to June 4 inclusive, the meeting being very successful in regard both to its size and to the material presented by the committees.

The following officers were elected for the coming year: L. L. Park, American Locomotive Co., Schenectady, to succeed W. W. Kincaid as president; M. S. Sloan, Brooklyn Edison Co., Inc., Brooklyn, N. Y., first vice president; Harry S. Dennison, Dennison Manufacturing Co., Framingham, Mass., second vice president; Dr. Lee Galloway, New York University, N. Y. City, secretary; and F. C. Henderschott, New York Edison Co., N. Y. City, treasurer.

The newly elected executive committee consists of Sidney W. Ashe, General Electric Co., Pittsfield, Mass.; C. E. Bilton, Bilton Machine Tool Co., Bridgeport, Conn.; Carl S. Coler, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; W. W. Kincaid, Spirella Co., Niagara Falls, N. Y.; John McLeod, Carnegie Steel Co., Pittsburgh, Pa.; E. E. Sheldon, R. R. Donnelley and Sons Co., Chicago, Ill.; George N. Van Derhoef, Dodge Manufacturing Co., N. Y. City.; K. W. Waterson, American Telephone and Telegraph Co., N. Y. City,; F. E. Weakley, Montgomery Ward & Co., Chicago, Ill.; and J. H. Yoder, Pennsylvania Railroad Co., Altoona, Pa.

Eight business sessions were held; the subjects of the principal reports presented and the name of the chairman of the committee presenting each report are given in the following list: "Public Education," C. E. Shaw; "Employment," John C. Bower; "The Application of Physchological Tests and Rating Scales in Industry," Dr. H. C. Link; "Job Analysis," Harry A. Hopf; "Trades Apprenticeship", E. E. Sheldon; (Sec. I) "In Manufacturing" R. F. Carey; (Sec. II) "In Steel and Iron Plant Maintenance," C. E. Strait; "Foremen Training," F. C. Henderschott; "Health Education," Dr. F. S. Crum; "Labor Turnover," L. L. Park; "Profit-Sharing and Allied Thrift Plans," Harold M. Thurston; "Skilled and Semi-skilled Labor," Dr. A. J. Beatty; "Unskilled Labor and Americanization," J. E. Banks; "Office-Work Schools," Miss Harriett F. Baker; and "Executive Training," Dr. E. B. Gowin.

The evenings were devoted to social sessions, and a sightseeing trip around New York City was held on the last day.

LD'S INDUSTRIAL FORGE
News Editor

Big Pattern To Be Constructed at Mare Island

The Mare Island Navy Yard is now constructing the largest pattern ever built on the Pacific Coast. The pattern is for the casting of the rudder post of the superdreadnought "Montana." The casting will weigh thirty-eight tons and will measure 22 x 17 x 18 feet. Ten thousand feet of lumber will be used in making the pattern, and in shipment to Pittsburgh it will be necessary to send the pattern in parts, as it is too large for the ordinary flat car.

Engineering officers of the shipyards of the West are awaiting with interest the result of the task undertaken by the machinery division of the yard and the success attending the shipment of the pattern and the casting of the rudder post.

The foundry here is not large enough to make a casting of thirty-eight tons at one pouring. This heavy work will be done at the private plant, but the intricate work in connection with the pattern construction is being handled in a very capable manner and will be ready early this month.

Convention of American Boiler Manufacturers

The American Boiler Manufacturers' Association held its thirty-second annual convention at the French Lick Springs Hotel, French Lick, Ind., on May 31, and June 1 and 2, 1920. At the opening meeting, held on the morning of May 31, the principal speakers were E. R. Fish and Charles E. Gorton, who reported on the "American Uniform Boiler Law Society," and David Moffat Myers, New York City, who presented a paper on "Fuel Conservation." At the evening meeting, the principal papers were "Electric Welding," by D. C. Alexander, Jr., president of the Quasi Arc Weld-trod Co., Brooklyn, N. Y.; "The Advantages of Co-operation between Boiler Manufacturers and Boiler Insurance Companies," by S. F. Jeter, chief engineer, Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn.; and a report on definitions and terms by E. C. Fisher, of the Wickes Boiler Co., Saginaw, Mich.

Among the speeches delivered at the executive session held on June 1 were the "Necessity of Establishing a Code of Ethics in the Boiler Manufacturing Industry," by Geo. W. Bach, and the recommendations of the executive committee on future activities, by A. G. Pratt. The morning of June 2 was devoted to the installation of officers and to a discussion of the problems encountered in boiler manufacture.

U. S. Exposition at Buenos Ayres

An exposition of United States manufacturers at Buenos-Ayres has been arranged for the month beginning Nov. 15, 1920. The object of the exposition is to introduce American manufactures to the public of Argentina and surrounding countries. Buildings for the purpose have been furnished by the government of Argentina, and space is available for about 500 exhibits. Detailed information can be obtained from the American National Exhibitions, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

What's Ailing America These Days?

From the *Fargo Forum*

Too many diamonds, not enough alarm clocks.

Too many silk shirts, not enough blue flannel ones.

Too many pointed-toed shoes, and not enough square-toed ones.

Too many serge suits and not enough overalls.

Too many satin-upholstered limousines and not enough cows.

Too many customers and not enough producers.

Too much oil stock and not enough savings accounts.

Too much envy of the results of hard work and too little desire to emulate it.

Too many desiring short cuts to wealth and too few willing to pay the price.

Too much of the spirit of "get while the getting is good" and not enough old-fashioned Christianity.

Too much discontent that vents itself in mere complaining and too little real effort to remedy conditions.

Too much class consciousness and too little common democracy.

Construction Materials and Machinery in Brazil

A report just issued under the above title by the Bureau of Foreign and Domestic Commerce points out the fact that, with its vast undeveloped territory and its immense resources, Brazil offers a market for all kinds of construction materials and machinery, not only in the immediate future but for an indefinite time to come.

Copies can be obtained by applying in person to any of the District or Co-operative Offices of the Bureau of Foreign and Domestic Commerce, or by sending 15 cents to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Final Declaration of the Seventh National Foreign Trade Convention

The Seventh National Foreign Trade Convention, composed of upward of 2,500 delegates from every part of the United States and many foreign countries, assembled in San Francisco from May 12 to 15, 1920, to consider the problem of foreign trade arising out of the present position of the United States as a creditor nation. As the authoritative voice of the foreign commerce of the nation, it presents its final declaration on questions of vital import to the future prosperity of our country, and commends to the careful consideration of Government and the people of the country these opinions and recommendations.

Final Declaration

The United States as a creditor nation should afford to other nations every fair and reasonable opportunity to sell their products to us, especially of raw materials, without detriment to existing industries.

(*a*) To permit of the liquidation of the obligations of the debtor nations;

(*b*) To promote exchange of products in view of the impossibility of their making all payments in gold;

(*c*) To provide return cargoes for our merchant marine; and

(*d*) To relieve the demoralization of industry and exchange in Europe.

Every proper measure should be devised to encourage our manufacturers and producers to exercise the full employment of all their facilities, (*a*) to satisfy home demand and (*b*) to provide a surplus for foreign consumption, for the occupation of our merchant marine, and for the provision of supplies to foreign nations more than ever dependent on us under present conditions for articles of necessity and sustenance, or for materials to rehabilitate their depleted stocks and war-worn industries.

As collateral influences in this program of expansion of exports and imports, it is important that (*a*) the interests of producers generally should be safeguarded and maintained on a fair and equitable basis; (*b*) that production should be increased to the maximum in order to restore normal conditions of employment and living; (*c*) that our banking institutions should be afforded every reasonable opportunity and protection in their efforts to expand their services to foreign commerce and in enlisting the interest of American investors in foreign securities, with united action to this end, if possible, by exporters, bankers,

manufacturers and other producers of this country (*d*) that a greater number of American merchandising houses should be established abroad. They would sell our goods, buy goods and create a better trade and financial situation

Many associations have been formed under the Webb-Pomerene act resulting in expansion of American exports. As time goes on supplemental legislation may be necessary to further develop international trading.

The Government should maintain as a principle of foreign policy that American enterprise abroad is entitled to the same measure of protection from the Government of the country where domiciled, that foreign enterprises domiciled in the United States receive from this Government.

The Americal Merchant Marine

Our Merchant Marine should revert as soon as practicable entirely to private ownership and operation as contemplated by the act creating the Shipping Board. We urge that legislation be passed promptly providing for the sale of Government-owned tonnage on terms uniform to all buyers, having regard to the current cost of building vessels of similar type and tonnage in American shipyards. Unsold ships should be chartered at current market rates for world tonnage without restriction as to trade routes.

Owing to the insufficient number of passenger vessels in the Trans-Pacific and South American trades, measures should be taken to relieve the situation by promptly utilizing available passenger vessels in their trades.

The investigation of the American navigation system which the Shipping Board was directed by its organic act to effect should be completed with the least possible delay, and such revision and improvement made as will enable the operation of the American Merchant Marine on a competitive basis.

Shipbuilding has become a great industry and we should build for the world's markets, as well as for our own requirements. American ships were once among the largest of our exports and there is no reason why they should not be so again. We sell locomotives, freight cars, agricultural implements and other manufactured products in all the markets of the world. A steamship is a commodity of commerce like any other product of the mechanic art, and labor should be employed in the building of ships for export as well as in the production of shipbuilding materials for export.

Marine Insurance

The convention considers that this important adjunct to foreign commerce can be best carried on by private enterprise. The State and Federal Governments are urged to take steps to remove those disabilities caused by non-uniformity of state laws and excessive taxation which place American insurance companies at a disadvantage with the foreign insurance markets with which they must necessarily compete.

The vast market which the United States offers to other nations on a basis of equality; the supplies of American raw materials exported without taxation or discrimination, and the large tonnage available in our ports to foreign shipping on equal terms with our own, entitle American export and import trade to equality of treatment in all foreign markets.

To insure such equality of treatment the American tariff, whatever its underlying principle, should provide for additional duties on imports from nations discriminating, by tariffs or administrative practices, against the trade of the United States.

For the non-partisan and scientific ascertainment of the effect upon our commerce of the world-wide readjustment of commercial treaties, revision of tariffs and erection of new preferences and discriminations, the appropriations for the maintenance of the United States Tariff Commission should be increased, and its investigations supported by Congress and the business public.

Efficient rail and inland waterway transportation is no less a part of export and import trade than ocean shipping. Sound public policy supporting private operation of the railways is imperative. Continued development of inland waterways is necessary to the perfection of economic trade routes.

Cables, Wireless and Mails

Conditions of communication with foreign countries are intolerable. The delays of foreign cables and mails hamper commerce and greatly increase the cost and risk of doing business. Additional cable facilities and the extension of wireless telegraph service are imperative.

The expansion of our foreign trade can be greatly facilitated by the further establishment of American chambers of commerce abroad and foreign trade sections of domestic commercial organizations. Effective assistance already has been afforded by these instrumentalities in promoting reciprocal relations, commercial arbitrations and adherence by their nationals to the best trade practices.

The establishment of foreign trade zones at the principal American ports, where products from all countries can be assembled, classified, manufactured and reshipped, will be of great assistance in developing full cargoes both ways, so essential to the success of the new American Merchant Marine.

The activity of the Post Office Department in extending international parcel post facilities for the United States is highly commendable. It is hoped that this activity will be continued until the service has been established with all nations and colonies.

The State Department should have adequate and competent representation in all lands, and especially in those new nations sprung from the reorganization following the war. Its representatives should be properly compensated and housed, and equipped with the means for effective service.

Legislation should be enacted establishing both the Diplomatic and the Consular Service on a basis which will attract competent and ambitious young men into our foreign service as a permanent vocation.

The commercial attaché and trade commissioner service of the Bureau of Foreign and Domestic Commerce should be materially expanded and placed upon a permanent basis with an adequate scale of compensation.

There should be such reorganization of the foreign service of the Government as will eliminate any duplication of effort, and enable it continuously to perform that effective work essential to the fullest development of our foreign trade.

Scientific Educational Preparation

Only in such measure as we equip our business agents and official representatives with accurate knowledge of foreign markets, with practical knowledge of foreign languages and with a wide knowledge of the economic, social and political conditions prevailing among the peoples of other lands, may we expect them effectively to represent us in official life or successfully promote the expansion of our commerce.

The convention, therefore, emphasizes the need of scientific educational preparation for overseas commerce by which the youth of the land may be fitted to cope with and solve intelligently the problems growing out of our increased participation in international affairs. Such training is an essential and fundamental factor in any successful foreign trade policy.

Federal Incorporation of American Companies in China

American companies in China must operate under American laws, owing to extra-territorial treaties with China. The present American laws do not give our corporations the same opportunity as corporations of other nations with which we must compete for trade in China. Under the Hongkong ordinances our British competitors operate as China companies without income tax. American companies that have organized under the Hongkong ordinances are compelled by recent British "Orders in Council" to replace American directors and executives by British.

Bill now pending in Congress, if enacted, will permit such companies to return to the protection of the American flag and will encourage the formation of new American enterprises in China for further development of foreign trade.

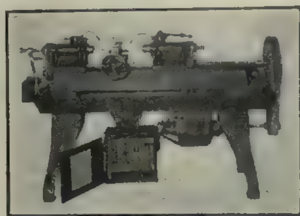
These bills provide for Federal incorporation, and will enable American companies to compete with corporations of other nationalities on even terms with respect to taxation.

A treaty of peace safeguarding every fundamental principle of the Government of the United States and protecting the rights of American citizens should be effected without delay.

Condensed-Clipping Index of Equipment

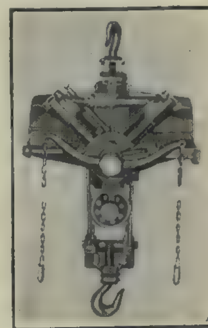
Patented Aug. 20, 1918

Tapping Machine, Double End
Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich.
"American Machinist," May 27, 1920



The machine is built with beds of different lengths, which give distances between the ends of spindles of 12, 24, 36, 48 or 60 in. Maximum size of tap used is $\frac{5}{8}$ in.
Machine is equipped with a 3-hp. reversing motor. Gear reduction is incorporated in the drive. When taps have entered work to proper depth an adjustable stop operates switch and reverses the motor. When entering taps into the work they are fed forward by hand, using lever on top of the right-hand head, which operates through a double rack, causing both spindles to feed forward equally.

Hoist, Thor Pneumatic Motor
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.
"American Machinist," May 27, 1920



The hoist is equipped with a worm-gear drive and it is claimed that it will not overhaul even should the air supply be cut off. An automatic stop is provided which shuts off air before cable is fully wound or unwound. This stop can be set for any length of lift within the capacity of the hoist.
Specification: Built in six sizes, 1, 1-x, 2, 2-x, 3 and 4. Capacity, $\frac{1}{2}$ to 2 ton. Lift, 10 to 40 ft.; speed, 8 to 32 ft. per min. Shortest distance between hooks, 30 to 36 in. Weight, 225 to 265 lb. Cu.ft. of air per ft. of lift, 1.9 for models 1 and 1-x; 3.8 for models 2 and 2-x; 7.6 for models 3 and 4.

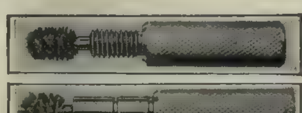
Planing Attachment, Elgin
Elgin Tool Works, Inc., Elgin, Ill.
"American Machinist," May 27, 1920

The attachment is arranged to be mounted on slide rest and to be used for such work as cutting keyways, small internal gears, slotting, etc. Stroke is adjustable from $\frac{1}{8}$ to 1 in., and feed is regulated by a large knurled knob. The ram housing is graduated in degrees and may be set to cut clearance inside of dies. A clapper is provided to clear the tool on the return stroke. Either round or square tools can be used. Slots in the base, matching the slide-rest slot, provide for different settings of the attachment.

Leveling Machine, Gang Slitting and
Yoder Co., Walworth Ave. at West 58th St., Cleveland, Ohio.
"American Machinist," May 27, 1920

The slitted strips produced are perfectly smooth and straight, without any warping or twisting. When using the adjustable cutters, strips as narrow as $2\frac{7}{8}$ in. can be cut in metal up to $\frac{1}{8}$ in. thick. On thicker sheets the minimum width of strip that can be cut is 3 in. When strips narrower than these are required, solid cutters and spreaders are used. The machines are made in various sizes to accommodate a wide range in width and thickness of material.

Gage, Brush Pilot
Brush Pilot Gage Co., Springfield, Mass.
"American Machinist," May 27, 1920

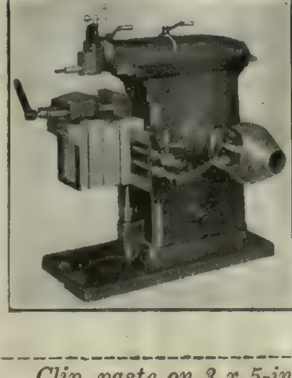


The brush serves to clean the dirt from the hole to be gaged and it is claimed that, thus equipped, the life of the gage is lengthened by not coming in contact with a hole charged with gritty substances. The bristles are slightly varying lengths so that when the brush is used in connection with a thread gage they tend to clean out the thread at both top and bottom.

Switch, Harvey Steadfast
Harvey Machine Co., Los Angeles, Cal.
"American Machinist," May 27, 1920

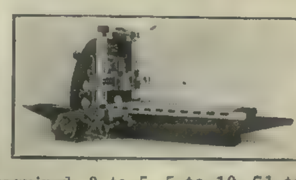
Is intended for use with a.c. motors of from 1 to $7\frac{1}{2}$ hp. and 110, 220, 440 and 500 volts. The switch is actuated by an oscillating magnet, having eccentrically formed pole-faces mounted within a laminated keeper which has similarly formed faces. The oscillating magnet exerts a uniform pull around a central shaft through an arc of 75 deg. and provides movement and power to operate the mechanical elements of the switch. Push-button stations may be arranged in convenient positions, while the switch is installed on a wall.

Shaping Machine, Whip 16-in.
Whip Machine Tool Co., Sidney, Ohio.
"American Machinist," May 27, 1920



The head is graduated for accurate angular setting. Down-feed screw is provided with a micrometer collar graduated to 0.001 in. Automatic cross feed can be adjusted for different feeds while machine is running. Stroke can also be adjusted without stopping machine. Vise is equipped with tool-steel jaws. Outboard table support can be furnished. Specifications: Stroke, $16\frac{1}{2}$ in. Table travel, horizontal, 20 in., vertical, 13 in. Maximum distance table to ram, $16\frac{1}{2}$ in. Down feed, 6 in. Table; width, 10 in.; length 16 in.; depth, 12 in. Ratio of gearing, 6 to 1. Shipping weights; domestic, 1,850 lb.; boxed for export, 2,000 lb.

Planer, Multi-Speed
Joseph T. Ryerson & Son, Chicago, Ill.
"American Machinist," June 3, 1920



Specifications: Built in 24-30-36-42- and 48-in. sizes. Respective widths between housing, 25, 31, 37, 43, and 49 in. Maximum distance table to cross rail, 25, 31, 37, 43 and 49 in. Length of working surface of tables for standard machine 6, 6, 8, 8, and 10 ft. Cutting speed, 25, 30, $37\frac{1}{2}$, and 45 ft. per minute. Return speed, 120, 120, 100, 100, and 100 ft. per min. Horsepower required, 3 to 5, 5 to 10, $7\frac{1}{2}$ to 15, 10 to 20, and 15 to 25; elevating motors, 1, 2, 3, 3, and 5. Total width without motor 5 ft. 9 in., 6 ft. 7 in., 7 ft. 9 in., 8 ft. 3 in., and 8 ft. 9 in. Total height including motor, 6 ft. 8 in., 7 ft. 3 in., 8 ft. $3\frac{1}{2}$ in., 8 ft. $9\frac{1}{2}$ in., and 9 ft. $3\frac{1}{2}$ in. Air pressure required 80 to 100 lb. Net weight, 8,000, 11,000, 18,000, 23,000, and 32,000 lb. Weight boxed for export, 9,200, 12,500, 20,500, 26,500, and 36,500 lb. Boxed for export 220, 250, 500, 750, and 1,000 cu.ft. Net weight additional for each 2 ft. length of table, 1,200, 1,600, 2,000, 2,500, and 3,000 lb.

Clip, paste on 3 x 5-in. cards and file as desired

Charles Ethan Billings

Charles Ethan Billings, of Hartford, Conn., chairman of the board of directors and former president of the Billings & Spencer Manufacturing Co., Hartford, Conn., died on June 4 after a long illness. He leaves a wife, two sons and one daughter. One of his sons, Frederick C. Billings, is president and general manager of Billings & Spencer.

Mr. Billings was born in Wethersfield, Vt., December 5, 1835, the son of Ethan F. Billings, a blacksmith of Windsor, Vt. After receiving a common school education, he became an apprentice in the machine works of the Robbins & Lawrence Co., of Windsor, Vt., serving for three years in the gun department. He entered the employ of the Colt's Patent Firearms Manufacturing Co. in 1856 as a toolmaker and die sinker. In the early stages of the Civil War, he was employed in the gun factories of E. Remington & Sons, of Ilion, N. Y.

From 1863 to the close of the war he was making drop forgings for the U. S. Government. In fact Mr. Billings was one of the first in the country to use drop hammers in the manufacture of arms. He perfected the forgings that were universally used in the manufacture of pistols for years after.

During the middle period of the civil war when the pistol business was at its height, and large contracts were coming in from the Government, it was often necessary to run the shops nights, much to the discomfort of the neighboring inhabitants, who soon discovered that the continual pounding of drop hammers was not conducive to peaceful slumbers nor pleasant dreams. No doubt Mr. Billings' drop hammers had considerable to do in enhancing the growth of the so-called "Peace Party" in the North.

Of course, the noisy hammers called forth a great deal of indignation from the surrounding neighborhood, and it was not long before a protesting delegation composed of the mayor and some prominent citizens waited upon Mr. Billings. The mayor, who was a son of Ireland and also a copperhead, began a somewhat lengthy speech deprecating the war in general, and complaining especially that the roar of Southern battlefields should be brought so close to their Northern ears in the "noises" that issued nightly from the shops. Mr. Billings briefly stated that he had orders to run his shop night and day until his contract was completed. "Orders," exclaimed the mayor, "Be pleased to understand, sir, that all orders in this town come from me. I should like to ask you sir, who gave you these orders?" "My orders," replied Mr. Billings, "come from Abraham Lincoln." It is needless to say that the mayor subsided with his retinue, and that the "war" in the neighborhood continued until the peace of Appomattox.

Mr. Billings returned to Hartford at the close of the war and was superintendent of the manufacturing department of the Weed Sewing Machine Co. for three years. In 1869, the Billings & Spencer Co. was organized, C. M. Spencer being the other member of the firm. The company was incorporated to manufacture drop forgings and develop various improvements and inventions in the numerous small parts of machinery, which, through the inventive genius of Mr. Billings, became of great value to the world.

He was the inventor of a score of valuable articles now in general use, such as drills, chucks, pocket knives,

CHARLES ETHAN BILLINGS

wrenches. He was a former president of the American Society of Mechanical Engineers and a member of its Honorary Council.

Mr. Billings was also active in the civic affairs of Hartford, serving for twelve years as President of the Board of Fire Commissioners and several terms as Councilman and Alderman. He was President of the State Savings Bank of Hartford and a Trustee of the Hartford Trust Company. He was a thirty-third degree Mason.

Personals

At the regular quarterly meeting of the board of directors of the Stanley Works, held recently PHILIP B. STANLEY and ROBERT N. PECK, of the Stanley Rule and Level Co., recently purchased by the Stanley Works, were elected to be vice presidents and given a seat on the board of directors.

DR. ALPHONSE A. ADLER has resigned from the Polytechnic Institute of Brooklyn to devote his entire attention to his consulting practice in New York City in power and industrial plant engineering. A testimonial banquet was given to him on June 5.

PAUL HOFFMAN has been appointed district manager of the Norton Co., Worcester, Mass., grinding machine division, with offices at 324 Bulletin Bldg., Philadelphia.

W. J. FULLER, who has been American manager for Alfred Herbert, Ltd., has resigned, and has been appointed American general manager for Harper, Bean & Co., automobile manufacturers of Great Britain.

H. A. PRATT has resigned his position as manager of the industrial department of the Westinghouse Electric Co., of 165 Broadway, New York, and is now associated with the Atlantic Elevator Co. His successor is U. R. Marshall.

H. J. BEARDS, formerly with the local office of the Hart-Parr Co., Charles City, Iowa, has been appointed temporary divisional manager of the Hart-Parr for Ohio, Michigan and Ontario, Can. His headquarters will be at Toledo, Ohio.

Business Items

The Clark Equipment Co., of Buchanan, Mich., has opened a new plant in addition to its plants at Buchanan and Battle Creek. The latest plant is located at Berrien Springs, Mich., with D. A. McIntosh as superintendent.

It has been announced that the Simonds Saw Co., of Fitchburg, Mass., has purchased the plant of Hunter Arms Co., at Fulton, N. Y. The transaction is said to involve between $250,000 and $300,000.

L. M. Baker, supervisor of sales of the motor equipment division of the Hyatt Roller Bearing Co., has resigned to take over the exclusive representation of the Ditmer Gear and Manufacturing Co., in the state of Michigan. Mr. Baker's headquarters will be located in Detroit.

The Sheldon Axle and Spring Co., of Wilkes-Barre, Pa., recently published the first issue of its shop paper, the *Sheldon News*. It will be issued each month to all employees.

Forthcoming Meetings

The American Drop Forge Asssociation will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting durring the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

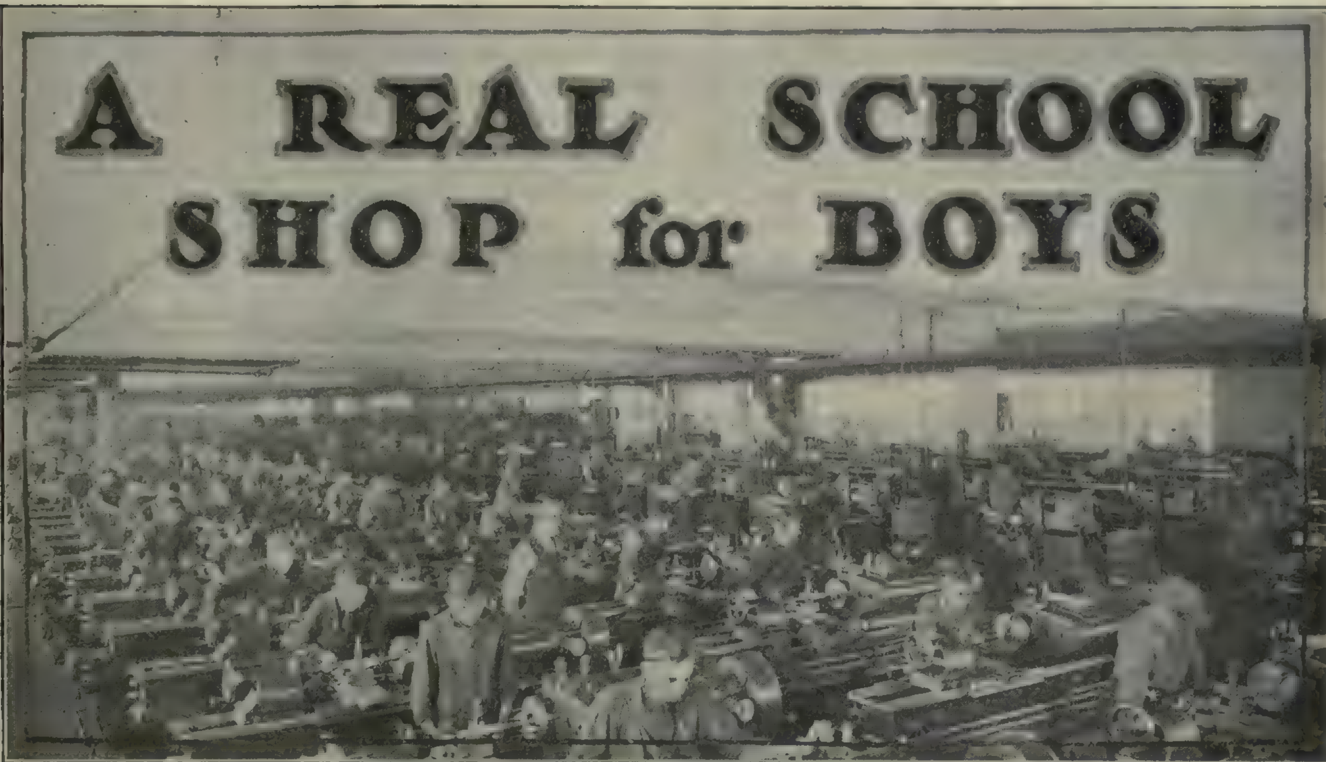
The Gas Products Association will hold its summer convention at Mackinac Island on June 21 and 22. A boat will leave Chicago on June 19 for the island. The association is composed of the leading manufacturers of electrolytic oxygen and hydrogen. D. B. McCloud, 140 South Dearborn St., Chicago, is secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25, inclusive.

The American Steel Treaters' Society will hold a convention in Philadelphia, Sept. 14 to 18. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is the secretary.

June 24, 1920 American Machinist Vol. 52, No. 26

A REAL SCHOOL SHOP for BOYS



BY FRED H. COLVIN
Editor, *American Machinist*

While thoughtful manufacturers and engineers have been more or less concerned over the lack of an adequate number of good mechanics, the war emphasized the need in unmistakable terms. It showed that we not only lacked toolmakers but also a supply of men sufficiently versed in the fundamentals of machine-shop work who could be well trained in a short time. Here is a school which is training boys to supply this need and paying them while they learn. It is a method and a school which is worth your serious consideration.

EVERYWHERE we go we hear the same story about the lack of good toolmakers, or of high-class mechanics upon whom you can depend to turn out accurate work in a reasonable time. Lack of tools and fixtures and the delay in getting them is holding up large enterprises today in more than one industrial city.

All sorts of reasons are given and the blame laid on everything from the administration to German propaganda, not omitting labor unions and general unreasonableness all along the line. But when all is said and done, the fact remains that we have not been training mechanics systematically for fifteen or twenty years; and as the farmer who complained of a poor crop when he had failed to plant his potatoes in the Spring would receive scant sympathy, so must we face the music squarely and see how to repair the error which is already of long standing.

We have been devoting all our time to mass production, taking green hands from the farm and the street-sweeper's gang and teaching them one operation. But we have quite overlooked the fact that we were using up our supply of toolmakers in making so-called fool-proof fixtures for the green hands to use. The demands of war brought this home to us very forcibly but comparatively few really woke up to the absolute need of consistent and persistent training in a systematic manner. The needs of industry do not seem to appeal as strongly as they should unless directly coupled with immediate profits, in spite of the fact that large profits have been made. It is also possible that some expenditure for real education might reduce the taxable profits more legitimately than some other methods and at the same time confer a direct advantage on the country as a whole as well as on industry in particular.

In spite of the fact that he is one of the largest trainers and users of semi-skilled operators, Henry Ford has inaugurated a plan in connection with his home plant in Detroit, Mich. This comprises a real shop school, an entirely separate institution, housed in a separate building and independent of the Ford Motor Co. The headpiece and Figs. 1 and 2 give an idea of the way in which it is handled.

It takes boys from 12 to 15 years of age and keeps them until they are 18 years old. The boys are picked from those who, on account of family finances, would have to leave school at an early age. As might be expected, most of the boys have lost a father or mother, or in some cases both. The only requirements are that the boy shall really want to learn, shall be fairly industrious and be capable of promotion. One boy is a Filipino, who ran away from home because his father would not let him go to school. He found his chance in Detroit, 8,000 miles away, and is making good. Among the nations represented are China, Italy, Mexico,

Russia and many others. And they are all laying the foundation for good mechanical training.

From the beginning the boy gets both classroom and shop work and furthermore, he gets 19 cents an hour, or $9.12 for a 48-hr. week. He also gets paid for holidays, a three-weeks' vacation in the summer and a special payment of two dollars per month to go into a personal saving fund. The only string on this is that he cannot draw the money out without the approval of the director; the idea being to start him into the habit of having a savings account without taking it out of the earnings which aid in the family support in nearly every case. The classroom gives the younger boy practically the same studies he would receive in public school up to the eighth grade. After that stress is laid on mechanical subjects such as drawing, mathematics, physics or mechanics, a little metallurgy and chemistry such as mechanics and good toolmakers should know. Laboratories are being fitted for this work.

FIG. 1. IN THE SCHOOL ROOM

FIG. 2. IN THE SHOP

All of this time, however, the boy is getting practical experience in real shop work. There are no "exercises" which are to be machined and scrapped, but every job has a commercial use. In the beginning, small parts of Ford cars are worked on to give experience in drilling, turning and the like. If the parts pass inspection, and it is the same rigid inspection which accepts or rejects parts of the regular product, they are purchased by the Ford Motor Car Co. at the same price it costs to make them in their own shop.

Toolmaking Work

When the boy gets experience in the use of several machines in the production department he graduates into the advanced or tool department. Here he gets away from the production work and begins to make direct progress in tool making, beginning of course on simple work, but all are genuine pieces which are needed in the great Ford plant. The tool-making rooms of the Ford Motor Co. afford a constant supply of material for the boys to work on. Parts of jigs, fixtures, and tools of various kinds are always available and are so selected by the instructors as to afford the kind of experience needed. For this is a school in every sense, production being a side issue and only adding interest in letting the boy know that he has done something worth while.

Some idea of the equipment may be had from the fact that there are about eighty special Reed-Prentice geared-head engine lathes each driven from a motor in the base under the head. Future equipment will include lathes of other makes so as to give advanced students experience on a variety of types. There are also milling and other machines found in all the toolrooms. One of the objects of this school is to give such fundamental training that the boys will be able to become good toolmakers with a few years' experience in the toolroom after they leave the school at 18 years of age. Some will go into the regular apprentice course which gives them experience in all the different departments. These will form a body from which shop foremen and other executives can be chosen, so that there promises to be a supply of practically trained young men for this company as the years go by. And the inducements offered are usually sufficient to hold those who are most valuable.

The Line of Advancement

Getting back to the boy who, as he enters the school, starts at 19 cents an hour. He receives monthly marks in classroom and shop industry. The industry involves *conduct* and *effort* and only these two things. *A* is excellent, *B* is good, *C* is fair and *D* is poor. If a boy receives a mark of *good* in both shop and class his rate for the next month is one cent more, if *fair* the rate is unchanged, if *poor* it is reduced one cent, but never below 19 cents. The maximum is now 27 cents.

Actual production or skill in either shop or class does not affect the rate. It is figured that if a boy tries, production will be a byproduct. The results show that a large number of boys respond to the treatment.

By the time this article is printed each boy will be receiving a hot lunch for which there will be no charge. This idea of paying boys while learning the trade was always a pet plan of our lamented Prof. John E. Sweet,

and it would have pleased him greatly to see it worked out as in this case.

Another interesting feature in connection with the school is the fact that a number of the boys come from the Juvenile court, where it is recognized that many young delinquents are unfitted, temperamentally or otherwise, for continuous study. The combination of study and work, especially the kind of work which shows them the real usefulness of their studies, offers a safe and constructive outlet for their pent-up energies. This has been brought out a number of times in various places, notably in the Milwaukee Trade School, which had cases where boys who were almost incorrigible in school were apt students where real work was concerned.

It is also a question as to whether any boy or girl will not study better and understand the problems better if they can work them out in actual practice to see how they apply. Mathematics, which seem dry and unnecessary, take on a new interest when they see, in solid metal or otherwise, just what the calculations are for and how they work out.

All this has no connection with the educational work done to teach English to the foreign-born, or other advanced work which will be treated in a later article. It is simply an earnest attempt, now about three-years old and embracing 330 boys at the present time, to aid in increasing the supply of good mechanics which we so sadly need.

Looking Backward

By Harry B. Stillman

Not long ago I overheard two gray-haired mechanics discussing regretfully the passing of the good old days of twenty-five or thirty years ago.

I remember well the period to which they refer. I also recall a number of unpleasant features of those earlier days that I am mightly thankful do not exist in the well-managed factory of modern times. In fact I believe that it wouldn't be far out of the way to state that the majority of shop men who have been "through the mill" have little inclination or desire to drop back to the conditions of a quarter century ago.

Many changes have taken place in shop management since that time; none more remarkable than the improvements in working conditions and in the interest shown by the employer in the well-being of his help. Human interest in and concern for the employee's welfare is rapidly taking the place of the indifference and unconcern of the past. To prove my statements one has but to observe how at the present time if a man is found unsuited to his job, or his job is found unsuited to him, he is given a chance to "try out" on other work.

By a little manouvering it is often found that John Smith, who is a poor grinder, turns out to be a good lathe-hand; a man with the necessary patience and a natural aptitude for close assembling is frequently discovered in the chap who is just "getting by" at kicking a blanking press, etc.

In the so-called "good old days" there was very little attention paid to square pegs in round holes. If, for example, Bill Jones, who tips the scales at 127 lb., was hired to wheel heavy castings, and after a few days' trial grumbled because of the physical exertion required, he was very careful that his mutterings did not reach the foreman's ear. The boss, as Bill was well aware, had no scruples in telling a man what he could do if he didn't like his job, and usually it was the very thing a man did not choose to do. A job in those days didn't grow on every bush, so Bill wisely refrained from pressing the matter and continued to wheel castings.

Nowadays there is hardly a plant of any size that doesn't keep a watchful eye on the general health of its employees. During the fall and early last winter fully 15 per cent of the help where I am employed were suffering with boils. It was a trouble for which the company was in no way to blame, yet every boil victim in the factory was given proper medical attention gratuitously, if circumstances permitted—(naturally, there *are* moments when one thus afflicted wishes to be alone). It was then that I had good reasons to be thankful for the present-day policy of allowing an employee to change his work occasionally, because at that time I found it much more convenient to stand at my work than to sit down.

Particularly would I call the attention of the past-loving advocates to the up-to-date facilities of the modernly equipped factory for the prompt and efficient treatment for wounds and injuries. Let us say an employee cuts his finger. He reports immediately to the factory hospital, or else is taken in charge by a white-clad nurse, who with experienced hands bathes the wounded member and deftly wraps it in antiseptic gauze. In a case of this kind twenty-five years or so ago the wounded finger would have been dressed with a moist chew of tobacco, held in place by a strip torn from the first rag that came to hand; a rag which had probably been used for a number of odd things before being utilized as a bandage. The finger would generally heal —in time—but at what risk?

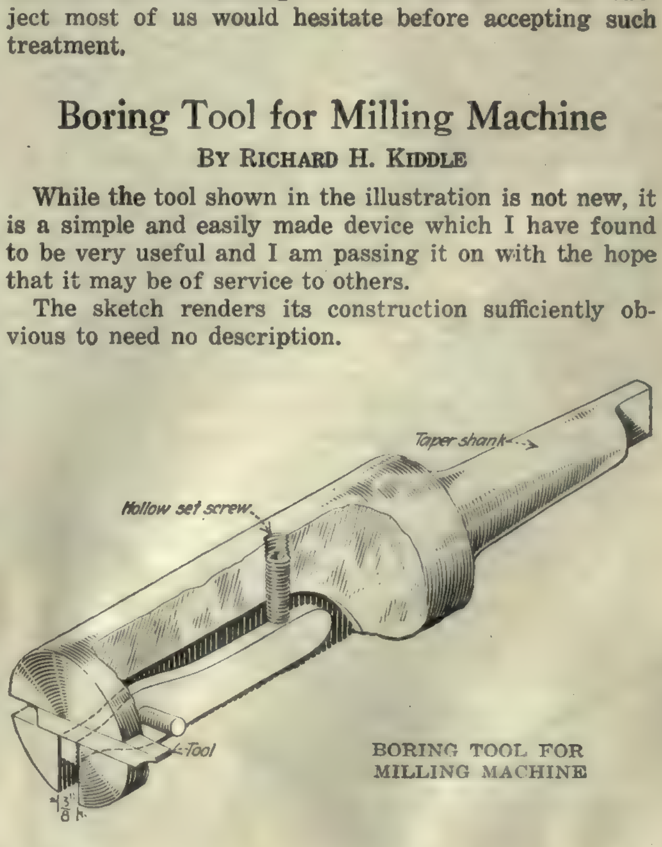
There may be a few champions of the olden days who will chuckle to themselves and say that the partly-chewed tobacco "cure" was quite as effective as the antiseptic wash and sanitary wrapping; but thanks to the instructive teaching we have received on the subject most of us would hesitate before accepting such treatment.

Boring Tool for Milling Machine

By Richard H. Kiddle

While the tool shown in the illustration is not new, it is a simple and easily made device which I have found to be very useful and I am passing it on with the hope that it may be of service to others.

The sketch renders its construction sufficiently obvious to need no description.



BORING TOOL FOR MILLING MACHINE

How Do You Regulate Materials?—I

BY HENRY H. FARQUHAR

The most pressing problem of the country, as a whole, is that of securing maximum attainable production. If the attention and co-operation of manufacturers and of labor may be turned wholeheartedly toward maximum economical output, the questions of hours and wages, representation, and division of profits will largely take care of themselves.

IN ORDER to secure maximum production, balanced attention must be paid to the factors underlying good management. Of these factors, few are more important or more susceptible of strict control than materials. It is some of the fundamental considerations in securing adequate material regulation which I wish to review. In this I am not talking particularly to the large manufacturer, but primarily to the owner of the average-sized plant. Neither am I dealing with details and mechanisms, but with certain universal principles of management upon which alone permanent success can rest. These basic principles may then be formulated into a number of simple rules for every-day use under the varying conditions encountered in practice. It is with no apology for "generalities," therefore, that I wish to stick absolutely to basic considerations. Once their significance is grasped, proper detailed methods will follow with a little thought and care.

Without question, adequate material control lies at the foundation of efficiency in production. We may have the very latest machines and ever so fine a toolroom; we may go to great detail in attempting to schedule each job to best advantage, or we may initiate an elaborate bonus system, and so on; yet, unless the right material in the right quantity and at a proper cost be forthcoming exactly when needed, all such measures cannot avail in the fight for high production and low costs.

In developing modern methods of manufacture in a run-down plant we may begin with inspection or with an incentive method of pay, or we may attempt to start a planning department. If we do so, however, without first getting a firm grip on materials, we are but taking steps which must usually be retraced. A manager said to me recently: "I wasted hundreds of dollars, after buying high-speed tools, in letting a man who said he knew the game take time studies which finally had to be ditched because taken before sufficient preliminary preparation. I finally had to go back and standardize machines so they could stand the heavier work with high-speed tools; then I had to go further back and get control of my material, and now I am just beginning to get results from time study which I can rely upon." The materials factor is simply fundamental; no matter where we start we are sooner or later forced back to it; it is to succeeding operations as the foundation is to the building.

In analyzing the factors which underlie adequate material regulation in the factory, it will be helpful to consider them under the broad natural subdivisions into which practical material handling naturally divides itself. We have, first, the group of problems centering around the *replenishment* of materials of all kinds: considerations entering into the determination and regulation of what materials we are going to use, in what quantities we need them, upon whom are to rest the responsibilities for maintaining a proper supply, and how these responsibilities are to be made definite and effective in practice. Second, there are the problems of the *receipt and storage* of materials: how and by whom materials are to be accounted for in quantity and quality, upon their arrival at the plant; where and how, and in whose charge, they are to be stored pending their subsequent issue, and how proper accounting for them is to be obtained. Finally, we have the questions relating to release of materials from storage, or their *issue* for use and the problems of *organization* for material control.

1. THE REPLENISHMENT OF MATERIALS

Materials, in the sense in which we use the term, exist solely for the benefit of production. In the ordinary plant, only by processing materials to the finished state may they be sold at a profit. Except in a strongly rising market, or with a seasonal product, such as coal for instance, the interest on money tied up, storage space costs, depreciation, and often obsolescence charges on materials in excess of current needs, may ordinarily be expected to more than offset any advantage gained from buying in excess of actual requirements for a reasonable future period. Aside from these factors, buying largely ahead of use has other disorganizing and psychological effects which cannot be so easily gaged. On the other hand, the lack of ten cents worth of just the item we need when we need it may produce disastrous consequences.

For all practical purposes, then, in the overwhelming majority of cases, we may state that the first and most important rule of effective material control to be:

I. REPLENISHMENT OF MATERIALS MUST BE GOVERNED STRICTLY BY REQUIREMENTS FOR PRODUCTION DURING A REASONABLE FUTURE PERIOD

This implies that we shall have an accurate up-to-date record or balance sheet for each item of material we carry. The balance sheets may be said to form the pivot about which the whole mechanism of material control revolves. Out of experience the following list of factors for such a balance sheet has grown:

The balance sheet should embody:

1. Materials outstanding on purchase orders.
2. Materials now on hand in the storeroom.
3. Materials assigned or reserved to manufacturing orders now in our hands, but not yet in process.
4. Materials available for reservation to future manufacturing orders.
5. A cumulative and accurate measurement of successive requirements against amounts still available.
6. A predetermined but flexible minimum or low limit (determined by considering rate of use and time needed to renew plus necessary allowance for safety) below which the amount on hand or the amount available shall not fall before a replenishment order is issued.
7. A predetermined but flexible standard amount to

order when this low limit is reached. This figure is based on:

(a) Rate of use in the past.
(b) Probable future rate of use.
(c) Percentage to allow for unforeseen delays.
(d) Time necessary to secure material at factory door after issuing replenishment order.
(e) How often it is desirable to issue orders for it.
(f) The present price.
(g) The probable future price curve.
(h) The space available for storage.
(i) The money available or expedient for the investment.
(j) The probable depreciation or obsolescence of the item.

By accepting this first "point" I do not mean that you must become hidebound in adherence to it. As intimated previously, in applying it in practice opportunity must be left for the exercise of common business judgment within certain limits. Obviously, when the purchasing agent sees a chance to better the purchase price by increasing the amount contracted for he must be free to speak right up in meeting to this effect; when traffic conditions become involved the traffic manager must notify everyone concerned so that we may not fall down in practice through reliance on the general principle which governs renewals partly by the time to renew. Responsibility must be placed also, so that an upset may not occur through an unexpected increase in the rate of consumption, through a discontinuance of the use of a particular material, nor through trouble with the source of supply. Similar contingencies may and do arise in any undertaking; the important point in this connection is that in most cases they may be adequately provided for through proper checks and balances so that we need not thereby doubt the wisdom of accepting this general principle as the North Star of adequate material control.

In partial explanation, and also in preparation for some of the things which will follow, it should be recalled that there are two quite distinct kinds of purchasing. Some articles are practically standard quality throughout the country no matter who makes them; the price is practically uniform everywhere at any given time no matter from whom they are bought, and but slight variations occur in price from time to time.

In the case of some other articles there is more variety offered, but once our choice is determined upon, little further judgment in purchasing is required. In this class fall most of the miscellaneous factory supplies and many of the raw materials used in making the product, and purchases of such material ordinarily form (with respect to routine work involved) the major part of the work of purchasing. Replenishment, in such cases, can be almost automatically governed strictly by current needs, as expressed through the balance sheet, and purchasing may be satisfactorily conducted by anyone with a systematic turn of mind. Such purchasing will hereafter be described by the term "routine."

The other kind of purchasing is of a different nature, partaking more of the nature of a speculative business, and it will be referred to as "speculative purchasing." Here we need a man of large calibre—one who can watch and gage market tendencies, and balance these tendencies against immediate and probable future production requirements as indicated in sales tendencies, against the condition of the exchequer, and against storage facilities, and who in general can interpret business tendencies. Indeed, the questions arising in the conduct of purchasing in such cases may involve questions of policy of the whole establishment, thus throwing decision on the general manager or on one of the higher officials; after a decision is reached, however, the order may be executed through the purchasing department in the regular way.

SF & AP Co.
DESCRIPTION 1½" Round Bethlehem high speed tool steel
BALANCE OF CLASSIFIED STORES TIME TO RENEW 3 Wks. KIND OF UNIT VOLUME — foot
WHEN QUANTITY AVAILABLE FALLS TO 225
ISSUE ORDER FOR 1500
LOCATION IN STORES B3C2
SYMBOL
SV1½ST2R

INSTRUCTIONS FOR POSTING
A. WHEN STORES ARE ORDERED ADD THE QUANTITY TO COLUMNS 1 AND 4.
B. WHEN STORES ARRIVE, SUBTRACT THE QUANTITY RECEIVED FROM COLUMN 1 AND ADD THE QUANTITY RECEIVED TO COLUMN 2
C. WHEN STORES ARE APPORTIONED, SUBTRACT QUANTITY FROM COLUMN 4, AND ADD QUANTITY APPORTIONED TO COLUMN 3.
D. WHEN STORES PREVIOUSLY APPORTIONED ARE ISSUED, SUBTRACT QUANTITY FROM COLUMNS 2 AND 3.
E. WHEN STORES NOT PREVIOUSLY APPORTIONED ARE ISSUED. SUBTRACT QUANTITY FROM COLUMNS 2 AND 4.
NOTE: IN ALL CASES BRING DOWN AT ONCE BALANCE IN EACH COLUMN AFFECTED AND VERIFY THAT BALANCES 1+2−3=4

1—STORES ORDERED BUT NOT YET RECEIVED	2—STORES ON HAND IN STORE ROOM	3—STORES APPORTIONED TO ORDERS BUT NOT YET ISSUED	4—STORES AVAILABLE FOR APPORTIONMENT

FIG. 1. HEADING FOR A SATISFACTORY BALANCE SHEET

Although a man responsible for decisions in this type of purchasing must be left a good deal of discretion, it is nevertheless imperative that he automatically have just as accurate information as his more strictly regulated brother. By this I mean that the items which are delegated to his care must be regulated by the balance sheets described just as carefully as must the routine items, that low limits and amounts to order must be just as carefully set, that the balance clerk must keep the same records and send the same replenishment orders to him as are sent to the routine purchasing agent, and that in general a uniform procedure throughout for all materials—both routine and speculative—be insisted upon.

The top of a satisfactory form of balance sheet, showing directions for posting, is illustrated in Fig. 1. In this case the estimated consumption was 60 ft. per week; therefore, during the time it takes to replenish the supply (three weeks) we should ordinarily use 180 ft. Adding 25 per cent to this for safety, we get a "low limit" of 225 ft. below which the amount on hand shall not be allowed to fall without issuing a replenishment order. If, other factors as explained in the text being considered, we desire when ordering to purchase a 25 weeks' supply, we get 1,500 as the amount to order.

After the replenishment order with its indication of the standard amount to order, as per manufacturing requirements, is received, however, the speculative purchasing agent is not necessarily bound to follow this advice. When he departs from the beaten path, however, the burden of proof should be distinctly upon him.

As has been indicated, the replenishment order is the means by which the machinery is set in motion for

FIG. 2. THIS OVERFLOW STOREROOM IS UNNECESSARY WHEN MATERIAL REPLENISHMENT IS PROPERLY REGULATED

supplying ourselves with goods. Certain safeguards, therefore, must be thrown about the procedure of ordering in that multiplication of individual opinion and preference may not replace demonstrated needs and adaptability as a basis for purchase. From such considerations spring the three following simple and obvious rules dealing with this phase of material handling.

II. There Must Be Predetermined Specifications for Each Article Purchased

It is easy to go too far with detailed, written specifications. Judgment is necessary in drawing the line. Responsibility for quality should be centered in the engineering or other technical department; every item and every use should be systematically scrutinized, and, after consultation with various interested persons, useless varieties and frills discarded.

This applies to miscellaneous supplies such as stationery, pencils, ink, etc., as well as to raw materials. Although in the former case the standardization may often stop with the simple designation of a few standard kinds which are to be thenceforth stocked, even in this case a surprising simplification will result all down the line, including the storeroom and the balance sheets. A case recently occurred where, through such a process as has been described, the varieties in certain classes of stores were reduced by over one-third.

III. All Replenishment Orders Shall Be In Writing and May Be Issued Only By Specified Persons

This simply means that we must not allow anyone, from office boy up, to ask the purchasing agent to buy whatever he considers he needs. If we do, we are by so much lessening our control of a most important phase of the work, and of course we need not hope to adhere to such standard articles as have been designated.

Probably nine-tenths of all replenishment orders in the well-organized factory will be made from the balance sheets described previously, and in fact the responsibility for writing and following all replenishment orders may be centralized in the balance clerks. In the case of special items not ordinarily carried in stock, however, opportunity may be left to department heads to order direct what they need.

An invariable rule should be made that no verbal orders will be accepted unless confirmed immediately in writing.

IV. All Replenishment Orders Shall Be Approved Before They May Be Honored By the Purchasing Agent

Responsibility for seeing that predetermined standards are adhered to when ordering materials should be centered in some one official, whose O. K. is necessary before the purchase order may be issued. Just who this official should be depends somewhat on local circumstances, but he should be in a position not only to check up on variations from standard and on needless orders, but also to catch an order for an amount of material inconsistent with probable future manufacturing needs and to substitute different materials where this seems desirable or necessary. He must, in other words, be in close touch with production, and responsibility for revision of low limits and amounts to order should be vested in him.

Through the enforcement of Rules II., III. and IV. many annoying irregularities in requisitioning supplies may be stopped at their source; it is by means of such simple regulations that authority may be definitely centered and routine systematically controlled. After the standard articles are requested and approved, however, there is one last step in the control of replenishment which is necessary in order to guard against division or avoidance of responsibility with changes in conditions brought on through shifting personnel or procedure:

V. All Purchase Orders Shall Be In Writing and Must Be Systematically Followed Up

"I ordered those screws three weeks ago; delivery was promised in one week, and they should have been here long before this." No such alibi should be accepted, for it is the purchasing agent's duty to see that purchase orders are not issued and then forgotten, either by himself or by the dealer from whom he buys. In initiating a nearly automatic system for governing the ordering of stores, part of the data which must be collected is the time necessary to secure material at the factory door after issuing replenishment order. This time, be it three days or three months, must be specified in writing for each article by the purchasing agent, consulting with the traffic manager if necessary. Using this time as one factor, the amount to order is determined, and thereafter no excuse should be accepted for the goods not arriving in the time set.

If for any reason the time set must be changed, this fact must be reported at once to whomever is responsible for the revison of low limits and order points (see preceding topic) so that they may be correspondingly modified. Since responsibility for time needed to renew is placed squarely upon the purchasing department, this department must of course take measures to see that all outstanding purchase orders be systematically followed. The tickler is of course the way to do this, and for this purpose a carbon copy of the purchase order, which must always be in writing, may be used.

These five simple rules express the principles by which supply of material may be adequately controlled. If we embody and enforce them in material routine, we may feel reasonably secure in the belief that we have adequately provided for the regulation of one of the most important phases of material handling—replenishment.

Care of Cast-Iron Straightedges

By E. A. DIXIE

Some years ago Professor Sweet wrote a series of articles for the "American Machinist," entitled "Things that Are Usually Wrong." Looking back at that series I wonder why he omitted a criticism of the cast-iron straightedge which is in such common use in machine shops and toolrooms.

I HAVE a straightedge which is, or *was*, straight until I loaned it to a toolmaker who thought, as I did at the time, that he knew how to take care of it. But perhaps I better tell you the whole story:

I have no desire to go into the methods of making these tools. Either by originating by making three straightedges or scraping to a true surface plate, any good scraper hand can produce a true straightedge. I have no quarrel with the methods employed to make them, what I am peeved at is the design. The one I refer to is the straightedge which is usually accepted as the correct one—the trussed arch, the one with a straight front and a humped back.

Theoretically, such a straightedge may be everything that is desirable, but in practice it is all wrong, for unless one has a true surface plate, or two more straightedges or one straightedge and a surface plate to check it with, one can never know whether it is straight or not.

As all straightedges warp, they should, if possible, be self-checking, and the only form I know which will afford this valuable feature is that shown in Fig. 1. In this type of straightedge the two opposite edges are scraped not only flat but parallel to each other. If the edges of such a straightedge become warped the error can be readily detected on any *fairly* flat surface, for instance a flat machine table or, in fact, any planed piece of metal as long as and a little wider than the straightedge itself.

After such a tool is made *straight* care should be exercised to keep it *straight*, for more straightedges are crooked by lack of care when the tool is not in use than from carelessness while in use. When not in use this type of straightedge should be *hung* up as shown in Fig. 2. If it is being used so constantly that it is not convenient to hang it up after each time it is applied to the work then it should be laid down, not on either of the finished edges, but *on its side*. If allowed to stand for any length of time with one of its finished edges in contact with an uneven surface it will take a set and require rescraping. If laid on its side even on an irregular surface so that it takes a set, the set will be sidewise and will not to any great extent impair the accuracy of the planes of the edges.

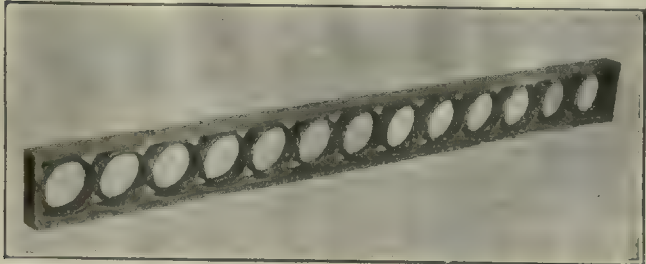


FIG. 1. CAST-IRON STRAIGHTEDGE WITH PARALLEL EDGES

It was just such a straightedge that I loaned to the toolmaker, as stated in the first paragraph of this article. When I loaned it I asked him to be careful with it and he assured me he would. When he brought it back the following morning I tested it as shown in Fig. 3.

In Figs. 3, 4 and 5 similar reference letters are used for similar parts, A is the straightedge; B the surface plate; C and C^1 points where pressure is applied and P and P^1 the pivotal points under various conditions. The condition shown in Fig. 3 indicates that the edge of A next the surface plate is straight. The straightedge is placed as shown by the full lines. Sidewise pressure, in the direction of the arrow, is applied by the finger at C. If the straightedge is straight it will turn about the pivotal point P. If sidewise pressure is applied at C^1 the straightedge will turn about the pivotal point P^1. The straightedge is now turned over and the other edge tested in the same manner, of course with parallel edges if one edge shows straight the other edge must be straight. The condition shown in Fig. 4 shows that the edge next the surface plate is convex and that the pivotal point P is about the center of the length of the straight-edge. Of course, in practice the straightedge may warp so that the high or pivotal point on the convex side may be almost anywhere on the surface. When one edge shows the condition just described the straightedge is turned over and if it has been scraped truly parallel we will then, on the other side, find the condition shown in Fig. 5. Here if the pressure is applied at C in the direction of the arrow the straightedge will pivot at P^1 and if applied at C^1 will pivot at P.

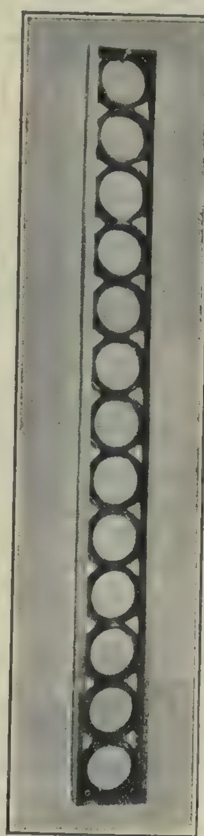


FIG. 2. STRAIGHTEDGE HUNG UP TO MINIMIZE WARPING

When I discovered that the straightedge was as shown in Figs. 4 and 5, I asked the toolmaker why he had not been as careful with it as he had assured me he would be. To this he replied that he had been very careful, that when he had finished with it the night before he had placed two pads of cotton waste at the back of his bench and had laid it gently down with one edge resting on the cotton pads. As a matter of fact it would have been better resting direct on the bench for it had sagged all night between the two supporting pads of cotton waste and had by that time taken a set of over a thousandth of an inch.

Obviously, tests such as shown in Figs. 3, 4 and 5 would be impossible with the truss-beam type of

straightedge for the reason that it has but one straight edge. We have a number of these in the works and while they may have been straight originally all of them are now more or less out of true. One in particular I am told was considerably over a hundredth of an inch out before it was last trued up.

And the peculiar thing about this is that the greater part of this variation from truth is caused not by wear in use but by improper care when the straightedge is not in use. From observations I have made I am thoroughly convinced that carelessness in storing straightedges is responsible for their warping or at least nine-tenths of it and that the other tenth may be attributed to seasoning.

It is not always convenient to hang up straightedges of the truss-beam type but they can usually be stood on end or they can be laid on their sides when not in use. And either of these positions will to a great extent preclude warping.

The Design of Straightedges

Regarding the designing of straightedges the rules to follow are few and simple. The edges and webs should be nearly the same thickness. This will result in better castings because the castings will cool and shrink uniformly, thus obviating defects due to unequal shrinkage such as shrinkage cracks and "draws" which are so common where a heavy member adjoins a light one. The molding should be carefully done to avoid sand and blowholes, the latter usually caused by ramming the mold too hard. Broadly, it may be stated that a pattern which produces a good sound casting free of "draws" will make a good straightedge, providing it is otherwise clean and well proportioned. The reason for this is that the stresses to which the casting is subjected during the cooling period are practically identical with those to which it is subjected during the seasoning period of its life. The only difference being in the *rate* at which the molecular changes take place.

The casting should be planed as soon as possible to see whether it is sound enough to make a perfectly clean straightedge. Before finish-planing, the casting should be subjected to some sort of seasoning. It can be left around the shop for a period of time to allow the casting and planing stresses to equalize. Or it can be subjected to one of the accelerated seasoning processes. The most commonly practiced form of rapid seasoning is as follows:

The casting is alternately heated and cooled for a greater or less period of time, depending on the size of the work and the amount of seasoning the individual seasoner guesses it ought to have. If there is a convenient core oven the casting can be placed in it over night and then put out in the yard during the day to cool off and again put in the core oven the following night. Personally I do not believe that the cooling period is of any assistance. The molecular change takes place much more rapidly under the influence of heat, the heated period therefore does the bulk of the work, the cooling period merely retards the molecular change.

Vibration Helps Seasoning

If the would-be seasoner can find some place in the factory where there is a lot of violent vibration, such as one often finds in shops where there are polisher's benches, he will find that castings season very rapidly when subjected to vibration. A couple of weeks on a polisher's bench, especially if his wheels are running out of true, will have as much effect on the castings as six months or a year just lying around the shop. If it is decided to season by leaving the casting around the shop care should be taken to protect it against being dented by coming in contact with other castings or hard material. For every time a dent is made in the castings new stresses are set up which will take time to relieve.

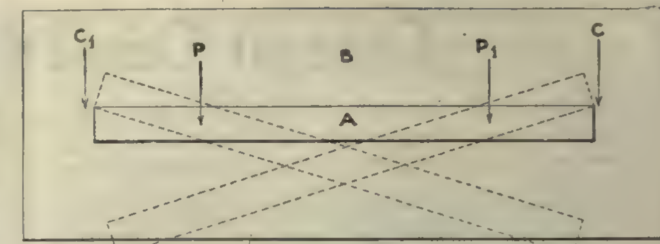


FIG. 3

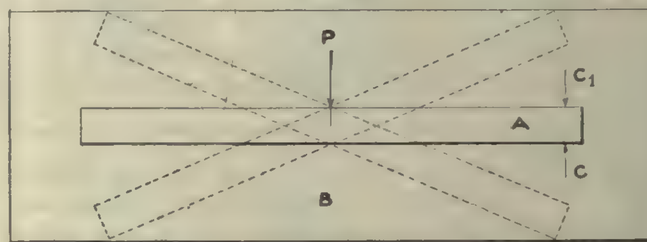


FIG. 4

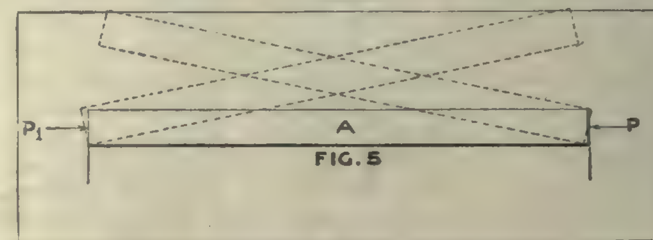


FIG. 5

FIGS. 3 TO 5. TESTING A STRAIGHTEDGE WITH PARALLEL EDGES

Fig. 3—Edge next to surface plate straight. Fig. 4—Edge next to surface plate convex. Fig. 5—Edge next to surface plate concave.

Finish planing should be very carefully done. The tools should be as keen as possible, for even under ideal conditions with the sharpest of tools, the surface is somewhat compressed, that is to say peened, which of course means more stresses to be relieved.

After finish planing a night in the core oven or an hour on the polisher's bench will serve to release practically all the stresses introduced during the planing operation.

Scraping should be carried on on both sides alternately. I mean by that that there would be poor results if one side were scraped to a finish before the other side was scraped. If time is no object the edges should be rough scraped all over and the work allowed to rest (hanging up of course) for a few days.

I have often been asked how long it takes to scrape such a straightedge. The one shown in Figs. 1 and 2 is 38½ in. long and the working faces are 1⅜ in. wide and 3⅜ edge to edge. It was scraped by one of the best and quickest scraper hands I ever saw and his time on that particular one was between 14 and 15 hr. It might, however, take 50 per cent more time to scrape a similar straightedge. When finished the one shown was not more than 0.0002 in. out of straight or parallelism *on the bearing spots*.

XXII. Cutting With the Gas Torch*

Details of the construction of the more common makes of cutting torches have already been given on page 1082, Vol. 50. This installment also gave tables of gas pressures and cutting speeds. On page 61, Vol. 51, a typical cutting unit was shown and instructions given for lighting the torch. In this article directions are given to the beginner as to how to use the torch and cut metal.

(Part XXI was published in our April 8 issue.)

THE gas-torch cutting process consists of heating a spot of the metal to be cut to a good red heat and projecting on it a jet of oxygen. This causes the metal to burn away, a stream of slag running out of the kerf thus produced. Cutting is not melting, in the ordinary sense, although since the heating flame is the only visible agent, such might be the beginner's conclusion. It should be remembered that the heating flame is only used to make the metal hot enough to oxidize easily.

Metals whose oxides have a lower melting point than the metal itself can be cut by the gas torch. Such metals are wrought iron and steel. Where the oxide has a higher melting point than the metal, cutting cannot be done with the gas torch. Such metals are copper, brass, aluminum, cast iron, etc.

A big factor in successful cutting is to properly support the body and torch to as great an extent as possible commensurate with the steady forward movement of the torch. The position must be an easy one, as muscles under tension will cause vibrations and these are fatal to good cutting. An ideal position for an operator, is shown in Fig. 263, although in actual, everyday practice one usually has to be satisfied with less desirable conditions.

Theoretically, with the cut once started the oxygen jet alone should be sufficient to keep up the combustion, as there is considerable heat generated in the process. However, the stream of oxygen is small and the burning metal confined to a very narrow slot, and scale, dirt, sand, blowholes and other things interfere to prevent the continuation of the cut of the jet without an accompanying heating flame.

A cutting torch is lighted in the same way as for welding, except allowance must be made for the drop in the oxygen pressure when the cutting jet is turned on. This allowance can be made by regulating the flame while the jet valve is open, which is done before starting to work.

When the flame is adjusted, hold the torch as shown in Fig. 264, the left hand grasping it well toward the head and the right hand on the handle with the thumb or fingers controlling the jet lever valve. The metal to be cut may be a piece of heavy boiler plate, steel bar or structural steel. Rest the elbow, forearm or hand on the plate to steady the torch. It is usually best when cutting without a guide wheel, to arrange to cut either to the right or to the left rather than toward or away from the operator. However, an operator should learn to cut in any direction. When it is possible, always start on the edge. Hold the flame on one spot until it is a nice red, then turn on the high-pressure oxygen jet. Hold the torch steady with the luminous cone almost touching the metal, until the cut goes through. Sparks should show as in Fig. 265. If they fly, as in Fig. 266, the cut is not going through.

*For author's forthcoming book, Welding and Cutting.

FIG. 263. AN EASY CUTTING POSITION

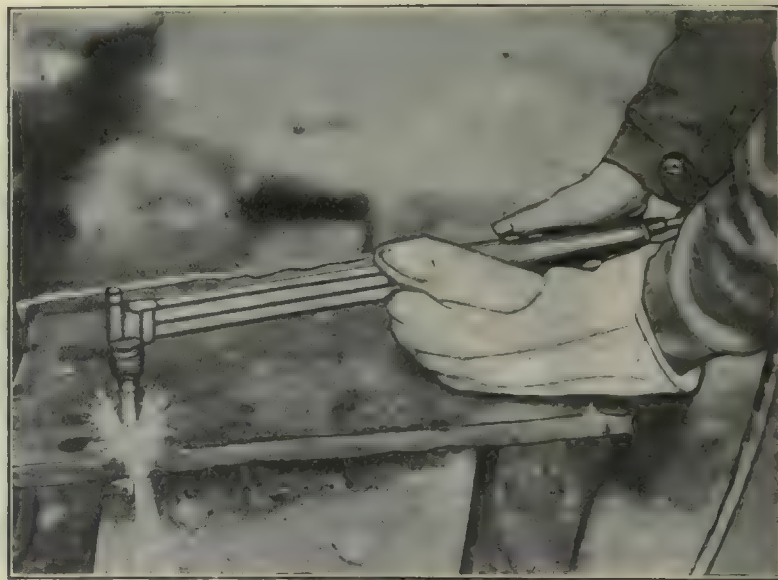


FIG. 264. STARTING A CUT WITH A DAVIS-BOURNONVILLE TORCH

In the cutting of plates, it is advisable to tip the torch head in the direction of the movement, once the cut has progressed a little. This rule does not apply in the case of blowing holes in metal where the nozzle must be tipped away from the slag so that no particles will impinge on the orifices or a back pressure be created on these orifices.

If the metal is very thick, the oxygen pressure will have to be high. In beginning a cut of this type, it is necessary to blow the oxide out at the bottom before the cut has traversed very far into the body of the metal, otherwise, a pocket will be formed and it will be impossible to penetrate to the bottom of the metal. In cutting heavy material, success depends entirely upon the ability of the individual. The nozzle must be turned outward in preheating and must be carried inward with the tip gradually moving to a vertical position and finally forward as the cut progresses. In blowing holes as in Fig. 267, the metal must be blown away from the tip, and to accomplish this it is advisable to begin with a very wide kerf, produced by rapid movement of the torch sideways while carried away from the origin of the cut. In this way the oxygen penetrates deeper into the metal while the torch is moving, until, finally, the oxygen emerges at the bottom, when the torch can be brought to a final cutting position and the metal cut in any direction.

Rivet head cutting in shipyards is generally accomplished by means of a specially designed nozzle, which rests upon the plate so that the preheating jets and cutting jet will act at the base of the rivet head as shown in Fig. 268. In blowing out countersunk rivet heads, the same procedure must be followed as in blowing holes, but more precautions are necessary in order that particles of metal do not impinge on the preheating orifices and clog them or cause backfire.

The "nicking of billets" became very common during the war. A narrow, shallow cut is made on one side or around the circumference of a steel section, then the billet is snapped off at the nick in a press or hammer.

When a cut must be reasonably smooth, use wheel guides, if possible. If a straight line must be followed, a bar of metal may be clamped to the work as shown in Fig. 269. A good way to both guide the cut and support the operator's hand, when cutting ship plates is shown in Fig. 270. This principle may be applied to other work.

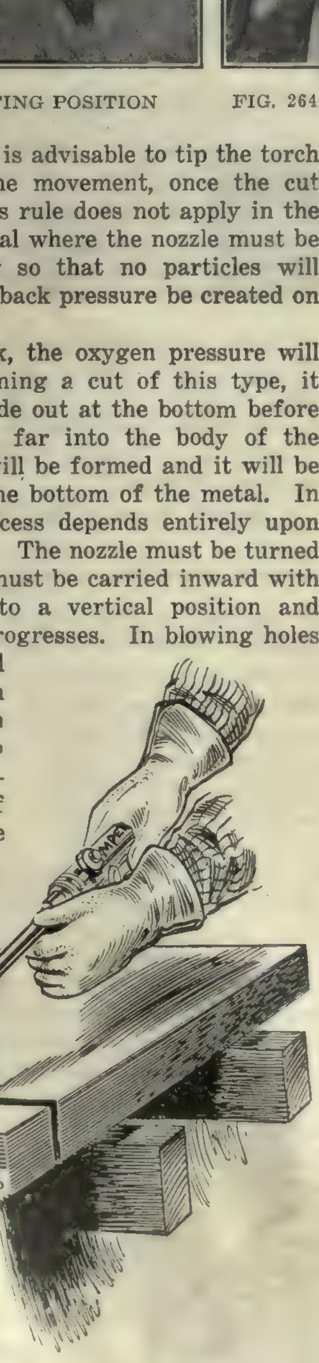


FIG. 265. MAKING A CLEAN CUT THROUGH A PLATE

FIG. 266. CUT NOT GOING THROUGH PROPERLY

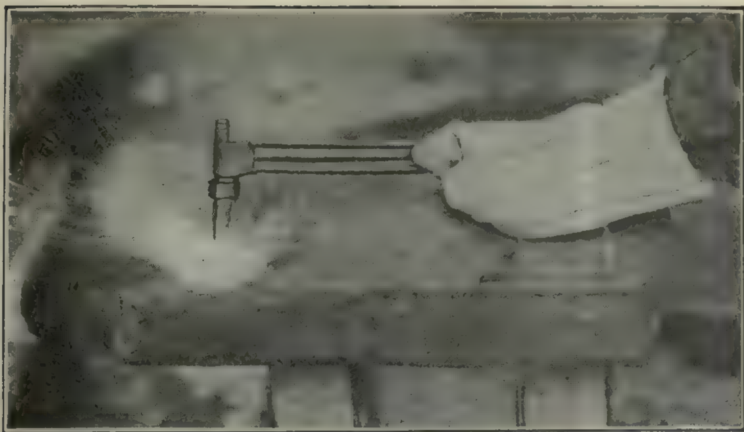


FIG. 267. BLOWING A HOLE THROUGH A PLATE

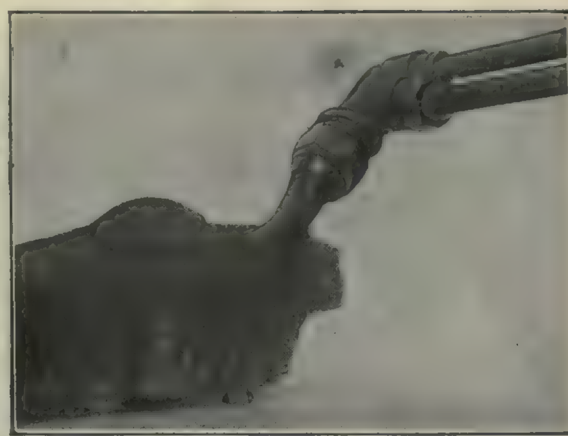


FIG. 268. CUTTING OFF A RIVET HEAD

For cutting circles, a radius attachment is used, similar to the one shown in Fig. 271. This device is made by the Carbo-Hydrogen Co., Pittsburgh, Pa., but practically every torch manufacturer makes something of the kind.

The way the cut on a 12-in. shaft looks, is shown in Fig. 272. This was cut with an Oxweld low-pressure torch. The chalked arrows indicate a blowhole and a crack which materially retarded the cutting. This cut took 3 min. 27 sec. and about 75 cu.ft. of oxygen was used. A similar cut, under similar conditions, but made without encountering any flaws in the steel, was made in 3 min. 10 sec. and 67 cu.ft. of oxygen was used.

On work 1 in. thick or over, a slot of from $\frac{1}{16}$ to $\frac{1}{8}$ in. is about right. For thinner stock, or when using a machine, the slot may often be reduced to less than $\frac{1}{16}$ in. by a skilled operator with special tips.

Flame Control

In working hold the flame so that the end of the cone just clears the metal—do not attempt to plunge it down into the cut. When cutting two plates or more, or where there is a lap joint, remember that there is more or less of an insulation (air, dirt, etc.) between these plates and that the oxidation cannot be as fast as where only one thickness is cut. Remember that the flame does not do the cutting—therefore, work with the smallest flame possible—it means a neater cut. Keep the oxygen pressure as low as possible and yet maintain speed. A high pressure is spectacular and there are a great number of sparks, but it is not economical and a wider kerf is made. Do not use the torch with greasy gloves—a spark in combination with a leak on the oxygent supply will badly burn the hand. If a cut must be started in any place except on an edge, drill a hole or use a cold chisel and a hammer to roughen up the surface, the idea being to get an edge to quickly start oxidation.

Making a Ladle Hook

As an instance of the many savings that may be obtained by the intelligent use of the gas-torch cutting process, the following will be of interest:

At one of the shipyards scrap ship plates are cut into special shapes for building up large hooks like the one shown in Fig. 273. These hooks are used for handling large ladles in a near-by steel mill and have resulted in a great saving.

The hooks are 8 ft. in total length and are made up of six layers of plates which run the full length, and four short layers, all securely held together with countersunk rivets. The four inner plates are each $\frac{1}{2}$ in. in thickness. The two outer full-length plate are of $\frac{7}{8}$-in. material. Adjoining the latter plates on either side is a half-length plate $\frac{1}{2}$ in. in thickness. The hook proper is still further reinforced by two slightly shorter outer plates, each $\frac{7}{8}$ in. in thickness.

The plates are first marked with the aid of a templet to serve as a guide for the cutting torch. After cutting, they are assembled and riveted as shown in the illustration. A laminated construction of this sort is not only exceptionally strong, but is a decided economy, as it makes use of what would otherwise be waste material.

Firemen are frequently confronted with locked steel doors or barred windows. These readily yield to a properly applied cutting torch. Fig. 274 shows a fireman demonstrating how an Oxweld emergency cutting outfit may be used. The entire kit weighs 118 lb.

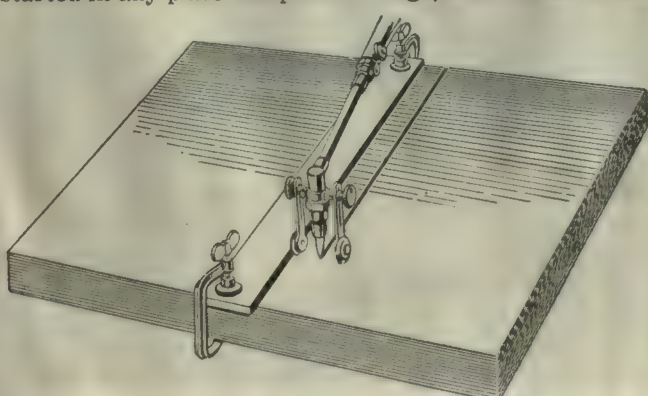


FIG. 269. USING ROLLERS AND A BAR GUIDE

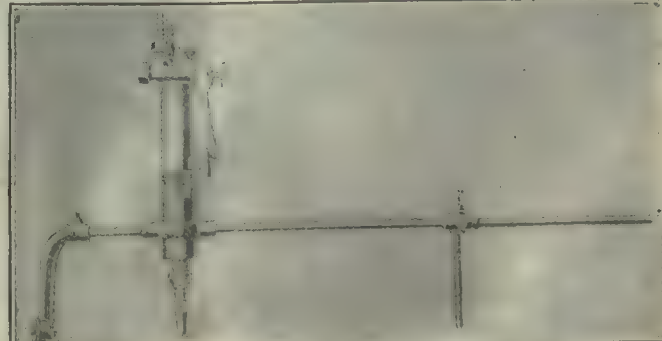


FIG. 271. RADIUS CUTTING ATTACHMENT FOR STRAIGHT-TIP TORCH

FIG. 270. CUTTING SHIP PLATES

FIG. 272. A 12-IN. SHAFT CUT WITH A GAS TORCH

A very wide field for the cutting torch is in reducing scrap to workable dimensions. The figures here given regarding the cutting of scrap, are taken from a bulletin issued by the Oxweld Co. Where costs are quoted the estimates should be about doubled for present conditions (1920).

An operator recently cut two twenty-ton steel fire boxes into scrap, prepared for the shears in twelve hours. More than 300 lin.-ft. of cut was made through $\frac{7}{8}$-in. plate (considering the mud ring and over-lapping plates). The total cost for oxygen, acetylene and labor was $24.10 per fire box—cost per ton $1.22.

In another case a locomotive boiler was cut into scrap at a total cost of $2.63, the number of lineal inches cut totaled 210 through $\frac{1}{2}$-in. plate, 9 through 3-in. plate and 172 through $\frac{3}{8}$-in. plate. This amount of cutting was completed in fifty-three minutes at a cost of 8 cents per foot for the various thicknesses. The foreman in charge of this job stated that the work done by one operator in one and one-half days would require the services of two men for, at least, a week, with ordinary working methods.

A ten-ton boiler was reduced to scrap ready for shears by one operator in nine hours at a total cost of $16.00 or $1.60 per ton.

On another piece of work, the operator cut 78 ft. of $\frac{1}{2}$-in. plate in two and one-half hours. One piece of this plate, 18 ft. long, was cut in 13 min. The cost of cutting the 78 ft. was $4.25 or $0.054 per foot through the $\frac{1}{2}$-in. plate at a rate of over 30 ft. per hour.

A three-ton boiler averaged $2 per ton cut in one and one-half hours. The total length of cut equaled 60 ft. 4 in. It would have cost $3 to $4 per ton to cut this boiler by hand.

A fourteen-ton boiler was cut at the rate of $1.23 per ton in nine hours and at a total cost of $17.38. One hundred and eleven feet eight inches of cut was made at the rate of $0.149 per foot.

Three fire-box boilers weighing ten, twelve and fourteen tons respectively were scrapped at the average rate of $1.40 per ton. The users of this plant state that the apparatus enables them to cut into scrap five locomotives where one was handled by the methods used before the Oxweld process was employed.

Cutting steel car frames into scrap shows equally important savings in time and money.

A five-ton car frame was cut in two and one-half hours at an average cost of $2 per ton. It was cut into $4\frac{1}{2}$-ft. lengths through three and four thicknesses of plate in some parts of the frame.

A record kept of cutting about 12,000 lb. of wrecked steel car frames shows a total cost of $8.10, or about $1.35 per ton. These frames were cut into $4\frac{1}{2}$- to 9-ft. lengths, in five hours.

FIG. 274. FIREMAN DEMONSTRATING AN EMERGENCY CUT

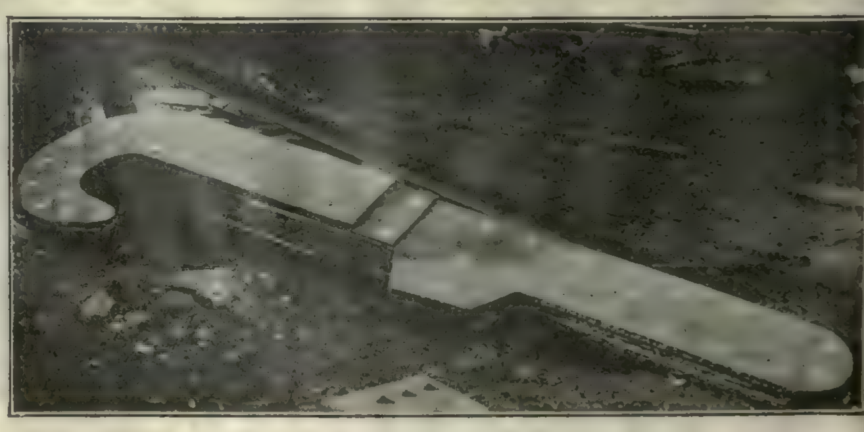


FIG. 273. LADLE HOOK MADE OF TORCH-CUT PLATES

Nichrome: A Heat-Resisting Alloy

EDITORIAL CORRESPONDENCE

Everybody remembers the red, white, and blue barrels so prominently displayed a year or two ago on the busiest corners of busy city streets, each barrel bearing a placard exhorting passers-by to drop therein peach stones, cocoanut shells, and fruit pits of every kind; the same being the raw material from which was to be made the peculiarly absorbent carbon that was the vital principle of the masks worn at times by our soldiers in France, to protect them from the effects of the deadly gases poured so lavishly into their trenches. The carbonizing of this material required excessively high temperatures, entailing all sorts of trouble with containers. It was not until the alloy called "Nichrome" was considered that a material sufficiently refractory to withstand the high temperatures involved, and at the same time capable of lending itself to the solution of constructional difficulties, was found.

NICHROME is a metallic alloy compounded from nickel, chromium and iron. Its melting point is about 2,750 deg. F. and it may be cast in sand molds in practically any form and in weights up to 5,000 lb. Owing to its high fusion point, it is melted in electric furnaces. It has a tensile strength of from 50,000 to 55,000 lb. per square inch when cold and possesses in a remarkable degree the property of maintaining a large portion of this strength at temperatures that would render iron or steel non-resistant.

There is a distinctive reduction in physical strength of ferrous materials when subjected to high temperatures that renders them useless for many purposes. Though certain experiments have shown an increase of 32 per cent over normal in the tensile strength of structural steel when heated to 400 or 500 deg. F., and 16 per cent in the case of ordinary wrought iron under similar conditions, the strength of either material is reduced to less than 16 per cent when the temperature has reached 1,500 deg.; while nichrome, at this temperature, has a tensile strength of 24,500 lb. per square inch or nearly 50 per cent.

Nichrome is further peculiar by reason of its ability to withstand continuous high temperatures without warping, cracking, swelling and blistering; and with little oxidization. The slight film of oxide which forms in an oxidizing atmosphere at high temperatures does not crack or scale off; it resists the action of strong alkalies, and of sulphuric and muriatic acid; and protects the metal against further oxidization when it is again exposed to heat. Because of these qualities, nichrome is peculiarly adaptable to the construction of receptacles for the annealing, case-hardening, or other heat-treatment of steel, as well as for electrical-resistance elements for heaters, rheostats, etc.

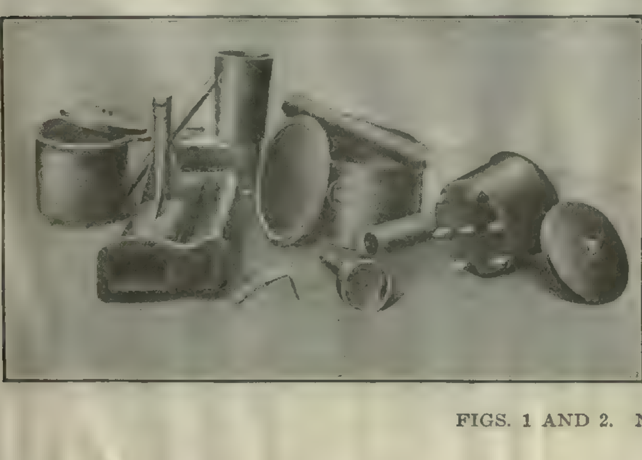
When steel or iron is used for annealing boxes, the original casting must be made quite thick because of the propensity of this material to scale away and be eventually consumed; while boxes of nichrome may be made as thin as is consistent with mechanical strength.

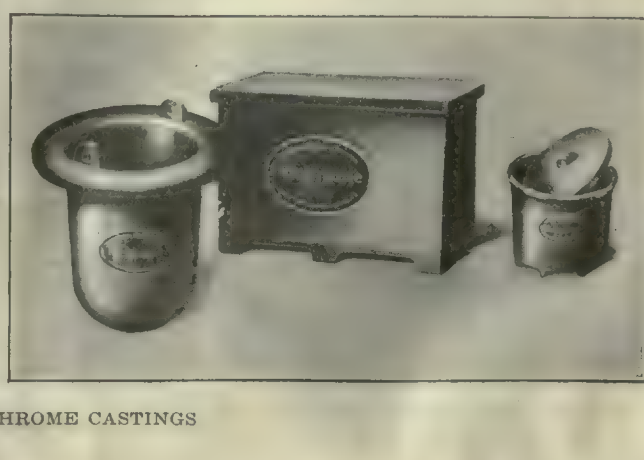
The average life of boxes of ferrous material subjected to temperatures up to 1,700 deg. F. is about 150 hr. as against 7,500 hr. for nichrome boxes; thus, while the first cost of nichrome is greater than steel, the operating cost is less in the case of the former because of its longer life.

Figs. 1 and 2 show some of the forms of receptacle into which nichrome is cast by the Driver-Harris Co., of Newark, N. J. Another important application is that of the dipping basket used for immersing small pieces in the cyanide hardening bath, and it is also used around pickling vats where small articles are to be treated with acid.

Cast nichrome is being substituted for other materials in many parts of glass-making machinery, for melting, pouring, conveying and rollng molten glass; the nichrome molds are less affected by the high temperatures and produce more highly polished glassware. Also, because of their greater strength while hot, they can be made much lighter than the parts they have displaced.

One very important service to which nichrome was adapted during the war was the making of special retorts used for producing vegetable carbon which formed the important part of the gas masks worn by the soldiers in the trenches. This carbon was made from fruit pits, cocoanut shells and similar material which was passed through two carbonizing processes; one of which necessitated a very high temperature and also involved manipulation of the material while under heat.





FIGS. 1 AND 2. NICHROME CASTINGS

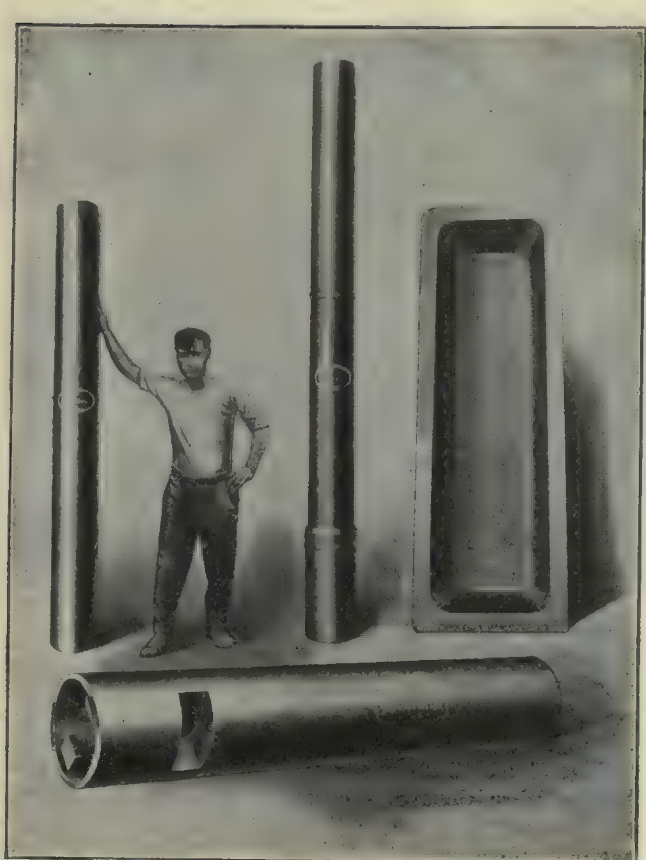


FIG. 3. TUBES USED FOR CARBONIZING RETORTS

Of all substances tested for the purpose of making gas-mask carbon by the Chemical Warfare Service, cocoanut shells were most satisfactory; that is to say, considered weight for weight, the carbon made from cocoanut shells would absorb more poison gas, and absorb it more readily and efficiently than carbon produced from any other source.

The shells were first broken in small pieces and then carbonized in coal-gas retorts at temperatures ranging from 1,750 to 1,850 deg. F. During this first process, the material lost about 70 per cent of its original weight. After coming from this process, the carbonized pieces were passed through a rotary grinding machine where they were reduced to a coarse powder which was then screened between 6- and 14-mesh sieves. Material that would pass the finer screen was allowed to go to waste as far as the making of gas masks was concerned.

The second carbonzing process or "activating," as it is called, was for the purpose of removing the hydrocarbons which are always present to a greater or less extent in all carbonized material; leaving a pure, porous, and highly absorbent carbon in condition of highest efficiency for the work it was intended to do.

The operation was conducted in a specially designed furnace, in which the carbon was raised to a temperature of 2,300 deg. F. in contact with steam. Iron or steel retorts, especially in contact with carbon, would break down long before this temperature was reached; receptacles of fireclay or similar refractory material were too fragile and their heat conductivity too low. It was not until the experimenters tried nichrome that a metal was found capable of withstanding the high temperature over a satisfactory length of time.

The carbonizing machinery consisted of a firebrick furnace, within which was placed a tube of nichrome, 15 in. inside diameter, ⅞-in. wall, 13 ft. 6 in. in length, and weighing 1,850 lb. Such a tube may be seen in Fig. 3. This tube rested upon roller supports 10 ft. apart, and lay at an angle of about 10 deg. from the horizontal. It was kept in continuous rotation during the carbonizing process by means of a chain and sprocket at one end.

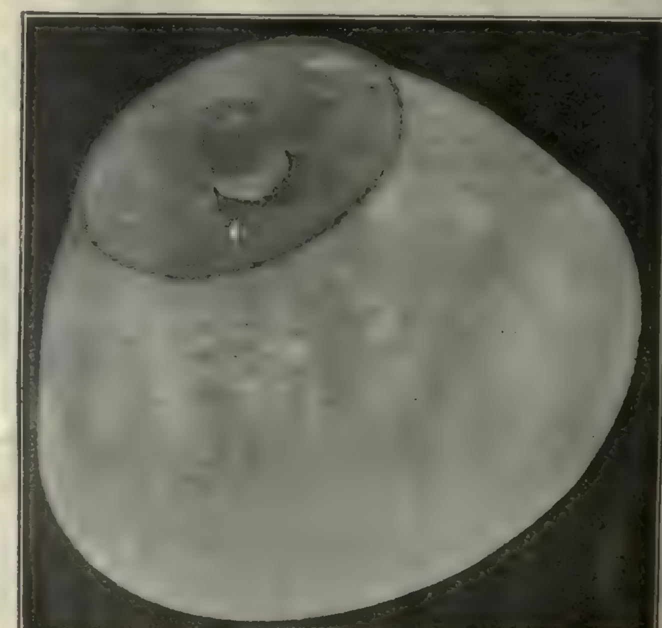
Steps or vanes of nichrome were bolted to the inner surface of the tube for the purpose of keeping the contents agitated, and steam was admitted throughout the length of the tube through specially constructed jets of the same metal. These revolving retorts were run continuously, producing from 100 to 150 lb. of charcoal per hour. As the entire central section of the tube was held at a dazzling white heat all the time, it is small wonder that the life of such a tube was but five or six weeks—though there is a record of one having run for 11 weeks before breaking down.

A Pattern Made From Odd Material

By E. A. Dixie

I have been knocking around pattern shops and foundries for nearly 40 years and up to a few days ago believed I was familiar with all the pattern makers' and founders' materials, from the proverbial "molder's thumb" (always referred to as the pattern used when the casting is not "to pattern") on up to some particularly fancy molds, which were gold plated to prevent discoloration of the plaster which was cast in them by a Philadelphia firm of near-meerschaum pipe makers.

On the boss patternmaker's bench yesterday I saw the pattern shown in the illustration. A customer brought in an earthenware bowl which he wished reproduced in iron, but a boss was to be cast on the bottom. The boss, an ordinary 1-in. core print was secured to the bowl with shellac varnish. The varnish was applied to both the bowl and the print and allowed to dry till it was very "tacky" when the print was applied to the bowl and the varnish allowed to set.



PATTERN MADE FROM AN ODD MATERIAL

The Manufacture of Household Appliances—III

BY J. V. HUNTER
Western Editor, *American Machinist*

Work of the character dealt with in this article must be rapidly machined and it is necessary that the fixtures allow the placing and removal of the work with the least effort on the part of the operator.

(Part II was published in last week's issue.)

IN the plant of the Hurley Machine Co., Chicago, Ill., manufacturer of the Thor line of household appliances, many of the castings that require lathe operations are handled on Potter & Johnson manufacturing automatics, of which two men usually attend a battery of six. One machine for work on the gear housing of the wringer is shown ready for operation in Fig. 14. A pneumatic chuck is used and it will be noted that the jaws enclose nearly the entire casting.

Several of the larger gear housings for the washing machines are also finished on these machines. One employs a Barker wrenchless chuck, Fig. 15, holding the casting, which is additionally clamped at *A*. Many types of chucks are found on these machines, but the ones having labor saving features are in decided favor with the workmen, who are operating on a piecework schedule.

Some hand-operated turret lathes fitted with air chucks are used for such work as boring and facing the hubs of gears. Many different types of machines are represented in the gear cutting department. The Pratt & Whitney gang milling machine, Fig. 16, is shown roughing out eight small bevel pinions at a time, previous to the finishing operation in a Gleason gear shaper.

Milling Operations

Numbers of special fixtures have been designed for milling machine operations with a view to increasing the accuracy and production on work of this character. A small drive shaft, *A*, Fig. 17, is milled with a square end, and for this operation it is clamped in the fixture *B* by the chuck which is tightened by a quarter turn of the spanner wrench *C*. One pass through the cutters finishes two sides, thereupon the clamping screw *D* is

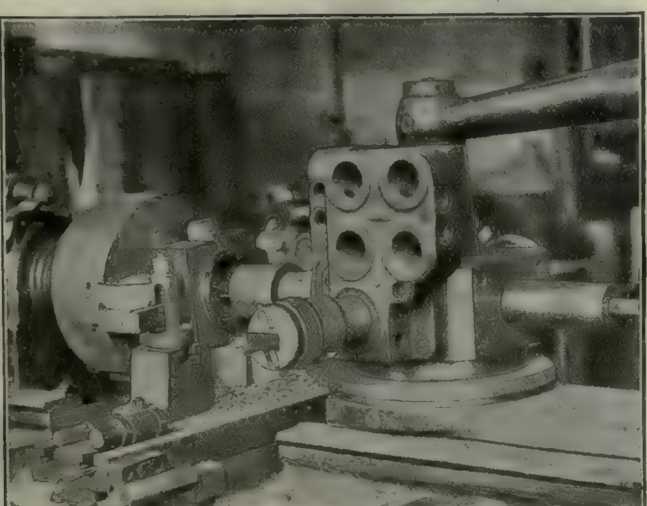


FIG. 14. OPERATIONS ON A BEVEL-GEAR HOUSING

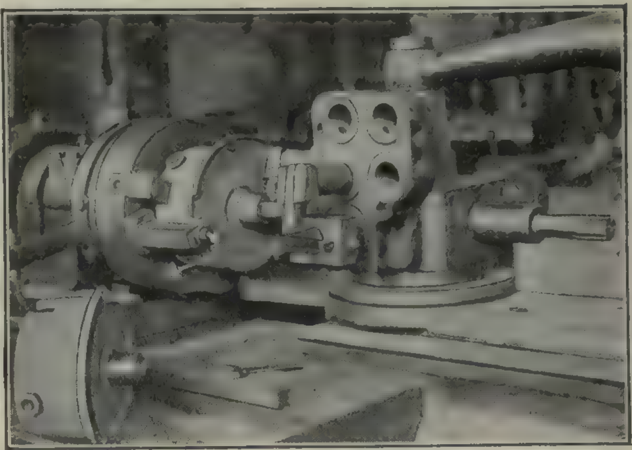


FIG. 15. FINISHING THE GEAR CASE

loosened, the index pin *E* withdrawn and the chuck revolved 90 deg. to a second stop, and the shaft again fed into the cutters to finish the other two sides.

The keyways in six of these same shafts are cut simultaneously while they are held in a fixture on a milling machine, as in Fig. 18. The shafts lie in V-grooves, parallel with the fixture, and are clamped by the T-head studs A, which are drawn down in pairs by the levers *B* beneath the fixture.

The ends of the collars *A*, Fig. 19, are milled by using the indexing fixture and milling cutters shown in the illustration leaving the rib *B*. The collars are placed in pairs on the studs *C* and clamped by the cross bars *D*. The fixture is indexed by drawing the index pin *E* and loosening the center tightening clamp *F*. Each movement brings a fresh pair of collars in line with the cutters and while they are acting the operator removes a finished set and replaces it with fresh ones.

The polishing shoe of the ironing machines is a long thin casting which must be finished on the inner face to a smooth polished surface so that it will impart the proper degree of gloss to the laundered pieces. This surface is obtained by first milling to sufficient depth to get a clean surface and later by polishing on a fine grit rag-wheel and felt buff. Preliminary to the milling operation the inside faces of the castings are smoothed off by the portable flexible-shaft grinding machine shown in Fig. 20.

The milling operation is done on an Ingersoll planer-type milling machine, Fig. 21. The flexible nature

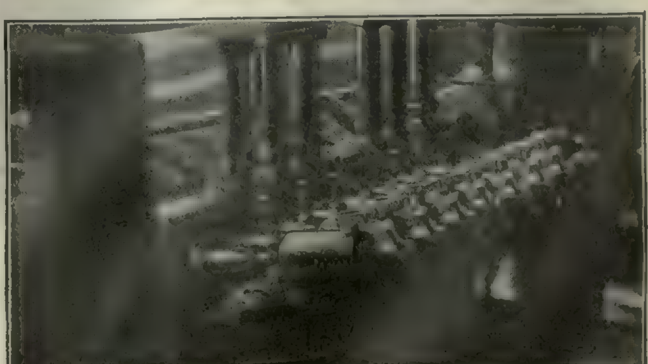


FIG. 16. ROUGHING BEVEL PINIONS

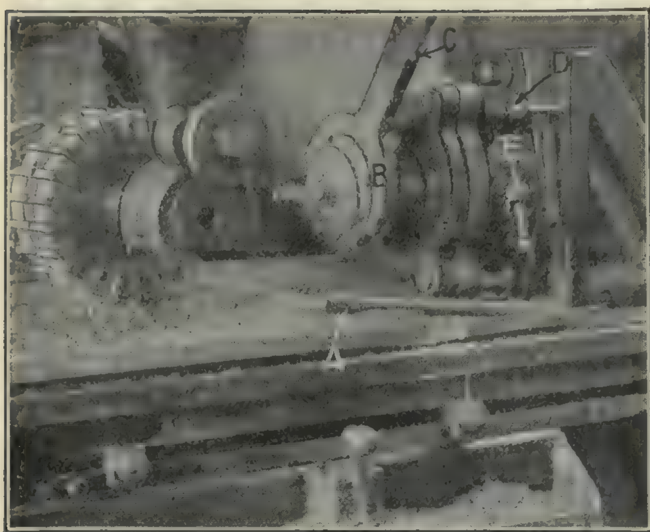


FIG. 17. MILLING SQUARES ON ENDS OF SHAFTS

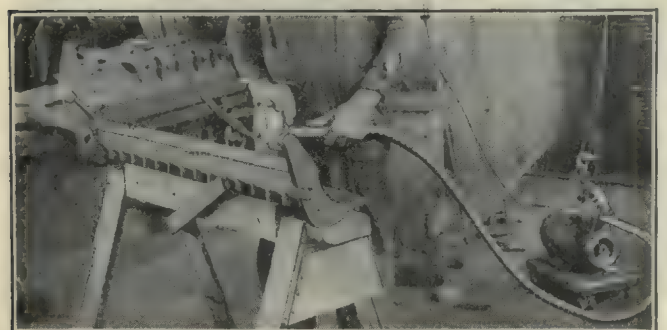


FIG. 20. SMOOTHING A CASTING BEFORE MILLING

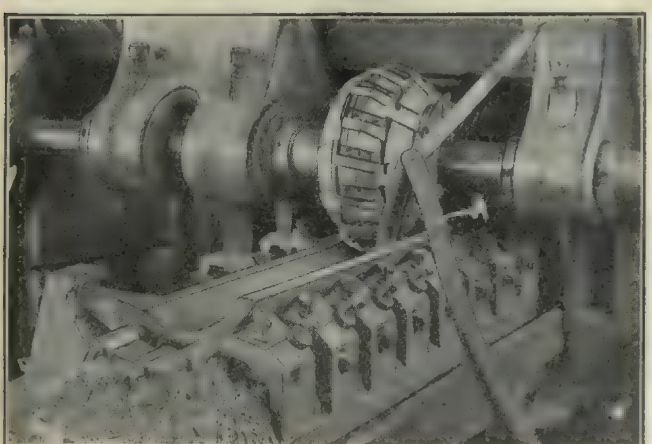


FIG. 21. MILLING THE FACE OF AN IRONING SHOE

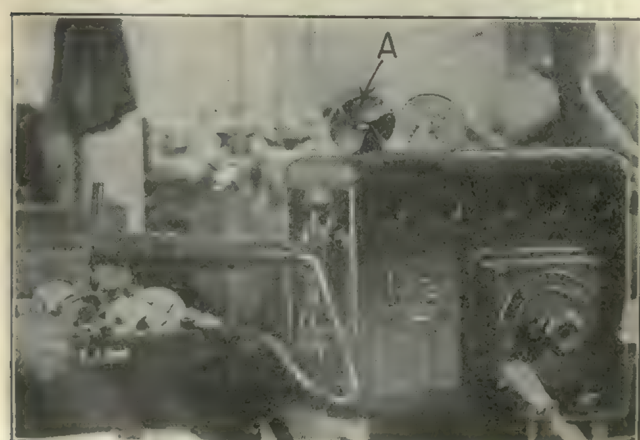


FIG. 23. SPOT WELDING VANES ON FANS

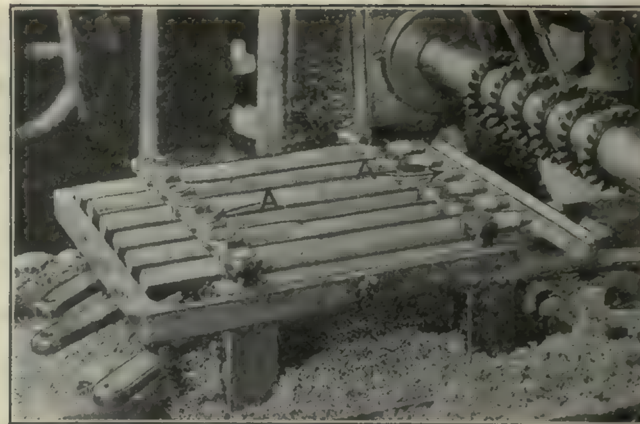


FIG. 18. CUTTING KEYWAYS IN SIX SHAFTS AT ONE SETTING

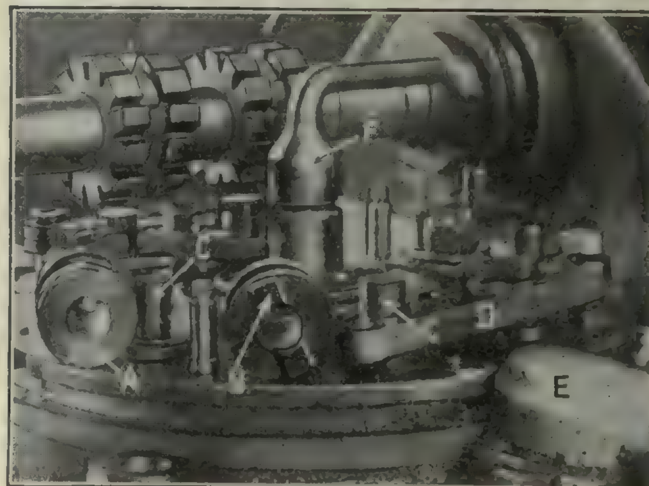


FIG. 19. AN INDEXING FIXTURE

FIG. 22. SOLDERING RIBS ON CYLINDER COVERS

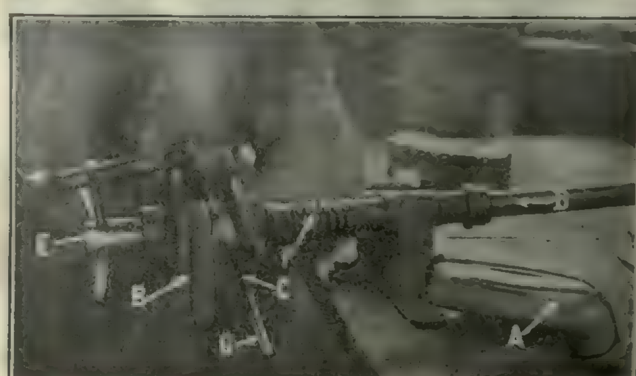


FIG. 24. WELDING FAN BODIES

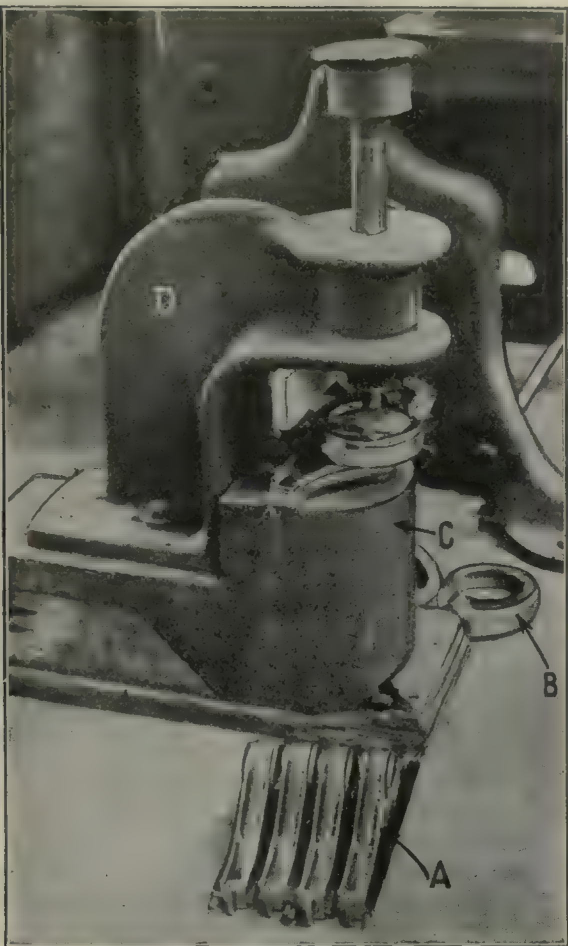


FIG. 25. SEAMING FLANGES OF FAN BODIES AND NOZZLES

of the casting necessitates that it be supported at close intervals throughout its length and the illustration shows the fixtures with its numerous clamping and supporting brackets. A large inserted-tooth cutter finishes the entire surface, including one edge, at a single pass through the machine. To clear the chips from the cutters a powerful blast of low-pressure air is sent through the flexible tube *A*. Some of the small units are assembled to make them more convenient for quick work when they go to the final major assembling operations. Many little devices are used for so positioning the parts that there will be no fitting trouble later on.

FIG. 26. BUILDING CYLINDERS FOR WASHING MACHINES

A simple fixture for soldering ribs on the insides of metal cylinder covers for washing machines is shown in Fig. 22. A few wooden pieces held together by metal strips serve to hold the ribs in their proper position while the operator solders them in place. This device also insures that the heat of the soldering iron will not cause the ribs to spring away from the cover so that the joint will loosen before the solder has a chance to set.

The vanes for vacuum cleaner fans are attached to the web as indicated at *A*, Fig. 23, by a series of spot-welds through their flanges which secure them along almost their entire length. The results obtained are more secure than if small rivets were used.

The fan bodies are made of two steel stampings, *A*, Fig. 24, placed together and the seams welded with an oxy-acetylene torch. The two pieces are placed in a fixture that holds their edgés in alignment. Two hollow castings *B* and *C* enclose the stampings with the exception of an open space of half an inch along the seam which is left to give the operator room to operate his torch for the seam weld. The container castings are a sliding fit on the arbor *D*, and the operator removes the pilot *E* and the container *B* to place the stampings in position. In closing the fixture the pilot wheel draws up on the threaded end of the arbor and brings pressure to bear against the inside castings, forcing it against the spring *F*. The spring insures constant pressure on the work preventing it from either jarring loose or buckling from too great pressure due to the expansion caused by the heat.

The operator can revolve the work on the arbor as he progresses along the seam, by means of the small spoke handles *G* in the casting.

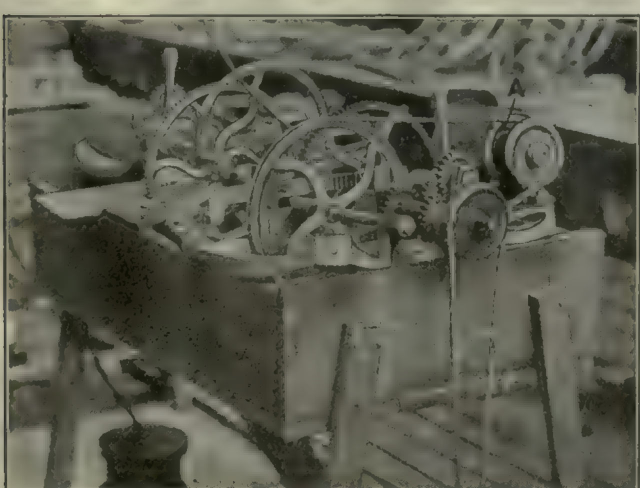


FIG. 27. A TESTING STAND

FIG. 28. INSPECTION OF FINISHED MACHINES

The nozzle *A*, Fig. 25, is made of two stampings welded in a similar manner. After welding, the part is taken to a grinding wheel where the surplus metal left on the seam is ground off preparatory to plating.

The nozzle together with the fan housing *B*, is placed on the anvil *C* of the staking press *D*, where the fixture holds them in alignment while the flanges on these two parts are seamed together by a die carried on the plunger. Several heavy blows with a sledge on the copper head of the plunger are required to complete the operation.

The wood cylinders of washing machines are made of maple and are assembled in lots of twenty by two workmen, Fig. 26, and one operation is followed through the whole lot before the workmen turn to the next operation. As here shown the trunnion casting and the lock which secures the cylinder in the tub are being fitted on.

A stand for a running test on the operating mechanism of the wooden-tub washers, Fig. 27, serves to hold two units while they are driven during the test by the motor *A* mounted on the rear of the frame. The final assembling is group work and one unit is placed on each machine before proceeding to place the next unit on any machine of the group.

Larger groups are handled when assembling the smaller household units, Fig. 28, and as here shown the assembly is practically completed, and the inspectors are engaged in testing the operation of the gear mechanism. The workman at the right has fitted up a small stool, *A*, with casters, and on this he is able to push himself from one machine to the next as he proceeds with his inspection.

After assembly, inspection and cleaning, the machines are given their coats of paint by spraying.

Sidelights on Automobile Building

By I. B. Rich

THERE are several phases of the automobile-building game which are not only of interest to the engineer, but which have a direct bearing on the question of manufacturing equipment, getting back in this way to the machine-tool field. The inability to secure steel and other materials has reduced the output of many automobile builders from 50 to 60 per cent of their estimates. Others have speeded production methods so successfully that they could exceed their estimates considerably if material was obtainable.

Steel, however, is not the only thing which is holding up production. Glass for windshields and windows of closed bodies is also very scarce. In fact the demand by the automobile builders has made it almost impossible for builders of dwellings and office buildings to secure sufficient glass for their needs. Another great shortage is in malleable-iron castings, which are so largely used in motor truck work for rear-axle housings and similar parts. Several thousand tons a month are needed in and around Detroit, as the malleable capacity of the country seems to be completely taken up. In some cases this is leading to the substitution of sheet-metal parts, and the change, once made with its initial expense for dies, means that the malleable-iron field will lose this business permanently.

If the aluminum-alloy foundries were not themselves so full of work, it is quite probable that this would be their chance to take over many parts which we have heretofore made of iron and steel castings, in spite of the increased cost. The new aluminum alloys under various trade names are so much stronger than we used to believe possible, that they are being used to some extent for rear-axle housings and wheel centers on heavy truck work. This has the advantage of reducing the unsprung weight which saves tires and fuel expenses.

The use of aluminum in motor work is a disputed point among automotive engineers, its use in pistons being the place where pro and con arguments wax hottest. Its opponents point to the makers who have tried aluminum pistons and have abandoned them for the old standby, cast iron. On the other hand, aluminum pistons are being used under the extreme heat conditions in the Franklin Motor and both the Essex and Oakland are also using them in water-cooled motors, while Marmon uses a combination of aluminum and cast iron. Then too, nearly all airplane motors, both in this country and elsewhere, use aluminum pistons.

But, whatever the outcome, the advantage of light pistons are admitted and advocates of cast iron are trying to reduce weight as much as possible. British practice has long been toward light pistons, some of the small motors of 1914 having cast-iron pistons of extremely light construction, a few of them being machined all over except for the piston pin bosses. Forged-steel pistons were also tried, but were not much lighter than cast-iron in the small diameters used in England. Forged and welded pistons have also been experimented with over here as well as pistons of the skeleton and slipper types. Experiments seem to show that lightening the pistons adds appreciably to the effective power delivered by the motor, which is a point to be carefully considered.

The desire for lightness is also leading to better steel alloys so as to allow of lighter sections and even some of the medium-priced cars are now machining the connecting rods all over, in order to secure minimum weight and aid in securing a good running balance. Experiments with molybdenum steel indicate that it is much better in every way than previous alloys and it is expected that advocates of light, thoroughly high-grade cars will make use of it to secure maximum strength with minimum weight. With this material, it is believed that a comparatively large five-passenger car can be kept very close to 2,000 lb. in weight.

Aluminum alloys are also being experimented with, particularly in forgings for parts where the reciprocating weight is so important. These experiments are not being confined to the higher priced cars but are being carried out in motors of even small powers and low prices. With the tendency toward higher-speed motors, the question of balancing becomes more acute, as does also the necessity for smooth-running motors. In spite of this there are comparatively few motor builders who test the crankshaft and assembled units for running balance. The contention is made by some that running balance machines are of little use at speeds over 500 r.p.m., but this does not seem to be borne out by the experience of builders of other kinds of machinery. There is, however, a growing belief among engineers that the use of a running balance machine is the only way in which satisfactory results can be secured, as even slight variations in the density of metal in various parts of the crankshaft, or the parts which go with it, make a decided difference in the final balance of the motor itself. It also plays an important part in the life of crankshaft bearings.

A Special Fixture for Milling Rails for Automobile Frames

By R. A. Wilson

This article tells how a standard machine, by the use of a special fixture, was adapted to large-scale production work upon one part of an automobile frame. The method of operation is a little unusual as it makes use of a "floating arbor" for holding the cutters.

IN THE manufacture of the Autocar 2-ton truck an unusual type of fixture is used for milling the flanges of the frame rails, which are pressed chrome-nickel steel channels. The tops of the flanges are milled to maintain a uniform height, since they must be flush with the wooden rail which is pressed in between them, as shown in Fig. 1.

In order to give clearance for the radii in the corners of several brackets it is also necessary to chamfer the tops of the flanges at several points. The operation of chamfering the rails under the old method of grinding was slow and difficult. To increase the production and

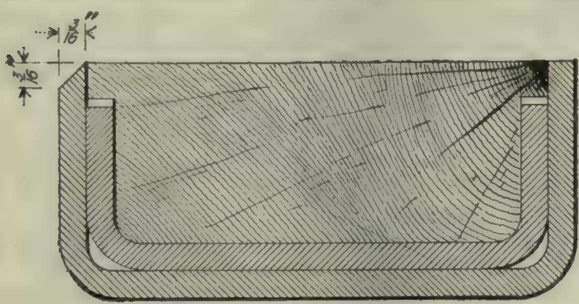


FIG. 1. SECTION OF RAIL USED IN FRAME OF THE AUTOCAR

improve the quality of work a fixture was designed which would mill off the tops of the flanges and chamfer them at the proper points simultaneously. Fig. 1 shows a section through the frame rail at one of the chamfered points.

Fig. 2 shows a photograph of the machine and fixture for doing this work. *A* is the body of the fixture, *B* the cutters and *C* the carriage for holding the rails, which is supported by the two rollers *D* at each end. *E* is a sheet-metal trough which collects the cutter coolant and returns it to the pan underneath the machine.

Fig. 3 is a sectional view looking along the length of the fixture from the right side of the machine. *Z* is the arbor, *A* the body of the fixture, *U* the table of the milling machine, *V* the saddle and *W* the side of the knee of the machine. It may be noted here that the fixture does not change position and that during operation neither the knee, saddle nor table move.

The body of the fixture *A*, Fig. 3, is a casting of rectangular box construction and is securely bolted to the table of an Aurora milling machine of early design. The rail to be milled is mounted in the carriage *B*, Figs. 3 and 4. Referring to Fig. 4, the rail *A* is located endwise by the fixed stops *C* and secured in this position by the clamps *D*. The carriage consists of a flat machine-steel plate *B* which is somewhat longer than

FIG. 2. MACHINE AND FIXTURE USED FOR MILLING FRAME RAILS

the frame rails, and to which angle irons are bolted, the upper ones for retaining the rails and the lower ones for carrying the rack and the cam plates.

The carriage is propelled through the milled opening in the top of fixture *A*, Fig. 3, by the spur gear *C* meshing with rack *D* on the carriage, and it is held down by the machine-steel strips *E* which are bolted to the casting. The spur gear *C* derives its motion from a train

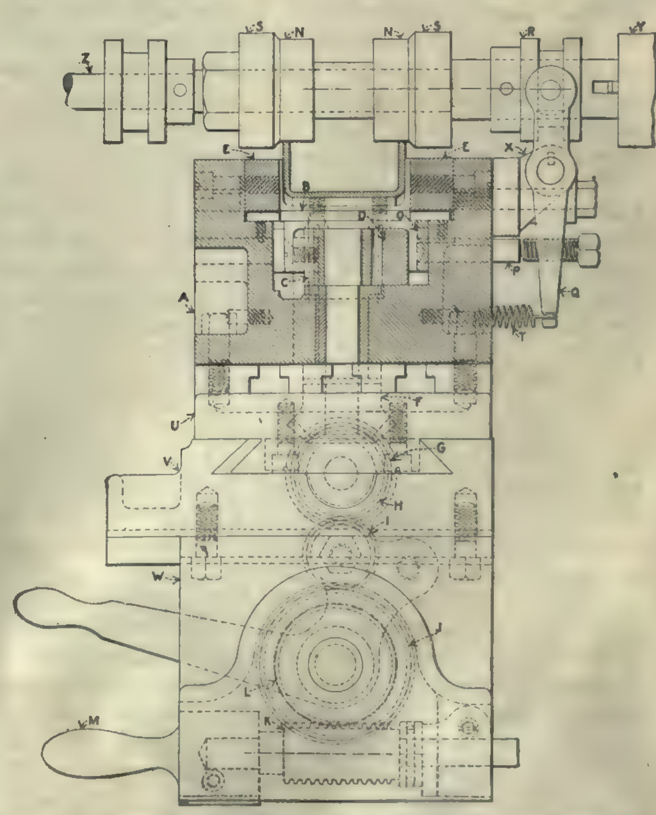


FIG. 3. SECTION SHOWING THE FEED MECHANISM OF THE CARRIAGE

of gears consisting of the two miter gears *F* and *G*, the spur gears *H* and *I*, the latter of which meshes with the large spur gear *J* on the worm-wheel shaft, which formerly drove the lead screw of the milling machine.

Method of Operation

When operating, the carriage is run all the way to the right of the arbor *Z*, which carries two standard 3-in. diameter, 1-in. face milling cutters *N* and two special 3½-in. diameter, 24-tooth bevel milling cutters *S*. A rail is then inserted and clamped in the carriage and the power feed is engaged by bringing worm *K* in engagement with wormwheel *L* by means of lever *M*.

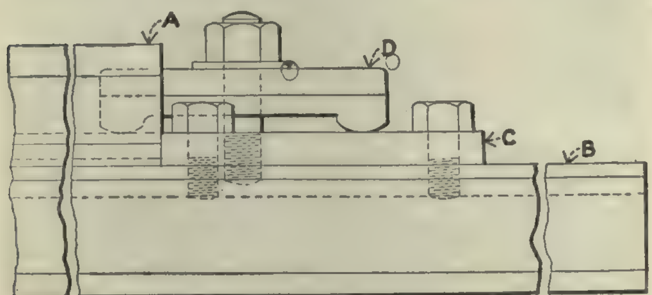


FIG. 4. METHOD OF FASTENING THE RAILS TO THE CARRIAGE

The carriage passes under the milling cutters *N* and only the top edges of the rail are milled until the camplate *O* engages the hardened plunger *P*, which is moved outward. This exerts a pressure upon the fork *Q*, which carries two steel blocks running in the groove of the hardened-steel collar *R*. This action forces the arbor in toward the rail an amount equal to the thickness of the camplate, thus bringing the bevel milling cutter *S* in contact with the rail and holding it there until the camplate passes out from beneath the plunger *P*. The action of the spring *T* pulls the arbor back to its normal position, where it remains until the next camplate engages the plunger *P*. This floating arbor *Z* slides in and out in a keyed driving sleeve *Y*, which is screwed to the spindle of the milling machine.

When the rail has passed out from beneath the cutters the feed lever *M* is disengaged, the carriage rapidly returned to its starting position by means of a handwheel, and the operation is repeated with a new rail. This handwheel is geared to the shaft upon which the gears *G* and *H* are mounted, and is shown at *F* in Fig. 2.

The Rails Are Right and Left Hand

The rails are right and left hand, due to the fact that the right-hand rail is chamfered in two places and the left-hand rail in but one place. This necessitates the placing of cams on each side of the carriage, two for the right-hand rail on one side and one for the left-hand rail on the other.

The rails are run through in lots of three hundred rights and three hundred lefts. After milling three hundred right-hand rails the plunger *P*, Fig. 3, is withdrawn and inserted in a hole provided for it in the front side of casting *A*. The bracket *X*, carrying the shift forks *Q*, is next removed and bolted on the front of the casting preparatory to milling the three hundred left-hand rails.

The production capacity of this machine is fifty-five rails per ten-hour day.

A Quick-Release Screw for Jigs

By John Wood

The accompanying drawing shows a quick-acting screw that is very simple and efficient. I use this form of screw whenever possible on all jigs or fixtures where the placing or removing of work necessitates backing out the screws for any considerable distance.

It is very simple to make, as it consists of but two parts and a few stock screws. The dimensions of the parts depend upon the conditions to be met in each case.

A represents the wall of the jig or fixture, through which a smooth hole is bored and reamed at the point and in the direction at which the screw is to be located.

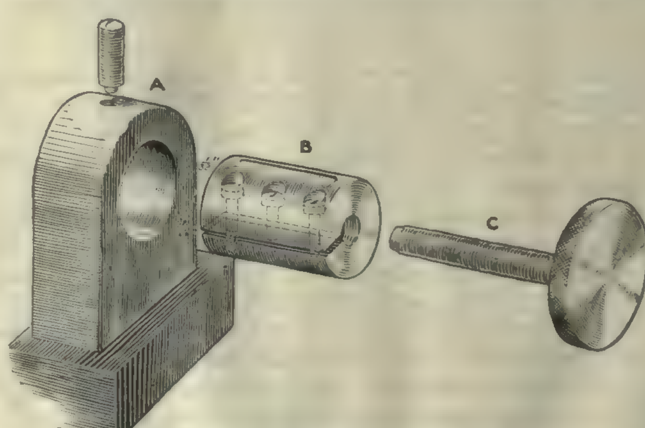
B is the nut, drilled and tapped for the knurled-head screw *C* and finished on the outside to a neat sliding fit in the hole at *A*. The screw must be nicely fitted to the nut *B* so that though it turns easily in the thread it will turn less easily than the nut itself turns in *A*. It is upon the nicety of these fits that the smooth working of the device depends.

The nut *B* is split longitudinally and three small fillister-head screws let into it in the manner shown, so that the two outer screws act to close the nut and the center screws to open it; thus by these screws the friction of the nut upon the screw *C* may be readily adjusted.

An L-shaped slot (with the short side of the L reversed) is made upon the outer surface of the nut *B*, the long side of the slot being paralled with the axis of the nut. A small headless, dowel-pointed screw is tapped into the wall of the jig so that the dowel point enters the slot in the nut when the device is assembled.

The dowel screw must fit rather tightly in its thread so that though it extends into the slot in the nut it does not bind the latter and will not work loose because of having no bearing endwise.

The operation of the device is obvious. The nut is pushed in until the dowel reaches the right-angled turn in the slot; then the screw *C* is turned in until it bears



A QUICK-ACTING JIG SCREW

upon the work. The first rotative movement is, of course, of the nut, which turns until the end of the shorter slot stops against the dowel, after which the screw turns forward until it bears against the work, the thrust of the screw being borne by the dowel.

To release the work the screw is turned back. The first movement is of the screw within the nut until the pressure against the dowel is released; then the nut turns back until the dowel stops it at the angle of the slot, when the nut and screw may be drawn out for the length of the long side of the slot.

Practical Methods of Appraisal

BY L. L. THWING

If there is any one thing that is difficult to get two or more men to agree on, it is the value of second-hand machinery. In this article the author gives the results of his experiences in the appraisal of used machine tools.

APPRAISALS are made for various reasons, such as insurance, income tax reports, mortgage or sale, or for determining the depreciation factor in costs. The basis of valuation varies according to the purpose of the appraisal. Overhead is usually based on original cost, income-tax reports on value as of a certain date (for purchases prior to that date), while insurance values are based on replacement costs.

In all cases, however, the factor of depreciation appears as a necessary part of the investigation. The existence of depreciation is universally admitted, but on account of the difficulty of measuring it accurately, many shops make only a perfunctory effort to measure it at all. Depreciation is not an exact science, as its findings are more strongly colored by the personal equation of judgment than by the direct application of known facts. In this respect it does not differ from many engineering problems, except that the latter are worked out by engineers, while the former is generally in the hands of accountants. Depreciation of any specific group of equipment such as machine tools involves a knowledge of physical detail, and the particular production problems of the shop where they are located. It is dependent on information that can only be secured in the shop.

Inventory of Equipment

An appraisal includes an inventory of equipment, priced at either replacement or cost values, and a depreciated value, which represents the actual or sound value at the time of the appraisal. In a going concern the usual elements of depreciation are wear, obsolescence and lack of utility. The actual work should proceed as follows: first an inventory with date of installation; second, cost of replacement values erected; third, depreciation and resultant valuation. An inventory is simply a list of machine tools or other equipment with sufficient description to identify the various items. Describe the things that affect the cost, the unusual features rather than the features that are too generally known to need description. It is not necessary to tell what features a machine does not have, unless such an omission is a departure from usual practice.

Nearly all machine tools are rated by arbitrary numbers, or by one or more of the dimensions of the maximum-sized piece that can be machined.

Age is not prima facie evidence of wear but it implies it. Ten years difference in age presupposes additional wear, and may be said to put the burden of proof on the older machine. The office records will show the date of purchase or invoice for a large proportion of the machines, but if for any reason this is not the case, inspection and the testimony of the shop men is the only recourse. Serial numbers, if they are found, can be used, if it is desired to go to the trouble and expense of writing to the manufacturers. To tell the age of a machine by inspection is not easy. It can be done approximately only by those who have handled the machine tools for years. The second-hand dealers can do this better than any other class of men. It is doubtful if the manufacturer himself could always tell the age of one of his own machines, except through the serial numbers.

Natural advance in the art, and the advent of high-speed steel, have made many changes in design of machine tools in the past 20 years. Few of these, however, effect a radical change in the appearance of the machine. All geared feeds, drives and gear guards are the most easily noticed, but there are many others that are apparent to a man who is interested in the evolution of machine tools and has taken the trouble to inform himself.

The Value of a New Machine

The value of a new machine is its current selling price plus transportation and erection charges. Any war-time bonus in addition to this is not value. The manufacturer's price is the only basis for replacement value, and the only way to secure this is through him or his agents. The additional items of freight, trucking, handling and installation may be included as one item and figured as a percentage of the cost. This is in fact the usual way, if not the most accurate. Without going to either extreme, such as bench precision lathes on one hand, or billet shears on the other, this percentage will be between 3 and 4 per cent of the cost for normal conditions.

If the appraiser will consider that the erection cost of a $2,000 planer will be three of four times as much as for a single-pulley-drive milling machine costing the same, this method will be sufficiently accurate. If, however, the shop records show these costs, they should certainly be used.

Having completed the list of machines with their actual or estimated age, together with the cost or replacement value (new); depreciation for wear, obsolescence and lack of utility are next in order. It is on the whole better to make a separate item for each of these factors as they will have different rates of change. A machine is sure to be worn more a year from now, but it may be no more obsolescent. If the appraiser is familiar with the shop's production problems, these factors may be considered at the same time, but it behooves an outsider to move slowly in matters of obsolescence and lack of utility, and if a separate item is made for each factor, the last two can be checked over with the superintendent.

As a matter of practice the bearings, feed screws, gears, etc., should be tested for backlash; broken or imperfectly repaired parts inspected; the age of the machine should be considered together with the policy and practice of the company in regard to repairs. The opinion of the operator, the gang boss and the foreman should be solicited, and checked against the facts determined by inspection.

In a well-conducted shop, where repairs are promptly made, the depreciation from wear alone will not accumulate faster than 2 or 3 per cent a year. It is more likely to be obsolescence than wear that puts a

machine on the scrap pile. A superintendent will hardly retain in active service a machine whose production is curtailed 40 per cent by wear alone. He will either repair it, replace it, or move it to some other part of the shop where the demands on it will not be so heavy.

As a check on depreciation, estimate the cost of repairs necessary to put the machine in first-class condition, and in doing this the facilities of the owner for such work should be considered. Repairs can be afforded when adequate facilities exist in the shop, but if not, repairs other than replacements of worn parts that can be supplied by the manufacturer are not usually warranted.

A machine whose annual repair bill is heavy is of diminishing value to its owner in proportion to the cost of upkeep, but it is not the function of the appraiser to consider this. The cost of repairs has gone into overhead expense, and should not be deducted from the value of the machine.

In the case of a machine so old that its original cost cannot be estimated with reasonable accuracy, it is manifestly better to give it a net value, rather than go through the form of deducting a carefully considered depreciation from an inaccurate cost.

Obsolescence

Obsolescence is the next factor for consideration and is estimated by comparing the machine with the most modern machine on the market. In the case of wear it is a question of comparison with a fixed quantity; in the case of obsolescence, a comparison with a variable. The physical condition of a machine is the same irrespective of other conditions, while the degree of obsolescence is vitally affected by circumstances and is a matter of deduction from variously acquired information and opinion. The first and most important suggestion is: Get all possible information and assistance from the production department. It can be safely assumed that this department knows the weak places in its equipment better than anyone else.

There is "style" to machinery, and an 1880 design is likely to suggest obsolescence strongly, when as a matter of fact the machine may be a better productive unit than it appears to be.

In 1916, there was in active service in a well-equipped machine shop an old chain-feed lathe so old that no one would attempt to give its age. It was then—and probably is today—standing in the carpenter shop beside a new, modern wood-turning lathe. It was used for turning wooden rolls up to 40 x 2 in. The original feed mechanism had been replaced by a belt drive giving a coarser feed to the carriage, but was otherwise the same as when it was built. The work that it turned out was light and it was not used all the time. The operator preferred it to the new lathe because the carriage was lighter and was controlled by handwheel at the head end of the lathe; consequently, it could be returned easily and quickly at the end of the cut. He preferred it because he was used to it. The new lathe could cut the time on heavier rolls, but not on the smaller ones. To what extent, then, is the old lathe obsolete? To decide this question it must be compared with another lathe that will do the same work as well or better. A second-hand engine lathe of more modern construction would not do it without some changes to the feed and the bearings might give trouble if run at high speed, so that the best machine to replace it would be a light patternmaker's lathe, which would probably cost today about $350. This would be a better all-round machine, but it would turn the rolls no better, and probably no quicker. It should be considered, however, that the utility of the old lathe depends entirely on the demand for small wooden rolls. If it should happen that these were replaced by rolls made from tubing or sheet iron (as has actually been done with larger rolls), then the value drops at once to scrap. After giving these factors proper consideration, a net value of $175 might be given to this machine.

The last factor in depreciation is lack of utility. Is the machine under consideration useful to its owner irrespective of mechanical condition or design? It is obvious that even a new machine is of no value as a productive unit unless its owner either has, or expects to have, suitable work for it. There are, for example, a number of special-purpose machines that were used in munition factories that are practically useless today. There are other machines that have only a limited sale in peace times, but were used extensively for war work. Gun-barrel drilling machines, rotary cutting-off machines and profiling machines are examples of this latter class if the owner has no work for them. In such cases the only value of the machines is their commercial value, or their value to the second-hand dealer, increased in proportion to the possibility of their again being used by the owner. Here again the advice of the shop man is invaluable, particularly in the case of standard tools that may be temporarily idle. If he has decided to sell said machines they have one value; if he intends to put them into production they have another.

Other Factors to Be Considered

In addition to the foregoing, there are two other factors that may be considered: that is, second-hand and scrap values. The actual value of any used machine cannot be greater than the cost (installed) of a similar machine in like condition acquired in the second-hand store. A few months ago many second-hand machines were offered at prices ranging from one-half to one-sixth of their present-day costs, new. Profiling machines, whose average selling price new is $1,100, were offered as low as $200. These machines are probably in good working order, and if appraised as productive units would have a value of $800. Any company owning and using ten of these machines could replace them with equally good machines at a total cost of not over $300 each.

In an appraisal for insurance purposes, the replacement value is supposed to be one that will actually replace it—or 80 per cent of it—and prices in the second-hand market are not very stable. How far second-hand values shall be reflected in shop valuation will depend on the purpose of the appraisal and the judgment of the appraiser, but its possible effect should not be entirely neglected.

The scrap value, particularly of light- and medium-weight machinery, need not be considered. The net cash return after deducting the cost of dismantling is too small a percentage of its value, and possible errors in depreciation will more than offset it. However, a machine, the major portion of whose cost is in cast iron, such as an alligator shear, would have a scrap value that should be taken into consideration. In general the heavier the machine the greater the necessity for including its scrap value.

In conclusion the writer wishes to insist that accurate depreciation is made possible only by considering each specific item by itself. It is not possible to secure accurate results by any process of averages, either average life or averages by rooms or departments. Age factors are a makeshift of accountancy, and group depreciation is no less a makeshift in appraisals. Greater accuracy cannot possibly be claimed for it, and at best it can only hope to equal the accuracy of detailed appraisal.

Finally, to repeat, do not expect the best results unless the owner or superintendent co-operates with the appraiser. The superintendent knows more about his own machinery and his future plans for its disposal than anyone else. The appraiser should not be expected to know all of these; nor should he, on his part, assume that he does.

Grinding Circular-Formed Cutter Teeth

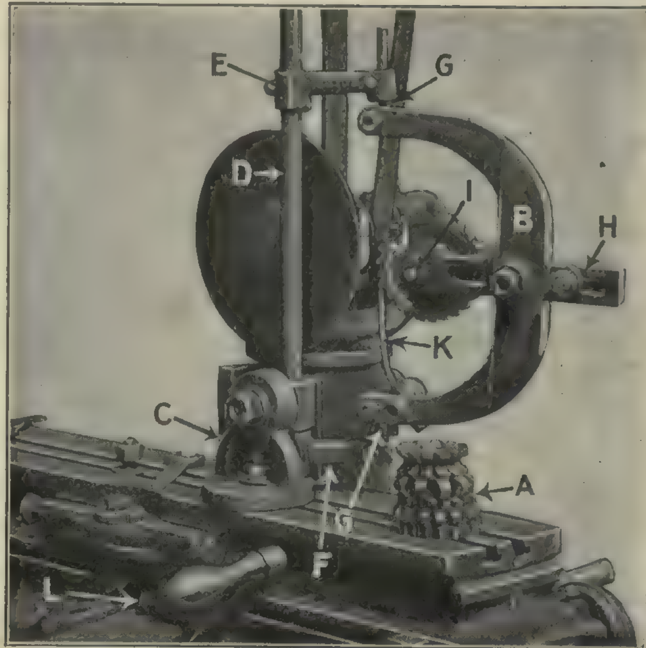
By Eugene E. Henry

The accompanying photograph shows an attachment used in the toolroom of the Holt Manufacturing Co., Stockton, Cal., for grinding the tops of circular-formed teeth on milling cutters. the attachment was made at a small cost, and can be used on any type of cutter grinding machine, although it was here applied to a No. 1 Le Blonde machine. Besides being used for regrinding clearance on stock cutters, the rectangular teeth of old cutters are often rounded with this attachment so as to form circular-shaped cutting edges, the type of work done being shown by the cutters *A* on the table of the machine. The same device is used for forming perfect radii on lathe tools and radius gages, these being clamped to the yoke *B*.

Referring to the sketch, *C* is a base bolted rigidly to the table of the cutter grinding machine and carrying a vertical rod *D*, which in turn carries the arms *E* and *F*. The outer ends of these arms carry center pins *G*, which fit in countersunk holes at the ends of the yoke *B*, thus enabling the yoke to be swung about a vertical axis through an angle of over 180 deg.

Yoke *B* carries the slotted bar *H*, which is fitted with the thread pin or stud *I* at the end toward the wheel. The cutter to be ground *J* is slipped on the pin *I* and held in place by a collar fitted with a setscrew, this being hidden by the cutter in the illustration. Spring stop *K*, which is secured to the lower end of the yoke, serves to hold the work in position while the teeth are being ground, and its height is so adjusted that the cutting edge of the tooth to be ground is level with the center of pin *I*. The cutter *J* is adjusted so that an imaginary line through the centers *G* intersects the center line of the teeth, the stud *I* being screwed in *H* to give the desired position and then locked by means of the locknut shown. The bar *H* is moved forward so as to make the distance from the cutting edge of the tooth to the line connecting the centers *G* equal to the radius it is desired to grind. When the cutting edge of *J* is in advance of the line through the centers *G*, a convex tooth is formed: but when it is behind, the tooth form is concave.

The grinding-machine table is dropped as low as is allowable with the proper clearance at the cutter, the carriage is advanced to where the cutter just comes in contact with the grinding wheel, and the limit stop *L* on the grinding carriage is set to this position. The



ATTACHMENT FOR GRINDING CIRCULAR-FORMED TEETH ON MILLING CUTTERS

work is lined up so as to be central with the wheel by means of the cross-feed screw of the grinding machine. The yoke *B* is swung while the wheel and the tooth are in contact, thus grinding the circular form. The carriage is then drawn back, the next tooth of the cutter shifted into position for grinding, the carriage advanced to the stop and the grinding operation repeated. A rubber-bonded grinding wheel of 8 in. diameter and $\frac{1}{16}$ in. thickness is used for this work.

A Non-Blotting Triangle

By Richard J. Jacker

Any triangle may be beveled at the edges as shown in the illustration so that the ink from the drawing pen will not blot the paper. Besides preventing this trouble, such a triangle will glide easily over the heads of thumb tacks.

A NON-BLOTTING TRIANGLE

The Employees' Magazine and Safety First

BY JOHN T. BARTLETT

"YOU know," narrated the employees' magazine editor, "Bill Ironsides is not what anyone would call a roughneck, but the fur on his neck sure showed points when he blew into our office a day or two after the last issue of our magazine was published.

"We only had to cast our lamps on the Safety Engineer for a moment to absorb the information that he was about to deliver himself of something.

"It came! He exploded! 'What d'yu mean by missing out on one of the most important departments of the yard in your new paper?' he hurled at us. 'You have a good magazine, and some good stuff in it, but you never said a blessed word (and that wasn't the word he used, either) about the safety-first branch of the yard's work, when you know that there are men in this yard, who practically refuse to take any precautions either as to their own or their fellow workmen's safety. We can't lose any opportunity of shooting Safety First into these guys!'"

When we suggested a Safety-First page for this number, Friend Ironsides subsided.

The commonest mistake in handling safety first and other material of an inspirational nature is to use altogether too much of it. One little story of two hundred words in an issue, containing ingredients of human interest which will arouse the reader and obtain a healthy mental reaction, is a thousand times better than 4,000 words, done in "hot air," space-filling manner.

The first thing to realize in connection with employees' magazine technique is that space alone is no device to obtain results. The magazine editor who heeds this knows a lot. He isn't going to clip long articles, run them, and hope they will accomplish results. He isn't going to editorialize vapidly in "hot air" fashion. He will use little safety-first material, relatively, but what he does use will be most carefully chosen and effectively presented. And he will plan to have some of it in every issue.

Giving the Personal Twist to Safety First

In the employees' magazine of one of our leading railroads, the successful editor, Robert M. Van Sant, finds monthly room for a "Safety Roll of Honor." This is not a mere list of names. In brief paragraphs, men who have done things to prevent accidents are commended. The act itself is tersely, but in detail, described. Each one of these stories is a thumbnail story, right out of life. It is safety first material of the very highest order.

The paragraphs are like these:

"On the morning of July 3, Signal Maintainer Carter, while working on his post, noticed two small children walking on westbound freight track while eastbound freight was passing. At the same time a westbound train was coming around a curve only a few hundred yards away. He quickly realized their danger, and started on a fast run just in time to reach them. Commendation is due Mr. Carter for saving these children from injury or possible death."

"What might have been a severe accident was prevented by the close observation of Leverman H. B. Hall, when he noticed brake rigging dragging under extra east 2699 while passing Carroll's. Crew was notified, train stopped, and obstruction removed. For his carefulness he has been commended by Superintendent Hoskins."

On this Safety Roll, mention is also made for acts of a somewhat different sort. For example:

"On September 10, Agent C. S. Mitchell at Flora shipped the storekeeper at Washington, Indiana, two kegs of old nails pulled from merchandise cars at his station. This not only saves that many nails but prevents a great deal of damage to freight from nails protruding and tearing sacks, etc. Mr. Mitchell is to be commended for his interest in making every saving possible. This is only one of his ways of saving money for the company."

Mention of this sort always pleases the person who was careful, strengthening his favorable feeling toward the safety idea.

Safety first material with a personal twist is safety first material par excellence. The Safety Roll of Honor is one ingenious, appealing use of the personal twist, and one of the very best. However, the clever employees' magazine editor finds individual, successful ways of his own.

This is one good way, oftentimes, to test the editor's size-up of his job. Let him decide to run a photograph of the physician the company employs for first aid. See how he does it.

Introducing the Company Doctor

If he is satisfied with a conventional, formal head of the physician, posed in his best professional manner, and if he runs this photograph with a caption like this, "James Towns, M. D., Company Physician," we can hazard an observation without any additional data. This employees' magazine editor still has something to learn about reaching workmen through the printed page.

In connection with its safety first work, a concern employing several thousand men naturally required the co-operation of the employees' magazine editor. The company maintained first-aid rooms, in charge of a competent physician. A photograph of this personage was in order.

The editor did it in this fashion. He got a snapshot of the doctor, standing within the works. The doctor had his pipe in one hand and his soft hat in the other. His fountain pen clip stuck out on his coat as big as life. The editor had a fine cut made of this snapshot, and ran it with the caption, "Doc. Hulse."

Then to go with it, he wrote a little story, headed in big type, "He's Your Friend." The story ran along something like this:

"This plant has a most enviable record as far as accidents go. For the size of the plant, and the number of the employees, the number of accidents that occur month by month is almost negligible. Our record is superior to any other industry in the state, and the chief of the hospital staff is anxious that we continue our good work, and keep our good name untarnished.

"He urges every man in the yard to take the greatest care of his own body, and to see to it that he does his share toward avoiding any possibility of accident.

"However, in even the best of regulated works, accidents do happen, but the injury from them can be minimized greatly if one simple rule is strictly adhered to by every employee.

"That is to report every accident, no matter how small it may appear, and to report it at once. Small bruises have turned into bad sores through delay in having them attended to. Lives have often been lost through neglect of a minor hurt.

"So remember this. The moment you are hurt, hike straight for the first aid rooms, and have Doc Hulse fix it up."

This was good safety first material. The familiar snapshot of "Doc Hulse" gave it a compelling personal twist. The photograph portrayed him a human sort of fellow, and helped to make employees feel acquainted with him. It helped to overcome the diffidence about going to first-aid rooms about a minor hurt which some men in overalls might feel. Informal, good photographs are always effective in lending interest and "punch" to safety first material in the employees' magazine.

The reference to the plant's safety record was a good touch. It appealed to shop pride. The language was informal about a matter which the company was anxious to shear of formality and ceremony. "hike" was exactly the right word to use. When a hurt was involved employees were urged not to "stand on ceremony," and the editor appropriately did not stand on ceremony himself in picking his words.

It is pertinent to remark, incidentally, that the employees' magazine is a publication in which "standing on ceremony" ought to be strictly taboo. I do not mean by this that it is necessary to use coarse language, or to make offenses against common good taste. But the flavor of the publication ought to be a familiar, sleeves-rolled-up, smiling kind. It ought to be a man-to-man, we're all-human publication. Such a publication will thereby be more readable, and thereby more fun to edit. The more important result is that the employees' magazine edited thus is going to be, by the same token, measurably more effective, whether handling safety first material or any other.

Short Stuff in Plant Publication Is Itself Safety First

Workingmen have not had practice on "dry stuff" in college or elsewhere, as some of the rest of us have, and their powers of concentration when the printed message is involved demand lively, easy-to-read matter. Otherwise they probably won't read it at all.

Bill Ironsides said:

"Always give SAFETY the first consideration.

"Warn a man when danger is near; you may save him from injury.

"If you remove a safety device for repair work, replace the guard when the job is done.

"A preventable accident is a disgrace to the foreman in whose gang it happened.

"Beware of blood poisoning; a scratch may cause it.

"Do not pile material so that there is danger of it falling; you may be the man hurt when it falls.

"Don't join the blind man's club—wear your goggles.

"To be careless, thoughtless or reckless, means injury sooner or later to yourself or others.

"Remember safety first, last and all the time; this slogan has delayed the cost of many a tombstone."

Lengthy stuff, taking on the character of unvarnished "hot air," to use an inelegant term for something which is far from elegant itself, is one error in handling safety first material in employees' magazines Even when the articles are well done, length frequently will destroy much of the effectiveness.

Another error is in tone. "Talking down" and an abusive attitude toward prevalent wrong practices, either don't accomplish the object sought or accomplish it at the cost of ill-will.

An editor who has the viewpoint of the men, who has a warm, human, man-to-man way of handling editorial matter will contribute to the upbuilding of safety first morale among the men. His material, in many cases, will be brief, pithy, full of fire. He will usually find the personal twist, obtained in one fashion or another, the most important device to make his safety first stories readable and effective.

Using Blanked Plates for Trimmer Dies

By H. W. Armstrong

The man who has a drop-forging plant connected with his factory, and who has to pay the bills, knows what a large item of expense is the making and repairing of trimmer dies and punches.

The usual way to make the trimmer die is to take a block of tool steel and lay out, drill or mill, and then file the interior so as to trim the flash from the forging. The dies are made solid in some cases and in other cases are made in two or more sections which are fitted together to form a complete die.

In the shop with which I am connected, we make a large number of dies of the same design to trim small forgings. Our practice in the past has been to make these dies from a solid block of tool steel weighing about six pounds and made so as to trim two forgings at once, the forgings being strung out under the hammer and the entire string being taken, while still hot, to the trimming press and trimmed by another workman.

The writer conceived the idea of making certain changes in the construction of these dies and punches which may be of interest to others in similar lines. The savings in labor and material in a plant making thousands of small forgings may easily reach thousands of dollars in a year's time. The first thing we did was to make a plate, as shown in Fig. 1, of tool

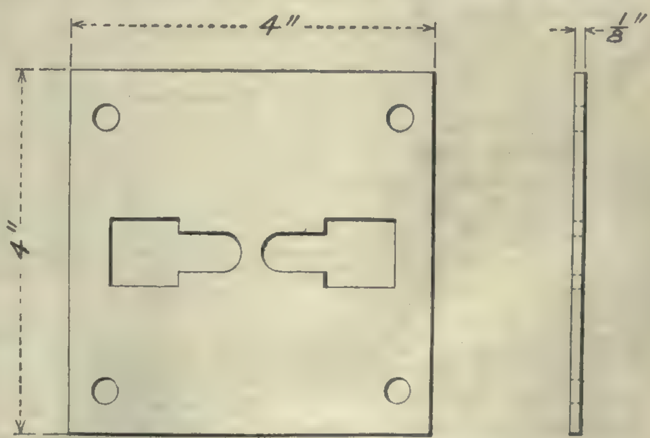


FIG. 1. PLATE FOR FACE OF TRIMMING DIE

steel ⅛ in. thick and of the same dimensions as on trimmer dies. Then we took a soft-steel base and fastened the plate to it by means of four screws, and milled and filed the stock out in the base so as to let the forging drop through after trimming, the same as in the regular die. After hardening the plate and attaching it to the base we used it as a trimming die and when worn out threw it in the scrap and attached another plate. Finding that the plates worked quite as well as a solid tool-steel die, we next made a punch and die and punched out a number of such plates. These plates were filed for clearance and then hardened. Instead of removing a die from the bolster when the plate is worn out we simply unscrew the plate and substituate another, which takes about three minutes.

A still further reduction in cost was made by substituting cold-rolled steel for tool steel and hardening in cyanide. We have not been able to get any two plates to run exactly alike, the poorest trimming about 1,200 forgings and the best ones trimming about 7,200 forgings. A fair average would be about 3,000 forgings—1,500 on each side of the die. Anyone who has had any experience with trimmer dies will see what a great saving we have effected. I will quote some figures from our own comparison of costs:

Cost of solid dies, labor, steel, overhead, etc.	$17.50
Cost of reworking five times	12.50
Total cost	$30.00

The reworking, of course, consists of annealing the worn die, peening in the stock while red hot and, afterward, filing and rehardening. After this has been done about five times the die is scrapped.

FIG. 2. BLOCK FOR TRIMMING DIE

The cost of the cold-rolled stamped plate is about eight cents, which includes labor and material. However, we use six of these while we are using one solid die six times, the cost of the plates being forty-eight cents.

The base or plate holder if made of soft steel, casehardened, costs about $5 and will last indefinitely. This is made in two pieces as it is much easier to make. See Fig. 2. It will be noted from the figures that we have over $29 on each die and as we used to make 200 per year the saving on the dies alone will amount to nearly $6,000 per year. We are now having some cast-iron holders made with the clearance cored in and will try these instead of the steel holders. We are unable to state at present how this will work out.

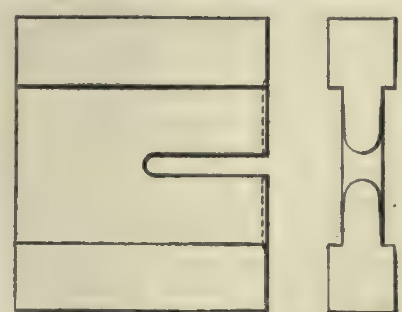


FIG. 3. TOOL-STEEL TRIMMING PUNCH

The punches were originally made of tool steel and shaped as shown in Fig. 3. They were planed in a long bar, then cut to length and milled out in the center and on the ends. Then they were fitted to the die and hardened.

The cost of the punches was as follows:

Labor, material, etc.	$ 7.50
Reworking five times	10.00
Total cost	$17.50

We then made the punches of malleable iron and after finishing on the ends they were ready for use at a cost of about eight cents each. These were reworked five times at a cost of about $2, making the total cost during the life of the punch about $2.80.

Difference in cost, $17.50 — $2.80, or $14.70

However, one trouble was that the iron punch wears rapidly; and we are now using a hardened-steel piece attached to the end of the punch as shown in Fig. 4. We expect this to reduce our cost still further, but at present have no figures to present.

The great difference in the reworking cost of punches is due to the fact that the steel punch had to be annealed, hammered out, filed and rehardened every time it was reworked, while we just milled the end of the iron punch over again. However, the iron punch does not last as long as the steel one but with the addition of the steel end will probably last much longer, as only the steel end will have to be renewed, the iron body of the punch lasting indefinitely.

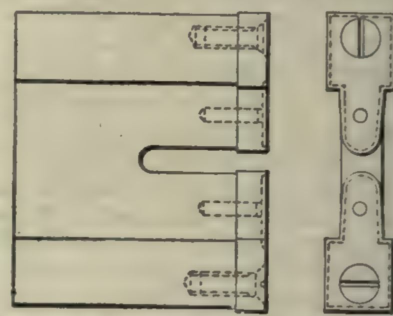


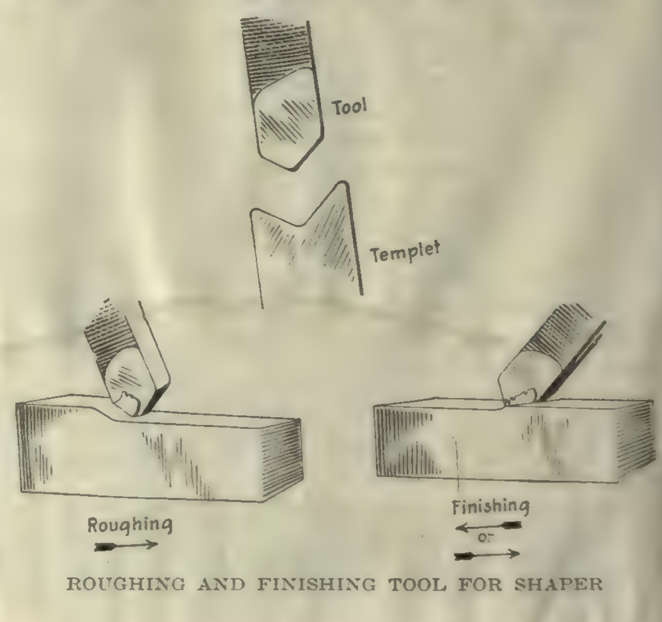
FIG. 4. TRIMMING PUNCH FACED WITH HARDENED-STEEL PLATE

Of course, it must be admitted that it is not practicable for anyone to use this system on all kinds of forging work, but for a shop which makes small forgings in large quantities it will be well worth trying. I would suggest that a plate and base be made and tried out thoroughly on the work before going to the expense of making punches and dies to make the plates in large quantities.

A Shaper Kink

By Charles D. Folsom, Jr.

When there is a considerable number of small castings over which one or more rough cuts and one finish cut must be taken, time may be saved by grinding the tool as shown in the sketch so that it may be used for both cuts. On the rough cut throw the clapper-box over to the left as shown. When finishing, throw it over to the right, using the drag or flat on the following edge of the tool. If care is taken to bring the clapper firmly against the clamping screw before tightening, the tool will obviously come to the same position each time. Hence, after a few trials, you can set the micrometer dial so that the roughing cut will leave just enough to finish, and the finishing cut will bring the work to size quite uniformly. It is advisable to make a little templet as at *A* for the tool, to avoid experimenting the next time it has to be ground.



ROUGHING AND FINISHING TOOL FOR SHAPER

Machining the Liberty Crankcase—II.

By H. A. CARHART,
Lincoln Motor Co., Detroit, Mich.

This shows the interesting method used in drilling the holes for the oil tubes. The crankcase is a "dry" type, instead of splash oiling as in general automobile practice. The final reaming of the bearings is a particular job and is of special interest.

(Part I was published in our June 10 issue.)

THE design of the Liberty motor includes what is known as a dry crankcase, which means that the oil for lubrication is carried in oil pipes directly to the different bearings, instead of depending upon or in any way utilizing the splash oiling so common in automobile practice. These oil pipes run along the bottom of the lower half of the crankcase, and as they must pass through the various partitions it is necessary that the hole be drilled for them and that this hole be of the correct diameter and in line from end to end. The fixture for drilling these holes, which vary from $\frac{31}{64}$ to $\frac{37}{64}$ in., is shown in Fig. 16. The fixture consists of a revolving bar stand having seven suitably-arranged extension arms to which the case is clamped, and each of these arms has guide bushings for the drill.

The revolving stand is pivoted at both ends, as can be seen. and the drills used are shown in the conveniently placed rack at the left. The lower end of the stand has an indexing plate operated by a foot trip. Seven different drills are used, the first hole being drilled by the shortest drill *A*; the longest drill is in place in the machine. Both the holes in the first partition are drilled with the $\frac{37}{64}$-in. drill, the work being indexed from one position to the other. After this, however, each hole is drilled separately, as it would be necessary to remove the drill in either case.

The length of each drill is arranged to take the various partitions so as to be correctly guided and insure the holes being in line. Each drill is provided with a guiding surface just behind the cutting edge. After drilling, these holes are reamed with a series of seven reamers. The oil tubes are afterward driven in, using a special driving tool consisting of a knurled bar having a small pilot at the end which enters the tube and holds the driver in position. The two oil tubes are inserted as far as they will go and are driven into place with a 2½-lb. machinist's hammer. About twenty-five cases can be tubed in an hour by a good operator.

Fig. 17 shows a special drilling head for drilling holes which hold the bail for the pump cover. The details of this special drilling head are shown in Fig. 18. The small horizontal drills are driven by the large bevel

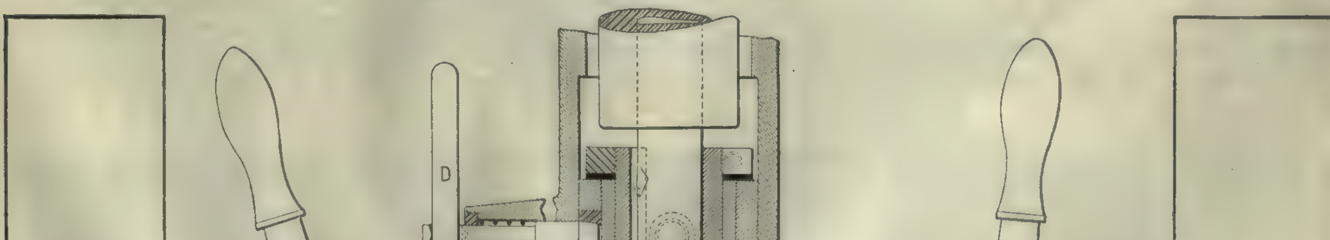


FIG. 18. DETAILS OF DRILLING HEAD

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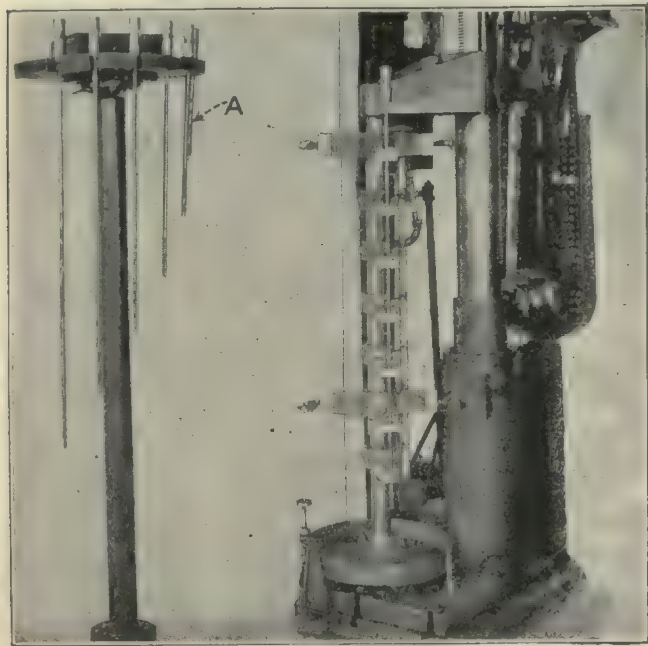

FIG. 16. DRILLING FOR OIL PIPES

gear *A*, which drives the pinions *B* and *C*. Each drill is fed independently by its handle, the springs returning the handle to normal position. The whole head can be indexed by means of the handle *D*.

The drills run 900 r.p.m. and can drill about 500 cases between grindings. The pilot *E* centers the drilling head with the part to be drilled, and also locates the holes at the proper distance from the end.

An application of the continuous track is shown in Fig. 19, where two three-spindle drills are used for counterboring and rough-tapping the stud holes in the oil-pump pad. The carriage in this case is also of aluminum, being mounted on a subcarriage, so that while the aluminum carriage moves crosswise of the rails, the subcarriage moves it from machine to machine, and in this way gives a full floating movement so as to locate the holes in any desired position. The drills approximate $\frac{1}{2}$ in. in diameter and run at 900 r.p.m. The drills and counterbores will handle 100 cases between grinding and the taps must be renewed at about the same time.

After inspection and, if necessary, the final lapping of the joint surfaces to insure perfect contact the whole length, the upper and lower half are bolted together and the main bearing reamed on the fixture shown in Fig. 20. This fixture is mounted on a lathe carriage from which the tool block has been removed. It consists of a bedplate having the two substantial end pedestals shown and the fixed posts which fit the cylinder holes and carry hardened bushings for guiding the reamer. There are six sliding shoes operated by the cross-handles shown, these sliding shoes supporting the case in its proper position. There are also two sliding wedges at the rear which bear against the angular face. After the crankcase has been placed correctly, six hooks, operated by the six long handles shown, hold the case rigidly in place during the reaming operation.

Washing Out the Chips

The bar carrying the reamer is hollow, and lubricant is pumped through it to wash the chips from the cutting edges of the reamer. Great care is taken in locating the case, a dial indicator being used which shows at once if the case is being sprung by the adjustment of the wedges. The reamer is 2.955 in. in diameter, has a land $\frac{1}{32}$ in. wide and a lead of $\frac{3}{8}$ in. The reamer increases the hole 0.01 in. and allows 0.005 in. for finish by the Martell system. The main-bearing bore is held to a limit of 0.002 in., the reamers maintaining their size for about ten cases. The speed is 200 r.p.m. and the feed 0.07 in. At this rate the machine handles about ten cases per hour.

The final reaming is shown in Fig. 21, the equipment consisting of a tubular stand for the motor and driving unit, and a stand of angle iron for holding the crankcase. A 2-hp. motor is used, driving through an inclosed worm and an Oldham joint. The feed is by the handwheel *A* through the reduction gears shown. A quick return is also provided. A lining bar is first placed in position, after which the eccentric bushings are inserted and everything lined up in accordance with the Martell system. After the bushings are lined up, the bar is pulled out sufficiently to allow the Martell reamers to be slipped over the bearings Nos. 5, 6 and 7, and the bar partly removed in the opposite direction, so that the remaining reamers can be put in place.

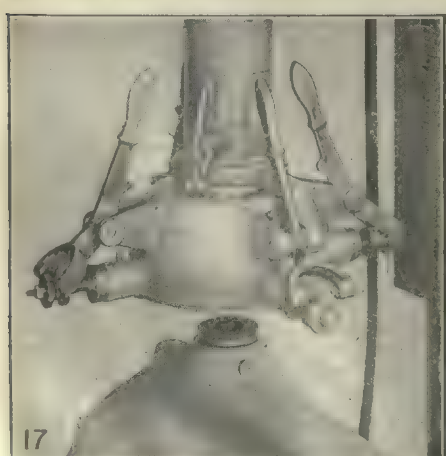

FIG. 17. SPECIAL DRILLING HEAD

FIG. 19. USING AN ALUMINUM CARRIAGE

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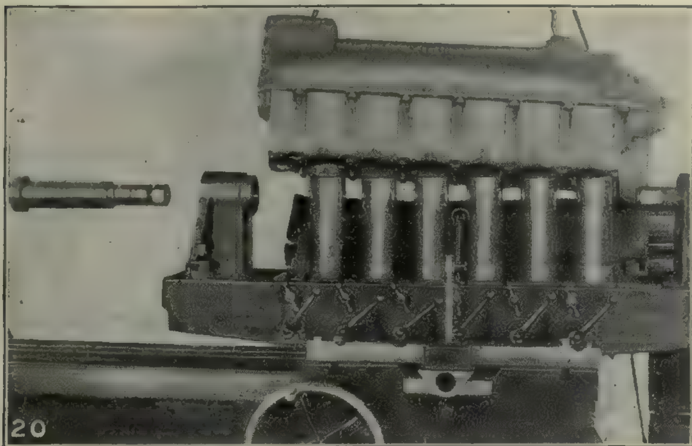


FIG. 20. REAMING MAIN BEARING

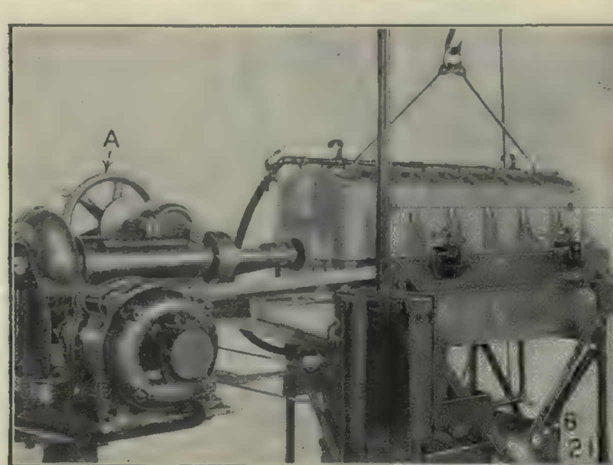


FIG. 21. THE FINAL REAMING

This is done before the case is lifted to the stand by means of the grapple hooks shown. The U-shaped pieces of sheet steel shown at *B* are placed on both sides of the reamers, which ream bearings Nos. 4 and 6, and on the front side of the reamers that ream bearings Nos. 2, 3 and 5. The reamer for No. 7 is placed in its proper driving notch of the lining bar, and this bearing partly reamed because it is considerably longer than the others. During the preliminary reaming operation the other reamers are prevented from entering the bearings by means of the sheet-steel pieces mentioned. The motor is then stopped, the U-shaped pieces removed, and the six other reamers placed in their proper driving notches, after which all of the bearings are reamed.

As soon as the front cutting edges of the reamers have passed through their bearings, the motor is stopped and the reamers are shoved through by means of the hand feed screw. This precaution was found to be necessary on account of the weight of the bar and reamers, as, when they are allowed to revolve after the front cutting edge has passed through the bearings, they will drag and make the bearings elliptical in shape. The reamers are 3 in. in diameter, backed off to $\frac{1}{32}$-in. land with a $\frac{3}{8}$-in. lead. They must be adjusted every fourth or fifth case and must be ground every twenty cases, while occasional stoning in between grindings is sometimes necessary.

The amount of stock removed is approximately 0.005 in. on the diameter. The reamers turn at the rate of 40 r.p.m., and the hand feed is about 0.1 in. per revolution. This equipment handles five cases per hour. The lubricant is a half-and-half mixture of thread-cutting oil and kerosene, which is distributed by means of a pump through tubing to each reamer from above and returning through a drain to a tank below.

Finishing the Thrust Bearing

An interesting fixture for finishing the thrust bearing to its proper width is shown in Fig. 22. This fixture is also mounted on a lathe carriage and has two uprights. the forward at *A* fitting the cylinder bore, and the other at *B* supporting the lining bar outside the case. The bar is removed, the crankcase lowered over the pilot, lined up by inserting the bar through all the bearings, and is then securely held by the clamps shown. The carriage is moved toward the faceplate and is located by the indicator shown.

The carriage is then clamped in the proper position, the machine started, and the cutter fed in by means of the star wheel to the proper depth. The machine is tnen

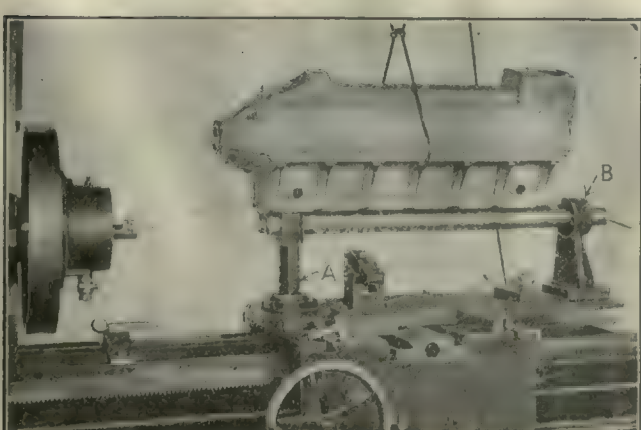


FIG. 22. FINISHING THRUST BEARING

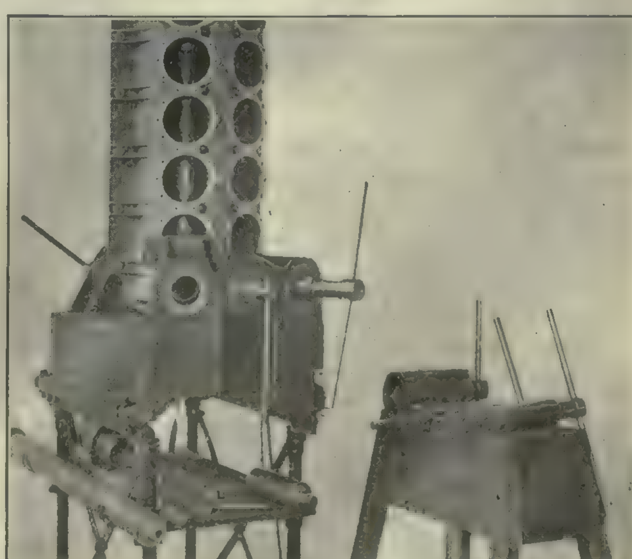


FIG. 23. HAND-REAMING FIXTURE

AUTOMOTIVE CONSTRUCTION

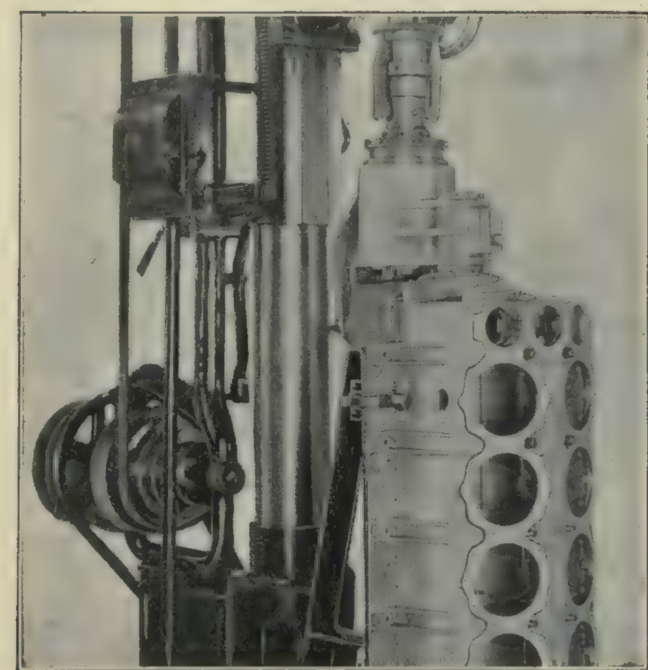


FIG. 24. A LIFTING ATTACHMENT

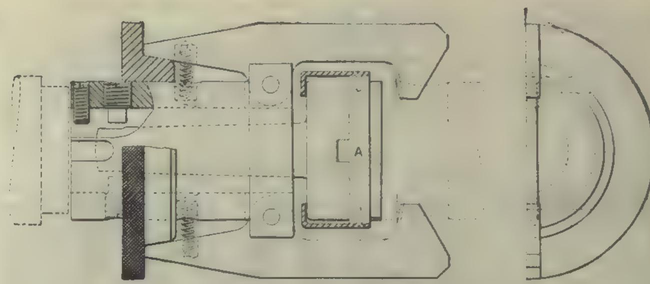


FIG. 25. DETAILS OF THE LIFTER

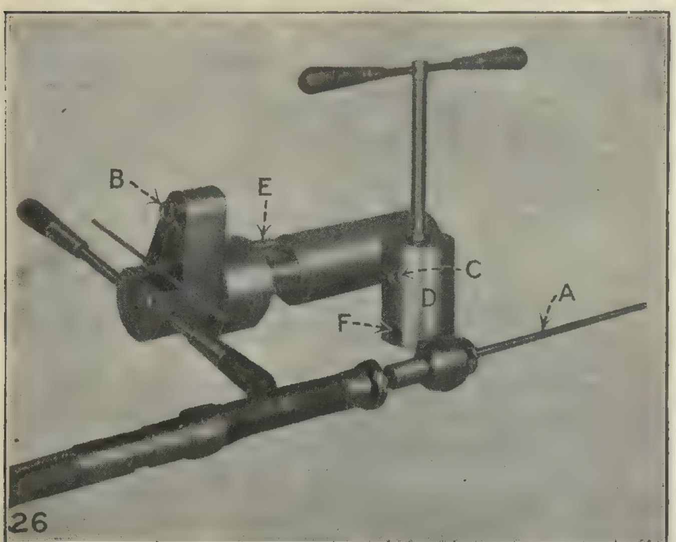


FIG. 26. A REAMING FIXTURE

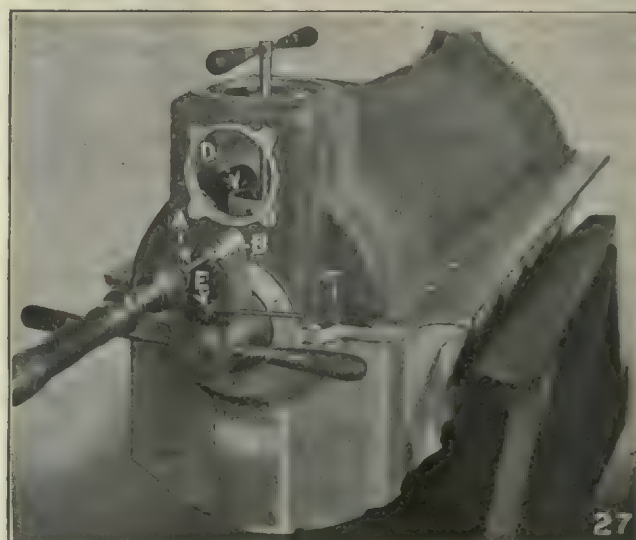


FIG. 27. REAMING FIXTURE IN PLACE

stopped, the cutter backed out, and the carriage run back in the usual manner. In order to have the operator handle the star wheel easily it was found desirable to limit the speed to 40 r.p.m., the feed being about 0.012 in. per revolution. By using a high-speed steel cutter with very little clearance it can be stoned on the front to some extent and will keep its size for about 100 cases. About 0.02 in. stock is removed on each side by this cutter, no lubricant being used.

A convenient hand-reaming fixture for finishing the holes for the camshaft drive and also the generator is shown in Fig. 23. It requires practically no description. The reamers are all of the hollow body type for convenience in handling, the bodies being hardened and ground on the outside, and 24-in. handles being used for turning. The camshaft holes are rough and finish-reamed in this fixture, 0.01 in. being allowed for roughing and 0.005 in. for finishing. All reamers are ground with about 0.0005 in. back taper and backed off to a land of $\frac{1}{64}$ in. with a $\frac{3}{8}$-in. lead. They handle between seventy-five and a hundred cases between grindings. A half-and-half mixture of thread-cutting oil and kerosene, applied from an oil can, is used as a lubricant.

Lifting the Crankcase

An unusual lifting and driving attachment is shown in Fig. 24, and in detail in Fig. 25. This is for reaming and facing the hole at the end of the crankcase, a combination tool being used for this purpose. The clamps

FIG. 28. BENCH AND TOOLS FOR STUDDING

AUTOMOTIVE CONSTRUCTION

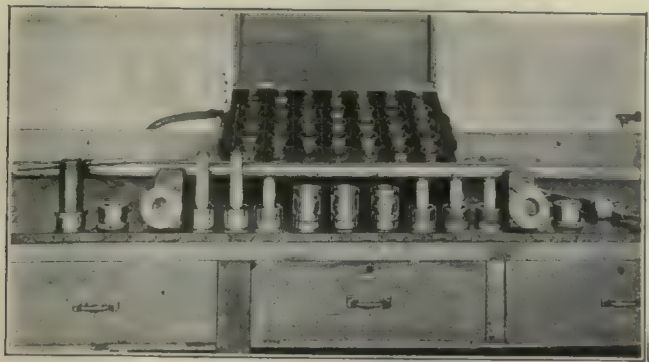


FIG. 29. THE FINISHING REAMERS

shown lift the crankcase into position. After lifting the crankcase into position, the reaming and facing tool is put in position and is driven by the Oldham coupling shown at *A*.

An Interesting Finish-Reaming Fixture

An interesting fixture for finish-reaming the lock-screw holes for the bevel-gear bearings is shown in Figs. 26 and 27. The first shows the different parts of this combination in approximately their correct position, while Fig. 27 shows them in place in the crankcase. It will be noted that the reamer *A*, which is driven by a flexible shaft, is guided by both the bushings *B* and *C*. In order to insure that these are in the correct position the guide plug *D* is located with respect to the other bushing by the pin *E*, which fits into the lower hole *F*. The roughing reamer uses thread-cutting oil and kerosene, but it has been found best to run the finishing reamer dry.

There remains only drilling, counterboring, and reaming various dowel and similar holes, after which a third assembly inspection is given, which is thorough and involves many details. Seven inspectors average an inspection of about fifty-five cases per day. Then the various studs are put in place, after which all the protruding ends are gone over with a hand die to remove burrs.

The oil manifold holes are retapped and the burrs removed from the edges of all reamed holes. This requires about three hours per case for one man.

Studding the Crankcase

Next comes the studding of the crankcase. The tools for this work are kept in kit boxes, which include all that is necessary, the studding bench and tools being shown in Fig. 28. The cases are tnen tnoroughly washed, after which they are ready to receive the main bearing. When these are finally in place they are finish-reamed with a set of Martell reamers, as shown in Fig. 29. This outfit includes thirty-five reamers. Each bearing is reamed 0.0025 in. larger than the recorded diameter of the crankshaft which is to go in it, so that each bearing is reamed for the particular shaft bearing which it is to carry.

A completed lower half of the crankcase, with the water pump in position on the end, and the oil pump at the bottom, is shown in Fig. 30.

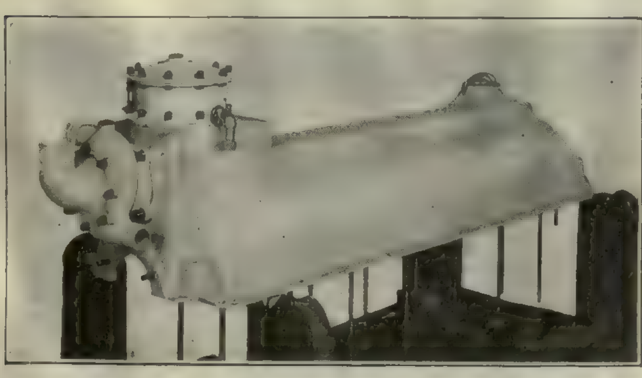


FIG. 30. THE COMPLETED LOWER HALF

How to Keep Employees on the Job in Summer Time

By Frank H. Williams

The problem of keeping all, or at least a goodly percentage of employees, on the job during the summer time, is a problem which has become of especial importance at this time of the year. Too frequently the Saturday half-holiday becomes an all-day holiday during the summer months, whether it is due to "sickness in the family" or to the old-time office-boy alibi of "burying a grandmother," or to any other cause which may be based entirely upon fact—or not.

How can the plant employing large numbers of workmen keep attendance of employees at pretty nearly 100 per cent during the summer time when every man feels the lure of nearby lakes, or ball games, or a trip through the countryside in his own flivver or the auto of a friend?

One method by which greater efficiency in this particular can be attained is through the use of a bonus.

The Edison Lamp works, Fort Wayne, Indiana, one of the plants of the General Electric Co., used a bonus with good effect last year and has anounced that the same plan will be inaugurated this year on June 14, continuing in effect until Sept. 11. Under this plan the factory will give a bonus amounting to about one week's wages to employees who have a perfect attendance during this period. The period includes sixty-two full working days and excludes the shut-down of a week for the summer vacation and the other holidays which will occur during the summer. The exact bonus is 10 per cent of the employees' earnings during the period to those who miss no time. The payments will be additional to regular bonuses. No bonus will be given those losing more than a week's time. All factory employees will be entitled to the bonus, while the office employees, foremen, assistant foremen, leaders, machinists, gatemen, watchmen and other persons not connected with the factory work will not be granted the extra money.

Isn't this plan about the most effective that can be evolved, in the long run? And isn't it, too, about the cheapest in the end?

Certainly, nothing much appeals to employees in a case of this kind as does money. If they can see where they are going to be a worth while sum of money ahead by sticking on the job it is quite probable that they will stick, no matter how strongly the call of the outdoors may be sounding in their ears.

The Spirit of the Federation

ONE of our editors recently sent in this item: "The Technical Club of Madison, Wis., held its first regular meeting June 7, 1920. This club, with a membership of 175, was organized for the promotion of good fellowship and spirit, with *special regard to the part the engineers can take in public affairs.*"

* * *

This is a 175-caliber gun set and ready for action in the great forward movement for engineering recognition. It, like all other such units, should take its place in the battery of the Federated American Engineering Societies.

Only by united action through such a group as the Federation can results befitting engineers be obtained.

* * *

Special attention is called to the following extracts from the Federation constitution, which was published in full in our last issue:

ART. II. OBJECT

"Service to others is the expression of the highest motive to which men can respond, and duty to contribute to the public welfare demands the best efforts that men can put forth; therefore, it shall be the object of this organization to further the interests of the public through the use of technical knowledge and engineering experience, and to consider and act upon matters common to the engineering and allied technical professions."

ART. VII. LOCAL AFFILIATIONS

"Sec. 1. Object. The American Engineering Council shall encourage the formation of local affiliations, to consider matters of local public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that there may be united action and that suggestions and advice may be offered to the Council."

* * *

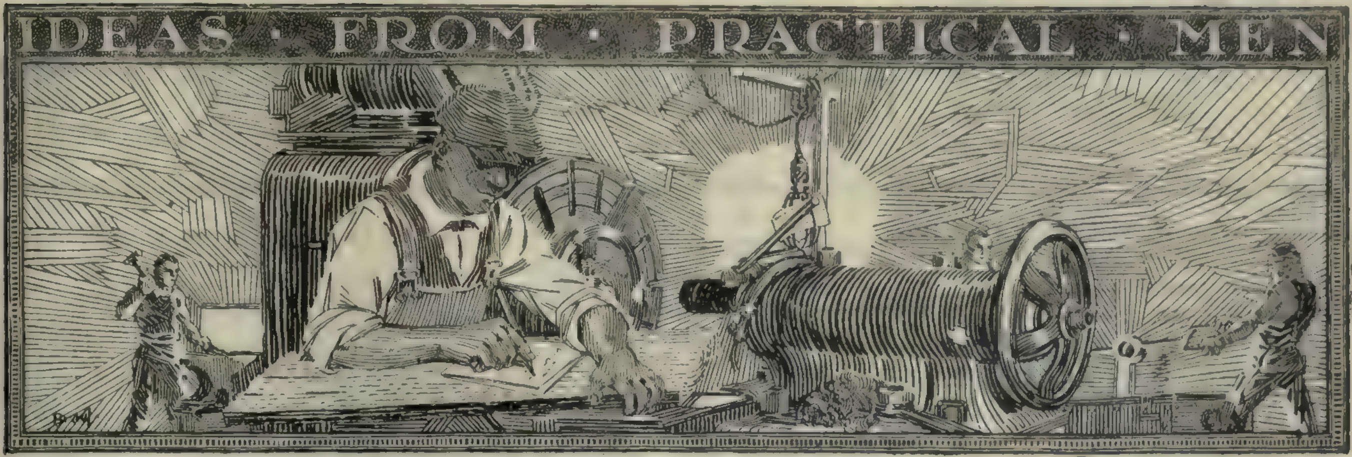
There is absolutely nothing in the object of the Federation that cannot be subscribed to with a clear conscience by every real engineer member of every organization eligible for membership.

Every engineer in the country should boost for the Federation and its object, and back to the limit his local organization for membership in the National body.

The time to apply energy is at the start—AND THAT TIME IS NOW.

Ethan Viall
Editor

(Inquiries regarding the Federation of American Engineers may be sent temporarily to the American Society of Mechanical Engineers, 29 West 39th St., New York City.)



Method of Hardening Long Small Wires

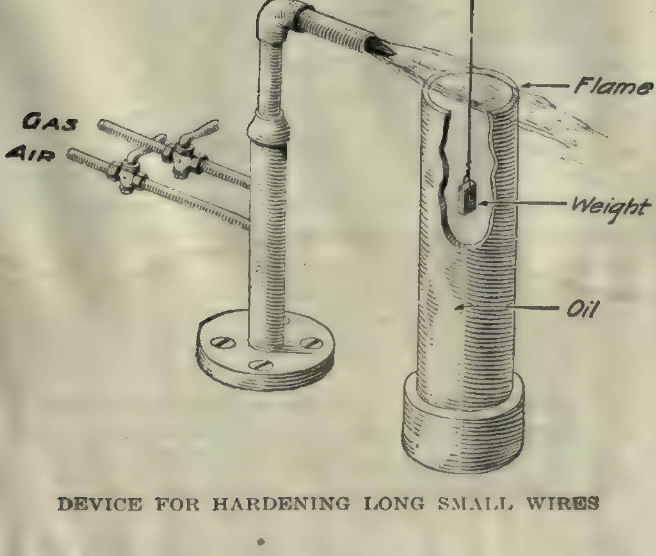
By Charles F. Stotz

A method of hardening long slender punches, which I have used with good results on punches 0.016 in. and 0.020 in. in diam. and about 1⅞ in. long, is as follows:

The wires from which the punches are made are first cut to about 14 in. in length. It is necessary that a gas flame be available which will just pass across the top of a piece of 3- or 4-in. pipe 16 in. long, set on end and sealed at the bottom. The pipe is to be filled to the top with oil suitable for hardening. The arrangement is shown in the illustration.

Attach a small weight on one end of each wire and hold the other end with tongs. Raise the wire in a vertical position so that the weight will about touch the oil, then lower it slowly into the oil as fast as the flame heats the wire properly.

When the wire is submerged to its whole length the flame is shut off or diverted so that the wire may be withdrawn. The wires are cut to the required lengths and then drawn to the desired temper.

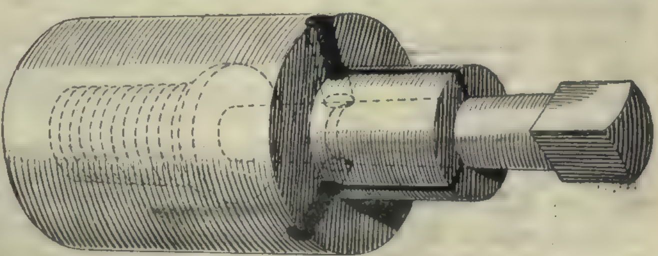


DEVICE FOR HARDENING LONG SMALL WIRES

A Simple Expanding Mandrel

By H. Kurzweil

In respect to the simple expanding mandrel described by E. A. Dixie on page 833, Vol. 51, I should consider it necessary, if the tool is to give satisfactory service, to drill holes at the ends of the slots, as shown in the sketch herewith.



SIMPLE EXPANDING MANDREL

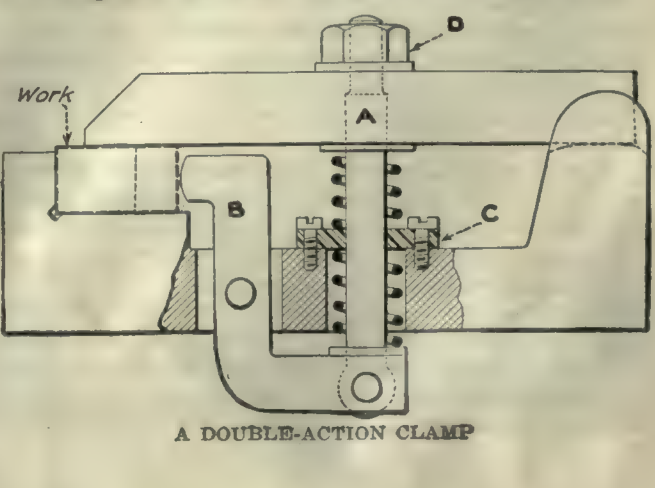
These holes will provide for the backspring of the leaves, not only giving a firmer grip on the work to be held, but also prolonging the life of the tool.

A Double-Action Clamp

By R. W. Belmont

A double action clamp that may be adapted to jigs and fixtures is shown in the illustration.

The stud *A* that tightens the clamp is pivoted to the lever *B*. Two coil springs supported by the plate *C* serve to throw the clamps open when the pressure is released. When the nut *D* is tightened the clamp is drawn down on top of the work at the same time that the latter is forced against the fixed jaw by the bent lever *B*.



A DOUBLE-ACTION CLAMP

EDITORIALS

The Value of High-Altitude Flying

MOST people—and this includes most editors as well—have looked upon Major Schroeder's high-altitude flying as "a fool stunt" of no practical value. Some conceded that to have an American hold the world's altitude record was good publicity, but that was about all.

However, very few know of the careful study and planning of the Air Service that preceded these flights, and the valuable data and conclusions that were the results.

The outcome of future wars—for we may as well face facts—will depend largely on the efficiency and knowledge of the Air Service. The higher an airplane can fly, the safer it will be from observation or destruction.

Early war planes had a ceiling around 5,000 ft., but this was rapidly raised by improved machines until in the later days of the war, 20,000 ft. was common for chasse planes.

Future wars will undoubtedly require very much higher altitudes than this, owing to improved anti-aircraft guns and other devices.

From this it will be readily seen how important is the study of high-altitude flying, and under such conditions as made by Major Schroeder it is not "stunt flying" but scientific research and deserves to be known as such.

In high-altitude flying, devices must be perfected to keep the aviators alive by furnishing them the necessary oxygen. Another problem is to increase the efficiency of the motor and the propeller, since the rarefied air rapidly lowers this efficiency as the machine rises above 5,000 ft.

To supply air to the motor at the proper pressure, a number of devices have been tried out. One which has proved very successful is known as the Moss Supercharger, and in conjunction with this a variable-pitch propeller has been used. A motor without a supercharger loses about 45 per cent of its sea-level power when operating at 15,000 ft.

A few of the difficult problems to be studied and solved may be outlined as follows:

How to keep the air and gas-mixture ratio of the carburetor constant at various altitudes.

How to properly deliver fuel to the carburetor against varying pressure.

How to cool at high altitudes and offset the rising boiling point of water.

How to provide a drain valve to let the water out of the radiator in case the motor stops, so as to prevent the freezing of the water in the cooling system, which would ruin it. This valve must be made so as not to freeze and become inoperative.

How to overcome pre-ignition, encountered when running with the supercharger in action.

These are merely samples of what the difficulties are. In Major Schroeder's great flight it appears that he suffered more from carbon-monoxide poisoning, due to unlooked-for expansion of exhaust gases, than from lack of oxygen.

Aside from the problems of the airplane itself, there are yet great unsolved problems of the upper air currents to be worked out. It is believed by some that above 40,000 ft. trade winds will be discovered that blow constantly from east to west, just as Major Schroeder apparently proved in his record flights around 30,000 ft., that there were winds blowing from west to east.

The settling of the air-current question alone will prove of enormous value in planning commercial or military movements.

From now on, let's give Major Schroeder and the Air Service credit for real scientific research efforts and not think of them as merely pulling off movie stunts. E. V.

Countersigns and Jobs

AS WE look forward to Independence Day, now close at hand, let us think, and decide in our own minds how many of us are keeping to the basic principles of a true Republic.

In a REAL Republic, the will of a majority of the people is supreme! It was for this purpose our Republic was founded.

When the majority does not rule, the purpose is defeated and the Government—recognized or otherwise—becomes that of a dictatorship, whether the power rests in an individual or a minority organization.

Washington said in his farewell address:

"The very idea of the power and the right of the people to establish government presupposes the duty of every individual to obey the established Government. All obstructions to the execution of the laws, all combinations and associations, under whatever plausible character, with the real design to direct, control, counteract or awe the regular deliberation and action of the constituted authorities, are destructive to this fundamental principle, and of fatal tendency. They serve to organize faction, to give it an artificial and extraordinary force; to put, in the place of the delegated will of the nation, the will of a party, often a small but artful and enterprising minority of the community. . . . However combinations or associations of the above description may now and then answer popular ends, they are likely, in the course of time and things, to become potent engines, by which cunning, ambitious and unprincipled men will be enabled to subvert the power of the people and to usurp for themselves the reins of Government, destroying afterward the very engines which have lifted them to unjust dominion."

The principles of our Republic make it plain that the rights of one individual end where those of another begin.

The rights of ANY group, secular or political, are subordinate to those of the nation taken as a whole.

No group has the right to interfere with the welfare of the majority.

No organization, outlaw or otherwise, has a right to close the channels through which the majority—the people—obtain the necessaries of life.

No group or organization has the right to monopolize any branch of trade or industry to the exclusion of other unallied groups or individuals.

This applies equally to trusts, religious orders, lodges or unions.

It is neither right nor legal to say that only Baptists, or Catholics, or Jews, or Gentiles, or Masons, or Knights of Columbus, shall have a chance to earn an honest living in certain lines.

To say that these have not the right and the freedom to work side by side on ANY job, if they are otherwise qualified, is to preach tyranny and oppression.

Prevention of such free working conditions either by force, intimidation, or otherwise, is un-American, unjust and illegal.

Put it up to yourself: Do you believe it is right to compel a man or woman to give a specific countersign in order to work?

Do you believe that inability to give such a countersign should result in the starvation of the individual, or his persistence in working, result in starving thousands of American people by the tying up of traffic or by other means? E. V.

The Mechanics of the Future

Everyone agrees that there is a shortage of good mechanics and joins in the general lamentation that this is so. Many attribute different causes, these depending on the various viewpoints as to both political and labor matters.

Interesting as these opinions are, they are not going to remedy the situation as long as they remain mere explanations of why the conditions remain as they are. The industry and the country need more and better mechanics—what are they doing about it?

There is much talk of vocational schools, of Federal aid to schools by the Smith-Hughes Vocational Education Law and these all have their place. But no plan can succeed unless every machine builder does his share in the work. If he cannot train apprentices well, he may be able to assist some of these vocational or part-time schools. But every shop should do something which will count in this work.

One way of doing this is shown in the article on page 1335 which outlines what Henry Ford is doing in Detroit. This has the great advantage of giving the boy in the poorest of families an opportunity to learn a real trade, which is too often denied by a combination of circumstances over which he has no control. And equality of opportunity removes the fuse from many explosive arguments of the ultra-radicals.

Few manufacturers may be able to go into this as extensively or as liberally as this, but all can and should put a shoulder to the wheel. Each should ask himself, "Am I doing my share to train good mechanics for the greatest industry in the world?" F. H. C.

THE Reparations Commission has discovered that the German dye monopoly has been selling dye products to its own nationals at one-sixth the price it was charging the Commission. The latter, of course, has simply marked the credits down to the legitimate German price.

If it is possible for Germans to sell at home dyes at one-sixth of what seemed to the Reparations Commission at first a fair price, what tariff wall could possibly protect the American industry against German dumping?

The life of the American dye industry hangs on the enactment of legislation giving it complete protection.—*Manufacturers' Record.*

Why the Blueprint?

By John Vincent

The article by Frank Richards on page 871 of the *American Machinist* is interesting reading, but he overlooked some essential features that would render absurd his photo-engraving process for reproducing drawings for use in a shop under conditions of practical service. His first illustration is an example of an ordinary catalog cut but gives practically no details of any value to a shop man, and was probably prepared solely for use in a sales organization. For instance, almost all of the details of the bearings themselves are indistinguishable, and a few larger details that are available will not help out a great deal in any assembling operation.

His second illustration shows a reduced drawing of a freight car frame which, he acknowledges, was taken from a technical article, and as such was prepared solely for the guidance of the reader and not for use of a shopman. Possibly if he had seen the drawing from which this cut was prepared he would have found it totally unlike the usual shop tracing. For instance, probably all the lettering was vastly enlarged so that it would be legible when reduced to the size of cut shown. With further reference to the details shown on this drawing, a shop man could tell at a glance that it would be of little practical service in the shop use because none of the riveting layouts or any of the structural details are shown for the benefit of the shopman and consequently would be either a case of providing additional drawings or leaving it entirely up to the shop man to worry about, which is poor engineering practice. Moreover, in a drawing of this size few dimensions could be shown on it without having it so cluttered up that it would give very poor service.

Another point which would show the impracticability of using too small drawings is the fact that they get dirty and if anyone will lay a dirty, smutty finger on two or three corners of so small a drawing he will find that without doubt important dimensions and other instructions are totally obliterated. The ordinary large-sized blueprint can collect considerable dirt and oily fingermarks and still be legible to the workman.

Lastly, with reference to the production of cuts, I think Mr. Richards would find that they could not be suitably reproduced from the ordinary working drawing, and that it would be necessary to ink in the drawings in order to obtain clear, sharp lines for reproduction by the photo-engraving process. Consequently nothing would be saved by this method over the ordinary work of tracing the drawings so that the cost of one process practically counterbalances the other.

Annual Convention of the Industrial Relations Association of America

The Industrial Relations Association of America met for its fourth annual convention at the Auditorium Theater, Chicago, on May 19, 20 and 21, 1920. The officers in charge of the association (formerly the National Association of Employment Managers) are: President, Philip J. Reilly, Retail Research Association, New York; vice president, John C. Bower, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.; secretary, F. C. W. Parker, Central Y. M. C. A., Chicago; treasurer, John C. Willits, University of Pennsylvania, Philadelphia; executive secretary, Mark M. Jones, Thomas A. Edison Industries, Orange, N. J.

Chambers Studio
PHILIP J. REILLY

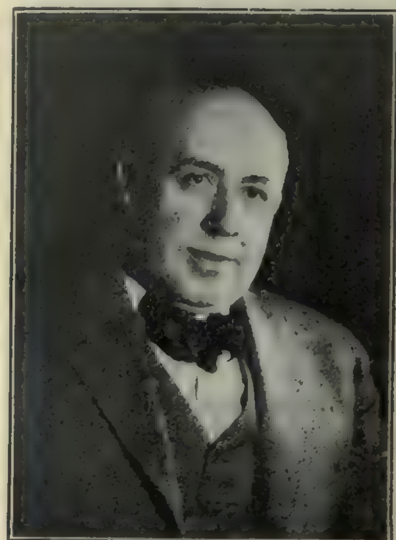
A singular arrangement of the program placed most of the interesting topics for discussion at concurrent luncheon or dinner meetings, and as many as eleven topics were thus placed for the discussion of different groups at widely separated places at the same time. Many of these topics were of interest to the same person, and this overlapping arrangement prevented some of the delegates from obtaining the full value of these discussions. An instance may be noted in "Apprentice Training" and "Shortage of Labor" which in many branches of industry employing skilled help are closely interwoven topics, and yet these were discussed in the same noon-day period before different groups.

On each day, short morning and afternoon sessions were devoted to general discourses with all of the delegates in attendance, but these addresses were usually not sufficiently fundamental in character to furnish a good working basis for individual action.

The afternoon session on Wednesday was devoted to addresses on "Incentives and Production," with the following speakers: H. H. Haylett, Labor Manager, Alfred Decker and Cohn, Chicago; Dean L. C. Marshall, School of Commerce and Administration, University of Chicago; and Frank J. Raymond, The Inter-racial Council, New York. The evening general session on the same day discussed: "Linking Up the Worker and the Finished Product." The speakers were: H. B. Bole, Hydraulic Steel Co., Cleveland, and Harry N. Clarke, The Cort-e-Scope Co., Cleveland.

Subjects discussed at later general sessions included: "Community Conditions Affecting Labor Stability," "The Status of Women in Industry," "The Foreman of the Present and Future," "Organized Labor in Industry," "What Management Wants" and "What Labor Wants." One of the interesting speakers on the subject "Organized Labor in Industry" was E. J. McCome, general manager of *The Buffalo Commercial*, who spoke of the open-shop conditions which are being maintained in that printing plant, claimed to be one of the four newspapers in the United States in which the conditions of a totally "closed shop" do not exist.

This speaker was followed by Sidney Hillman, general president of the Amalgamated Clothing Workers of America, who attempted to convey the impression that his organization was free of the faults that have been charged against other labor organizations to the effect that they are attempting to curtail production and continually raise the cost of living by strikes and wage increases. Another striking address was made by Sherman Rogers, formerly a lumberjack of Oregon, who spoke on the present and past methods of handling labor. He said in part: "If you want to know what makes Bolshevism, go home and take a squint in the glass and you'll see. It is time to stop passing the buck; slam the cards on the table face up where everybody can see them and then we will get somewhere. All men are right when they get the truth. The attitude of employers in staying asleep at the switch and letting radicalism spread has been one of criminal apathy. . . .



Chambers Studio
F. C. W. PARKER

"Ninety-eight per cent of labor is right, absolutely square. In the last six months labor and capital have drawn closer together than in the previous hundred years.

"Establish the human contact between the office and the shop, preach the truth openly, come out in the open, quit passing the buck, and it won't take long to convince the worker that the stuff the radicals are preaching is the doctrine of destruction."

A. C. Horrocks, director of education of the Goodyear Tire and Rubber Co., Akron, described the training courses that have been established in their plant for creating supervisory foremen in gang leaders. These courses have proved successful as shown by the constantly increasing enrollment of employees. The first class had about 325 enrolled, the second about 480, and the third, which will complete its course some time in June, has about 2,700.

The foreman of the present found a warm defender in Dudley R. Kennedy of Philadelphia, who claimed that he is just as the management of the present makes him, and that the faults of the foreman but reflect the corresponding faults of the management. He further said, " . . . the foreman is the most abused and least understood man in the manufacturing field today. . . . He is really the solution of the labor problems of the present because he is the sole connecting link between the board of directors and the man with the wheelbarrow."

The Railroad Wage Case

To the Honorable Members of the
United States Railroad Labor Board.
Gentlemen:

The outcome of the Railroad Wage case, which is at present before your honorable body, is of such vast importance to the manufacturers and producers generally, that the Illinois Manufacturers' Association, through its Board of Directors, takes the liberty of submitting the following for the consideration of your Board:

First. The practice of basing wages on the cost of living, without taking into account the work performed for the wages, is, in our opinion, at the very bottom of the present disturbed and unsatisfactory labor condition. It is usual now, in presenting claims for wage advances, to attach an estimated family budget, upon which the percentage of wage increase is predicated. Unfortunately, this family budget is presented only to further the claims of a particular body, but we believe it to be the duty of your Board to consider where a universal application of the budget presented in the railroad case would lead.

If, for instance, we accept the figures submitted by Mr. Lauck, that $1,700 represents the lowest subsistence level and $2,500 the lowest comfort level for an American family, and base the scale of wages in the transportation service on the assumption that every man engaged in this service, no matter where he lives, whether married or single, is entitled to a wage based on a scale with those figures as minimums, would it not be fair to assume that every wage earner in every character of employment everywhere in this country is entitled to a scale based on that same minimum?

From our experience as manufacturers we should say that, if Mr. Lauck's budget were made the basis of a universal demand, the farms, the mines, and the industries would be wholly unable to meet it on a straight-time basis.

If this is true, then you would improve the living conditions of railroad employees by impairing the living conditions of all the other workers.

Your Board can render a signal service to the country by indicating to these claimants that, while wages should be equalized in those cases that have lagged behind in the wage readjustment, wages can't be paid unless they are earned, and that we can't get more out of the common pot than we put into it.

Second. The divorce of wages from production has been one of the calamities of the war, for it has created, in the mind of the wage earner, the delusion that, irrespective of output, performance, or character of service rendered, he is entitled to live on a certain scale. Statisticians spend their time in developing elaborated lists of family requirements, instead of determining how wage increases based on these requirements can be paid.

And so it happens that during the most critical time in the industrial history of the country, when the consumption of commodities has expanded, and world production of commodities has been greatly impaired, we have established a shorter working day, have abolished piece and premium forms of payment, and have imbued the wage earner with the idea that he is entitled to a good living if he but spends eight hours at a job.

We recognize that there is considerable justice in the demand for an increase among railroad workers, and have no intention of arguing against a fair increase.

We do think, however, considering the importance of the decision which you are about to render, that you should emphasize the necessity, during these times of extraordinary prices, that part at least of the increased cost of living shall be met by longer hours of service and increased output, and that piece and premium rates of payment, which during Government operation of the roads were wholly abolished, should be re-established.

Third. The industries have, for the past eighteen months, been adjusting their wage scales to meet the changed conditions. We think your honorable body should be guided in the final determination of wages to be paid, by the rates obtaining in similar crafts in the industries. If the wage scale fixed by your body for the transportation service is above that now current in the industries, it will force another readjustment of wages there, and will be followed by another increase in the price of commodities.

The industries can quickly adjust themselves to conditions of supply and demand in the labor market, but the scale fixed by your Board will be of a rather permanent character.

Unless provision is made for readjustment when conditions change, high wage rates and their concomitants, high freight rates, are likely to endure longer than conditions justify.

Fourth. The advances in cost of living have affected most adversely the lowest paid wage earners, and the increases in the wages paid unskilled labor have, therefore, been largest.

It is only fair to suggest to your Board, therefore, that no uniform percentage increase in wages be granted, but that the rate of wage increase be greater in the lower paid classes than in the higher.

This would but repeat what has actually happened in the wage readjustment of the industries.

CHARLES PIEZ.

Conditions in France

BY MASON BRITTON

PARIS, May 25, 1920

The street lights are burning dimly at night in Paris hot water is obtainable in hotels twice a week, and most manufacturing plants are shut down one day a week on account of lack of coal—all of which is symbolic of the twilight period through which France is now passing. Daylight is coming fast, however, and optimism appears on all sides as to the near-approaching and ultimate prosperity of France.

The industries are handicapped principally by lack of raw materials, coal and the railroad congestion caused by worn-out equipment.

The recent general strike about which we have read so much in the papers was a fizzle for two reasons—the firm action taken by the Government and the fact that the French workmen are tired of striking and losing the money consequent to strikes. When the strike order went out many of the men obeyed it, but only stayed out for a few days. Practically all of them have returned and manufacturers here think that except in isolated cases they will have no more labor

trouble for a long time to come. Some of them have announced a unique policy. When the men in a plant strike, the manufacturers will lock them out for the same duration of time as the men stay on strike. In other words, if the men strike for a week they are forced to stay out an additional week, losing two weeks' pay.

Good machinists are getting between three and a half and four francs per hour. The pay before the war ran from sixty centimes to one franc per hour. A week's work now is forty-eight hours. When the shops are closed down, the men work overtime and thus total forty-eight hours a week. The French workmen like the piecework system and the unions do not seem to be opposed to it. The spirit of the workmen is good, and, when they work, good production is obtained.

Principal Machine-Tool Builders

The following are the principal French machine-tool builders:

H. Ernault, Paris. (Lathes and horizontal boring machines.)

Gazeneuve, La Plaine Saint-Denis, near Paris.

Bariquand and Marre, 127 rue Oberkampf, Paris. (Lathes, turret lathes, milling machines and small tools.)

P. Hure & Cie, Pantin near Paris. (Milling machines and lathes.)

Jost & Cie, Paris. (Drilling machines.)

Rouchaud & Lamassiaude, Limoges. (Vertical milling machines.)

Lubin & Weiffenbach, Saint-Quen near Paris. (Keyway milling machines, spline-shaft planing machines and cylinder boring machines.)

Philibert, Gamin & Cie, Paris. (Milling machines.)

Cuttat, Paris. Small single-spindle automatic screw machines.)

Guillet & Fils, Auxerre. (Lathes, drilling machines and a complete line of wood-working machines.)

Leflaive & Cie, Saint-Etienne. (Big planers, boring mills, etc.)

Societe Nouvelle de Machinesoutils, Asnières, near Paris. (Grinding machines.)

Anciens Etablissements. Lomont, Caen (Calvados). (Radial drilling machines, planers, lathes.)

Anciens Etablissements. Requier Frères. Paris.

The French machine-tool builders sell mostly direct, and few of them have exclusive agents, it being an open market and a commission being given to anyone who sends an order. Their prices are much lower than American prices, but, if exchange is figured at normal, it amounts to about the same. A French 16-in. x 8-ft. engine lathe with three-step cone and double back-gears sells for 14,000 francs; a French 36-in. lathe, 15 ft. between centers, all geared-head and single-pulley drive, 70,000 francs; a French 12-in. slotter, with rotary table. 20,000 francs. All of the French builders are busy.

If the dollar exchange stays as it is for an indefinite period, many of the smaller French machine-tool builders will become strong enough to put up real competition when conditions become more normal. Many competent observers believe that the future of the American machine-tool market in France for such standard tools as engine lathes and planers, will be very limited from now on, and that the French, English and Germans will divide this market.

Soon after the Armistice the Ministry of Armament advised the manufacturers in the devastated region not to buy English and American machinery on account of the high exchange rate and to confine their purchases to German and Austrian machinery as far as possible. The Comptoir Central d'Achats pour les Régions Libérées (the official purchasing organ of the Government for the devastated districts) opened offices in Baden, Germany, to help the manufacturers get this machinery. A good deal of it was bought just after the Armistice from stocks that the Germans had on hand, but recently the French manufacturers have been having a great deal of difficulty in getting their orders filled. It is said that the Germans accept orders for such and such delivery at certain prices and four or five times before the tools are delivered letters are received raising the prices and stating that the tools cannot be shipped at the old prices. And, then, when the French agree to the new prices, delivery does not seem to be obtainable. In the majority of cases the new prices equal the Amrican prices.

Only a limited number of English and Swiss tools are coming in. The exchange rate works against them as it does against the American tools, only to a lesser extent. The English tool builders are handicapped, too, by the long delivery quoted. Two or three Belgian concerns are selling lathes here.

Machinery-Using Concerns Busy

All of the machinery-using concerns are as busy as the limited supply of raw material permits. The automobile manufacturers are months behind in delivery and are sold out for from one to three years.

André Citroën, who is making a small light car (thirty miles to a gallon of gasoline), has an output of seventy-five cars a day and is three months behind. Within sixty days, this output will be a hundred per day. Most of the Citroën munition machinery was changed over to motor-car production.

There is a big demand for high-grade labor-saving machine tools, and the only thing that stops a big business is the exchange.

But the French manufacturers have not been educated far enough in the use of labor-saving machinery to pay the existing high prices for American tools. They have been taught too much to buy on price and cannot understand how it is good business to pay what they think is double the value of American tools. Many of the French shops are very small and have only limited capital, which prevents them from making the outlay necessary for buying American tools.

The dealers who have had a stock that was bought when exchange was ten or twelve francs to the dollar and can consequently sell the tools at something like a normal price, from the French standpoint, are disposing of them. The demand for tools bought at the present exchange rates is an emergency one, caused by concerns needing certain equipment to fill out or where some special tools are urgently required.

A great deal of the high-grade labor-saving machinery in the French and American surplus stocks is being rapidly absorbed. The dealers here do not seem to mind the surplus stocks, and say that they could sell all the American tools that they could get at the present time but for the exchange wall.

There are about as many solutions to the exchange problem as there are dealers and buyers. Most of them are predicated on the supposition that the American machine-tool manufacturers have gotten rich during the war and can afford to act in a banking capacity. The most common suggestion is that the manufacturers sell on a ten-franc-to-the-dollar basis, deposit this money in an American bank in Paris and wait for the exchange to become normal. A couple of the large American machine-tool builders tried this but discontinued it.

The same complaint is made by the agents, here, that I reported from London—poor packing and slushing. Shipments from America often lie on the French docks for weeks before they can be moved, on account of the freight congestion. One dealer showed me some high-grade American tools that were practically worthless from rust. The same complaint is made about small tools.

Carpenter Has Started an American Agency

C. E. Carpenter, formerly general manager of the Allied Machinery Co., has started an agency to sell American machine tools. J. Ostertag, until recently with the Director of Sales, War Department, in Belgium, and Birger Erichsen, formerly head of the Allied Machinery Co. in Italy, are associated with him.

R. S. Stokvis & Fils have bought the place formerly occupied by Alfred H. Schuette in Paris. It is a fine showroom and will be occupied about the first of September. A. M. Peskine, formerly with Isnosskoff & Company of Russia, is connected with the Paris office of Stokvis.

F. W. Horstmann & Co. are erecting a new warehouse and showroom about a couple of blocks from their present location.

Agents here also complain that many of the smaller manufacturers still quote f.o.b. factory, not realizing that, while in America their towns are very important, the French maps do not show them. Of course, the only way to quote is f.o.b. New York, unless you want to quote f.o.b. point of destination.

The market here, as soon as exchange becomes more normal, will be good for high-grade labor-saving American tools. They will have to be *sold*, however, and a great deal more care will be needed in the future in the selection of agents. The time for the order-taker in the machine-tool business in France has gone by. Sentiment will not enter into selling anything American any more in France, and the mere fact that a tool is marked "American" does not stamp it high-grade, as it did before the war—too much war-made stuff has almost irretrievably hurt the American reputation. Tools must be *sold* in the future, agents who will *sell* them must be selected and manufacturers will have to keep more closely in touch by having factory representatives here on the ground.

French Looking for More Help

The French are wondering what the American people are going to do to further help them. President Wilson sold them the idea of the League of Nations and then his factory, Congress, refused to deliver the goods. The French business men do not understand our political system and feel that we are leaving them in the lurch. In explaining their recent move into Germany, they seem to be actuated more by a feeling of self-preservation than revenge. They realize that in thirty years Germany will have more than double the number of men of military age than France, and that if French interests and safety are not protected now, they never will be.

"Honor To Whom Honor Is Due"

Some two months ago there died in Syrcause, N. Y., a man who, to judge from obituary notices, was just an ordinary mechanic and an average human being.

If publicity were given to his noble character and the many examples of his unusual manly qualities, he would have his rightful place among great men, instead of sinking into the oblivion of humble mortals who are satisfied with virtue as being its own reward.

As a shop-mate, he was not socially inclined, being rather reserved, though very highly respected. He was ever ready to help those who came to him and would give his evenings or Sundays to those to whom he might be of service. He had a real kindness for apprentices who were anxious to get on, spending his time showing them how to do things, telling why they were so done, encouraging the boys through the difficult jobs that so often come up in a boy's early days. The writer recalls in his own experience how, after a strenuous day at what would be considered an ordinary job, the subject of this article listened with patience to the cub's lament and afterward asked if ever he had read "Treasure Island." He had not, but next morning this good friend brought the book to him. It goes without saying that new life was put into the cub after reading in the book of the difficulties overcome.

He would speak ill of no one and would mix in no one's affairs unless invited to do so. He was an excellent mechanic and his general knowledge and experience gave him the foremanship when that position was vacant.

As a foreman he was as square a man as ever drew breath. His aim was to honestly serve the man who paid his salary, at the same time treat the men under him fairly.

He was a student of human nature and could handle each man according to his own peculiarities of makeup and get the best out of him.

He absolutely ignored all gossip—whether it related to others or himself. He once remarked "no matter how fair a foreman tried to be, he was no good anyway."

He had his enemies of course, and right here is where he shone. Among those who were in the shop under him were two old employees who had a stand-in with those higher up. After this man had been appointed foreman by the owner, these two trusties tried to undermine him. Their stand-in made them so bold in it that he could not help but see it. Did he take the usual course of human nature? He did not. Instead of firing them, he reasoned they were good mechanics capable of doing a fair amount of work and as such were valuable men for the employer. He forgot his personal right to a grievance and eventually won them over to good will.

Much more could be said in his favor. He dies as he lived—humble, but a great, real man.

This person was Frank Rooks, many years with the Alexander Iron Works.

J. H. Slater,
Works Manager,
Hydraulic Machinery Co., Ltd.,
Montreal, Can

What Other Editors Think

The Railroads and the Public

From *Manufacturers Record*

THERE is an old adage that there can be no happiness in a family unless people learn to bear and forbear with each other. Neither side is always right nor always wrong, and the only way that peace and happiness can prevail is through bearing and forbearing, one with the other.

As true as this is in family life, it is pre-eminently true at the present time in that larger national relation which must exist between the public and the railroads. The railroads are bearing the burden for the whole nation which a man harassed by poverty and strain and strife must bear when he is seeking to earn enough to care for his family. He cannot do his best work in any way because of this harassing burden, which strains every ounce of his strength. Nor can he give to his family the comforts which he may in times past have been glad to afford them.

The railroads are in a state of desperate poverty. They are literally hanging on by their eye teeth. For years they have been unable to secure the capital needed to provide facilities for expansion and new rolling stock. They need today not less than five or six billion dollars for immediate work to fill up the vacuum of shortage in rolling stock, rails and ties and terminal facilities. But that money is not available under present conditions, and so the best they can do is to struggle on, making such improvements as they can, utilizing to the best advantage every facility they have, and in doing this every officer of every railroad in the country will be living under a strain akin to that of the man who was once rich but now is poor, as he struggles to maintain his family.

It matters not what have been the mistakes of railroad managers in the past, and they were many, though not all railroad men were guilty. But the innocent had to suffer with the guilty. Today, however, the whole railroad work of the country needs the sincere sympathy, the patient endurance by the public of railroad mistakes and shortcomings, in order that the men at the head of railroads may through public co-operation gradually rebuild their systems into strength and ability to meet the pressure of freight and passenger traffic. We shall see many shortcomings in railroad facilities. We shall see freight handled with exceeding slowness. We shall see fewer passenger trains and more crowded cars than will be for the good of the public. But the railroads are probably doing the very best that is in their power, and will continue to do so. While the public has a right to watch with a jealous eye to see that railroad managers put forth their very best efforts, the public should yet patiently await the return of better times for the financing of railroads and the time which will be needed for providing the hundreds of thousands of freight cars and the thousands of locomotives so badly needed.

Whether a man looks at the railroad situation from this point of view or from the purely selfish standpoint of his own interest, he should recognize that his own selfish interest will be best served by co-operating with the railroads. Every club that hits railroad management will be merely a boomerang to strike the man who threw it. The nation's business life depends upon the rebuilding of the railroads. They cannot be rebuilt except through the heartiest co-operation of the public and the fullest recognition on the part of the public of the fact that the railroads are broken down, that their credit is temporarily gone, and that through two years of Government mis-management they are in a situation for which the whole country is responsible. The Government represents the nation. The Government as representing all the people so managed the railroads as to bring on the present condition, and therefore the people, who are responsible for the Government, are responsible for the railroad situation. It behooves the Government and the people to unite in the utmost effort to rebuild the railroad system, which alone can save this country from a business collapse within the next few years. If transportation completely breaks down, business itself must of necessity break down.

No "Panic" in Sight

FROM *Iron Age*

IT WOULD be well for those who talk of a "panic" seizing the people of the United States in the not distant future, and those who listen to the talk, to see that they understand the terms employed. A panic involves sudden fear, sometimes unreasoning fear. If a panic were universally predicted and believed in it could not occur, by the very nature of things.

There are different kinds of fears, likewise different kinds of panics. The United States has experienced only one kind of a panic, but many of them; therefore it should not be assumed that when panic is mentioned the one particular kind of panic is the only kind that could occur. Our panics have been money panics, and the Federal Reserve system, put in operation late in 1914, is held to be an almost certain preventive of money panics. There has been much criticism of bankers because of loose use or interpretation of terms, the critics asking why bankers say the present banking system should prevent panics and at the same time say there is going to be a panic. The point is simply that a purely "money panic" may be avoided, while another kind of panic could still occur.

The explanation of why we have had money panics exclusively when there are various kinds of panics is simply that when there is an attack by economic laws or by whatever one chooses to call the attacking force, the weakest thing yields first, and in times past our money system was very weak. If the weak line of defense has been removed to the rear the attack falls upon the next line of defense.

Panics have usually been followed by periods of industrial depression, but it has not been established that the panic is the cause of the depression. There are strong arguments for holding that recognition that an

industrial depression is coming is the cause of the panic. There is much literature on panics and depressions, but a great deal of it is more or less confusing, and the principles deduced are in the main difficult of application. The testimony of some of the historical cases reviewed is made of little practical value for the future by reason of world events interwoven as the cause, when similar events would not occur again. A difficulty which some writers have failed to handle adequately is the separation of real evidence from evidence that is manufactured by the panic and depression itself. In particular, there is the obvious circumstance that a panic and an industrial depression are accompanied by a great decline in commodity prices, the decline making the prices prevailing prior to the panic seem high. Hence the observer is disposed, in the retrospect, to conclude that prices were "too high," whereas instead of high prices having produced a depression it may be a depression causing prices to become unduly low.

On one point, however, practically all the observers are agreed that undue expansion in industry by the conversion of too much liquid capital into fixed capital, by way of productive enterprises being expanded beyond the ability of the public to patronize them continuously, is the most important single cause of industrial depressions. If so, it is a reasonable inference that a panic, or sudden fear, occurs when the unfortunate fact is realized. The case is quite like that of a man who buys a house, difficult of resale, and suddenly discovers he is unable to pay all the taxes and employ all the servants necessary to keep the house going.

If one is willing to take this viewpoint, there can be no question about what he will see. He will observe that the very last thing that threatens the United States is an industrial depression. We have not spent too much money on railroads, but altogether too little. We have not erected too many dwelling houses, but on the contrary almost every other man is feeling keenly the effects of there being too few dwelling houses. We do not have too many hotels and office buildings, the reverse being obviously the case. There are not too many power plants, but too few. We are wasting a large part of the coal we use, and are letting vast quantities of water power go idle, because we have not lived up to our progress in engineering knowledge by installing better methods of coal consumption and by harnessing the water power.

If there is to be no industrial depression, there cannot be any panic produced by sudden realization that an industrial depression is about to come. Eliminating this cause of panic, also the cause resulting from a weak and inefficient banking and currency system, such as we used to get along with in fair weather, there remain some panic possibilities. Commodity prices and wage rates are very high indeed compared with the historic averages, but men are very freely paying the commodity prices and the wage rates, seeking to buy more material than is available and hire more men than there are. These rates may be wrong, and indeed most observers insist they are. A suddenly acquired fear that too much is being paid, resulting in less buying and less employing, would mean a panic, for the country would move practically as a unit. Such a panic would promptly produce a readjustment. Many who assert vehemently "There will be no panic" at the same time believe there will be a readjustmnt or what is often popularly called a "shakeout." It is chiefly a matter of nomenclature or definition of terms. The results of a readjustment would be very beneficial. There being no basis, in overexpansion in construction work, for a prolonged industrial depression, business would be fortified to go ahead with greater physical activity and more confidence.

Neglect of Airplanes Invites National Destruction

FROM *New York Sun*

The decision of the Curtiss Aeroplane and Motor Corporation to abandon all its plans for the manufacture of commercial airplanes in this country is of supreme importance, not only to the industry it affects but to the United States as a nation and to eevry man and women in it. From the day on which hostilities ceased in the war and we were released from the danger which had inspired our costly and feverish efforts to build up an air force to fight Germany, Army, Navy and commercial authorities have urged us to foster and sustain an airplane industry which could be transformed in time of emergency to the uses of national defence.

Soldiers and sailors have instructed us in the imperative necessity of providing adequate squadrons of the most modern airplanes to meet all the varied requirements of the land and water forces.

Engineers have preached to us the facts that in the present state of the art of airplane building a machine is obsolescent when it is completed, and that the organizations of designers and scientists and skilled artisans needed to build them and keep abreast of their development can be formed only by maintaining production at a steady pace.

Bitter experience in the war proved to us that an airplane industry cannot be improvised over night, though every dollar needed be promptly forthcoming, though every ounce of national energy called for be expended, though every individual and every industry which might contribute to success give time and labor and material and service freely and single heartedly.

All these things have been dinned into our ears for months, into the ears of Congressmen, into the ears of executive officers of the Government. Intelligent and far-sighted men and women have urged the adoption of a broad policy of support for the airplane makers; a policy which should make possible the creation of an American airplane industry completely equipped with men and machines for rapid production, for experimentation, for expansion to meet the necessities of any national crisis.

In spite of all there has been no adequate and inclusive program of aircraft production, no Government aid for aircraft producers, no comprehensive scheme to preserve the essential of national defense. The needed encouragement has not been given. Apathy and heedlessness have ruled where enthusiasm and foresight were required. Now we begin to see the consequences.

The Curtiss corporation represents three-quarters of the American airplane industry. Its retirement from the business means the smashup of a great and elaborate war engine sorely needed by this country. That smashup is the country's own fault.

Losing our airship shops and their organizations is like losing our shipyards and their organizations. Without them we shall be helpless in another war, and in that war we may not have more provident friendly nations to stand between us and destruction while we seek to repair the errors of our reckless past.

WHAT *to* READ
—*for the man in a hurry*

Suggested by the Managing Editor

"EVERYWHERE we hear the same story about the lack of good toolmakers, or of high-class mechanics upon whom you can depend to turn out accurate work in a reasonable time." Our leader this week opens with this statement which has been made so often that it is becoming almost bromidic. The sad part of it is that it is undoubtedly true.

Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.

Schools of various sorts have sprung up in many places in an attempt to supply the deficiency and have met with varying degrees of success. Fred Colvin describes here the school at the Ford plant in Detroit. Mr. Ford has been the butt of a good many jokes and the subject of much criticism, some of which was probably deserved, but there has been little question of his earnest desire to improve conditions in industry as he found them. Consequently, an apprentice school established by him merits attention.

The *American Machinist* is very much alive to the importance of this matter of training mechanics and has devoted considerable effort to the securing of practical information along this line. We have been fortunate in securing an extensive series describing the training methods in use in a number of large shops and we hope to begin the series in an early issue. The author is a trained observer and an expert in the field of vocational training.

This being the off-week in the "Modern Production Methods" series we are running the first article in a short series on the regulation or control of materials. This installment begins on page 1338 and takes up the subject of material replenishment. It will be followed by others dealing with receipt and storage, with issue for use and with organization and control problems.

Our old friend Dixie is with us again on page 1341. This time he has some pointed remarks to offer on straightedges; how to make them straight and what is perhaps more important, how to keep them straight.

Article XXII of Viall's welding series starts on page 1343 and covers the subject of cutting with the gas torch. Following this is a short sketch of the alloy known as nichrome.

Automotively inclined readers will find Part II of Carhart's article on the Liberty crankcase on page 1361. This installment deals mostly with drilling and reaming operations.

On page 1366 is another special appeal for the support of the new Federated American Engineering Societies. Engineers the country over are vitally concerned in this undertaking and owe it to themselves and to their profession to get behind this plan and push.

Over on page 1371 is a letter from Mason Britton written in Paris on May 25, giving his viewpoint on the general outlook in France. We might hesitate to use our efficient business manager as a writer on design or the fine points of operation but when it comes to selling and general business matters he is one of the best informed men in the field. He gives first-hand information on French machine-tool builders and dealers and also something on machinery-using concerns in general.

We are glad to print, on page 1373, an appreciation of "just an ordinary mechanic and an average human being." How many of us when it comes our turn to check in our tools for the last time will have made records good enough to call forth a letter like Mr. Slater's? Not very many, probably. With a few more men like Frank Rooks in our shops labor troubles would be as scarce as they now are numerous and the way of the labor agitator would be hard indeed. Two sentences in this letter could well be taken as the text for a sermon on foremanship or framed as a creed for every foreman. "His aim was to serve honestly the man who paid his salary, at the same time treat the men under him fairly. He was a student of human nature and could handle each man according to his own peculiarities of makeup and get the best out of him."

Two short articles which come under the head of management appear on pages 1355 and 1358. The first one, by L. L. Thwing, takes up the practical side of appraising the value of second-hand machinery. The other, by John T. Bartlett, gives more of his valuable suggestions for improving the employee's magazine.

SHOP EQUIPMENT NEWS

—Edited By—
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT NEWS
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

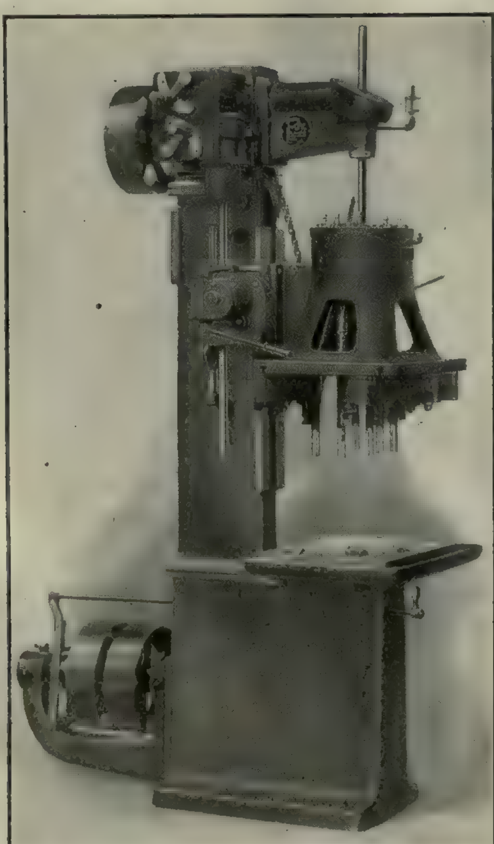
CONDENSED CLIPPING INDEX
A continuous record of modern designs and equipment

Fox Multiple-Spindle Drilling Machine

The D-12 multiple-spindle drilling machine illustrated herewith is one of a series built by the Fox Machine Co., Jackson, Mich.

The table and column are bolted to the base which contains the reservoir for the coolant. The column is of box section and houses the counterweight for the spindle head. The gear box, mounted on the column, contains the spindle change-gears, the shafts for which are mounted on Hyatt bearings. The crown gear on the spindle is carried by a steel sleeve running in a bronze bearing. The feed gears are contained in a box at the side and are controlled by levers on the outside of the box. The feed is engaged by a quick-acting clutch operated by a lever and may be disengaged, either by hand or automatically, by an adjustable stop on the column.

The saddle has a long bearing on the face of the column and is separate from the head which is bolted to it. Spindles are carried in bronze bearings and the thrust is taken by ball-thrust bearings. Spindles are provided with two spindle-gears permitting variation of relative speeds and which can be shifted to neutral position for spindles that are to remain idle. The drive is constant speed.

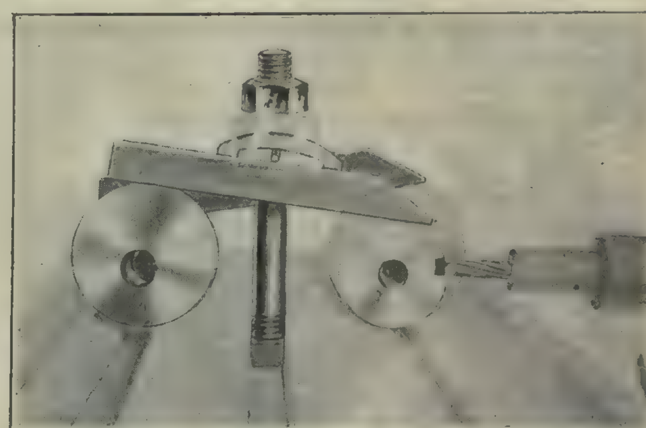


FOX D-12 MULTIPLE-SPINDLE DRILLING MACHINE

Specifications: Head; travel, 15 in.; drilling surface (rectangular) 8 x 14 in., (round) 12 in. Center of head to face of column, 12 in. Table; working surface, 17 x 22 in.; height from floor, 32 in. Number of spindles, 10 to 16. Clutch pulley; size, 14 x 4½ in.; speed, 450 r.p.m. Power required, 10 hp. Floor space, 28 x 36½ in. Height, 105 in. Weight; net, 2,250 lb.; crated, 2,500 lb.; boxed for export, 2,900 lb. Export box, 96 cu.ft.

Force Universal Clamp

Burwin Co., Inc., 87 Warren St., New York City, has placed on the market the Force Universal Clamp made by the Black Rock Manufacturing Co., Bridgeport, Conn.



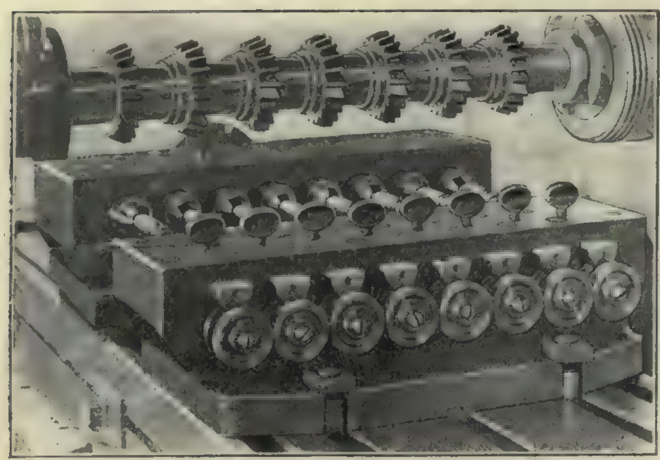
ONE TYPE OF FORCE CLAMP HOLDING IRREGULAR WORK ON MILLING MACHINE

The accompanying illustration shows one style of the clamp for general use. The clamp is designed for holding work on machine tools, being particularly adapted to clamping irregularly shaped pieces, straddling bosses, or fitting different angles by means of the swivel adjusting device.

The clamp is made of hardened steel and in a wide range of sizes.

Scully-Jones Multiple-Spindle Dividing Head

Scully-Jones Co., 80 East Jackson Boulevard, Chicago, Ill., is the manufacturer of the multiple-spindle dividing head shown in the illustration. The spindles are all driven from an index plate located at the opposite end of the machine from that shown in the illustration.



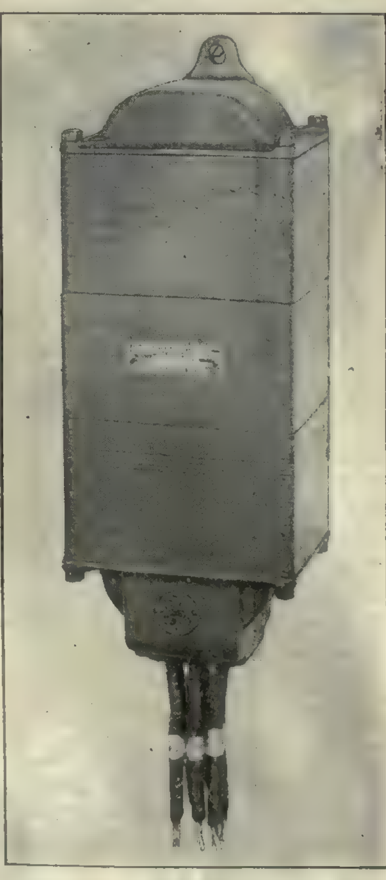
SCULLY-JONES MULTIPLE-SPINDLE DIVIDING HEAD

The work drivers are somewwhat flexible so that they may be adjusted to suit work that is off center. Both the index plate and the work drivers are made to suit the needs of the user of the tool. All parts of the device are interchangeable. The dividing heads are built in six sizes with 2, 4, 6, 8, 10 or 12 spindles, as may be required.

The device may also be arranged for cutting either spur or helical gears.

General Electric MTQ Auto Transformers

The General Electric Co., Schenectady, N. Y., has recently listed as standard equipment 1:1—ratio auto transformers in the following sizes: 1, 3, 5, 7, 10, 15, 20 and 25 kva. output, one of which is shown in the accompanying illustration. These transformers are air-cooled, suitable for indoor or outdoor use, and are for service on 220-volt circuits having frequencies between 50 and 140 cycles per second. They are designed for deriving 3-phase current from 2-phase, 4-wire service, and vice versa; and they cannot be used either for 2-phase, 3-wire service, or for operating motors with inter-connected phase. These standardized transformers are adaptable to a wide range of work, their principal application being to adapt polyphase motors to any circuit.



GENERAL ELECTRIC CO. MTQ 10-KVA. AUTO TRANSFORMER

Business Conditions in England

By Our London Correspondent

London, May 14, 1920.

The only astonishing feature of the ballot taken among engineering workpeople on the question of payment by results, is the small number actually voting, namely, 14,170 for and 54,167 against, with a majority against the system of 39,997. This result was certainly not unexpected; in fact five to one was unofficially reported. Engineers and many British workmen have long expressed their opposition to piecework, premium bonus, etc. Nevertheless, particularly perhaps in the Birmingham and Coventry districts, large numbers work on one or other of these systems, and some at least would be sorry to change.

The employers are understood to have claimed the right to introduce any system in any district, subject to safeguards as to insurance of standard rates, cutting of prices, etc. In practice this would have one rather important effect: it would deprive the district trade-union committees of much of their power. That they have power and are prepared to use it was shown in the recent molders' strike that was supported by these local committees, though frowned on officially by headquarters. The point is that the district committees would lose control of the local workshop conditions, as far as they have it, and that this did actually happen during the war owing to the working of the labor dilution schemes, has been asserted.

Output Has Decreased with Reduction of Hours

Exactly what will follow cannot be seen, everything depending on the attitude of the employers. When the normal working week was reduced from 53 to 47 hours, it was understood to be a condition that output should be maintained and every endeavor actually made to increase it. Generally speaking the reverse has happened. It is therefore quite on the cards that the employers may use the refusal of payment by results to attempt to revert to the 53-hour week.

Whether in the present condition of trade they would be successful is quite a debatable point, while here and there indications may be found making toward a decline on the whole, the actual existance of a machine, or in fact any commodity, is all that is needed to ensure its sale at a price satisfactory to the owner and presumably to the purchaser. Obsolete tools can in fact be sold. There is but little prospect at present of foreign competition—which is another name for German competition—breaking down prices. True, a consignment of German tools has reached Great Britain and can be seen in Leeds and London. There are both new and second-hand, and in certain instances the prices of the new tools are below current rates. This, however, must be regarded as exceptional, for the German export authorities maintain fairly complete control of such matters, insisting, for instance, that payment must be in the currency or bills of the importing country. In the instance of an offer recently brought before the notice of the writer, while prices were mentioned in marks, it was stipulated that the mark was regarded at the pre-war value of 1s.

The difference then in price as compared with that of a corresponding British tool was very slight; not in fact such as would suggest an attempt on the part of a British firm to act as agent.

Tools in the Consignment

The consignment of tools noted above included a Bilgram bevel-gear shaper by Reinecker, a gear hobbing machine, a Wotman crank-drive shaper of 16-in. stroke, plain grinding machines of the Norton type, 12-in. swing by 50 in. between centers by Schubert & Salzer, others of 15-in. swing by 39 in. between centers, universal grinding machines of the same sizes, and a number of Landis-type machines of 10-in. swing by 30 in. between centers, all by the firm named. These tools were part of a purchase by a firm of printers' engineers not directly known as machine-tool merchants. The object of purchase in the first instance was to supplement the plant in the firm's own works, which were

being reorganized and for which the tools were wanted quickly. It is gathered, by the way, that German printing machines have been on offer through Scandinavia.

Pay Question Up Again

To return to the subject of payment by results, the suggestion has been made that the engineering workpeople, not content with turning-down the employers' proposal, will make their own, based on a collective contract. It is said that experiments on these lines have already been made in several workshops. Inquiry at the headquarters of the chief engineering trade union has not disclosed the firms concerned. The experiments would appear to be quite unofficial. Apparently, the idea is for a department, through its shop committee, to enter into a contract as to the price to be given for the department output, payment being divided among the workers according to an agreed basis.

A somewhat similar system is actually being worked in the shops of a well-known Birmingham firm, where the price for the machining of each complete article is set not by the workers, but by the employers, this of course by agreement as to reasonable amount. The machines are arranged in relatively small gangs and the operations are timed so that the work passes successively from one machine to that geographically next until it is finished, the price of the work then being divided among the men concerned according to their wages. In this particular instance of progressive machining it is not uncommon for the men to make a bonus of 90 per cent on their standard rates.

It may be worth mentioning that while the skilled workers seem to be decidedly against payment by results, the unskilled and semi-skilled men have agreed to the system, or at least those in authority in the unions have agreed to recommend it to them. They include the class of worker engaged mainly on repetition work and it is held that consequently it is much easier to set prices for these than for really skilled men.

Unions To Combine

The rules are being prepared by the engineering union that will absorb nearly a dozen existing unions. The new organization, to be known as the Amalgamated Engineering Union, will have funds of about three and one-half million pounds, the membership being about 460,000. The most important unit in it is of course the present Amalgamated Society of Engineers. After a second ballot the Society of Amalgamated Toolmakers has now joined, bringing in more than 46,000. The new rules are expected to provide for the ordinary members a more direct influence on policy and greater control of working conditions by shop officials. At present the wages for time workers vary somewhat, according to the district, the minimum in the London area being about 88s. a week, with say 80s. at Colchester 50 miles away. Apparently, the aim is to raise the standard rate to £6 10s. (130s.) a week, after which payment by results will be considered.

Financial Conditions

The government obtained the second reading of the finance bill and the opposition to the new excess profits duty has not proved brilliant. A further attack however will be made on it in the committee stage by representatives of the manufacturing interests, and an amendment will probably be proposed by way of revision of standards of profits, and in connection with the remuneration of directors, the valuation of stocks, the reckoning of debentures and loans as part of the capital of the business, and so on. The Chancellor of the Exchequer offered to substitute a flat rate of 5s. 6d. in the £ if all firms paid, or 7s. 6d. in the £ for firms that at present pay the duty named, this suggesting that firms at present liable to the duty are about 70 per cent of the total.

Both the ordinary household and the industrial worlds were startled this week by the official raising of coal prices, in the case of household coal by 14s. 2d. a ton and of industrial coal by 4s. 2d. a ton. It is clear that all articles manufactured will be raised in price once more, and miners, railwaymen and engineering people will, it is anticipated, use this increase in the cost of commodities in their claims for higher wages. In fact it is thought that the whole body of industrial workers will move in this direction. It has been estimated in a rough and ready way that the increased cost of coal will cause a further advance of between 15s. and 20s. a ton on prices of finished steel. At the recent London market, by the way, it was suggested that the higher prices demanded have driven off part of the inquiry from abroad. Reports from other areas also suggest a more scrutinizing attitude toward prices. The whole demand is, however, well in advance of production. Some German steel plates are, it is understood, being delivered, but relative to the call this supply is insignificant.

New Enterprises

A new firm, a wheel manufacturer, is having built at Brixton, S. W., a factory with an area of about 22,000 sq.ft. on one floor in three spans, each of about 19 ft. The ninety-three north light trusses for the roof are assembled and held in simple jigs placed on the ground, the various members being previously cut to length. The joints are thus welded by the arc process, using electrodes. Gusset plates, etc., are welded on. The stanchions are cut to length and have cap and base plates welded similarly, and the joists are lifted on to the cap plates and clamped to position while being welded. The trusses are then lifted to place and welded to the joists. The guttering also is welded. The time for assembling and welding one truss, employing one welder and two laborers, is stated to be 50 min., and one welder and one laborer can complete a stanchion in 30 min. The cost of electric welding is said to be £11 or less per ton, as against £18 to £20 at present where drilling, bolting, riveting, etc., is the rule, this of course apart from the cost of the steel work itself. Further as to times, the firm concerned states that at Brixton a joist can be fixed on the cap plate in 15 min. and the trusses fixed at both ends in 30 min. by one welder. Steel buildings to be used for the forthcoming horse show at Olympia, London, W., are also being erected in the same way, the floor space being about 9,000 sq.ft. and the span about 14 ft., the price being the cost of material plus £10 a ton. The same system of welding is put forward for tying rods and wire employed in reinforced-concrete construction.

Armstrong Whitworth Prominent in Building Locomotives

While all the ordnance firms have turned over to peace production, none seems to be quite so prominent in this direction as the Armstrong-Whitworth concern, possibly because its orders are largely for locomotives, in which there is a marked shortage both in Great Britain and on the continent. The firm has, for example, just obtained a repeat order for twenty-five 6-coupled side-tank locomotives for the English Northeastern Railway, one of its first orders being for fifty 8-coupled goods engines and tenders for the same company. Indeed the conversion of Armstrong-Whitworth's Scotswood works from munition-making to locomotive-production was carried on while these engines were being built. The development of the works for this purpose is, in fact, continuing. The marine engineering works at Elswick are also fully occupied. The Beardmore organization has also turned largely to locomotive building, and the ordnance and armour plate shops at Parkhead, Glasgow, are being turned to this purpose. At Dalmuir the construction of locomotives proceeds in a department that formerly was engaged on gun mountings, and locomotive repair work is also being undertaken, a Scottish correspondent mentioning that 60 engines are at the moment thus being treated by the Beardmore firm.

The cost to the engineering industry of the molders' strike is but a matter of estimate. The loss of funds on the part of the trade unions concerned can of course readily be known. It has come out that the Ironfounders' Society expended all its available funds—that is, about a quarter of a million pounds—and moreover borrowed some £50,000, so that the loss here is about £300,000. The employers naturally had their losses, but think they have learned a lesson, and the next strike of a similar character, probably the next industrial dispute, will not be fought the same way.

SPARKS FROM THE WOR

Valentine Francis

Metropolitan Section of S. A. E. Discusses Piston Rings

A meeting of the Metropolitan Section of the Society of Automotive Engineers was held on the evening of Thursday, June 10, in the rooms of the Automobile Club of America on 54th St., New York. Arrangements were completed for transportation of members of the S. A. E. Convention at Ottawa Beach, Mich.

The subject under discussion at the meeting was Piston Rings. Charles G. Nilson delivered a very able and comprehensive address, illustrated by lantern slides, briefly sketching the history and development of piston rings from the days of James Watt to present-day automotive engines, with a discussion of ring sections, wall pressure, wear and leakage.

Representatives from many of the leading manufacturers of piston rings were present and a general discussion followed the reading of the paper, in which many points of interest were brought out.

L. I. Yeomans Becomes Manufacturer

Lucien I. Yeomans, the man who put the Amalgamated Machinery Corporation, of Chicago, on the ordnance map, has severed his connection with that concern. He will retain his office in the Edison Building, Chicago, as general consulting engineer, and will manufacture and put on the market various small tools and devices of his and others' design.

Born at Walworth, Wayne County, New York, April 3, 1878, Mr. Yeomans has crowded a world of mechanical experience and achievement into his life. He served an apprenticeship with Brown & Sharpe and after leaving them worked as machinist, patternmaker, toolmaker and foreman in a number of shops in diversified lines. He returned to Brown & Sharpe in 1900 and shortly afterward was employed by Governor Goodell, Antrim, N. H., to develop a line of apple-paring machines, since some of Mr. Yeomans' earliest experiences were in the machine and cooper shops of the great New York apple district. While in the employ of Governor Goodell he designed and patented what is said to be the only successful full automatic apple-paring and coring machine ever made. He later became superintendent of the shop of L. S. Heald & Son, at Barre, Mass., and moved its shop to Worcester where the business was, and is, continued under the name of the Heald Machine Co. From Worcester he went to Madison, Wis., as superintendent of the gasoline-engine plant of the Fuller & Johnson Manufacturing Co. From Madison he went to Chicago as assistant superintendent of production for the Link-Belt Co., later becoming general superintendent. His next step was assistant superintendent of the motive-power department of Armour & Co., and at the end of six months he was made superintendent.

In 1913 he opened offices in the Edison building, Chicago, as consulting engineer, and he still retains them. In 1915 he designed and patented a line of shell machines which were built by the Amalgamated Machinery Corporation and which were fully described in the *American Machinist*, May 11, 1916. His work on these lathes won him the John Scott medal given by the Franklin Institute.

L. I. YEOMANS

It was in connection with the making of large gun-boring lathes that he designed and built some of the largest planers ever made. These were largely of concrete, with beds 184 ft. long, 17 ft. wide and 18 ft. from bottom of bed to top of housing. Each planer contained approximately 212,000 lb. of iron and 13,500 cu.ft. of concrete, reinforced with 17 tons of steel bars. At the time the armistice was signed a planer with a 500-ft. bed was under construction.

This brief outline will give the reader an idea of the kind of man who, for four and one half years as works manager of the Amalgamated, gave the best that was in him to help us win the war, and who now is starting into other fields.

New Departure Has New Hotel Club for Employees

The new hotel-club being erected by the New Departure Manufacturing Co., at Bristol, Conn., will be ready for occupancy by Sept. 1. The building will will be used strictly for the employees and will be one of the best of its kind anywhere in the United States.

In the basement will be located pool and billiard tables, bowling alleys and a barber shop. The first, or street floor, will contain a cafeteria, where food will be served for a reasonable price. Here also will be located a large lounging room and lobby. The second, third, fourth and fifth floors will be entirely devoted to sleeping rooms and tub and shower baths. The sixth story will be used exclusively for club purposes. The exterior of the building is very attractive also.

At present there is a contest on for factory employees of the N. D. Co. to guess a name for the new hotel, and the one chosen will receive a $10 gold piece from President Page of the company.

Work in Connection with Industrial Safety Codes

During the month, the final list of changes proposed for incorporation in the "National Electrical Safety Code" was sent out. As soon as comments from the interested parties have been received, the new edition of this code will be sent to the printer and it will be available for distribution late in the summer. A similar stage has been reached in the case of the first edition of the "National Safety Code for the Protection of the Head and Eyes of Industrial Workers." This code is being prepared in co-operation with an advisory committee of experts in this subject and final changes have been sent to the committee for consideration. This code is also to be printed in the near future by the Bureau of Standards.

Southern Stove Manufacturers' Meeting

The annual convention of the Southern Stove Manufacturers' Association was held at Rome, Ga., June 8 and 9. The convention was attended by representative men of the industry from the Southern states. Topics of pertinent industrial interest were discussed in open forum following talks by prominent men. There are four stove foundries in Rome which is one of the centers of the industry in the South, and officials of these companies acted as hosts to the visiting delegates.

LD'S INDUSTRIAL FORGE

News Editor

Floating Foreign Trade Exposition an Assured Success

Hundreds of inquiries from manufacturers and others located in every state in the Union testify to the interest in the First National Foreign Trade Floating Exposition, announcement of which was made recently. The largest exporting firms in the country have signified their intention of joining in the idea which will place American exporters on the same basis as the merchants of Great Britain and Japan. Negotiations are under way for the refitting of a vessel large enough to accommodate the exhibitors of American products so that, from present indications, the boat will leave New York during October as per schedule.

The exposition offices at 50 Broad St., New York, have been enlarged to take care of the inquiries that are arriving by every mail, thus proving that American manufacturers, interested in foreign trade, are alive to the opportunities presented by this novel method of introducing their wares to foreign customers.

In a statement, explaining the objects of the exposition, W. P. Brawley, New York manager said:

"The need of any facilities to cement more firmly our relations with the foreign buyer of American manufactured goods is very evident. The support and co-operation we have received from all sources has heartened us in our idea. The functioning of this exposition ship can be expressed in very few words. The vessel will do away with the present method whereby an individual manufacturer must send his representative with sample cases to the foreign countries where he desires to introduce his merchandise. This method which entails the setting up of an exhibit in a sample room for the purpose of interesting prospective buyers is very difficult. The aim of the floating exposition is to do away with this inconvenience and to enable American manufacturers to exhibit their goods advantageously in a manner that will attract the foreign buyer.

"Publicity is being given to the project in Central and South America and the Far East at this time. Preceding the ship some six weeks or two months, a competent publicity man will arrange for an advertising campaign. An interesting feature of the visit at the foreign port will be the program to be outlined by an entertainment committee to be selected by the exhibitors. After sufficient time has been devoted to the more interested visitors the ship will be thrown open to the general public.

"The floating exposition will stop at the most important ports only and the duration of the stay will vary from five days to two weeks. Interpreters will be on board with a view to promoting business relations between the representatives of American exporters and the buyers who came to view the exhibits. The exhibits will be segregated according to classification; that is, there will be a special department for textiles and wearing apparel; another for hardware; one for foodstuffs, etc. While it is not the intention to have exclusive exhibits, it has been decided that not more than one exhibitor of competitive lines will be accepted.

"Experts versed in all the phases of foreign-trade methods will be on hand to advise exhibitors and prospective purchasers.

"The itinerary embraces the particular ports of Central and South America, New Zealand British Strait Settlements, Australia, Philippine Islands, China and Japan. The trip will be of eight months' duration. The primary objective is to furnish a convenient and economic means for the manufacturer to have his personal representative come in actual contact with the foreign buyer by compounding a number of firms and having one ship devoted wholly to their activities."

Yale & Towne Manufacturing Co. Announces Change in Personnel

At a recent meeting of the Yale & Towne Manufacturing Co., Stamford, Conn., several changes were made in personnel of the company. The resignation of John B. Milliken as treasurer of the company, which had been presented at a previous meeting, was accepted and a resolution expressing the regrets of the company was presented to him. Willard L. Case was elected to succeed Mr. Milliken.

At the same meeting Edward C. Waldvogel, who has been in the employ of the company for fifteen years, four of which were spent as general manager, was elected a director.

To Equip Spanish Steel Mill

The Compania Siderurgica del Mediterraneo of Sagunto, Spain, has placed a contract with the Alliance Machine Co. of Alliance, Ohio, for openhearth charging and crane equipment. It has also placed a contract with the Pennsylvania Engineering Works, New Castle, Pa., for a 600-ton hot metal mixer. The machinery is to be installed at the new iron and steel works now in process of construction by the company at Sagunto.

Interstate Commerce Commission Defines "Scrap Iron"

A recent decision of the Interstate Commerce Commission regarding the shipment of scrap machinery might be of interest to dealers and manufacturers. The Griess-Pfleger Tanning Co. entered a complaint with the commission alleging an overcharge in freight rates on a shipment of a broken press bed from Waukegan to Champlain, N. Y. The company contended that the bed was cracked to such an extent as to make it unrepairable, but the bill of shipment described it as a "press"—therefore the railroad charged the regular rates as for shipments of machinery. The company asked that the charges be made the same as for scrap iron, which are considerably less than those for machinery.

After a review of the case and taking the testimony of several witnesses, the commission decided in favor of the railroad and dismissed the complaint.

Electrical Society Chooses Officers

At the annual meeting of the New York Electrical Society, held on June 8, officers for the coming year were elected. W. N. Dickinson was chosen president, succeeding Edwin B. Katte. Ernest W. Muller, Charles E. Speirs and J. M. Buchanan were elected vice presidents. For the 23rd time, George F. Guy was elected secretary. He has served in this office almost since the organization of the society. Another re-election was that of Thomas F. Honahan as treasurer.

The New York Electrical Society is the oldest organization in the electrical field. It was formed in 1888 when the lighting industry was in its infancy and it has always been a potent factor in electrical progress.

Mr. Dickinson, the new president, is a consulting engineer, connected with the Otis Elevator Co. During the war he was engaged in war work at Washington.

Oil Associations Hold Joint Conference

Presidents, superintendents and managers of oil mills in the five Southeastern states gathered in Atlanta, Ga., recently for the joint conference of the Interstate Oil Mill Superintendents' Association and the Oil Mill Machinery Exhibitors' Association. About four hundred delegates attended the meetings, which lasted for three days, and the exhibit at the Atlanta auditorium. About one hundred firms occupied space at the auditorium for exhibits, which included oil mill machinery, etc.

Exhibition and Conventions of Railroad Men

A million-dollar exhibition, staged recently at Young's Million Dollar Pier, Atlantic City, N. J., was an important auxiliary to the combined conventions of the railroad men.

The American Railroad Association is an old, thoroughly organized and well-managed society that had its beginning in the nineteenth century. Owing to the vast size of the organization, it comprises several branches, some of which have been formed within the past year or two. The purpose of these is to sub-divide and handle more efficiently the big business of railroad engineering and equipment. The sub-divisions meeting in the June conventions were section III (mechanical) and section VI (purchases and stores).

The Railway Supply Manufacturers Association is not affiliated with the American Railroad Association, but meets with them merely as a matter of mutual benefit and convenience.

The several conventions followed each other in continuous daily sessions, from June 9 to 16, and the meeting as a whole was the most enthusiastic and successful in the history of the organizations. As an indication of this the registered attendance, which included many visitors from Canada and abroad, exceeded six thousand. This was much greater than that of any previous convention of the association. As to the exhibition, it was stated that although the space available for exhibits amounted to a total of 100,000 sq.ft., there was not enough space to supply the demand, even with curtailed allotments. In this connection a noteworthy feature, due to good management, was the promptness in which the shipments of exhibits were handled during these days of strikes and embargoes. With one or two exceptions the shipments arrived on schedule time in an almost mysterious manner.

The exhibition included a number of machine tools in full operation and in charge of expert operators, and some of the demonstrations of both the machine and tool were surprising even to those familiar with modern shop practice. In addition to the power-operated machines and equipment in Machinery Hall, there was a full line of railroad equipment, supplies, tools, etc., displayed in Exhibition Hall and other sections of the pier, including the annexes and balconies. Acetylene welding and cutting was demonstrated at the extreme end of the pier on account of the fire hazard.

The daily sessions in Convention Hall were devoted to consideration of the problems of railroading and the papers and discussions dealt comprehensively with the latest devolpments in engineering and equipment. Among these were, "Mechanical Stokers," "Modernization of Stationary Boiler Plants," "Fuel Economy and Smoke Prevention," "Auxiliary or Safety Connections Between Engine and Tender," "Design, Maintenance and Operation of Electric Rolling Stock," "Scheduling and Routing Systems for Locomotive Repair Shops," "Superheater Locomotives, and Snow Fighting Apparatus."

Other subjects taken up the following day were: "Locomotive Headlights and Classification of Lamps," "Feed Water Heaters for Locomotives," "Locomotives as a Big Investment," "Design and Maintenance of Locomotive Boilers," "Engine Terminals, Design and Operation," and "Train Resistance and Tonnage Rating." The fourth day's session was devoted to reports and discussions on "Autogenous and Electric Welding," "Specifications and Tests for Materials," "Repair Shop Layouts," "Standard Blocking of Cradles of Car Dumping Machines," "Standard Method of Packing Journal Boxes," and "Establishment of a Cooperative Research Bureau." On the fifth day the discussions included "Revision of Passenger Car Rules of Interchange," "Prices for Labor and Materials," "Depreciation for Freight Cars," "Arbitration," "Tank Cars," and "Brake Shoe and Brake Beam Equipment."

The subjects handled on the last day of the convention were: "Couplers and Draft Gear," "Car Wheels," "Car Construction," "Loading Rules," "Train Brake and Signal Equipment," "Train Lighting and Equipment," and "Safety Appliances."

At the conclusion of each day's business, the delegates and guests with their wives and friends enjoyed varied forms of high-class entertainment provided by the entertainment committee. The Railway Supply Manufacturers' Association elected the following officers: President, J. F. Schurch, of the T. H. Symington Co., Chicago, Ill. Vice president, C. D. Jenks, Cleveland, Ohio. Executive committee members: For the first district, comprising New England and Canada, G. W. Denyven, succeeding J. G. Platt; second district, comprising New York and New Jersey, W. K. Krepps, succeeding C. D. Eaton; fourth district, Ohio, Indiana and Michigan, Edward M. Savercol, succeeding C. D. Jenks; fifth district, Illinois, S. B. Sherman, succeeding E. H. Bankard, Jr.; seventh district comprising Wisconsin, Minnesota, Louisiana and states west of the Mississippi River, Sterling Campbell.

The officers elected by Section VI (purchases and stores) are: Chairman, H. C. Pearce; vice chairman, H. E. Gray; on the general committee for two years, E. N. Bender, F. A. Bushnell, J. P. Murphy, H. H. Laughton, W. G. Phelps, J. G. Stuart, W. A. Summerhays; members for one year, U. K. Hall, W. A. Hopkins, D. K. Jellison, F. D. Reed, F. B. Wight, H. P. McQuilkin and E. J. McVeigh.

It was announced that the convention of the association would be held in Atlantic City again next year.

The National Steel Rolling Co., Newark, N. J., will build a plant in Baltimore having a daliy capacity of 25 tons of bar iron and bar steel.

B. G. Koether Promoted in General Motors Corporation

B. G. Koether, whose promotion to vice president of the Hyatt Roller Bearing Co., the early part of the year, brought to him the congratulations of his large circle of friends throughout the industry, has now been made assistant general manager of the Hyatt Division of the General Motors Corporation.

Although he still remains a vice president of the Hyatt selling company Mr. Koether has relinquished his duties as director of sales and advertising work to devote his entire efforts to boosting Hyatt production

C. M. EASON

to meet the tremendous demand he so recently played an important part in creating.

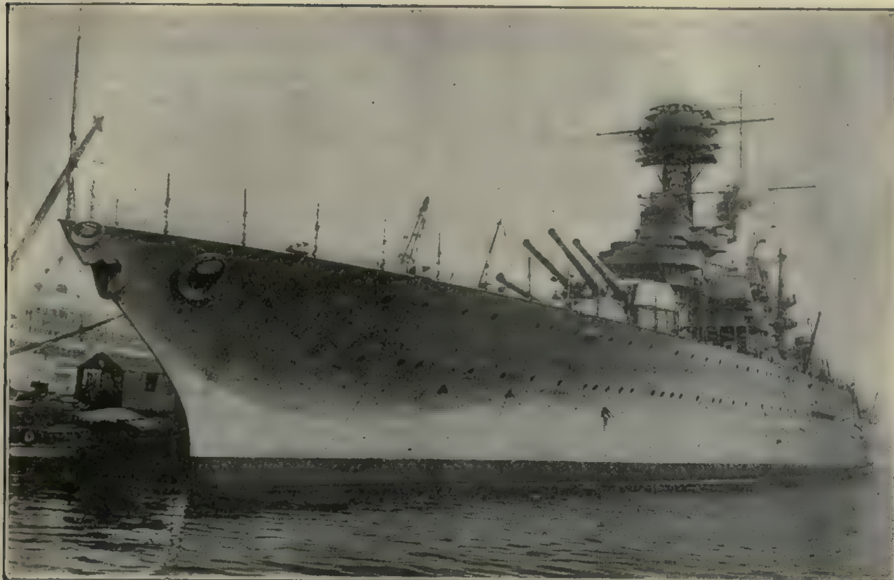
This work will keep his at the company's plant at Harrison, N. J., where he has made his headquarters since leaving Detroit.

Coincident with Mr. Koether's change to work more closely identified with the factory, comes the appointment of C. M. Eason, widely known in the trade for his development of the tractor business of the Hyatt Roller Bearing Co., as sales manager of that department.

Mr. Eason will take up the sales work formerly handled by Mr. Koether, this marking his return to the company after several months as general manager of the Engineering Development Co., Moline, Ill., an organization which had been formed to serve in advising and consulting capacity.

Short News Note

At the Exposition of the Railway Supply Manufacturers' Association on Young's Million Dollar Pier, Atlantic City, N. J., June 9-16, 1920, the Chesapeake Iron Works, of Baltimore, Md., had an exhibit and display illustrating the merits and special features of the Chesapeake electric traveling crane — a "standardized" crane — as applied in railway and other heavy work.



Underwood & Underwood

THE U. S. S. TENNESSEE

The United States battleship "Tennessee," which went into commission on June 3, is the most powerful fighting vessel in the world today. She is 625 ft. long, has a beam of 98 ft., and displaces 32,500 tons. Her main battery consists of twelve 14-in. guns, and she is protected by a belt of armor 14 inches thick. She is electrically propelled, her main engines consisting of two Westinghouse turbine generators, rated at 15,000 kva. each, and each of her four propellers is driven by an 8,000 hp. Westinghouse motor. Her maximum speed with full power is 21 knots.

New Officers of the National Research Council

The National Research Council, a co-operative organization of leading scientific and technical men of the country for the promotion of scientific research and the application and dissemination of scientific knowledge for the benefit of the national welfare, has elected the following officers for the year beginning July 1, 1920: Chairman, H. A. Bumstead, professor of physics and director of the Sloane physical laboratory, Yale University; first vice chairman, C. D. Walcott, president of the National Academy of Sciences and secretary of the Smithsonian Institute; second vice chairman, Gano Dunn, president of the J. G. White Engineering Corporation, New York; third vice chairman, R. A. Millikan, professor of physics, University of Chicago; permanent secretary, Vernon Kellogg, professor of biology, Stanford University; treasurer, F. L. Ransome, treasurer of the National Academy of Sciences.

The Council was organized in 1916 under the auspices of the National Academy of Sciences to mobilize the scientific resources of America for work on war problems, and reorganized in 1918 by an executive order of the President on a permanent peace-time basis. Although co-operating with various Governments scientific bureaus it is not controlled or supported by the Government. It has recently received an endowment of $5,000,000 from the Carnegie Corporation, part of which is to be expended for the erection of a suitable building in Washington for the joint use of the Council and the National Academy of Sciences. Other gifts have been made to it for the carrying out of specific scientific researches under its direction.

Business Items

The Hergi Manufacturing Co. has recently moved into a new and larger plant at Fifth St., Bridgeport, Conn.

The Gillespie Manufacturing Co., Gillespie Motor Co., Gillespie Foundry Co. and the Brokaw-Eden Co. announce that they consolidated on June 1, 1920, under the name of the Gillespie Eden Corporation, with executive offices at 50 Church St., New York. Under this consolidation the Gillespie Eden Corporation will manufacture the Eden washing machine and the castings, motors and wringers used in its production.

The Batavia Steel Product Corporation has sold its plant in Batavia, N. Y., to the Gray Machine Tool Co., Inc., Buffalo, N. Y. The Gray people manufacture thread millers and a piston blasting machine and other automatic machinery.

The Greenfield Tap and Die Corporation, Greenfield, Mass., acquired 100 per cent of the common stock of the Lincoln Twist Drill Co., of Taunton, Mass. This company manufactures twist drills, reamers and milling cutters. These, added to the products of the Greenfield Tap and Die Corporation, give it a complete line of small tools.

The new plant of the Wayne Steel Co., Erie, Pa., poured its first furnace on May 29. The plant is 100 x 150 ft. It is equipped with two 25-ton basis openhearths, having an annual capacity of 30,000 to 35,000 tons. The concern will manufacture basic openhearth steel ingots, blooms, billets, bars and shapes, nickel and alloy steel. The officers are L. A. McElroy, president; B. S. Fletcher, vice president; H. H. Hanchett, secretary; J. S. Curtis, treasurer; R. C. McElroy, assistant to the president. The directors are L. A. McElroy, R. C. McClenathan, A. C. Pratt, C. B. Shaffer, B. S. Fletcher, R. C. McElroy and J. S. Curtis.

The Pennsylvania Pump and Compressor Co., of Easton, Pa., announces the opening of sales offices in New York; Philadelphia, Pa.; Pittsburgh, Pa.; Richmond, Va.; Birmingham, Ala.; Salt Lake City, Utah; Milwaukee, Wis.

Adolph Lewisohn, chairman of the New York Committee of the National Public Works Department Association, 61 Broadway, in announcing last night the result of the referendum, said that the Council voted in favor of the creation of a Department of Public Works "by a suitable modification of the existing Department of the Interior, excluding therefrom the non-related bureaus and offices and by change of name from Department of the Interior to Department of Public Works."

The second annual sales convention of the Greenfield Tap and Die Corporation, Greenfield, Mass., will be held at the Weldon Hotel, Greenfield, June 24, 25 and 26.

The Spafford Machine Screw Works, of 516 Asylum St., Hartford, Conn., has been recently incorporated under the name of the Hartford Machine Screw Works, Inc., and will carry on the present business of machine screw manufacturing. The capital is $330,000 and the incorporators are: Fred L. Spafford, Charles W. Cramer, C. B. Stevens and E. E. Crommitt, all of Hartford, and Claude Creighton, of White Plains, N. Y.

The Standard Equipment and Tool Works, directed by Joseph Presner, has recently taken up spacious showrooms and offices in the heart of the machinery district of Montreal, Can., at 307 St. James St.

The Chester Bertolette Co., Cincinnati, Ohio, manufacturer of punches, presses, shears and a general line of sheet-metal machinery, has moved into its new quarters at the Commercial Tribune Building, Cincinnati.

At a recent meeting of the board of directors of the Watson Stillman Co. several changes in the personnel were made, due to the retirement of A. F. Stillman from active interest in the management. E. A. Stillman remains as president of the company, and also has full supervision of the sales. Carl Wigtel, chief engineer, was elected vice president, J. D. Brocks, treasurer, and A. Parker Nevin, secretary. LeRoy T. Brown was appointed works manager, J. W. Delano, assistant works manager and W. H. Martin, purchasing agent.

The American Iron Products Co., Inc., 107 Liberty St., New York, has taken over the sole distribution in the United States of the high-speed tool steel made in Sheffield, England, by John Nicholson & Sons, Ltd. It will carry a large stock on hand.

Obituary

JOHN P. HARRINGTON, seventy-six years old, one of the founders of the Erie Forge Co., Erie, Pa., and widely known in industrial circles in this section of the state, died at his home, 940 West Sixth Street, May 27. For a number of years Mr. Harrington was superintendent of the Erie Car Works.

GEORGE E. REID, chief mechanical engineer of the Treasury Department, died at his home, 1326 Euclid St., Washington, D. C., on June 9. Mr. Reid was sixty-nine years old. He was born in Troy, N. Y., and came to Washington in 1892, entering the Government service in 1897 as assistant chief engineer of the Treasury Department.

SAMUEL FLORY, Bangor, Pa., founder and general manager of the S. Flory Manufacturing Co., died on June 10, at his home from heart disease. He was sixty-six years of age. Mr. Flory founded the S. Flory Manufacturing Co., twenty-four years ago. From a very humble beginning, he developed the industry into one of the best known manufacturing plants for mine and quarry machinery in the country.

Personals

A. H. MITCHEL and E. R. ABBOTT announce their resignation from H. W. Cotton, Inc., and their association with the Coe-Stapley Manufacturing Corporation in charge of the contract sales department with headquarters at 136 Liberty St., New York.

WILLIAM R. MARSHALL has been appointed manager of the industrial division, New York office of the Westinghouse Electric and Manufacturing Co., to succeed Harlan A. Pratt, who has resigned to become sales manager of the Atlantic Elevator Co., of New York.

ALEX HART, JR., is now manager of the tool steel department of the American Iron Products Co., Inc., New York. Mr. Hart was formerly in charge of the Detroit office of the Davidson Steel Co. He will have charge in his new position of the John Nicholson & Sons, Sheffield, England, high-speed tool steel.

MAXWELL C. MAXWELL, formerly assistant general superintendent of the Yale & Towne Mfg. Co., has been appointed to the position of general superintendent.

CARL WIGTEL, vice president and chief engineer of the Watson-Stillman Co., sailed on June 14 on the SS. "Drottningholm" of the Swedish-American Line, for a ten weeks' trip to the Scandinavian countries. He also expects to visit England, France, Belgium and Holland. While Mr. Wigtel is going mainly for a vacation, this being his first trip to his old home in Norway, since his connection with the Watson-Stillman Co., thirty-three years ago, he will also investigate new developments in the line of hydraulic machinery in all of the above countries.

FRANK L. PLATT, formerly retained by the War Department as a specialist on industrial planning projects, and later first lieutenant, 24th Engineers, A. E. F., has returned to civil life, and has become associated with the firm of Waldron & Van Winkle, consulting engineers, of New York and Boston. Mr. Platt will be in the New York office at 37 Wall St.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES DURING APRIL, 1920
METAL-WORKING MACHINERY

Countries	Lathes	Other Machine Tools	Sharpening and Grinding Machines	All Other
	491	492	493	495
Belgium	$33,712	$41,880	$5,616	$47,780
Bulgaria		2,520		
Denmark		5,434	2,773	5,202
France	157,893	267,372	45,923	308,948
Greece		334	64	
Italy	21,475	41,652	3,891	66,157
Netherlands	191	6,308	2,565	2,465
Norway	1,229	7,133	70	6,890
Portugal		2,015		
Roumania		3,436		48
Spain	22,873	34,116	8,096	20,791
Sweden		3,782	1,846	4,017
Switzerland	2,250	7,536	191	
Turkey in Europe		4,734		
England	119,568	281,138	128,559	498,294
Scotland		10,138	4,099	4,359
Ireland				1,166
Bermuda		644		
Canada	43,928	229,154	40,006	160,416
Costa Rica		306		
Guatemala		8	16	
Honduras				5,447
Nicaragua		680		1,125
Panama	1,969	363		
Salvador		41		
Mexico	8,754	13,226	4,211	9,070
Newfoundland and Labrador	552	374		640
Barbados		48		
Jamaica		26	351	800
Trinidad and Tobago		60		
Other British West Indies				50
Cuba	14,475	43,067	1,449	20,531
Virgin Islands of U. S.	29	160	66	
Dutch West Indies				173
Haiti		813		
Dominican Republic	375	769	109	
Argentina	11,145	10,109	726	13,059
Bolivia		720		
Brazil	6,752	3,713	2,361	4,133
Chile	1,462	5,392	3,864	4,327
Colombia	6,415	5,065	2,685	5,774
Ecuador	400		51	
British Guiana				21
Dutch Guiana				50
Paraguay		1,493	394	
Peru	978	4,952	505	4,011
Uruguay	675	591	83	116
Venezuela	950	139		3,800
China	19,870	17,132	5,896	20,273
Kwantung		405		
Chosen			29	3,500
British India	23,854	25,931	25	61,017
Straits Settlements	2,153		539	1,193
Dutch East Indies	11,746	3,563	960	1,940
Hongkong	1,073		78	
Japan	30,728	90,749	56,748	180,016
Siam	705			
Turkey in Asia			39	
Australia	8,415	26,688	5,463	5,164
New Zealand	2,305	4,802	2,418	3,287
Other British Oceania			55	
French Oceania				33
Philippine Islands		2,090	519	6,335
British West Africa		2,970		
British South Africa	1,109	10,207	955	7,207
French Africa		809	240	
Morocco		642	41	
Portuguese Africa		479		
Egypt		1,911		
Total	560,008	1,229,819	334,269	1,489,625

Trade Catalogs

Iron Wire. Page Steel and Wire Co., Monessen, Pa. Pamphlet, pp. 31, 4 x 6½ in. This pamphlet presents data and tables of the electrical and physical properties of American ingot iron wire.

Grinding Wheels. L. Best Co., 28-30 West Broadway, New York. Catalog, pp. 144, 6 x 9 in. This catalog contains illustrations and descriptive matter of the company's abrasive disks and cloth, grinding machinery, polishing machinery, grinding-wheel dressers, polishing supplies, abrasive grains.

Drill and Countersink Tool. Lindquist Engineering Works, Portland, Conn. A small circular illustrating its combined drill and countersink tool; list price is also given.

Science Endorses the Detroit Twist Drill. Detroit Twist Drill Co., Detroit, Mich. Some interesting facts about drilling and the performance of the Detroit twist drill are given in this bulletin.

Cutter Grinders. William O. Barnes, Leominster, Mass. Booklet, pp. 7, 8½ x 11 in. An illustrated and descriptive catalog of the Barnes precision cutter grinder for grinding formed cutters, gangs of formed or plain cutters, plain cutters, shank cutters, plain or taper reamers. A list is given of the standard equipment of the Barnes No. 78 precision cutter grinder.

Flexible Shafts and Equipments. N. A. Strand Co., Chicago, Ill. Catalog, pp. 12, 3¾ x 6¾ in. This catalog describes and illustrates its various types of flexible shafts.